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THE CRUSTACEANS

OF

SOUTH AUSTRALIA.

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Part II.

WITH ILLUSTRATIONS.

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Chapter VIII.—Order ISOPODA. The Sea-lice, Wood-lice or Pill-bugs, Sea-centipedes, and their Allies.

The body of a typical Isopod is more or less depressed and is somewhat oval in shape when viewed from above. The Slater (p. 336), so common under stones and rubbish in our gardens, is a familiar example of the order, although the members of some of the groups do not at all resemble this form—indeed, species of one family (Phreatoicidae) have much the appearance of Amphipods. Isopods are plentiful in our southern seas, but many of the species are of a somewhat retiring disposition and need to be searched for. The following distinguishing characters may be compared with those of the preceding order. As in the Amphipoda, there is never a distinct carapace, and the first thoracic somite is always completely fused with the head. Thus, only seven free somites of the thorax are apparent; in the descriptions the free somites are referred to as the first to seventh segments. Of these the first is sometimes immovably fixed to the head (and in one ex-Australian genus the second free segment also is coalesced). The eyes, when present, are never set on movable stalks but are sessile or elevated on immobile processes of the head. The first antennae have only one flagellum, or feeler, excepting in *Bathynomus*. The thoracic appendages of the first pair are modified as maxillipeds; the seven remaining pairs (legs or peraeopods) are often all similar and ambulatory or subprehensile

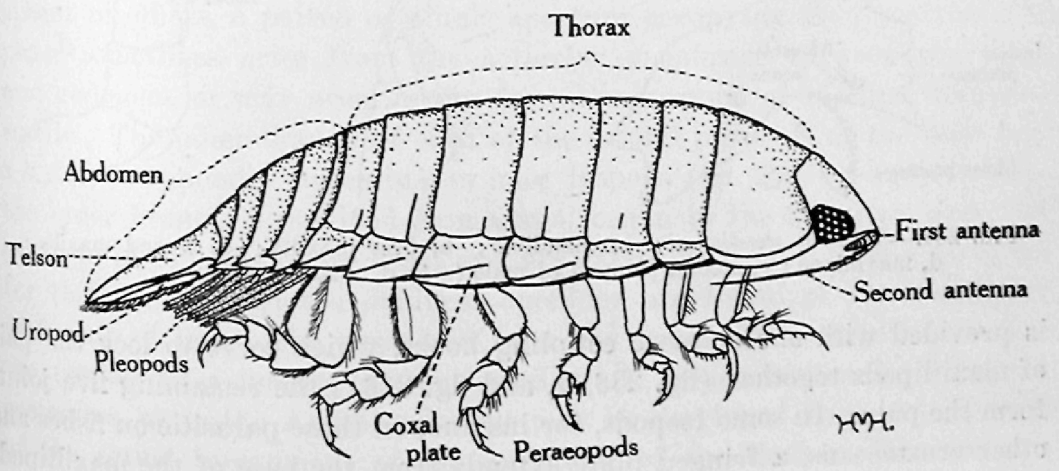


Fig. 232.—The Smooth Sea-louse, *Cirolana woodjonesi* (x 7).

in character, or are variously modified. The coxae of the legs are commonly expanded into coxal plates, which are generally fused with the thoracic somites, thus forming a lateral extension of the segments. In many Isopods the junction of these plates with the body is indicated by a suture on the second to seventh segments, but there is very rarely such suture on the first free somite. The telson is, as a rule, fused with the sixth abdominal somite, so that only five abdominal segments and a telsonic segment are apparent; in some families less than six segments are distinct owing to

further fusion. In typical forms the pleopods have two broad, lamellar branches; the second (and sometimes also the first) pair are commonly modified for sexual purposes in the male. The general external features, as indicated above, are illustrated in fig. 232 (the dorsal view of this common sea-louse is shown in fig. 240).

The mouth parts, as in the Amphipoda, consist of a pair of mandibles, two pairs of maxillae, and one pair of maxillipeds; these parts are much modified in some species in accordance with their habits. The typical mandible has an incisor process with a serrated cutting-edge, a palp, a molar process, and a movable lacinia (fig. 233, a); as in the previous order the last-named may be present on the left mandible only. The coxa, or basal joint, of the maxillipeds is short, and on the outer side bears a plate-like epipod; the basis is produced distally into an inner plate or lobe which

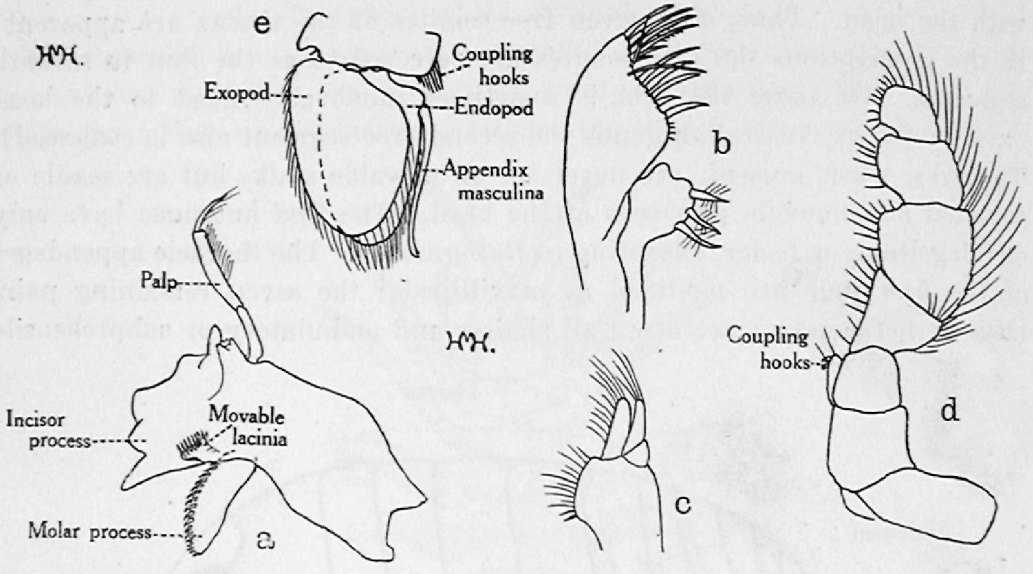


FIG. 233.—*Cirolana woodjonesi*: a, mandible; b, first maxilla; c, second maxilla; d, maxilliped; e, second pleopod of male (a to d, x 20; e, x 10).

is provided with one or more coupling hooks, which serve to lock the pair of maxillipeds together (fig. 233, d, and fig. 316); the remaining five joints form the palp. In some Isopods, for instance in those parasitic on fishes and other crustaceans, a fringed plate extends from the base of the maxillipeds of the egg-bearing female into the brood-pouch, and the epipod and inner plate are expanded (fig. 253); this enlarged and flattened maxilliped causes a current of water to flow through the pouch containing eggs or young.

Respiration.—Respiration is effected by means of some or all of the pleopoda, of which there is usually a pair on each of the first five abdominal somites. Each pleopod consists of a short base (protopod) from which spring two lamellar, overlapping branches (endo- and exopod); these plates are thin and vascular and act as gills (fig. 233, e). The five pairs are in many cases all similar (excepting for those modified in the male)

and are often used for swimming as well as for respiratory purposes. When the pleopods are used as natatory organs they are fringed with fine hairs and the inner side of the base of each pair is furnished with coupling-hooks (fig. 254). In some families the anterior pairs are used only for swimming while the posterior pairs are exclusively respiratory. The pleopods of the large Cymothoids of the genus *Bathynomus* (not represented in South Australia) bear tufted gills. Certain other forms, when adult, have the abdominal appendages very small, altogether absent, or even developed as branched gills. A branchial chamber in which the respiratory pleopods are protected is found in some Isopods. In the Isopoda-Valvifera a gill-chamber is formed by the arched telson above and closed in below by the much modified uropods (fig. 10, C). In most genera of the family Anthuridae (Isopoda-Flabellifera) a somewhat similar chamber is closed in by the operculiform first pleopods below, by the thickened bases of the uropods laterally, and by the telson above. The overlapping, greatly enlarged and curved outer branches of the first pleopods of the interesting Cymothoid *Ourozeuktes* constitute the bottom of a gill-chamber which is roofed above by the abdomen, the segments of which are all fused together. Other modificatioons are noted in place.

Reproduction and Development.—The vasa deferentia of the male terminate in two little processes (penes) usually situate one on each side of the middle of the posterior margin of the last thoracic somite; these processes are fused together to form a single penis in some groups and are absent in others, a paired or single aperture occupying their position. The penes sometimes arise from the articular membrane between the thorax and abdomen, or may even spring from the sternum of the first abdominal somite. The inner branch of each of the second pleopods of the male bears a stylet, or appendix masculina, in most Isopods (fig. 233, e), and sometimes the inner branch is modified as a sexual organ in the first pair also. The oviducts of the female are short and are rarely dilated to form a receptacle for the male sperm; the oviducal openings are found at the base of the fifth pair of legs. The eggs, and later the young Isopods, are carried by the mother in a marsupium or brood-pouch, which is usually formed of oostegites, as in the Amphipods, but may be developed from invaginations of the actual integument of the underside of the thorax. The oostegites arise from the sides of the ventral segments, at the bases of the legs. As a rule, four pairs of overlapping plates are present, one pair on each of the first to fourth, or second to fifth somites; in some cases a greater or lesser number of plates occur.

Excepting in parasitic forms, the young on leaving the brood pouch of the mother, have much the general appearance of the adult, but differ in never having the last pair of legs developed. The aforementioned parasites are free-swimming symmetrical creatures in their young stages, but after permanently attaching themselves to some host or other, gradually assume the often much distorted adult shape.

South Australian Isopoda have received more attention than have our Amphipods; all of the six suborders into which the order is split up are represented.

a. Uropoda hinged to sides of telsonic segment.
  b. Uropoda forming a tail fan with telsonic segment FLABELLIFERA.
  bb. Uropoda not forming a tail fan with telsonic segment but modified as a pair of covers, folding under abdomen and enclosing the pleopoda .. .. VALVIFERA.
aa. Uropoda styliform, not forming a tail fan with telson, but hinged to or near terminal end of telsonic segment, or absent.
  c. Aquatic species. Pleopoda branchial.
    d. Free forms.
      e. Abdominal somites all fused together in species occurring in South Australia. Peduncle of second antennae composed of six segments. Body more or less depressed .. .. ASELLOTA.
      ee. Abdominal somites free. Peduncle of second antennae composed of five segments. Body more or less compressed (amphipod-like) .. .. PHREATOICIDEA.
    dd. Forms parasitic on other Crustacea .. .. EPICARIDEA.
  cc. Almost always terrestrial species. Pleopoda almost always fitted for air breathing .. .. ONISCOIDEA.

Only one of the South Australian Oniscoidea is aquatic; this species (*Haloniscus searlei*) is dealt with on p. 334.

Suborder FLABELLIFERA.

Members of this suborder are distinguished from other Isopoda in that the uropods are attached to the side of the pleon, and form a more or less distinct caudal fan with the last, or telsonic, segment, which, it will be remembered, usually consists of the telson fused with the sixth abdominal somite in the Isopoda. Ten families are represented in our waters. Of these the families Eurydicidae, Corallanidae, Phoratopodidae, Aegidae, and Cymothoidae form a connected series, known collectively as the Cymothoid group. The species of these families range from forms which are parasitic upon fishes to free-swimming predators, which attack and destroy living marine creatures, or which act as scavengers.

a. The adult has six pairs of legs, only five pairs of which are apparent .. .. GNATHIIDAE.
aa. The adult usually has seven pairs of legs, all of which are apparent.
  b. Uropods lateral and superior, the outer branch arching over base of telson .. .. ANTHURIDAE.

bb. Uropods lateral, not arching over base of telson.
c. Abdomen almost always composed of six segments (in one genus all segments are fused in the adult).
d. Uropods with both branches well developed.
e. Palp of maxillipeds free, the last two joints furnished with hairs, but not hooks.
f. Distal part of mandibles usually stout and conspicuous. Inner lobe of first maxillae expanded at apex and furnished with three or four spines; outer lobe wide, and capped with many strong spines. Second maxilla with three free, setose lobes.
g. Last four pairs of legs ambulatory, with normal finger and claw; the three penultimate joints of the fourth and fifth pairs not greatly expanded.. .. .. EURYDICIDAE.
gg. Last four pairs of legs natatory, with dactylus rudimentary or absent; in the fourth and fifth pairs the three penultimate joints are greatly expanded and flattened, each of these joints being about twice as wide as long.. .. .. PHORATOPODIDAE.
ff. Distal part of mandibles narrow, partly or quite concealed by upper and lower lips. Inner lobe of first maxillae without spines; outer lobe narrow, tapering, armed with a few spines. Second maxilla not having three distinct lobes, usually with apex simple .. .. CORALLANIDAE.
ee. Palp of maxillipeds embracing cone formed by distal parts of mouth organs; the inner upper margin and apex never with hairs, at least, the apex furnished with curved hooks in males and non-ovigerous females.
h. Both pairs of antennae with well-defined peduncle and flagellum.. .. .. AEGIDAE.
hh. Antennae reduced, without clear distinction between peduncle and flagellum CYMOTHOIDAE.
dd. Uropods with one of the branches rudimentary . LIMNORIIDAE.
cc. Abdomen composed of two or four segments.
i. Abdomen composed of two segments.
(1) Uropods with one branch fixed and immovable.. .. .. SPHAEROMIDAE.
ii. Abdomen composed of four segments. Uropods with both branches movable. SEROLIDAE.

(1) In all known Australian species.

Family GNATHIIDAE.

This family includes some truly remarkable creatures. The sexes of the species are so unlike when adult that the male and female at one time were not associated, and were actually placed in separate families. The pleopods are not modified for sexual purposes in the male. The first free thoracic segment is fused with the head, but the suture may be distinct. A striking feature is that the first and last segments of the thorax are very small, and that the last pair of legs remains undeveloped throughout life. It has already been mentioned that young Isopods in general lack the posterior legs when very young, but in most cases these limbs are developed soon after the juveniles abandon their parent.

GNATHIA (Leach).

In their earlier, or larval, stages the tiny "Sea-mites" lead a parasitic life, and are then commonly found in numbers on such fishes as rays and skates. The mouth parts project in front of the head, and are apparently modified for puncturing the skin of fishes, and for extracting the "juices" underlying

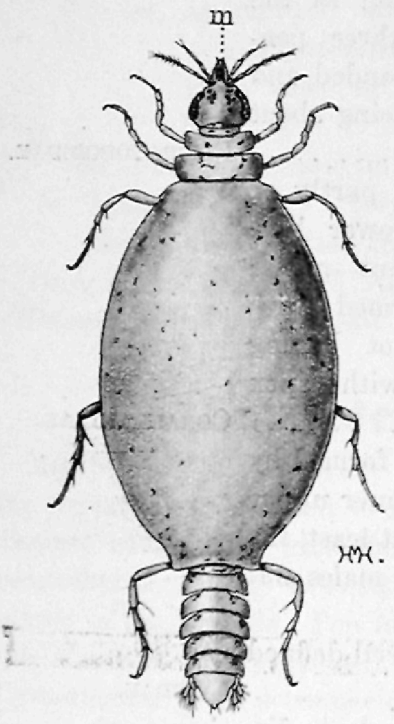


FIG. 234.—Praniza larva of *Gnathia mulieraria*; m, projecting mouth parts (x 21).

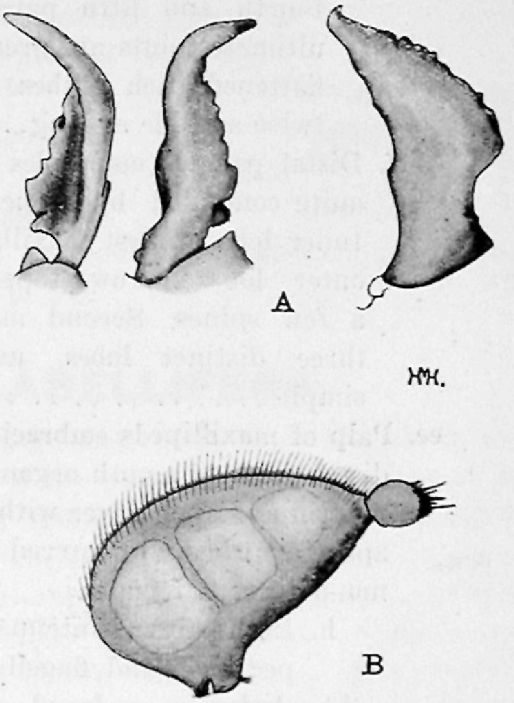


FIG. 235.—A, Dorso-interior, ventral and lateral views of right pseudo-mandible of male of *Gnathia mulieraria*: B, first leg of same animal (x 30).

the epidermis (fig. 234). As the creatures leave their host and mature, the male assumes an astonishing form (fig. 236 and 237). The head becomes massive and quadrate, and a pair of powerful pseudo-mandibles is developed (fig. 235, A). These organs are attached to the front of the head, and at least one of their functions appears to be that of holding the female

during mating. The first "legs" are much modified, two-jointed, flattened, and opercular (fig. 235, B), so that only five pairs of walking legs are evident. The female does not differ from the larva in general appearance to such an extent as the male; the head is small, subtriangular in shape, and the mouth-parts are much reduced. The semi-transparent thorax of the adult female becomes greatly swollen with contained eggs, and later with young. The fourth and fifth thoracic segments—and sometimes the sixth segment also—are fused, and the divisions are sometimes indiscernible. It is necessary to have males in hand for the determination of the species, as the larvae and females are of little use in this connection. Adult specimens may be dredged in weed, and in some cases may be found in sponges. Two species have been recorded, and females of at least one other, and larger, form have been taken in St. Vincent Gulf.

a. Head with large and small tubercles on anterior third; remainder with large and distinct areoles. Fifth and sixth thoracic segments not medianly divided dorsally . . . . . *mulieraria.*

aa. Head almost wholly covered with small granules, without areoles. Fifth and sixth thoracic segments medianly divided dorsally . . . . . *pustulosa.*

Big-jawed Mite. *Gnathia mulieraria* (Hale). (a lover).

In the male the head is large and almost square, with a broad furrow on the front part of the upper surface. There is a large median tubercle in this excavation, on each side of which are rounded tubercles; to the rear

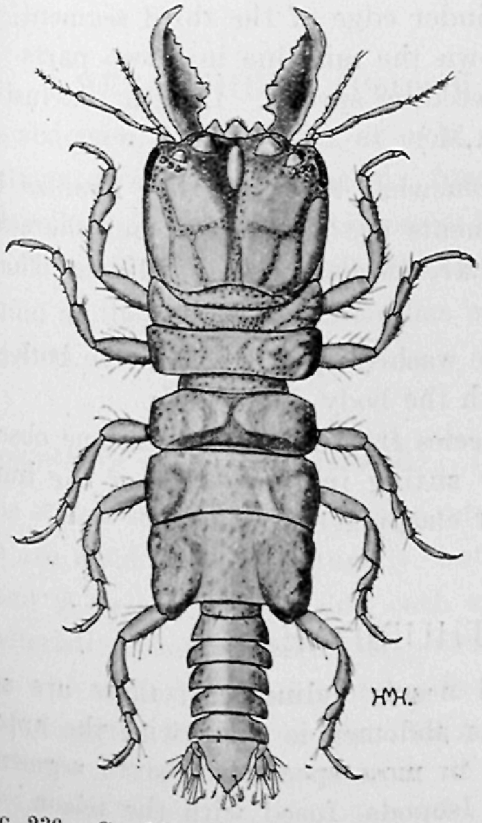


FIG. 236.—*Gnathia mulieraria*, male (x 20).

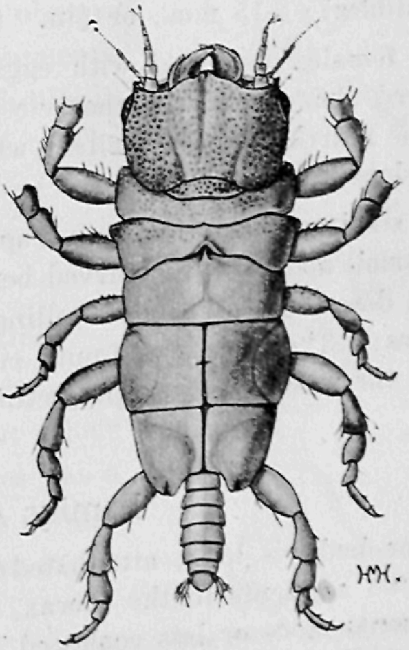


FIG. 237.—*Gnathia pustulosa*, male (x 20).

of the last are three tiny projections. The "jaws" are large and prominent, almost as long as the head, scoop-shaped, with the upper margin thickened and the inner lower edge cut into irregular teeth. None of the thoracic segments is divided medianly; the first is as wide as the second but is very short. The side portions of the abdominal segments are rather prominent. During life the antennae, legs, mandibles and head tubercles were white. The areoles on the upper surface of head and thorax were yellow, and the interspaces were closely dotted with brown colour cells. The first five abdominal segments were yellow, the remainder semi-transparent. Length (exclusive of mandibles): 4·1 mm., or $\frac{1}{6}$in. (S.A.M.)

The Praniza larva of this species is shown in fig. 234. When alive this had the head pale brown with a few black spots. The thorax and the greater part of the abdomen were milk-white with some scattered black colour-cells. The little creature was found amongst *Zostera* dredged in St. Vincent Gulf. The Gnathiae are not to be confused with the true aquatic mites (Hydrachnidae), some species of which are marine.

Sponge-mite. *Gnathia pustulosa* (Hale). (with pimples).

In the male the head is much wider than long, with a median furrow on the upper surface, which is almost covered with small granules. The "jaws," which are not very large and prominent, are scoop-shaped, and have a notch in the upper margin. The first segment of the thorax is small and inconspicuous, less than half as wide as the second, and has a granulate surface. The front part of the fourth segment is furnished with a median tooth which fits into the thickened hinder edge of the third segment. The fifth and sixth segments are split down the mid-line into two parts. The legs are much stouter than in the preceding species. Length (exclusive of mandibles): 3·15 mm., or $\frac{1}{8}$in. (S.A.M.)

A female, distended with eggs, somewhat resembles the Praniza larva figured above. All the thoracic segments are discernible, but the sutures of the fourth to sixth somites (which are swollen) are indistinct. The legs are slender.

A single pair was found in a sponge washed up at Glenelg. In both sexes the small abdomen was curved beneath the body during life.

In describing a sponge-dwelling species from South Africa, one observer writes: "The male was found either sitting in the mouth of the burrow with the mandibles just projecting or clasping the female."

Family ANTHURIDAE.

The body is long, attenuated and nearly cylindrical; there are seven distinct segments in the thorax. The abdomen is short with the anterior segments more or less coalesced, but in most species the sixth segment is not, as in the great majority of the Isopoda, fused with the telson. The

first pair of legs differ from the others in being large and strong; usually this and the second and third pairs are subchelate; the remaining legs are ambulatory. In our genera the outer branch of the first pair of abdominal appendages is expanded and covers the other pleopods; the outer branch of each uropod arches over the base of the telson. Thus, as described at the beginning of this chapter, the respiratory branches of the pleopods are enclosed in a chamber formed by part of the first abdominal appendages, the bases of the uropods, and the telson.

Little is known of the habits of these slender-bodied Isopods, but the mouth-parts are often modified for suction, and doubtless many of the species lead a parasitic life. The family is divided into two groups, one including forms with the mouth organs modified for biting, the other species with oral parts adapted for piercing. A pair of statocysts is usually developed in the telson of the genera of the first group, and a single statocyst is found in the telson of a few species of the second. At least three genera are represented in South Australian waters.

a. Mouth parts for biting. Maxilliped five-jointed .. .. *Mesanthura.*

aa. Mouth parts for piercing. Maxilliped with less than five joints.

b. Maxilliped three-jointed .. .. *Paranthura.*

bb. Maxilliped four-jointed.. .. .. *Accalathura.*

MESANTHURA (Barnard).

The abdomen is short, with at most only obscure indications of sutures on the six fused segments. The flagellum of the first antennae is brush-like in the male and two-jointed in the female. The flagellum of the second antennae has no more than four joints.

Mesanthura maculata (Haswell). (spotted).

It is stated that the few species referred to this genus are much alike structurally, but that colour pigment is well developed and each species has a characteristic colour pattern. *M. maculata* is light yellow with extensive black blotches as shown in the figure. Length: 19 mm., or ¾in. (S.A.M.)

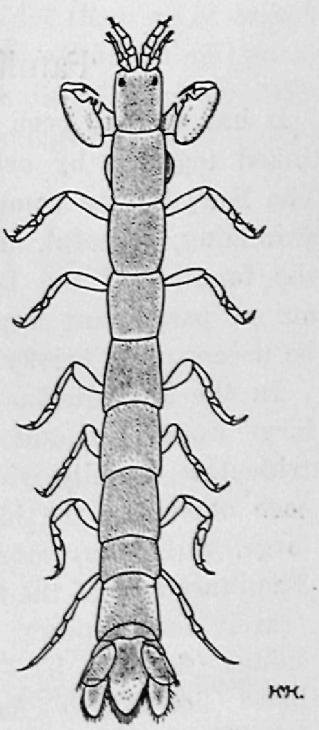


FIG. 238.— *Mesanthura maculata* (x 9).

PARANTHURA (Bate and Westwood).

The abdomen is short, with the sutures more or less distinct, at least towards the sides. The first antennae have a brush-like flagellum in the male and a four to six jointed lash in the female. In both sexes the flagellum of the second antennae consists of one flattened joint.

Paranthura punctata (Stimpson). (marked with small spots).

This species is pale, usually marked with many small pigment spots producing a greyish appearance. Sometimes there are irregularly arranged pigment specks, but usually they are massed into spots, particularly on the hinder part of the body. Length: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

ACCALATHURA (Barnard).

The short abdomen has distinct sutures, and the flagella of both pairs of antennae are many jointed in both sexes.

Accalathura gigas (Whitelegge). (very large).

South Australian specimens differ from the syntypes of this species in having well pigmented eyes. Eyes are apparently wholly absent in one of the syntypes recently examined, and our examples should possibly be referred to *A. sladeni* (Stebbing), a species described from Seychelles. New South Wales examples of *A. gigas* attain a length of 42 mm. Length (largest South Australian specimen): 25 mm., or 1in. (S.A.M.)

Family EURYDICIDAE (Sea-lice).

It has already been mentioned that this and the next four families are linked together by certain features and form the "Cymothoid group." The Eurydicidae comprise the sea-lice, the majority of which are free-swimming, graceful, and predaceous creatures. A reference to the key to the families of the Isopoda-Flabellifera will show that the mouth-parts are of paramount importance in the Cymothoid group; it will therefore be necessary to briefly describe the oral organs of each family.

In the Eurydicidae the jaws, or mandibles, meet squarely behind the large upper lip, and their incisor processes have a sharp, more or less tridentate, usually wide cutting edge (fig. 233, a); these edges glide past each other like the blades of a pair of scissors. The movable lacinia is large, with many spines, and the molar process is large and triangular. The inner lobe of the first maxillae is expanded at the apex and bears three (rarely four) spines; the wider outer lobe is furnished with many strong spines (fig. 233, b). The second maxillae have three lobes capped with hairs (fig. 233, c). In this and the two following families the palp of the maxillipeds is free and provided with hairs, not hooks, on the apical joints (fig. 233, d).

Only one genus, *Cirolana,* has so far been recorded. Dr. Leach is said to have derived this and other generic names, such as *Nerocila,* from anagrams on his wife's name Caroline.

CIROLANA (Leach).

The sea-lice are very agile in the water, and many of them, for a short time at least, display some activity on land also. They are eminently carnivorous, and at times are encountered literally in swarms; fishes captured in set nets are sometimes rendered useless through their depredations. The keen-edged jaws are capable of cutting out a comparatively large piece of flesh. Persons wishing to obtain vertebrate skeletons, and not desiring to undertake the unpleasant task of maceration, take advantage of the scavenging habit of the sea-lice, and submerge their material, in the flesh, at a place where these creatures are abundant; the bones are rapidly and very cleanly denuded of all flesh. At least some of the sea-lice not only feed upon offal, but attack living animals. Some time ago a female Port Jackson shark (*Heterodontus phillipi*) was observed to be in difficulties in St. Vincent Gulf. When captured and cut open, it was found to contain hundreds of individuals of *Cirolana woodjonesi,* which had entered the body cavity and were literally eating the unfortunate fish alive. The Cirolanas sometimes inflict irritating little wounds on the legs of bathers, and some of them bite quite sharply if incautiously handled. A learned professor once found a living fish teeming with sea-lice. In his hurry to secure this rich harvest he "tried to help himself by keeping some of the parasites in his closed hand, but they bit him so ferociosly that he was obliged to let them go at once." In the tropics I have collected a series of a species of an allied genus (*Excirolana orientalis*) by the simple expedient of standing in shallow water in a mangrove swamp; as the "lice" attacked my bare legs they were picked off and bottled.

Four South Australian species have been described:

a. Flagellum of second antennae not reaching to hinder margin of fifth segment of thorax.

b. Frontal lamina (the small plate between the antennae) sublinear, very much longer than wide.

c. Basal joint of last leg expanded, twice as long as greatest width. Body plump . . . . . *corpulenta.*

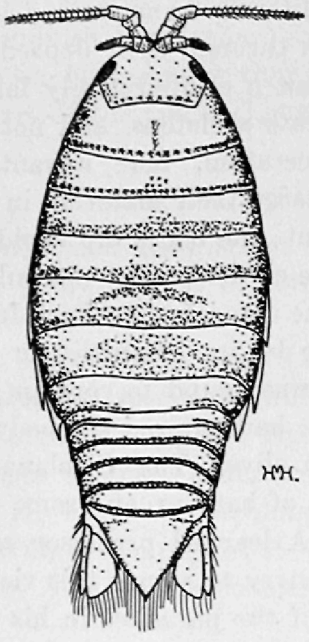
cc. Basal joint of last leg greatly expanded, only one and one-half times as long as greatest width. Body more slender, but moderately robust . . . . . *woodjonesi.*

bb. Frontal lamina broad, only slightly longer than wide *cranchii australiense.*

aa. Flagellum of second antennae reaching back well beyond hinder margin of last segment of thorax . . . . . *vieta.*

Banded Sea-louse. *Cirolana corpulenta* (Hale). (fat).

The first antennae are short, and do not reach to the end of the peduncle of the second antennae; the second antennae reach back to about the hind margin of the second thoracic segment. During life the plump body is white, with bands of black colour cells near the hinder margin of the head, and of the thoracic and first five abdominal segments. Length: 12 mm., or ½in. (S.A.M.)



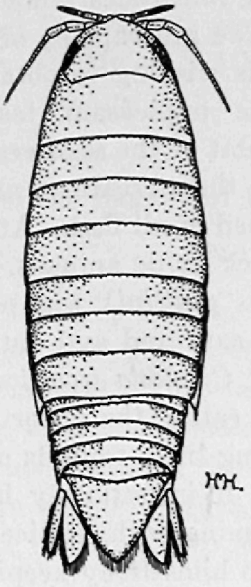


FIG. 239.—*Cirolana corpulenta* (x 5). FIG. 240.—*Cirolana woodjonesi* (x 3).

Smooth Sea-louse. *Cirolana woodjonesi* (Hale). (personal name).

The first antennae are short, and do not reach to the end of the peduncle of the second antennae; the second pair reach back to the hinder margin of the long first thoracic segment. The legs are all flattened, and the basis joint of the posterior limbs is greatly expanded, much more so than in our other species. The body is rather slender. During life this sea-louse is porcelain-white, sometimes suffused with colour owing to food contained in the capacious stomach. Length: 24 mm., or 1in. (S.A.M.)

This is one of our commonest sea-lice, and often renders itself objectionable by attacking the bait of line fishermen in prodigious numbers.

Grey Sea-louse. *Cirolana cranchii australiense* (Hale). (Australian).

The first antennae reach a little beyond the end of the peduncle of the second antennae, which reach back to the posterior margin of the third or fourth thoracic segment. The whole of the upper surface is closely covered with tiny black dots on a white ground, giving the animal a grey appearance. Length: 13 mm., or ½in. (S.A.M.)

A very common sea-louse, often taken in company with the foregoing species.

Wrinkled Sea-louse. *Cirolana vieta* (Hale). (wrinkled).

The first antennae are very short, but the second pair have unusually long flagella, which reach back to the hind margin of the fourth segment of

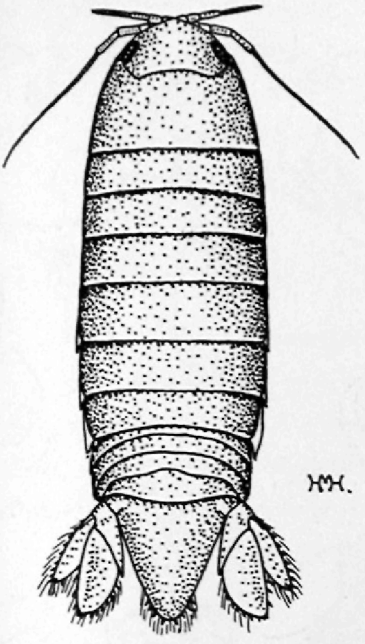


FIG. 241.—*Cirolana cranchii australiense* (x 5).

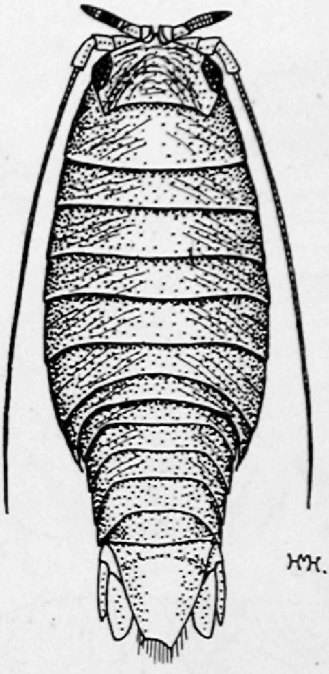


FIG. 242.—*Cirolana vieta* (x 5).

the abdomen. The upper surface of the head, thorax, and part of the abdomen is marked with numerous furrows, giving the animal a wrinkled appearance. The long second antennae and the sculpturing readily separate this from our other forms. Length: 13 mm., or ½in. (S.A.M.)

Family PHORATOPODIDAE.

The mouth parts are much as in the preceding family, but the molar process of the mandibles is small. The extraordinary development of the legs of the single known representative is, however, very distinctive.

PHORATOPUS (Hale).

Oar-legged Sea-louse. *Phoratopus remex* (Hale). (an oarsman).

Both pairs of antennae have the peduncle expanded, and the flagellum short. There is no trace of eyes. The coxal plates of the second to sixth thoracic segments are very large, those of the last segment relatively small. The first legs are subchelate, the second and third pairs imperfectly subchelate and furnished with curious, hair-like sensory organs. The fourth, fifth, and sixth pairs are greatly expanded and flattened, and the seventh legs are flattened, but only moderately expanded. The last joint or dactylus

is rudimentary in the fourth to sixth legs, and altogether absent in the last pair. Length: 20.5 mm., or $\frac{4}{5}$in. (S.A.M.)

A single specimen of this queer Isopod was collected at Encounter Bay.

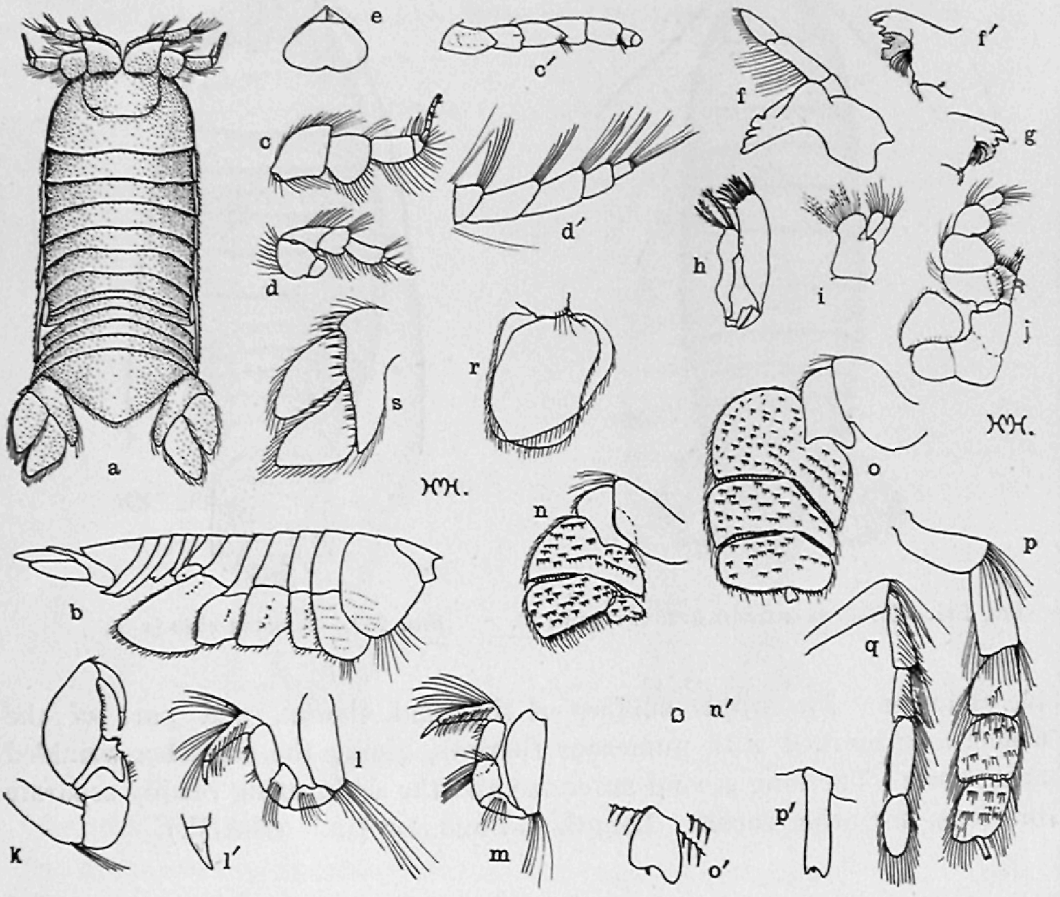


FIG. 243.—*Phoratopus remex*: a and b, dorsal and lateral views (x 2); c and d, first and second antennae (x 4); c′ and d′, flagellum of first and second antennae (x 15); e, clypeus and labrum (x 4½); f, left mandible (x 6); f′, ventral view of anterior part of left mandible (x 6); g, ventral view of anterior part of right mandible (x 6); h and i, first and second maxillae (x 8); j, maxilliped (x 8); k to q, first to seventh legs (x 4); l′, claw of second leg (x 32); n′, o′, and p′, dactylus of fourth, fifth, and sixth legs respectively (x 15); r, second pleopod (x 4); s, uropod (x 4).

Family CORALLANIDAE.

The mandible and maxillae of the one species so far taken in our waters is shown in fig. 244. The distal part of the jaw is narrow and inwardly directed; the movable lacinia is small or indiscernible. The molar process in the mandible illustrated is represented by a feeble blade, but this process may be well developed or absent. The outer lobe of the first maxillae is slender and tapering, and armed with one or more large spines, or with minute spines. The apex of the second maxillae is simple, sometimes capped with a few hairs.

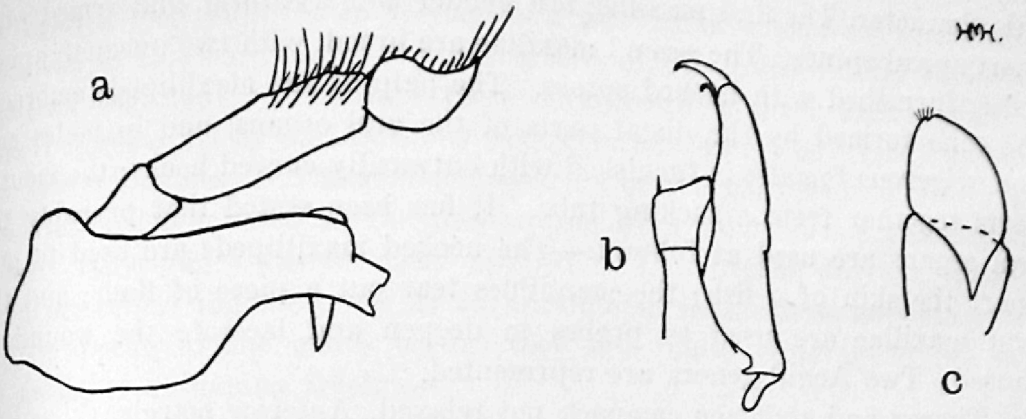


FIG. 244.—a, Mandible; b, first maxilla; and c, second maxilla of *Argathona similis* (x 30).

ARGATHONA (Stebbing).

Argathona similis (Richardson). (similar).

The first antennae are very short, and the second pair have a flagellum longer than, or as long as the thorax. The body is brownish or white during life, and is clothed above with moderately long hairs; this hairy covering is

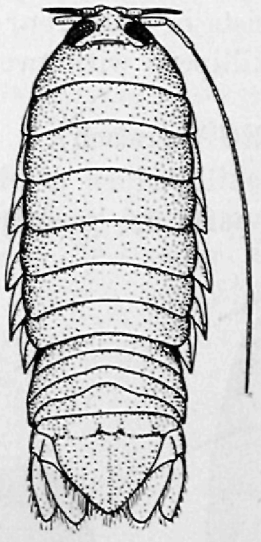


FIG. 245.—*Argathona similis* (x 2½).

not shown in the specimen illustrated. Length: 21 mm., or ⅘in. (S.A.M.)

This animal, although a free swimmer, attaches itself to fishes, upon which it feeds. Examples taken from the hinder part of the body of a Parrot-fish were gorged with blood corpuscles and epidermal cells ingested from the host.

Family AEGIDAE (Fish-lice).

The species placed in this and the following family are true parasites, and attach themselves more or less permanently to fishes. It is not surprising, therefore, that the mouth parts are considerably modified. The palp of the mandibles has no inflated joints in the Aegidae, but in the next family, the Cymothoidae, the first joint is inflated, or both first and second joints have

this character. The first maxillae are slender and styliform, and armed with short apical spines. The second maxillae are broad, with two unequal, apical lobes, furnished with hooked spines. The palp of the maxillipeds embraces the cone formed by the distal parts of the oral organs, and in males and non-ovigerous females is furnished with outwardly curved hooks; the mouth-parts together form a sucking tube. It has been stated that probably the oral organs are used as follows:—The hooked maxillipeds are used to pull apart the skin of a fish; the mandibles tear out a piece of flesh; and the first maxillae are used as probes to deepen and lacerate the wound so caused. Two Aegid genera are represented.

a. Thorax and abdomen compact, not relaxed. Anterior margin of head with a small, median process, separating more or less the basal articles of the first antennae. Flagellum of first antennae composed of numerous articles, as a rule. Frontal lamina rather large. Maxillipeds with five-jointed palp . . . . . *Aega.*

aa. Thorax more depressed and abdomen relaxed. Anterior part of head overhanging the basal joints of the first antennae, the flagellum of which consists of only four to six articles. Frontal lamina small. Maxillipeds with two-jointed palp. . *Rocinela.*

AEGA (Leach).

In females with eggs the maxilliped as a whole is lamellar; the palp has no hooks and the other parts are greatly expanded. The anterior

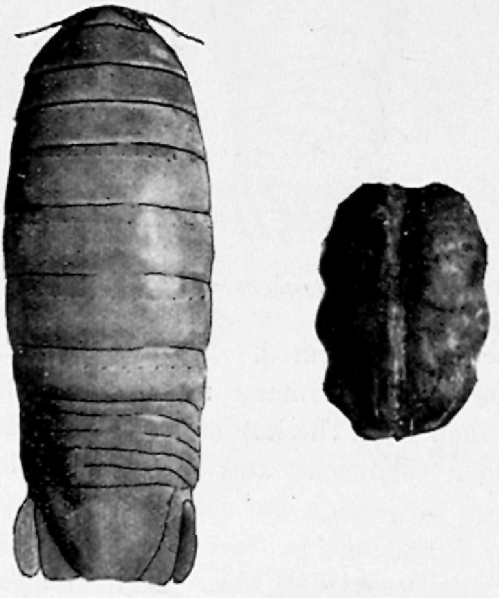


FIG. 246.—*Aega serripes*, and the food mass removed from stomach (x 1½).

marsupial plates of females in this condition overlap the greater part of the mouth organs, and it is said that the creatures are then unable to feed and have never been found attached to a fish.

Ingested food solidifies in specimens preserved in alcohol or dried, and, removed in this hard state, provides a cast of the inside of the capacious stomach (fig. 246). In Europe these dark-brown or black masses were at one time regarded by superstitious fishermen and others as "lucky stones" or "Peter's stones". The stomach contents of the European *A. psora* are said to have been used in the preparation of a salve, hence the popular name "Salve-bug" was formerly applied to the species; further, medical men prescribed the substance as an antidote to sea-sickness and other ills. Three species of the genus occur: they are found clinging to the skin of fishes, or swimming freely:—

a. Eyes of moderate size, distinctly separated one from the other . . . . . *serripes.*

aa. Eyes very large and confluent and occupying the greater part of the dorsal surface of the head.

b. Inner branch (endopod) of uropods narrow, with outer margin prominently notched near the apex, which is rounded . . . . . *antillensis.*

bb. Inner branch of uropods wide, with outer margin not notched and with apex subtruncate . . . . . *nodosa.*

Saw-legged Fish-louse. *Aega serripes* (M. Edwards). (with serrated legs).

The eyes are rather large, but are distinctly separated. The telsonic segment and inner branch of the uropods are truncate, the hinder margins straight or slightly incised. The outer inferior margin of the last four pairs of legs is produced into a crest which is cut into three or four large

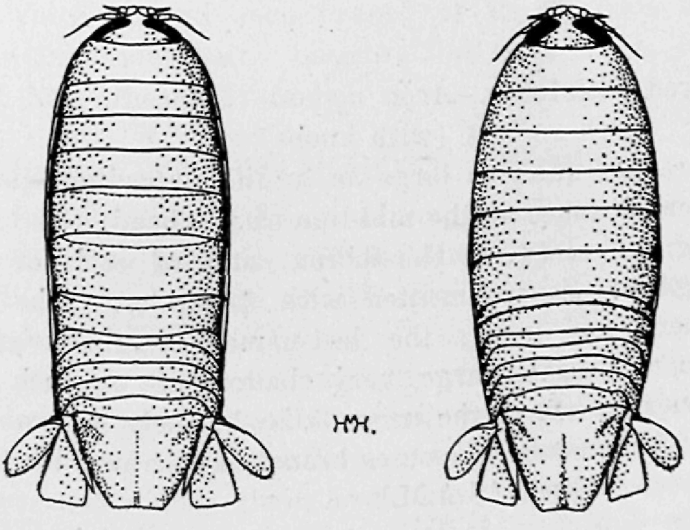


FIG. 247.—*Aega serripes*, male and female (slightly enlarged).

and prominent teeth, a feature which is referred to in the specific name. As shown in the illustrations, the sexes differ somewhat in shape. During life the colour is brown above, marked with longitudinal whitish streaks. The peduncles of the antennae are marked with dark brown, a brown bar

connects the eyes, and there is a brown streak at the antero-lateral angles of the first segment of the thorax. Length: 50 mm., or 2in. (S.A.M.)

This large parasite is fairly common in South Australia.

Shark Louse. *Aega antillensis* (Schioedte and Meinert). (from the Antilles).

The eyes occupy the greater part of the upper surface of the head, leaving a small V-shaped piece at the middle of the anterior margin and a large triangular space behind. The apex of the telson is acute; the branches

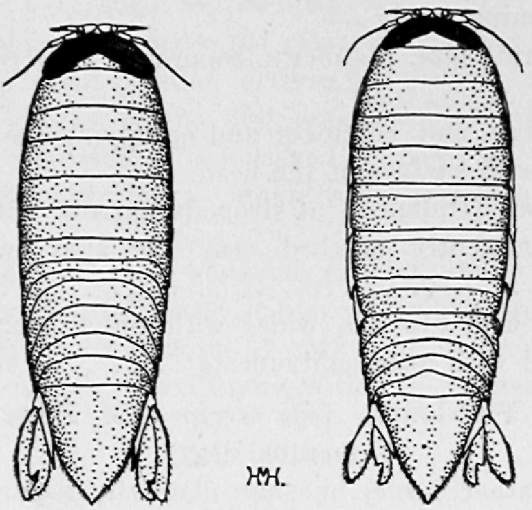


FIG. 248.—*Aega antillensis*, male and female (slightly enlarged).

of the uropods are narrow, suboval in shape, and the inner ramus is conspicuously notched on the outer margin. Length: 48 mm., or $1\frac{15}{16}$in. (S.A.M.)

Sculptured Fish-louse. *Aega nodosa* (Schioedte and Meinert). (with knobs).

The eyes are not quite as large as in the preceding species and meet for only a short distance at the mid-line of the head. The hinder margin of the last segment or two of the thorax, and of each of the first five abdominal segments, is ornamented with tubercles. The uropods and telsonic segment are large; the last-named is subtriangular in shape, apically acute, and has a large, very shallow pit on each side near the base. The inner branch of the uropods is obliquely subtruncate, with the postero-lateral angle acute; the outer branch is narrow with the apex acute. Length: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

ROCINELA (Leach).

Flat-nosed Fish-louse. *Rocinela sila* (Hale). (pug-nosed).

A flat, loosely built fish-louse. The body is suboval in shape, with prominent coxal plates, and the lateral parts of the second to fourth abdominal segments produced and prominent. The front margin of the

head is truncate. The creature is delicately coloured during life. The head is margined with white, has a submarginal black line and a white spot alongside the black eyes. The upper surface of the thorax and abdomen is closely covered with brown markings, so that the ground colour appears to be pale brown. A pair of dark stripes extend down the mid-line of the body from the front of the head to the fifth abdominal segment. On each

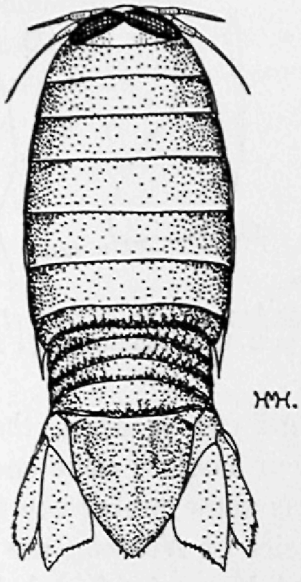


FIG. 249.—*Aega nodosa* (x 3½).

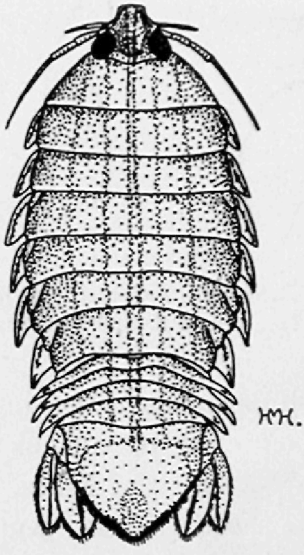


FIG. 250.—*Rocinela sila* (x 2⅓).

side of these markings are two other longitudinal dark stripes. The legs and antennae are almost transparent, with a few dark dots. The coxal plates and basal half of the uropods are orange. The telson has black postero-lateral margins, and each branch of the uropods has a median black streak on the hinder half. Length: 23·5 mm., or $^{15}/_{16}$in. (S.A.M.)

Family CYMOTHOIDAE (Fish-lice).

Both pairs of antennae are always of comparatively small size and are not clearly divided into peduncle and flagellum as in other families of the suborder. Owing to their mode of life the mature parasites are often twisted and distorted.

Parasites in general are usually viewed with disgust, and the so-called "degenerate" Isopods of this family are not, as a rule, regarded with much favour; the bloated and misshapen form of some species and their grasping movements when taken from their hosts may to some extent explain the antipathy. Nevertheless, an examination of the creatures offers no more unpleasant feature than does the study of butterflies. The legs and mouth parts of these parasites are very nicely modified in accordance with their habit of clinging to fishes and other animals, and sucking the "juices" therefrom. In almost all species the legs are provided with strong, sharp hooks for piercing and clinging to the skin (fig. 251, a). The mouth parts

are much as in the preceding family, but the mandibles have the first one or two joints of the palp inflated and the palp of the maxilliped is always composed of two joints (fig. 251, b).

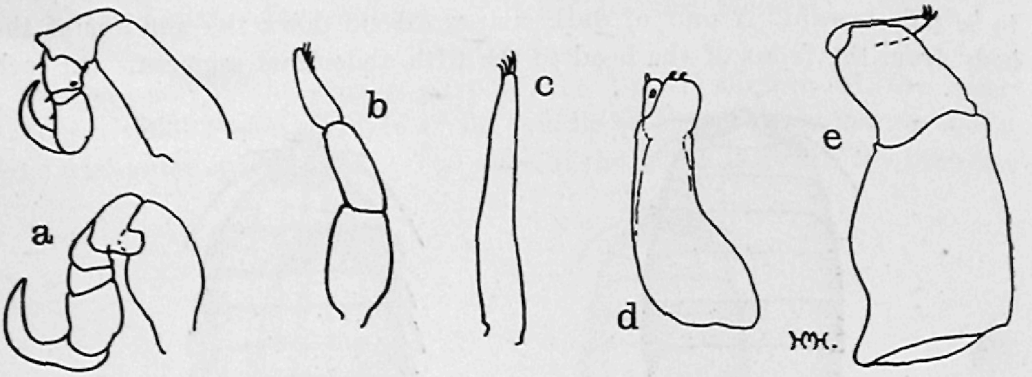


FIG. 251.—*Nerocila laticauda*; a, first and seventh legs (x 7); b, palp of mandible (x 27); c and d, first and second maxillae (x 27); e, maxilliped (x 27).

These fish-parasites lodge beneath the gill-covers or in the mouths of their hosts, or cling to various parts of their bodies; some species burrow into the body-cavities of fishes. Some forms show preference for a certain part of the host. Thus, Australian species of *Nerocila* are often found clinging to the fins (fig. 256), the Garfish-louse is found beneath the

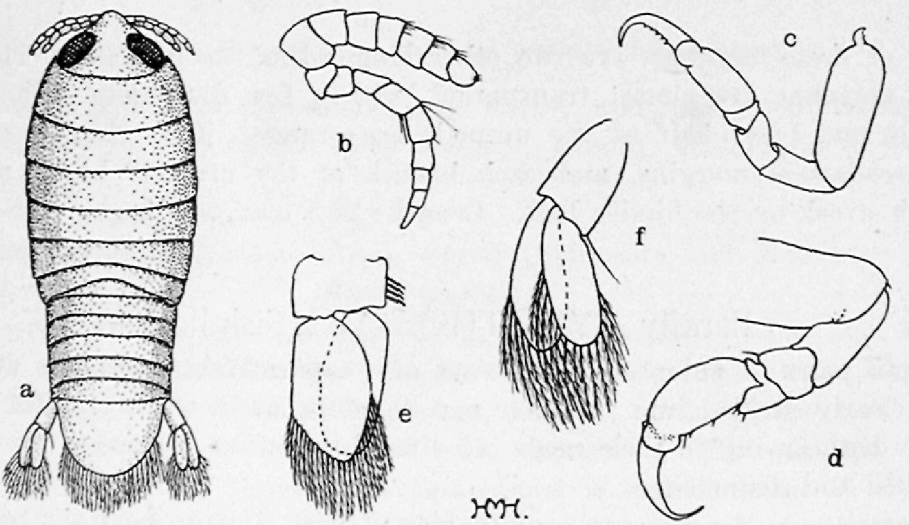


FIG. 252.—Juvenile fish-louse (*Codonophilus imbricatus*); a, dorsal view (x 13); b, antennae (x 39); c and d, first and sixth legs (x 29); e, second pleopod (x 39); f, uropod (x 39).

gill-covers of our Garfish, the Tongue-biter occurs under the gill-cover or in the mouths of fairly large fishes, and the Leatherjacket-louse burrows into the body-cavity of leatherjackets.

Reproduction and Development.—In their young stages Cymothoids are free-swimming, and then differ in some important characters from the adults. These differences are as follows:—The form is bilaterally sym-

metrical, the head is relatively large, and the eyes (which in the adult are small and sometimes entirely absent) are large and conspicuous. The claw, or dactylus, of the anterior legs is serrated on the inner edge, the swimming-fan (telson and uropods) is furnished with natatory hairs, and the pleopods are fringed with hairs (fig. 252).

In some species of the Cymothoidae the sexes are separate, but in certain genera protandrous hermaphroditism occurs; that is to say, each individual at first functions as a male and then later develops a brood-pouch, assumes other female characters, and produces a family; this condition obtains in at least one of the genera (*Nerocila*) represented in our waters, and it is extremely probable that the same thing happens in the Leatherjacket-louse (*Ourozeuktes*) also. As in other Isopods, the second pleopod of the male bears a sexual appendage (fig. 233, e), and in some of the species in which protandrous hermaphroditism occurs the male characters do not always entirely disappear when an individual passes into the female phase.

FIG. 253.—Maxilliped of egg-bearing female of *Livoneca raynaudii* (x 6½).

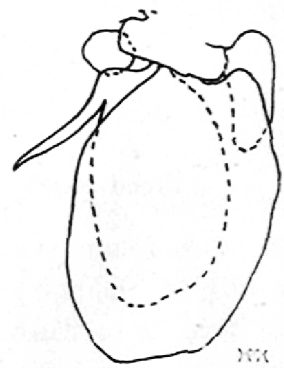


FIG. 254.—Second pleopod of egg-bearing female of *Nerocila laticauda*, showing persistent male appendage (x 5).

Thus it may happen that a female having a well-developed brood-pouch crammed with eggs or young still retains the male appendage in a thin and abbreviated form. The examination of Australian species of *Nerocila* indicated that this appendage is long in young male individuals, but does not increase in relative size as the animals grow; nevertheless, the reduced organ commonly persists in old females (fig. 254).

The brood-pouch is large, and accommodates a tremendous number of eggs, the egg-mass being sometimes considerably larger in bulk than the body of the mother, as shown in fig. 255, which illustrates a fish-louse taken off the east coast of Australia. As previously mentioned, in the Cymothoids, and in certain other Isopoda, the maxilliped of females bearing eggs or young is much expanded (fig. 253), and is used to fan a current of water through the marsupium.

An occurrence which throws a little additional light on the habits of the juveniles was recently observed at Long Bay, in New South Wales. Hundreds of young examples of a Cymothoid, comprising individuals of

several different stages, were observed attacking a shoal of surf-fishes (*Iso rhothophilus*), a species which attains to only an inch or two in length. Many of the fishes were disabled by the attacks of the actively swimming little fish-lice, which evidently had no intention of utilising them as permanent hosts. It would be interesting to learn whether each Cymothoid species adopts a wholly sedentary existence at some definite stage of its life-cycle, or whether it attaches itself to different fishes for longer and longer periods until at last it becomes so modified that it is no longer able to swim. An interesting feature in connection with the above-mentioned happening at Long Bay was that numbers of Copepod fish-parasites

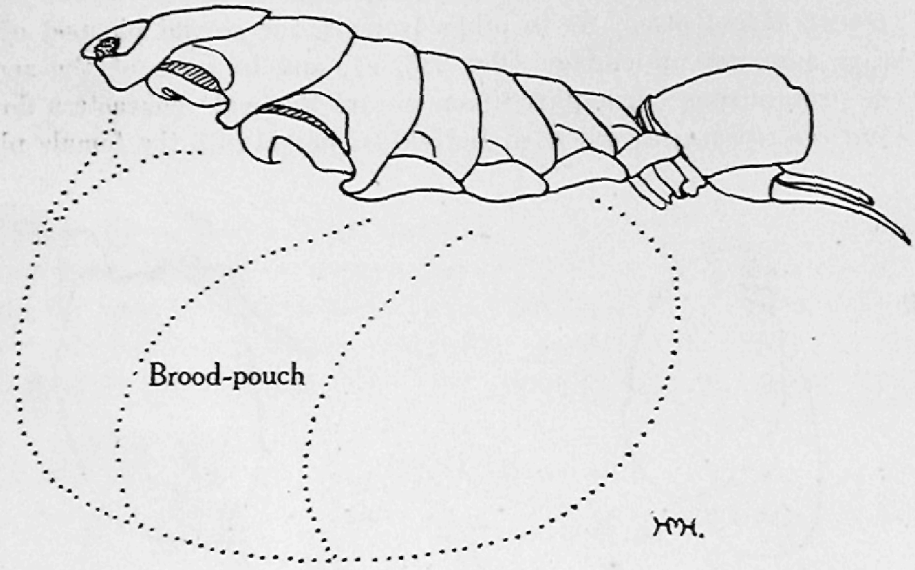


FIG. 255.—Egg-bearing female of *Irona renardi*, showing the great size of the brood-pouch; the legs are removed (x 3).

(*Caligus*) accompanied the Cymothoids and were also feeding upon the surf-fishes. This Copepod is free-swimming in the adult, but not in the young, stages, and the examples attacking the surf-fishes were all mature.

Representatives of five genera occur in South Australian seas.

a. Abdomen composed of six distinct segments, and outer branches of first pair of pleopods soft, not curved over sides of abdomen.

b. Head not immersed in (partly surrounded by) first thoracic segment, and with the hinder margin trilobate. Front edge of first thoracic segment trisinuate . . . . . *Nerocila.*

bb. Head more or less immersed in first thoracic segment, with the hinder margin not trilobate. Front edge of first thoracic segment not trisinuate.

c. Antennae rather compressed, not at all dilated, the bases of the first pair widely separated.

d. Abdomen rarely strongly immersed in thorax. Upper lip not prominently projecting. Basis of hinder legs with a more or less prominent ridge *Livoneca.*

dd. Abdomen usually strongly immersed in thorax. Upper lip prominently projecting. Basis of hinder legs without a prominent ridge .. .. *Irona.*

cc. Antennae much dilated, the first pair touching at base .. .. *Codonophilus.*

aa. Abdominal segments fused together, and outer branches of first pair of pleopods hard and curved over sides of abdomen in the adult .. .. *Ourozeuktes.*

As only one species of each of the above genera has been found in our waters, further generic description is unnecessary here.

NEROCILA (Leach).

As mentioned above Australian species of this genus are often found attached to the fins of fishes (fig. 256).

Striped Fish-louse. *Nerocila laticauda* (Schioedte and Meinert). (with a wide tail).

The head of the adults is somewhat truncate in front, and the eyes are tiny. The body is usually wide, often with the lateral angles of the segments expanded and produced backwards, as shown in fig. 257 (a and b); the angles of the last segment are always produced back to at least the level

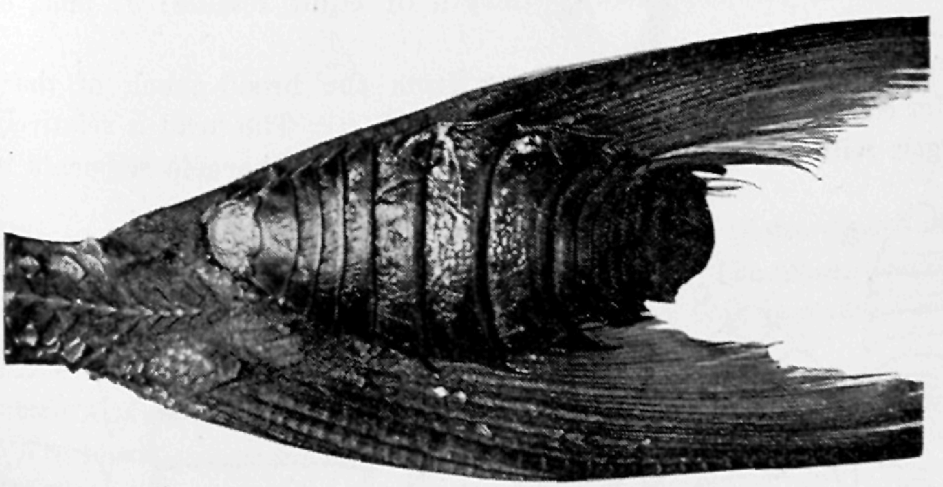


FIG. 256.—*Nerocila macleayii* clinging to tail of *Temnodon saltator.*

of the hinder angles of the third abdominal segment. In examples which have the lateral margins of all the thoracic segments expanded, the coxal plates are all hidden in dorsal view; the apices of the last pair of side-plates do not reach beyond the middle of the length of the lateral margin of the

seventh thoracic segment. The branches of the uropods are, as a rule, sub-oval, but occasionally the outer branch is rather acutely rounded at the apex; the uropods rarely reach beyond the level of the hinder margin of the telson. The upper surface of the body is dark olivaceous, with a diffused

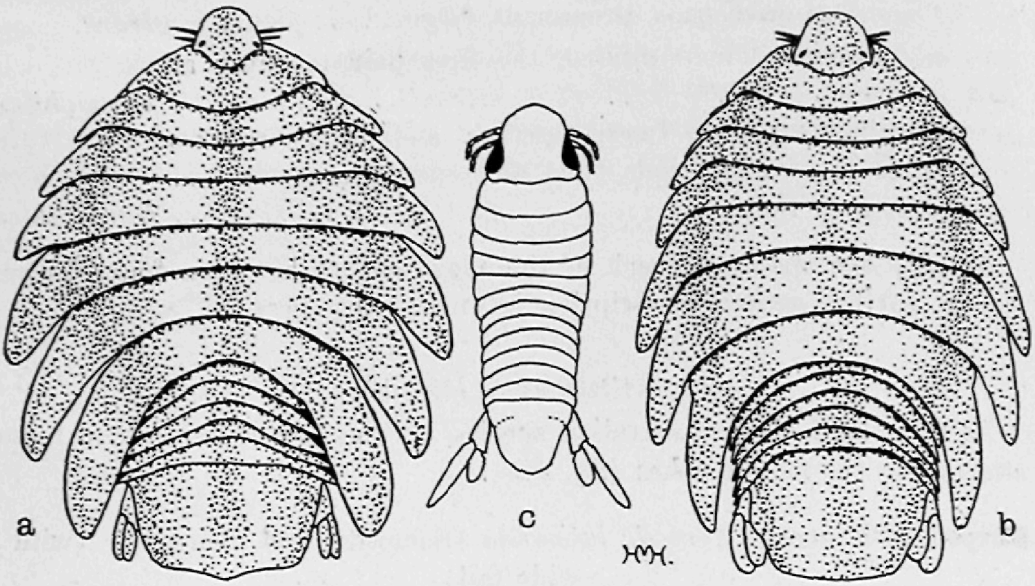


FIG. 257.—*Nerocila laticauda*; a, a large male (x 3); b, an egg-bearing female (x 2); c, a juvenile from the brood-pouch (x 14).

whitish stripe on each side of the mid-line. The underside is whitish, with the outer face of each coxal plate, and the outer half of the exopod of the first pair of pleopods, sooty. Length of adult female: 32 mm., or 1¼in. (S.A.M.)

As in other Cymothoids, young from the brood-pouch of the mother differ considerably from the adult (fig. 257, c). The head is relatively much larger, with conspicuous eyes, and none of the thoracic segments is at all

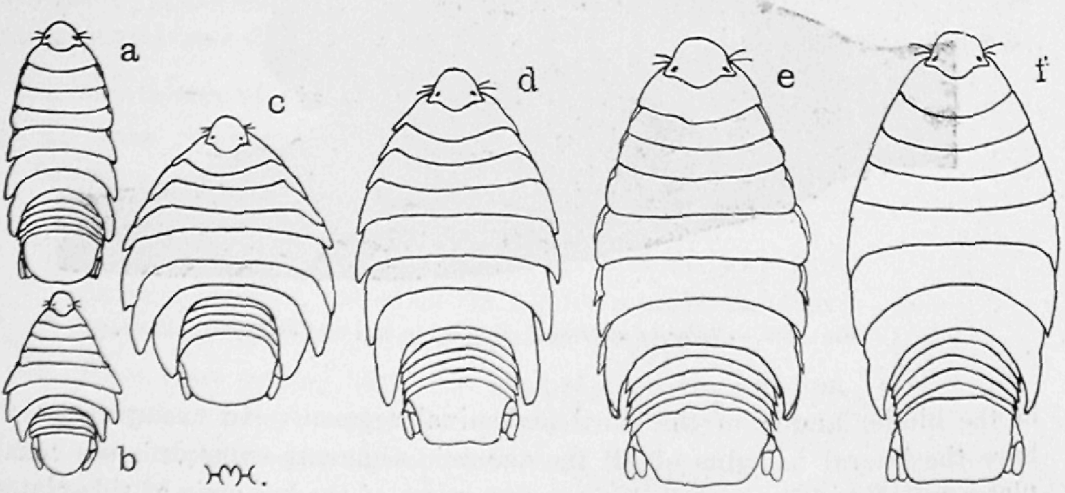


FIG. 258.—Variation in form of *Nerocila laticauda*; d, e, and f, are outlines of egg-bearing females (x 2).

expanded. The uropods are of interest in that the outer branch is long and lanceolate, not suboval, as in mature examples. As indicated above, there is a good deal of variation in the form of the adult owing to the lateral parts of the thoracic somites being less expanded in some specimens than in others (fig. 258). The species occurs off western, southern, and eastern Australia.

LIVONECA (Leach).

Broad Fish-louse. *Livoneca raynaudii* (M. Edwards). (personal name).

In adult females the body is broadly oval in shape. Some specimens are quite symmetrical; others are curved slightly to the right or left. The small head is a little concave on the upper surface, and suddenly narrows near its

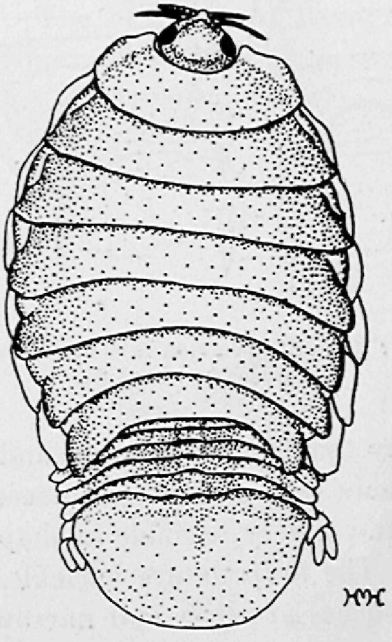


FIG. 259.—*Livoneca raynaudii*, egg-bearing female (x $1\frac{2}{3}$).

apex; the eyes are distinct but rather small. The coxal plates do not reach beyond the hinder angles of their respective segments. The telsonic segment is semi-circular in shape, and the short uropods have both branches suboval and do not reach much beyond the middle of its length.

The male attains to only half the size of the female, and is of more slender build. The telsonic segment is relatively a little longer and more triangular, and the uropods sometimes reach to the level of the hinder margin of the telson. The colour of both sexes is yellow or pale horn. Length of adult female: 38 mm., or $1\frac{1}{2}$in. (S.A.M.)

A more widely distributed species than the last, ranging from South Africa to Japan, Australia, and New Zealand. As shown by the figures, in this and our remaining species of the family the hinder margin of the head is not trisinuate as in the preceding form.

IRONA (Schioedte and Meinert).

Garfish-louse. *Irona melanosticta* (Schioedte and Meinert). (with black dots).

The body of the female is wide, somewhat oval in shape, and usually decidedly twisted to one side or the other. The head is partly immersed in the first thoracic segment, and the eyes are distinct. The coxal plates are wide, rather thin, and nearly flat; the hinder and lateral parts of each

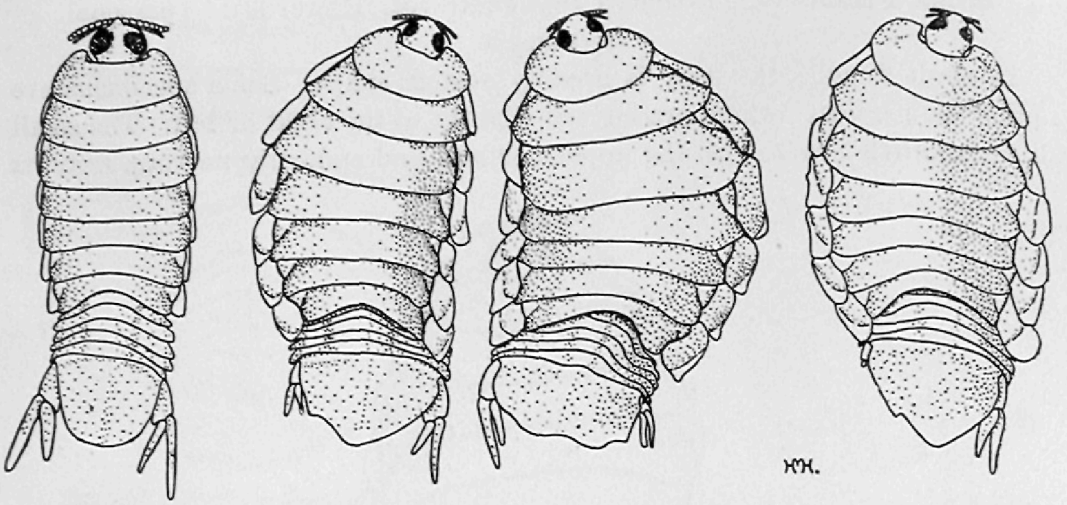


FIG. 260.—*Irona melanosticta*; the left specimen is a male, the other three are egg-bearing females (x about 4).

are softer and more fleshy than the remainder, and in dried specimens this portion shrinks and becomes thin and membranaceous. The hinder part of the telson is also fleshy, and is very variable in shape, but the stronger basal portion is semi-circular. The uropods are variable, and usually the pair is not symmetrical; the branches are thin and narrow.

In the male the body is more slender and more symmetrical, and the head is relatively longer than in the female. The sexes are often taken together on the same fish. The colour of both is white, or pale brown. Length of adult female: 18 mm., or $^{11}/_{16}$in. (S.A.M.)

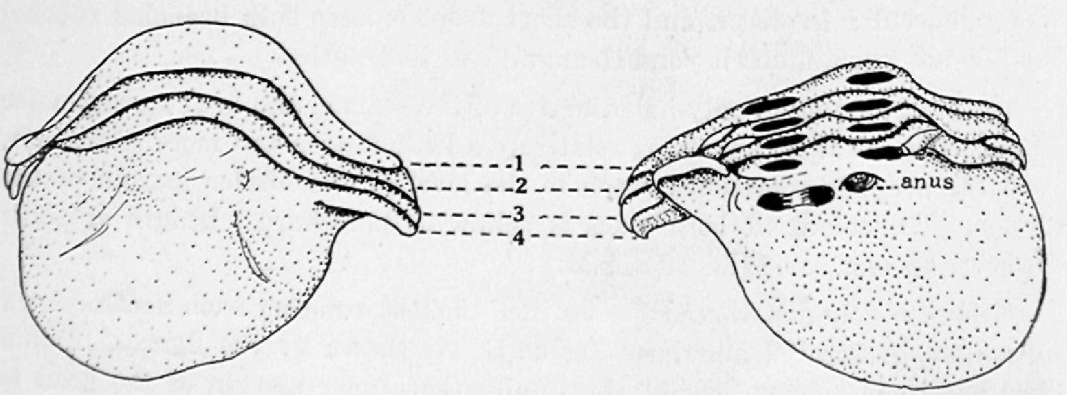


FIG. 261.—Dorsal and ventral views of abnormal abdomen of adult female *Irona melanosticta*; pleopods removed (x 5).

In South Australia this parasite is found beneath the gill-covers of our common Garfish (*Hyporhamphus intermedius*); in Japan and South Africa it parasitizes the related "Long-toms." The distortion of the female is due to the cramped position in the gill-cavity of the host. In some cases the distortion is extreme. In one much-twisted female the fourth and fifth abdominal segments have become fused together, and with the telsonic somite, so that only four separate abdominal segments are present, instead of the normal six. Uropods are wholly absent in this individual (fig. 261). The egg-pouch is of very large size in the species of *Irona* (fig. 255).

CODONOPHILUS (Haswell).

Tongue-biter. *Codonophilus imbricatus* (Fabricius). (scaled).

In adult females the body is usually somewhat distorted, rather elongate, and roughly egg-shaped. The head is subtriangular, with the margins rounded, sinuate or emarginate; the eyes, though small, are usually distinctly defined. The front angles of the first thoracic segment are forwardly

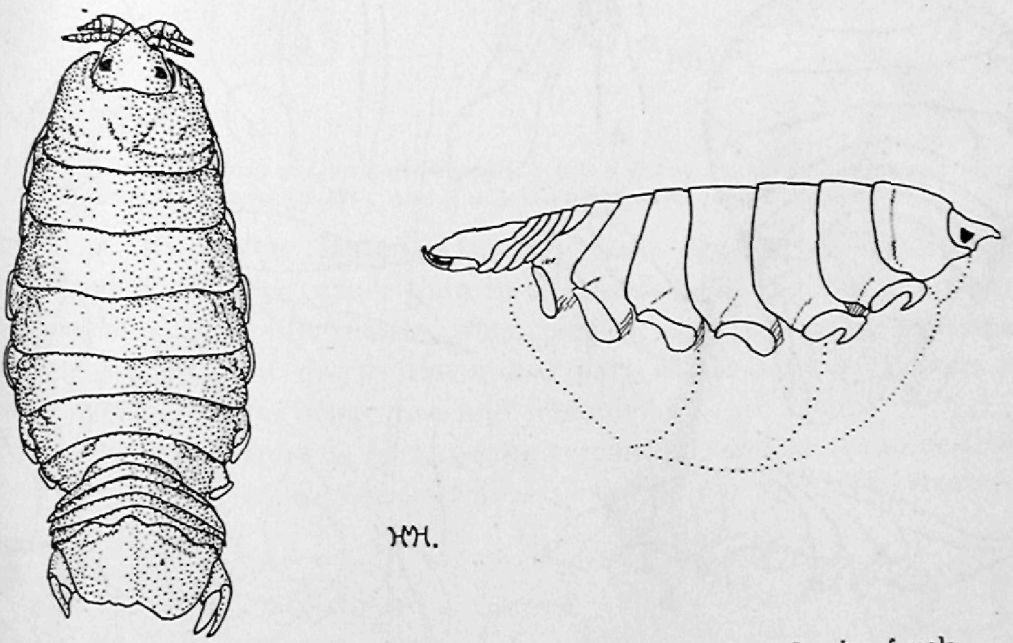


FIG. 262.—*Codonophilus imbricatus*, dorsal and side view of egg-bearing female (legs not shown); the dotted line indicates the brood-pouch (x 1½).

produced and partly embrace the head; the apices of these produced parts may be wide and rounded, or tapering and acute. The branches of the uropods are narrow, scythe-shaped, and subequal in length, but these appendages are often subject to some distortion and abbreviation. Length of adult female: 57 mm., or 2¼in. (S.A.M.)

Egg-bearing females range from ⅝in. to over 2in. in length. This large species occurs in the Indian Ocean, Java, New Zealand, Australia, and South Africa. In our waters it has been taken clinging to the tongue, or lodged under the gill-cover, of the Yellow-tail, Schnapper, Red Gurnard,

Blackfish, Trevally, and Mullet. Doubtless further investigation will show that it occurs on other fishes also; unfortunately, when securing fish-parasites, collectors often fail to record the name of the host. One of the young stages of the Tongue-biter is illustrated in fig. 252.

OUROZEUKTES (M. Edwards).

Leatherjacket-louse. *Ourozeuktes owenii* (M. Edwards). (personal name).

The adult female has a bloated, usually egg-shaped body. The head is rather small, with distinct eyes. The abdominal segments, as mentioned in the generic key, are all fused together, and the outer branches of the first pair of pleopods are curved over the sides of the pleon. The colour is white, sometimes with a smoky median stripe on the body and with the telson black.

The small and symmetrical males are of entirely different form (fig. 265, a), and have all the segments of the body distinctly separated.

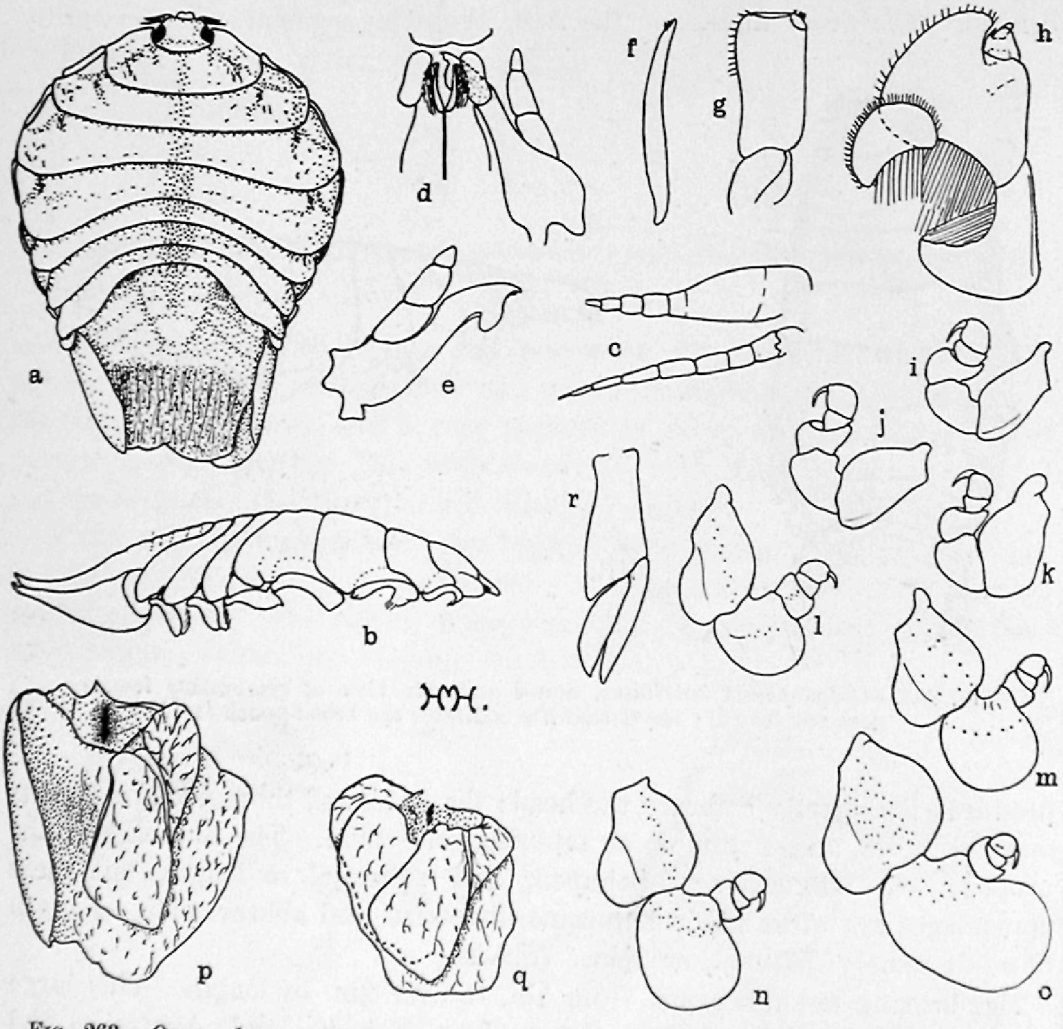


FIG. 263.—*Ourozeuktes owenii*; a and b, dorsal and side views of egg-bearing female (x 1⅔); c, antennae (x 8); d, mandible of left side, labium and margin of labrum (x 8); e, mandible (x 8); f and g, first and second maxillae (x 8); h, maxilliped (x 7); i to o, first to seventh legs (x 2); p and q, ventral view of first and third pleopods (x 2); r, uropod (x 3½).

Individuals of this sex, ranging from 5 mm. to 8 mm. in length, have been found associated with females. The colour of these was yellow, dotted with brown colour cells excepting on the telson; on the body darker cells formed a median stripe and a stripe on each side. The base and outer branch of each uropod bore a line of colour cells along the outer edge. Length of adult female: 52 mm., or 2in. (S.A.M.)

This parasite has been taken off the south-eastern, southern, and south-western coasts of Australia, and a single specimen is said to have been

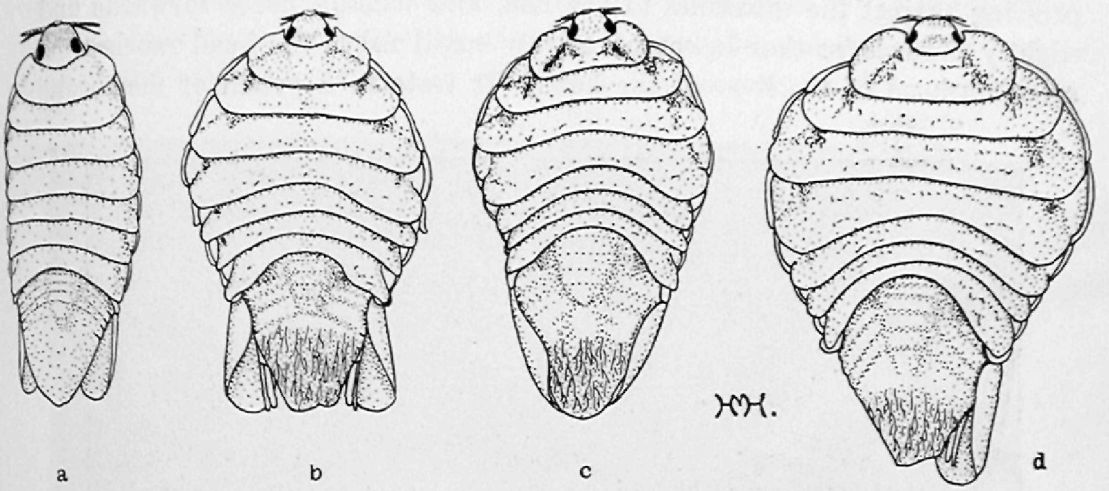


Fig. 264.—Variation in form of *Ourozeuktes owenii*; a is a young female (x $3\frac{2}{3}$); b and c, are egg-bearing females (x $1\frac{3}{4}$); and d is a large ovigerous female (nat. size).

collected at Kerguelen Island. In very large egg-bearing females the body is usually relatively wider than in smaller females (fig. 264, a and d). The abdomen of the adult female, when perfect, is subtriangular in shape, and has the sides bent down; the apical part of the telson, however, is liable to damage, and is often torn and irregular.

This unmistakable form is perhaps the commonest, and at the same time the most interesting, of the fish-parasites inhabiting our seas. The creature

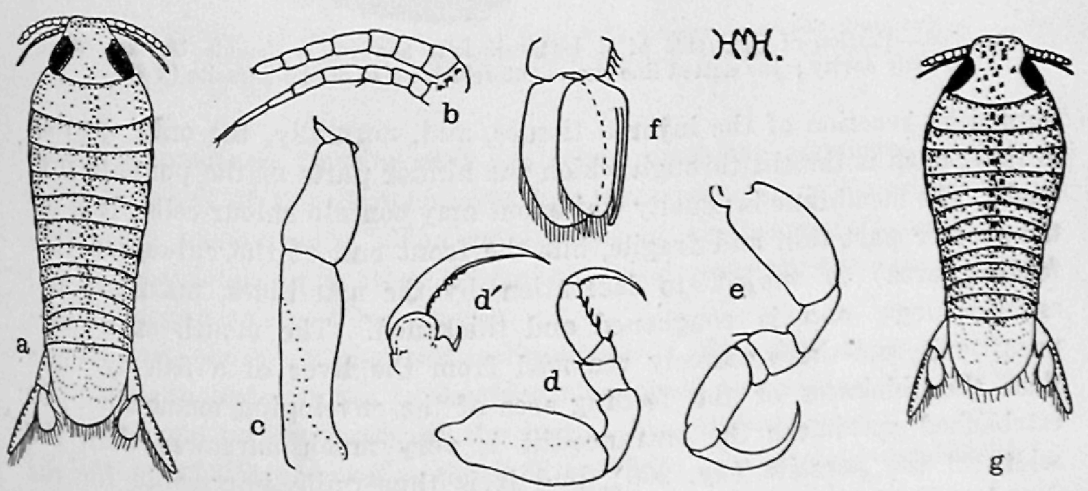


Fig. 265.—*Ourozeuktes owenii*; a, male (x $7\frac{1}{4}$); b, antennae (x 20); c, maxilliped (x 40); d and e, first and seventh legs (x 20); d′, dactylus of first leg (x 40); f, second pleopod (x 20); g, juvenile from brood-pouch (x 25).

burrows into the sides of fishes, is for the greater part concealed within the body of the host, and, when adult, is unable to leave its host. Apparently the parasite rarely, if ever, attacks fishes other than leather-jackets. The crustacean bores through the skin, and enters the body cavity of its host some distance behind and below the pectoral or side fin (sometimes very close to the anus), but is never completely concealed, the posterior parts of the abdomen and pleopods protruding through the entrance slit (figs. 266 and 267). It lies always with the underside pressing against the intestines of the fish, and usually bores forwards and slightly inwards, so that in comparatively small fishes the head reaches the neighbourhood of the liver of the host. It rests in a pouch of membrane

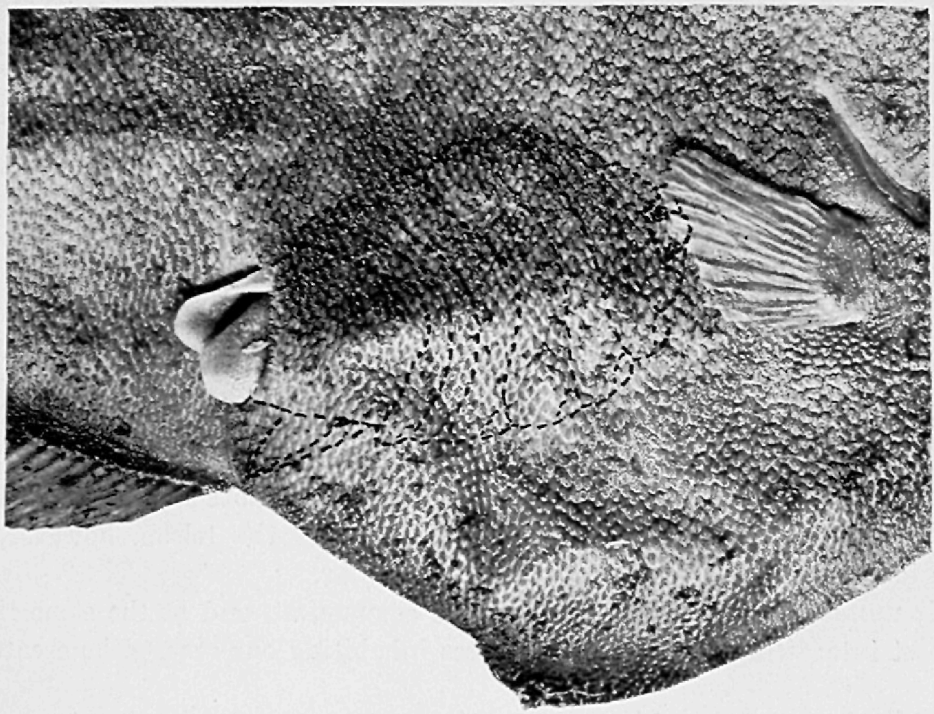


FIG. 266.—Portion of right side of a leatherjacket, showing a female *Ourozeuktes* in body cavity; the dotted line shows the relative size of the parasite (x 2).

formed by reaction of the injured tissues, and, normally, the only opening in this pouch is the slit through which the hinder parts of the parasite protrude. The membrane is usually white, but may contain colour-cells; it is for the greater part thin and fragile, but the front end of the cul-de-sac (the feeding area) is subject to laceration by the mandibles, maxillae, and anterior legs, and is roughened and thickened. The mouth of a large parasite is sometimes scarcely removed from the liver of a fish by more than the thickness of the feeding area of the enveloping membrane. In established specimens the entrance-slit is very much narrower than the width of the parasite (fig. 266), and it is thus quite impossible for the female to leave its host. In small fishes, as the parasite grows it becomes jammed between the two halves of the shoulder-girdle of the host. This

doubtless causes the crustacean to become pear-shaped as it increases in size (fig. 264, d). The four hinder legs of the Leatherjacket-louse are curiously expanded (fig. 263, l to o); they are pressed outwards against the soft enclosing membrane, and probably assist the parasite to maintain its position. The small but sharp dactyli of the front legs are hooked into the thickened anterior part of the sac. The large curved outer branches of the first pair of pleopods are modified for the purpose of holding open the aperture in the skin of the fish (fig. 266); these branches overlap below, and, with the abdomen, form a funnel-like gill-chamber in which the inner respiratory branch of the first pleopods, and the respiratory plates of the other pleopods, are enclosed. The second to fifth pairs of

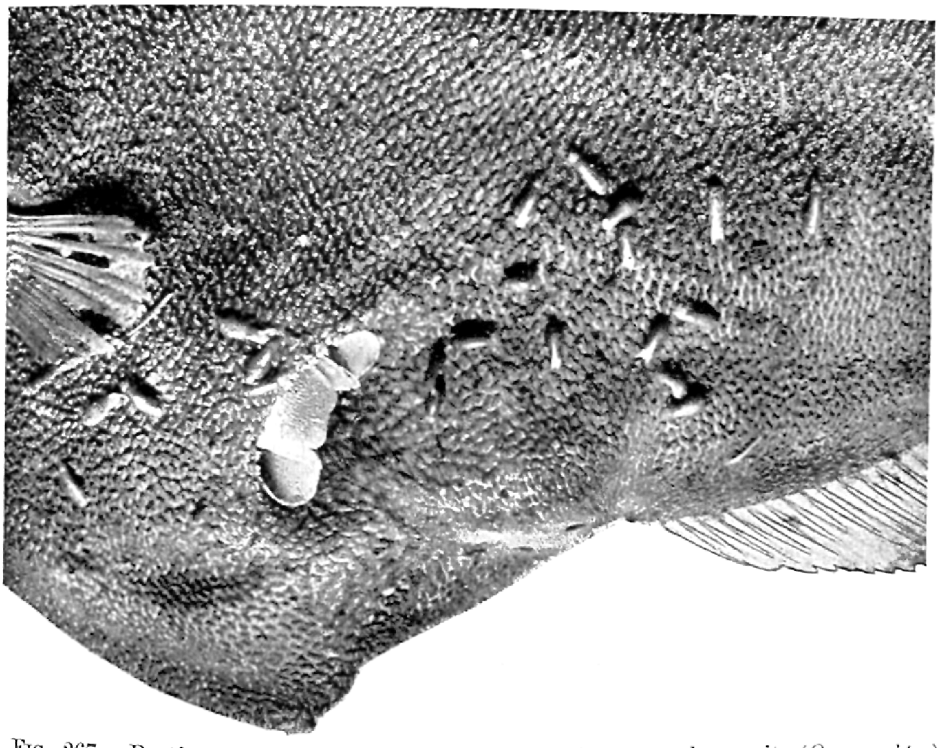


FIG. 267.—Portion of left side of same fish, with a second parasite (*Ourozeuktes*) ensconced; the juveniles clinging to the skin have recently vacated the brood-pouch of the crustacean (x 2).

abdominal appendages have a well developed plate-like expansion of the base, so that each of these appendages has three respiratory leaves, richly supplied with blood-vessels. The maxillipeds of egg-bearing females are lamellar in character, as in other Cymothoids, and probably the expansions of the hind legs also assist respiration.

Usually only one adult parasite is found on a fish, but it sometimes happens that an unfortunate leatherjacket is forced to maintain two large *Ourozeuktes*, one on each side of the body. The two sides of a leatherjacket thus afflicted are shown in figs. 266 and 267; both of these individual parasites are of considerable interest. The example on the right side (fig. 266) has allowed the outer branch of the first pleopod of the right

side (which normally assists its fellow branch to hold open the slit in the skin) to slip inside the body-cavity of the fish. This has resulted in the rupturing of the delicate membrane sac and also of the wall of the intestine, so that the crustacean is partly imbedded in a mass of food material from the gut of its host. The young of the example on the other side (fig. 267) are in progress of leaving the maternal brood-pouch. A great number of juveniles still remain in the marsupium, some are clinging to the abdominal appendages of the mother, and others have made their way out through the gill-chamber and attached themselves temporarily to the skin of the leatherjacket. These youngsters have the claws of the legs relatively much stronger than in the adult.

Males, as described above, have been taken associated with females which have not yet developed the plates of the brood-pouch, or which have the pouch incompletely developed. These males, up to the number of seven with one female, were found nestling under the basal joints of the legs of their comparatively gigantic consort. The males are evidently free-swimming; it is highly improbable that, as individuals, they have attained their maximum size and development, and it is very possible that protandrous hermaphroditism occurs in the Leatherjacket-louse.

Family LIMNORIIDAE.

The thorax is depressed and the abdomen is divided into six segments. Both antennae are short, the flagellum of the first pair consisting of but a single joint. The coxal plates are slightly movable on the second to seventh thoracic segments. One widely distributed species has been taken in our waters, but fortunately, so far at any rate, does not occur commonly there.

LIMNORIA (Leach).

Gribble or Timber-boring Louse. *Limnoria lignorum* (Rathke). (of wood).

The illustration shows the main features of this tiny but most destructive species. The plates of the brood pouch are large, and it is stated that "the number of eggs is rather moderate (twenty-nine were found in one specimen) . . . The volume of each full-grown young one is very considerably larger than that of an egg, the marsupium containing such larvae is accordingly exceedingly distended, more than twice as deep as in a female with eggs recently laid." The male is only about one-third the size of the female. Length: 3mm., or $\frac{1}{8}$in. (S.A.M.)

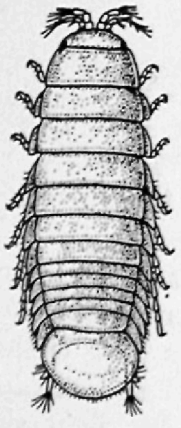


FIG. 268.—*Limnoria lignorum* (after Sars, x 20).

The Gribble has unusually strong, chisel-edged jaws, and causes considerable damage to piles of jetties and other structures owing to its habit of burrowing into submerged timber. Unless a hard knot or other obstruction is met with, the animal

tunnels straight into the wood to a depth of an inch or two; if an obstacle is encountered the creature burrows around it and then resumes its former direction. Where many Gribbles are working together the timber soon becomes absolutely riddled with cylindrical holes and rapidly disintegrates. Wood affected in this way has been collected (on one occasion only) at Port Lincoln. *Limnoria* has also been observed boring into the rubber covers of marine cables.

Family SPHAEROMIDAE (Marine Pill-lice).

Members of this family are plentiful on the South Australian coast; the different species may be found amongst weed, on sand in shallow water, beneath stones, in cavities of sponges and other marine growths, clinging

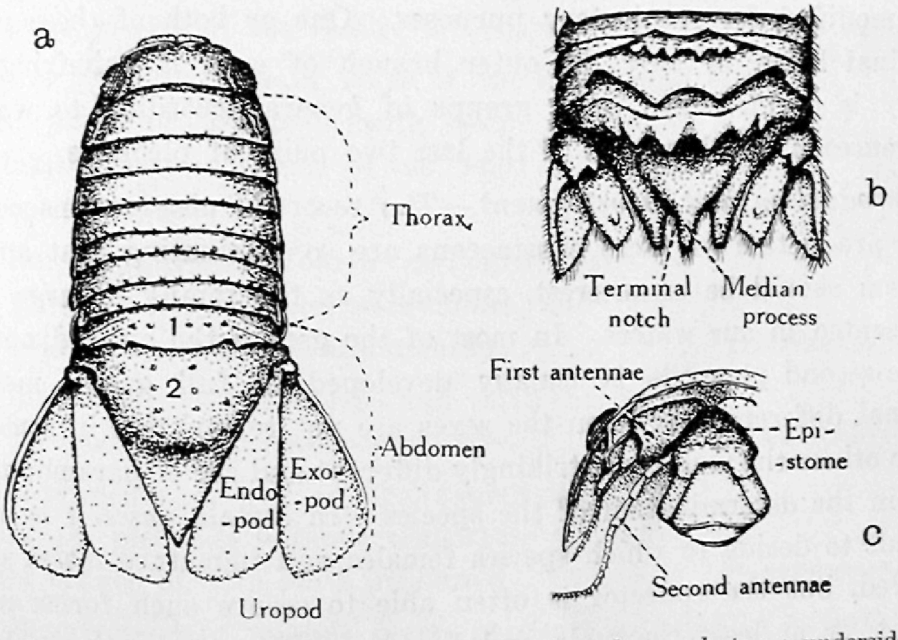


FIG. 269.—a, *Exosphaeroma alata*; b, abdomen of *Cymodoce aculeata*; c, underside of head of *Cymodoce aculeata*.

to the outside of sea-squirts and sponges, burrowing in sand and mud, and so on. The Marine Pill-lice are easily separated from representatives of our other Isopodan families. The body is usually wide and almost always convex (in which case the animal can curl into a pill-like form), or, more rarely it is flattened (in which case the animal folds itself like a closed book when alarmed). The coxal plates are all immovably fused with their segments, but often at least some of the plates are marked off by barely discernible furrows. In almost all species (and in all known Australian forms) the five anterior segments of the abdomen are solidly fused together (fig. 269, a, 1). As a rule, traces of the divisions of some of the segments remain in the form of grooves on the upper surface. The sixth segment

and the telson, as in most Isopoda, are coalesced to form a telsonic somite (fig. 269, a, 2). Thus, the abdomen of our Sphaeromids consists of only two distinctly articulated segments. The apex of the telson may have a more or less distinct notch, in or above which may be a small median lobe or process (fig. 269, b). The outer branch (exopod) of the uropods, when present, is movable, but the inner branch (endopod) is always fixed. In one known case, an interesting species recently discovered in fresh-water on the Chatham Islands, the abdomen is composed of five separate segments and uropods are wholly absent; this form, however, need not be considered here.

The abdominal appendages are of considerable importance in the classification of the Sphaeromidae. Both branches of the first two or three pairs are fringed with feather-like hairs, but the branches of the fourth and fifth pleopods are rarely furnished with such hairs, but are wholly or in part modified for respiratory purposes. One or both of these pairs lack marginal hairs, or only the outer branch of each is hair-fringed. The family is divided into three groups of genera according to well-defined differences in the branches of the last two pairs of pleopods.

Reproduction and Development.—The recorded observations concerning the reproduction of these crustaceans are so fascinating that an epitome of them should be of interest, especially as the family is large and well represented in our waters. In most of the genera the appendix masculina of the second pleopods is usually developed in full grown males. The external differences between the sexes are not remarkable in some genera, but in others the males are strikingly different and are of paramount importance in the determination of the species. In certain cases it is extremely difficult to decide to which species females and immature males should be referred, but the collector is often able to secure such forms in family groups, or at least the male and female are found together. Immature males which have not yet developed the sexual modification of the pleopods may be recognised by the little pair of penes on the sternal surface of the last thoracic somite.

The females of some Sphaeromids have deep pits or pouches in the underpart of the thorax; the plates which form the usual Isopodan marsupium may be well-developed, rudimentary or absent. The thoracic pits have slit-like apertures, and the eggs, instead of remaining in the usual marsupium, are protected in the internal pouches; the developed young later squeeze out through the slits. Accommodation for eggs and young varies in the different genera; it may be limited to the usual brood-pouch of plates, or to internal pouches, or may consist partly of plates and partly of a large body-pit. In some genera, particularly, it has been pointed out, in those having a well-developed notch at the end of the abdomen, some

remarkable changes take place in females bearing eggs or young. The maxillipeds become expanded as in the Cymothoids (fig. 253), while the mandibles and other mouth-parts become soft and much reduced, so that the animals cannot eat. Mr. W. H. Baker, who has made a special study of Australian Sphaeromidae, remarked on this condition as follows: "With regard to the young-bearing females, whose mouth-parts and viscera have been so much altered, one fails to see how the animal recovers itself after rearing a brood, and is driven to the conclusion that the individual perishes in the effort, and is probably, in some cases at least, eaten by the brood. In the female of a species of *Cymodoce* . . . . I have observed the transverse slits in the sternal plates referred to by Dr. Hansen, and have seen well-formed young emerge from under the marsupial plates; these were somewhat hardened. The young ready to emerge from the body through the slits are very soft, and can consequently squeeze through a small space."

The three groups of the family are characterised thus:—

a. One or both branches of each of the fourth and fifth pairs of pleopods with deep transverse wrinkles; outer branch of at least the fifth pleopods two-jointed.

  b. Inner branch of fourth and fifth pairs of pleopods with transverse wrinkles and outer branch somewhat membranaceous . . . . . HEMIBRANCHIATAE.

  bb. Both branches of fourth and fifth pairs of pleopods with transverse wrinkles . . . . . EUBRANCHIATAE.

aa. Both branches of each of the fourth and fifth pairs of pleopods without transverse wrinkles; outer branch of both pairs unjointed . . . . . PLATYBRANCHIATAE.

The descriptions of species given here are admittedly superficial, but the keys and the figures, together with the short diagnoses, should render the separation of the forms mentioned moderately simple. Excepting where otherwise indicated the male is described and illustrated.

Group **HEMIBRANCHIATAE.**

This and the following key to genera of Sphaeromidae are adapted in part from Dr. Hansen's work on the Propagation, Structure, and Classification of the family (1).

a. Abdomen without a terminal notch in the male, or with end of abdomen produced and a notch on each side. Abdomen of female without notch.

(1) Hansen, Quart. Journ. Micros. Sci., xlix., 1905, p. 69.

b. Maxillipeds without well-marked lobes on fourth, fifth, and sixth segments. Outer branch of third pleopods unjointed .. .. *Sphaeroma.*

b. Maxillipeds without well-marked lobes on fourth fifth, and sixth segments. Outer branch of third pleopods two-jointed.

c. Last segment of thorax without process. End of abdomen sometimes a little produced, but not acute.

d. Inner branch of third pleopods with transverse wrinkles .. .. *Neosphaeroma.*

dd. Inner branch of third pleopods without transverse wrinkles .. .. *Exosphaeroma.*

cc. Last segment of thorax of male with a slender median process. End of abdomen somewhat acute, often very considerably produced.

e. End of abdomen similar in both sexes, much produced, with a distinct groove on lower side of produced part .. .. *Isocladus.*

ee. End of abdomen somewhat produced in the female, strongly produced and with a pair of lateral notches in the male; an oblong groove is scarcely developed .. .. *Zuzara.*

aa. Abdomen with a semi-circular or bilobed terminal notch in both sexes.

f. Abdominal notch divided by at least the vestige of a median process; usually the last-named is well developed.

g. Median process of abdomen almost or quite obliterating the terminal notch .. *Cymodopsis.*

gg. Median process never completely obliterating terminal notch.

h. Anterior part of abdomen of male with a large median process .. .. .. *Cilicaea.*

hh. Anterior part of abdomen of male without median process, or with only a small process.

i. Inner branch of uropods moderately developed or large .. .. *Cymodoce.*

ii. Inner branch of uropods short or rudimentary .. .. *Paracilicaea.*

ff. Abdominal notch semicircular, with no vestige of a median terminal process .. *Cilicaeopsis.*

SPHAEROMA (Latreille).

Some species of this genus are, like the Gribble, of most destructive habit. One widely-distributed form (*S. terebrans*), which burrows into the piles of jetties and other structures, occurs in New South Wales and Queensland; in Florida this Isopod is said to have reduced the diameter of piles from 16in. to 7½in. in eight years. Our *S. quoyana* is responsible for considerable damage to submerged wood.

Burrowing Pill-bug. *Sphaeroma quoyana* (M. Edwards). (personal name).

The segments of the body are faintly granulate, but have no processes. The telsonic segment has the hinder margin rounded in both sexes, with no trace of notches, and its upper surface is ornamented with two longitudinal

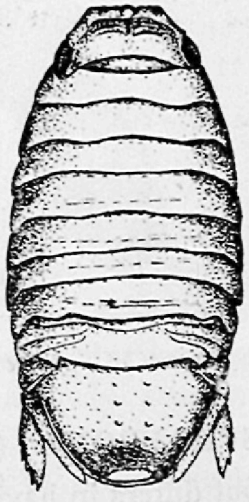


FIG. 270.—*Sphaeroma quoyana* (after Baker, x 4).

rows of four or five tubercles. The branches of the uropods are of about the same length; the fixed inner ramus reaches to the level of the end of the abdomen, and the outer margin of the exopod is cut into four or five shallow teeth. There are numerous black markings on the dorsal surface of the body. Length: 14 mm., or 9/16in. (S.A.M.)

This species is common in South Australia, and is often found burrowing in mud, sometimes into partly solidified mud-nodules on our beaches. It has been noted that in Port Jackson and in New Zealand the animal bores into submerged timbers, sandstone, and other soft rock. In 1926 the late Dr. W. E. J. Paradice wrote in the *Australian Zoologist*:—"On the northern side of Cockatoo Island, under a wharf, and thus protected from the sun throughout the day, are to be found numerous pieces of sandstone riddled with holes made by the crustacean . . . . . Among the sandstone are the remains of some old piles, which are completely honeycombed by the same animal . . . . . Exactly similar

sandstone lying between tide-marks, but outside the shade of the wharf, is not attacked by *S. quoyana.*" A tiny Isopod (*Iais pubescens* var. *longistylis*) is often found in the burrow in company with the pill-louse.

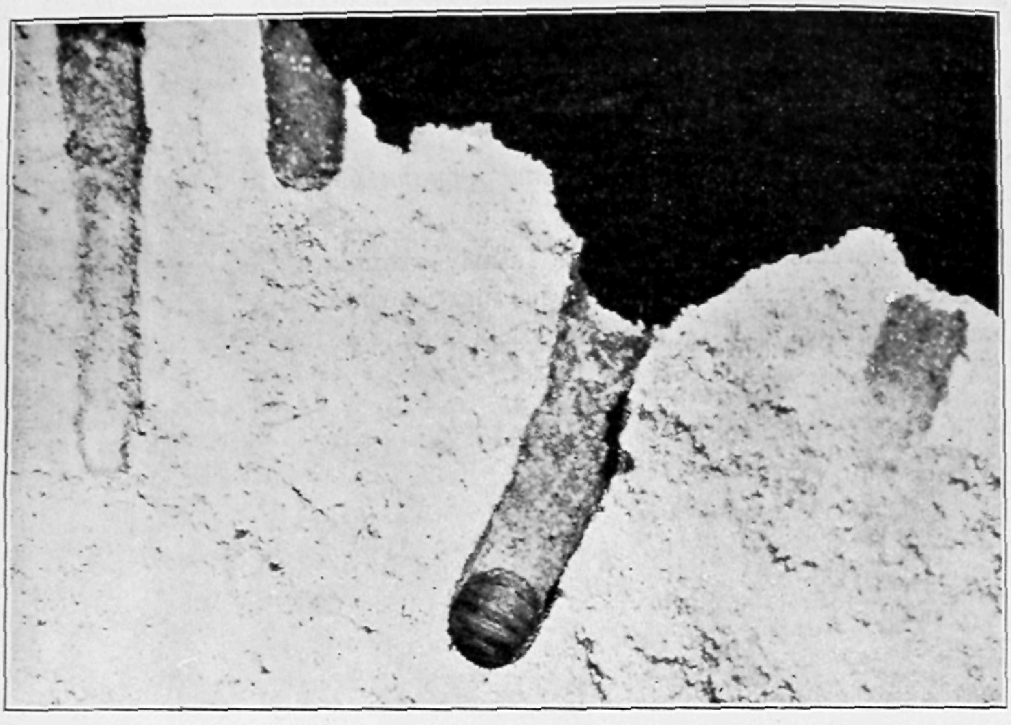


FIG. 271.—Sandstone, with burrows of *Sphaeroma quoyana* (after Paradice).

NEOSPHAEROMA (Baker).

Very like the next genus, but differs in having some branchial folds on the inner branch of each of the third pleopods, and in having plumose hairs on both branches of the fourth pleopods. In the male the inner branch of the first, as well as the second, pair of pleopods bears sexual appendages.

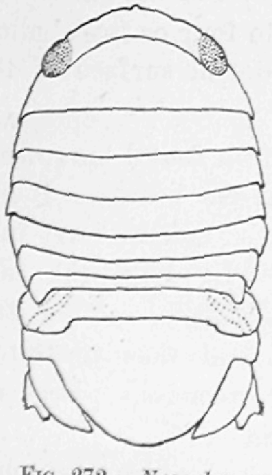


FIG. 272.—*Neosphaeroma laticauda* (after Whitelegge, x 4½).

Wide-tailed Pill-bug. *Neosphaeroma laticauda* (Whitelegge). (broad tailed).

Somewhat resembles the Burrowing Pill-bug in general appearance, but the body is relatively wider. The broad telsonic segment is strongly convex and smooth, with the hinder margin evenly rounded and unbroken. The outer branch of the uropods is only about half the length of the fixed endopod, which is somewhat scythe-shaped and reaches to the level of the end of the abdomen; the exopod is incised postero-laterally, and the apex and outer margin are furnished with tiny teeth. The colour is cream. Length: 21 mm., or ⅘in. (S.A.M.)

EXOSPHAEMORA (Stebbing).

Five species have been taken in our waters.

a. Outer branch of uropods suboval, with apex rounded. Joints of peduncle of first antennae not subequal in length.
  b. Uropods reaching almost or quite to end of abdomen. Telsonic segment smooth above.
    c. Large species attaining to 1 inch in length. Body very broad. Epistome apically rounded .. .. *gigas.*
    cc. Small species under $\frac{3}{8}$ of an inch in length. Body not very broad. Epistome apically subacute.
      d. Apex of telsonic segment acute in the adult .. .. .. *laevis.*
      dd. Apex of telsonic segment roundly subtruncate.. .. *alii.*
  bb. Uropods only three-fourths as long as telsonic segment, which has a pair of very short, low ridges near the base *varicolor.*
aa. Outer branch of uropods lanceolate, apically narrowed, and very acute. Joints of peduncle of first antennae subequal in length .. .. *bicolor.*

Exosphaeroma gigas (Leach). (very large).

A rather variable species. In the adult the body is broad and almost smooth, with the sides of the thorax nearly parallel in dorsal view. The infero-lateral edges of the thoracic segments are grooved. The convex telsonic segment is smooth and subtriangular in shape, with the apex narrowly rounded and the sides a little sinuous. The first antennae have the first joint of the peduncle nearly twice as long as the second and the third narrower but longer than the second. The epistome is widened and rounded apically. The fourth, fifth, and sixth joints of the legs are furred on the inner margins, and the merus and carpus each bear a group of apical spines. The male appendage of the second pleopods is much longer than the rami and ends almost acutely. The branches of the uropods are subequal in length, suboval in shape, with rounded apices; the endopod reaches to about the level of the apex of the abdomen. The animal is dark or light brown, with whitish markings on the thorax, and the margins of the segments bordered with yellow or orange. Length: 25 mm., or 1in. (S.A.M.)

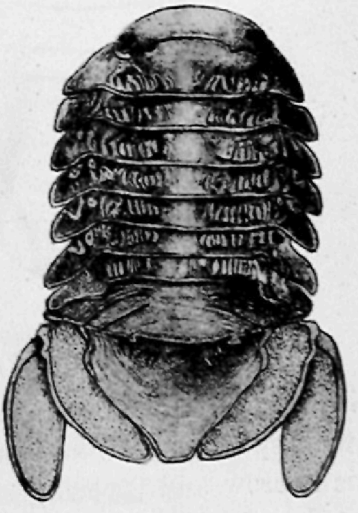


FIG. 273.—*Exosphaeroma gigas* (after Stebbing, x 3).

It has already been noted that a variety of *Iais pubescens*, one of the Isopoda-Asellota, is commonly associated with *Sphaeroma quoyana*. The typical form of *I. pubescens* is found with *E. gigas*.

Exosphaeroma laevis (Baker). (smooth).

The surface of the suboval body is smooth. The telsonic segment is domed, triangular in shape, with the apex acute in the adult and bent slightly downwards. The first peduncular joint of the first antennae is twice as long as the second and slightly longer than the third narrow segment. The narrow epistome is subacute apically. The male appendage of the second pleopods is long with several small setae at the apex. The branches of the uropods are broad, suboval, and rounded apically; the inner branch reaches nearly to the end of the abdomen, and in the male the exopod is a little longer than the endopod. Length: 8 mm., or $^{3}/_{10}$in. (S.A.M.)

Exosphaeroma alii (Baker). (personal name).

The body is somewhat narrowly oval in shape, with the surface smooth. The telsonic segment is not strongly domed, subtriangular with the apex rounded and subtruncate. The third peduncular joint of the first antennae is narrower and a little longer than the second, which is only half as long as the first. The rather long epistome is acute at the apex. The

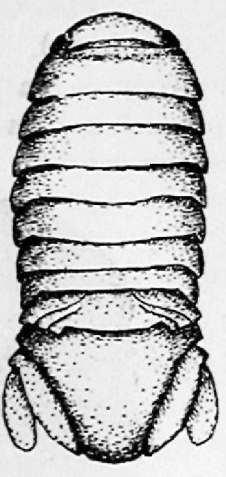


FIG. 274.—*Exosphaeroma alii* (after Baker, x 7).

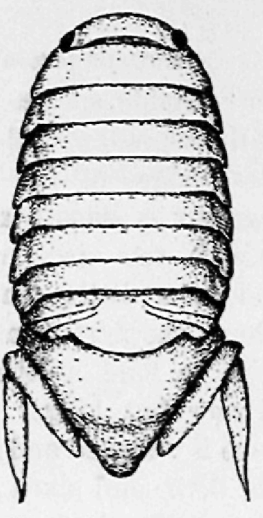


FIG. 275.—*Exosphaeroma bicolor* (after Baker, x 5).

legs are somewhat slender, the first pair furnished with fine hairs, the others with sparse spines and hairs. The male appendage of the second pleopods is narrow and tapering towards the end, and is longer than the rami. The endopod of the uropods barely reaches to the end of the abdomen, and has the inner margin nearly straight and the outer edge convex, and is subacute at the apex. The exopod is a little shorter, suboval, with narrowly rounded apex. The colour is white with dark markings. Length: 7 mm., or $^{9}/_{32}$in. (S.A.M.)

Exosphaeroma varicolor (Barnard). (with various colours).

The body is smooth and strongly convex transversely. The side-plates of the thorax are bent down nearly vertically, and are not so much separated as in *E. gigas*. The abdomen has a pair of obscure tubercles on the hind

margin of the fourth segment in both sexes. The telsonic segment is long, as long as broad, triangular, with the sides almost straight and the apex narrowly rounded; near the base there is a pair of short, submedian, blunt carinae, one on each side of a groove. The second joint of the peduncle of the first antennae is about two-thirds as long as the first, and the third is a little longer than the second. The epistome is rather narrow, with the sides concave and the apex truncate. The legs are armed with a few spines and pads of fur on the fourth to sixth joints. The male appendage of the second pleopods is half as long again as the inner branch, and tapers to a fine point. The uropods are only about three-fourths of the length of the telsonic segment in both sexes; both branches are ovate and the inner ramus is slightly longer than the outer, with the apex somewhat acutely rounded. The colour is variable. Length: 10·5 mm., or $\frac{2}{5}$in. (S.A.M.)

This species was originally described from South Africa, and the South Australian record is based upon some specimens dredged at Beachport.

Exosphaeroma bicolor (Baker). (with two colours).

The body is moderately wide, suboval in shape, almost smooth, and slightly shining. The convex telsonic segment is subtriangular in shape, with the apex narrowly rounded. The peduncular joints of the first antennae are subequal in length, and the epistome is elongate and rounded apically. The legs are robust and well armed with spines on the ischium, merus and carpus, and have furry pads on the merus, carpus and propodus.

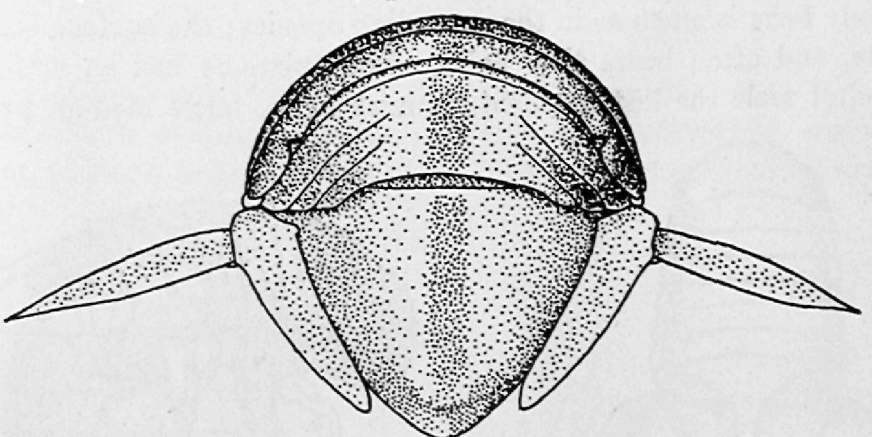


FIG. 276.—*Exosphaeroma bicolor*, attitude when alarmed.

The male appendage of the second pleopods is thick, apically obtuse, and is longer than the rami. The rather broad inner ramus of the uropods does not reach to the end of the abdomen and is subacute apically; the exopod is narrower, lanceolate with a very acute tapering apex, and in the male is longer than the endopod and reaches beyond the end of the abdomen. The colour is very variable, sometimes greyish-black, pale grey or white without markings, sometimes variously mottled or striped. Length: 10 mm., or $\frac{2}{5}$in. (S.A.M.)

This species was discovered in the Bay of Shoals, Kangaroo Island, most of the specimens being taken in places where the bottom consists of broken

shell. When crawling over or resting on debris of this sort the animals were difficult to detect owing to their protective colouration. They roll into a perfect sphere when disturbed, with the outer branches of the uropods directed outwards. A female in this posture is shown in fig. 276 and the male is illustrated in fig. 275.

ISOCLADUS (Miers).

Isocladus excavatus (Baker). (excavate).

The body is ovate in shape, and practically smooth. The seventh thoracic segment of the adult male has a large process, which reaches back to the end of the abdomen. The anterior part of the abdomen is short, but the telsonic segment is large, triangular, and apically subacute. The anterior part of the epistome is not crested, and its lateral limbs recede more than in the following form. As shown in the figure, the uropods are very large, broad, and lamellate. Length: 8 mm., or $\frac{3}{10}$in. (S.A.M.)

This species is apparently rare, being known only from a male taken near shore in St. Vincent Gulf, and a male found in a rock-pool in Western Australia; the generic characters, as outlined in the key to the genera of Hemibranchiate Sphaeromids, and other features given above, separate it from the next species, which it greatly resembles.

ZUZARA (Leach).

Zuzara venosa (Stebbing). (veiny).

The body form is much as in the preceding species; the surface is minutely granulate, and often bears tiny hairs. The epistome has an arched crest. In the adult male the last thoracic segment has a large median process, so

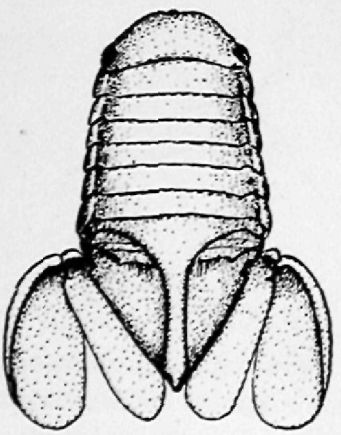


Fig. 277.—*Isocladus excavatus* (after Baker, x 6).

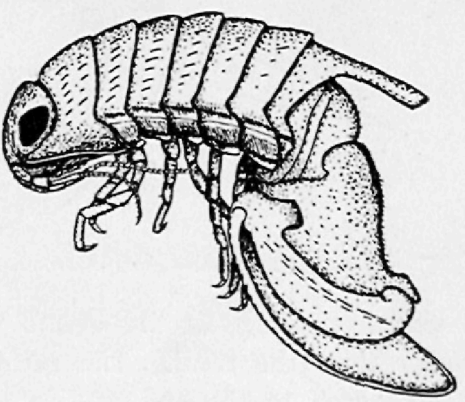


Fig. 278.—*Zuzara venosa* (after Baker, x 4½).

that this segment, with its posterior projection, is as long as the fourth to sixth segments together; the process is rather narrow, may be obtusely rounded, or nearly truncate apically, and sometimes there is a pair of tubercles alongside the base, one on each side; it is absent or short in young males, but increases in length with age, until it attains the size given. The

end of the telson has a humped terminal projection (as shown in the illustration of an adult male), on each side of which is a small tooth. The uropods are large; the outer branch is much longer than the inner, with the upper surface excavate and the external border raised and thickened.

The female differs considerably from the male. There is no large process from the seventh thoracic segment. The telson has no terminal notch, and the uropoda are smaller, with the branches subequal in length. The adult female has two faint submedian tubercles at the base of the telsonic segment, and the crest of the epistome may be nearly obsolete. The colour, which is somewhat variable, is usually brownish or grey. Length: 13 mm., or ½in. (S.A.M.)

An exceedingly common species, and almost certain to be taken anywhere along the shores of our Gulfs where rocks and stones occur at the edge of the sea. Numerous colonies of individuals of both sexes, in all stages of development, are commonly secured by turning over such shelters, either in or near the water.

CYMODOPSIS (Baker).

Although this genus belongs to a section of the Hemibranchiate genera, having a semicircular or bilobed notch at the end of the abdomen, in both sexes, the notch in this case is completely obliterated by a pointed median, terminal process. The end of the abdomen has a vertical exit channel to the branchial cavity, and the apex of the telson often projects slightly beyond this passage.

Cymodopsis crassa (Baker). (thickened).

The body is smooth, oval in shape, and very convex transversely, especially near the front, where it is deep and plump. The rounded epistome is swollen

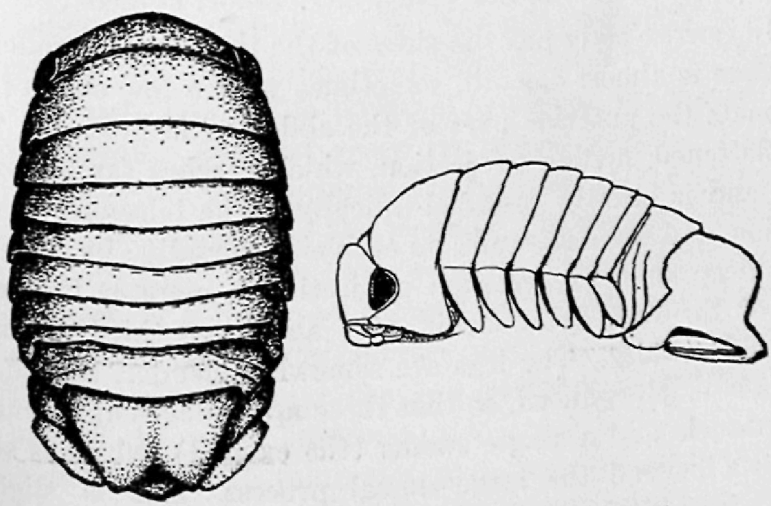


FIG. 279.—*Cymodopsis crassa* (after Baker, x 4).

anteriorly, and the legs are sparsely spined. The short anterior portion of the abdomen has no projections, but the telsonic segment has a pair of large conical dorsal elevations, between which is a shallow depression.

Behind these bosses the telson is abruptly declivous; the end of the abdomen is very obtuse, with a wide, shallow, vertical excavation. The male appendage of the second pleopods is whip-like, and twice as long as the rami. In both sexes the inner fixed branch of the uropods is somewhat scythe-shaped, and does not reach to the end of the telson, while the outer branch is very tiny. During life the known specimens, which were taken in St. Vincent Gulf, were pink, marked with minute dark dots. Length: 12 mm., or ½in. (S.A.M.)

CILICAEA (Leach).

The thorax has no median dorsal processes, but in the adult male a large projection extends back from the anterior part of the abdomen. In the introductory remarks to the family it has already been mentioned that in genera such as this, in which marked sexual dimorphism occurs, the females cannot always be identified with certainty; in all such genera it is most desirable, and in some cases absolutely necessary, to base determinations upon adult male material. Three species have been recorded.

a. Large dorsal abdominal process of male rounded apically. Endopod of uropods rudimentary.
   b. Exopod of uropods truncate, or bifid apically. Terminal process above apical notch of abdomen more or less trilobed . . . . . *curtispina.*
   bb. Exopod of uropods apically rounded. Terminal process above apical notch of abdomen simple . . . . . *latreillei.*

aa. Large dorsal abdominal process of male tridentate. Endopod of uropods large . . . . . *tridens.*

Ciliceaea curtispina (Haswell). (short-spined).

The strongly convex body has the sides of the thorax subparallel in dorsal view; the surface is almost smooth, sometimes with a few obscure tubercles. In the adult male the anterior part of the abdomen is produced backwards into a large, flattened median projection, which reaches far beyond the end of the telson, and is bluntly rounded apically. The telsonic segment has a conical elevation, and some granules on each side dorsally; its posterior notch is moderately deep, and the terminal projection is more or less trifid. The second joint of the first antennae is only about one-third as long as the first, and is bifid distally. The legs are somewhat slender, and the endopod of the uropods is much reduced, so that these appendages apparently consist of a broad peduncle and a single ramus (the exopod), which is strong and curved, projects beyond the large dorsal process, and is slightly bifid apically.

As is usual in the genus, the female is very different from the male; the anterior portion of the abdomen has two short, longitudinal submedian ridges, but no large process, while the telsonic segment has two small tubercles above each of the conical dorsal projections; the notch at the end

of the abdomen is deeper than in the male. Both rami of the uropods are bifid distally, the rudimentary endopod being grooved to receive part of the edge of the exopod when the latter is folded. Length: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

A very common species in shallow water around our coasts.

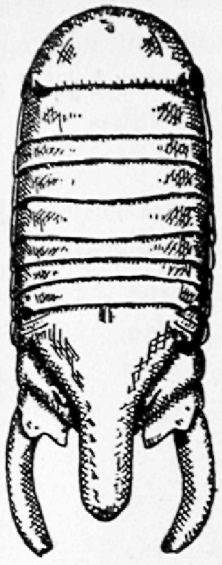


FIG. 280.—*Cilicaea curtispina* (after Baker, x 3).

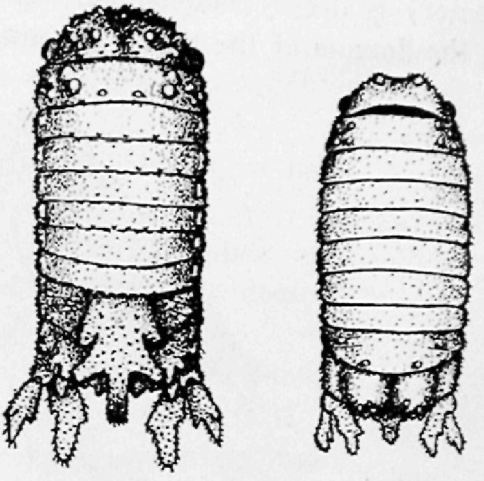


FIG. 281.—*Cilicaea tridens*, male and female (after Baker, x 7).

Cilicaea tridens (Baker). (three-pronged).

In the male the very convex body has the sides nearly parallel; the surface is slightly hairy and rough on the abdomen. The head and first thoracic segment are tuberculate, and the other thoracic segments each have stout spines on the hinder margin. The large median dorsal process of the anterior portion of the abdomen is trident-like and extends a little beyond the apex of the telson. The telsonic segment has three large tubercles on each side anteriorly, and behind these is cut into three small projections on each side. The terminal notch of the telson is deep, and the median projection does not reach its lateral angles. The second joint of the peduncle of the first antennae is half as long as the first, and the third is narrow but longer than the second. The moderately robust legs are spiny, but without furry pads. The exopod of the uropods is smaller than the large endopod, is apically acute, and has a sharp process on the inner edge and another on the upper surface near the acute outer angle. The endopod is obtuse distally and has two rounded elevations on the outer edge and one on the inner margin.

A female associated with the males, and therefore presumably belonging to this species (see illustrations) has the surface much smoother, and, as usual, lacks a dorsal process from the anterior part of the abdomen. There are no spines on the thoracic segments and the median process in the terminal telsonic notch is somewhat tridentate. Length: 6 mm., or $\frac{1}{4}$in. (S.A.M.)

Cilicaea latreillei (Leach). (personal name).

The surface of the body is very finely granulate and covered with hairs. In the male, which is illustrated, the median dorsal process of the anterior part of the abdomen is thick, obtuse at the end, and projects much beyond the end of the telson. The end of the telsonic segment (which, as in the males of other species, must be viewed from below in order to ascertain its character) is deeply notched and has a low, simple, mesial lobe on each side; the dorsum of the telson is roundly elevated. The second joint of the

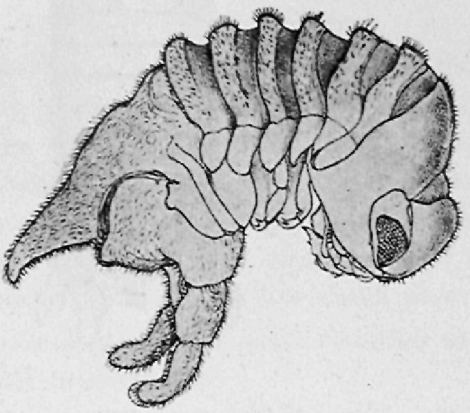


FIG. 282.—*Cilicaea latreillei* (after Stebbing, x 5).

first antennae is only one-third the length of the first and the third is longer than the second. The fixed endopod of the uropods is rudimentary, being represented only by a short, thick, inner process of the peduncle; the outer branch is subcylindrical, curved inwards, extends beyond the end of the large dorsal projection, and has a more or less distinct tooth on the outer margin. Length: 13 mm., or ½in. (S.A.M.)

The female of this species may be confused with the female or immature male of *Paracilicaea pubescens*, which see.

CYMODOCE (Leach).

As in the preceding species, there are often considerable differences between the sexes of the species, and between immature and mature males. It must be remembered that the characters given in the key to the South Australian species do not necessarily refer to females and immature males, but are based on adult males.

Classical appelations are commonly used in the nomenclature of animals and plants, and, amongst others, the names of the mythical sea-nymphs are freely applied to crustacean genera. In this handbook alone we may notice *Cymodoce, Dynamene, Cerceis, Cymothoa, Apseudes, Ampithoe, Leucothoe, Galathea, Actaea, Callianassa,* etc.

a. Body very convex. Terminal process of abdomen not very narrow, and not projecting as far as, or much beyond, lateral angles of posterior notch. Branches of uropods not narrowly lanceolate.

b. Outer branch of uropods small, much shorter than inner branch.

c. Body scantily clothed with coarse hairs. Hinder margin of anterior division of abdomen with a pair of well marked submedian processes . . . . *bidentata.*

cc. Body covered with short pubescence through which longer hairs protrude. Hinder margin of anterior division of abdomen straighter, with small submedian processes or tubercles . . . . . *coronata* var. *fusiformis.*

bb. Outer branch of uropods large, as long as, or not much shorter than, inner branch.

d. Telsonic segment with at least one pair of rounded dorsal elevations or bosses, or domed with a median longitudinal furrow.

e. Telsonic segment with two large dorsal elevations. Size moderate (under $\frac{3}{4}$in.).

f. Endopod of uropods reaching well beyond level of apex of telson, and tip of exopod not bent. Appendix masculina of second pleopods long and slender, not widened apically . . . . . *coronata.*

ff. Endopod of uropods not, or scarcely, reaching beyond level of apex of telson, and exopod with tip bent outwards and slightly upwards. Appendix masculina of second pleopods widened apically . . *unguiculata.*

ee. Telsonic segment with four large dorsal elevations. Size large ($1\frac{1}{2}$in.) . . . . . *aculeata,* var. *grandis.*

dd. Telsonic segment without dorsal bosses.

g. Anterior part of abdomen without backwardly directed processes.

h. Apex of outer branch of uropods not bidentate . . . . . *gaimardii.*

hh. Apex of outer branch of uropods bidentate . . . . . *tuberculosa.*

gg. Anterior part of abdomen with a pair of backwardly directed processes . . . . . *tuberculosa,* var. *bispinosa.*

aa. Body not very convex. Terminal process of abdomen very narrow, long and acute, projecting much beyond lateral angles of posterior notch. Branches of uropoda narrowly lanceolate . . . . . *longicaudata.*

Cymodoce bidentata (Haswell). (with two teeth).

The convex, subovate body has the sides nearly straight; the surface is granulate and scantily clothed with coarse hairs, particularly posteriorly. The hinder edge of the anterior division of the abdomen has two submedian, backwardly-directed, thick processes (to which the specific name refers) on each side of which is the usual tooth or tubercle, and, in addition, two or three smaller tubercles. The telsonic segment has two pairs of dorsal tubercles; the anterior pair (which are smaller than the others) are nearly beneath the submedian processes from the anterior part of the abdomen, and the second are spiniform and upturned; posterior to these is a median, spinform tubercle. The terminal notch is wide, and the median process is tongue-shaped, blunt, and slightly bifid, or rounded apically, and projects back a little beyond the lateral angles of the notch. The male appendage of the second pleopods is about half as long again as the rami. The uropods are thick, hairy, and granulate; the large, inner ramus reaches well beyond the apex of the abdomen, and is elongate S-shaped, with a tooth on the underside, near the acute apex. The outer ramus is very small, with a tooth below the acute apex, as in the endopod. Length: 13 mm., or ½in. (S.A.M.)

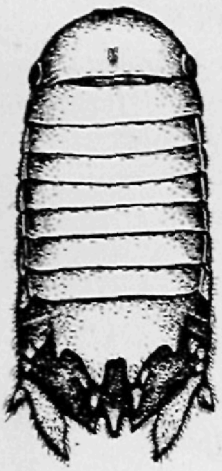


FIG. 283.—*Cymodoce bidentata* (after Baker, x 4).

This species occurs in Victoria and Tasmania, and has been dredged in St. Vincent Gulf.

Cymodoce coronata (Haswell). (crowned).

The body is convex, with the anterior segments smooth, and the hinder coarsely granulate and hairy. The anterior division of the abdomen is short, with a pair of submedian tubercles (which are variable in size and shape) on the posterior margin. The telsonic segment is moderately convex, divided into two bosses by a shallow median furrow, and with two tubercles (one behind the other) on each boss. The posterior notch is deep, and the median process is slightly upturned and reaches to the level of the angles of the notch. The appendix masculina is long and very slender. The uropods are thick and hairy; the inner branch reaches slightly beyond the apex of the abdomen and ends in a tooth; the outer ramus is somewhat shorter, has the inner margin curved, and the outer margin straight, and is very acute apically.

The female is less hairy, and is almost smooth. The telsonic segment is obtusely angular apically, with little trace of a posterior notch. The inner ramus of the uropods is truncate apically, and does not reach to the end of the abdomen; the outer branch is considerably shorter. Length: 17 mm., or ⅝in. (S.A.M.)

This species, and varieties of it, are common on southern Australian coasts. It is a difficult matter to separate some of the varieties from the preceding species.

Cymodoce coronata var. *fusiformis* (Baker). (shaped like a spindle).

The body is covered with short hairs, intermixed with which are longer hairs; the clothing is easily rubbed off. The hinder margin of the anterior division of the abdomen bears six tubercles; the telsonic segment has the median process of the notch with a wide raised base and a slight sulcation above it, and close to its end is a small bifid tubercle. The sides of the notch are acute and bifid. The inner ramus of the uropods is more tapering than in typical specimens of *C. coronata,* and the outer ramus is much shorter. Length: 17 mm., or $\frac{2}{3}$in. (S.A.M.)

This variety is very like typical specimens of *C. bidentata,* from which it differs in the characters given in the key. Intermediate forms separate the var. *fusiformis* from typical examples of *C. coronata.*

Cymodoce unguiculata (Barnard). (with a little nail or claw).

The sexes do not differ greatly. The surface of the convex body is smooth, clothed with fine, scattered hairs, and the margins are thickly fringed with hairs. The telsonic segment has a large boss on each side of the dorsum in both sexes; the terminal abdominal projection extends slightly beyond the lateral angles of the apical notch in the male, and has a tubercle on its upper surface. In the female this process is short and blunt, and conceals the notch when viewed from above. The male appendage of the second pleopods is distinctive in shape; it is longer than the rami, with the terminal part widened to the form of a spatula, with an acute apex and thickly armed with short, curved spines on the margins. The uropods do not, or scarcely, exceed the end of the telson; the endopod is suboval in shape, and subtruncate apically; in the male the exopod is ovate, with an acute, outwardly curved apex, and a subapical tooth on the inner margin. In the adult female the apex of the exopod is usually short and blunt, not falcate, as in the male. Length: 13 mm., or $\frac{1}{2}$in. (S.A.M.)

Originally described from South Africa, this species was recorded from South Australia on the evidence of some small examples, dredged on the south-eastern coast.

Cymodoce aculeata var. *grandis* (Baker). (*aculeata,* sharp; *grandis,* very large).

The thick, convex, subovate body is nearly smooth and polished; the abdomen and hinder parts of the last two thoracic segments are a little granulate; the margins of the posterior three or four side-plates of the thoracic somites, and the lateral and postero-lateral margins of the anterior part of the abdomen, are fringed with brown fur, while the dorsal surface of the posterior part of the abdomen bears a similar fringe, and the branches

of the uropods are margined with fur. There is a transverse rugosity on the anterior part of the abdomen, and on each side of the dorsum of the telsonic segment are two elevations or bosses, behind the outermost of which is a small oblique ridge, covered with fur. The posterior notch is deep and the terminal process is truncate, and reaches to the level of the acute lateral angles of the notch. The legs are robust, with furry pads on the merus, carpus, and propodus of each. The branches of the uropods are subequal in length; the endopod narrows slightly towards the obliquely truncate apex, while the exopod is suboval, with the outer margin thickened and curving slightly outwards at the apex. Length: 39 mm., or 1½in. (S.A.M.)

This large and striking variety is twice the length of typical specimens, which range from New South Wales to Tasmania.

Cymodoce gaimardii (M. Edwards). (personal name).

The convex, suboval body is smooth and there are no large dorsal processes from any of the somites. The telsonic segment has the terminal notch deep and the median process large, apically truncate and reaching to the level of the acute lateral angles of the notch. The first three pairs of legs are rather more robust than the others. The uropods do not reach to the end of the abdomen; the branches are subequal in length, with their apices obtuse or subacute.

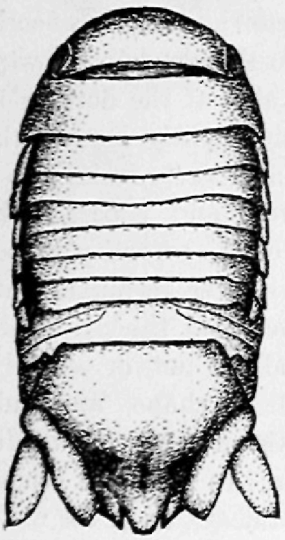


FIG. 284.—*Cymodoce gaimardii* after Baker, x 2).

The female apparently does not differ much from the male; the terminal notch of the abdomen is not so deep and the median projection is rounded (not truncate) apically. The example illustrated is probably a young male. Length: 25 mm., or 1in. (S.A.M.)

A small variety of this species also occurs.

Cymodoce tuberculosa (Stebbing). (with tubercles).

The body is ovate in shape, with a granulate and tuberculate surface. There are no processes from the anterior portion of the abdomen. The terminal notch of the telsonic segment is deep, with the median process not reaching as far as the rounded lateral angles of the notch, on each side of which is a small nick. The anterior portion of the epistome is furnished with two projecting teeth. The robust legs are spine-armed. The male appendage of the second pleopods is a little longer than the rami; it is rather broad and of equal width to within a short distance of the end, where the inner margin slopes obliquely to the subacute apex. The uropods are very granulate, sometimes with spine-like granules; the inner branch is longer and wider than the outer and terminates in a curved spine, below which are two further spines; the exopod is deeply bifid at the apex.

The body of the female is smooth and slightly hairy, the epistome has no projecting teeth, the uropods are shorter, and the hinder margin of the abdomen is upturned, with a shallow incision instead of a longitudinal channel. Immature males have the hinder margin of the abdomen arched, without a terminal notch, and in other respects differ considerably from

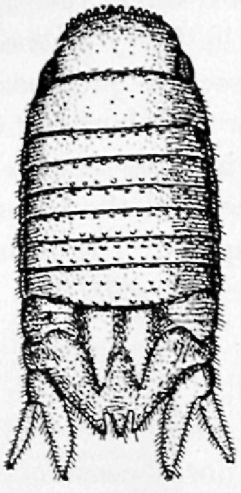


FIG. 285.—*Cymodoce tuberculosa* var. *bispinosa* (after Baker, x 5).

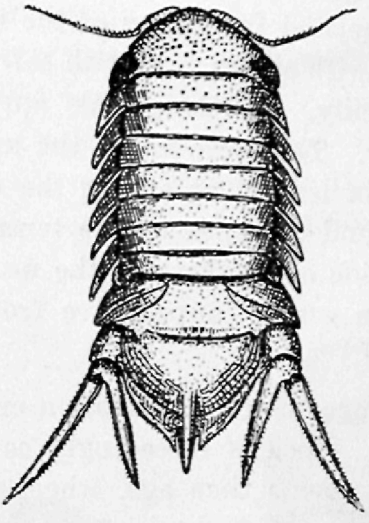


FIG. 286.—*Cymodoce longicaudata* (after Baker, x 3).

adult males. The colour is pale brown, with varying black markings; in degenerate females with young pigmentation is almost or quite lost. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

This, like some other species of the genus, may sometimes be found in numbers in the cavities of sponges.

Cymodoce tuberculosa, var. *bispinosa* (Baker). (with two spines).

The varietal name refers to the presence of two processes which extend back from the anterior part of the abdomen of the male. The adult male of the variety differs from the male of *C. tuberculosa* in the following characters also:—The body is not so markedly granulated; the terminal notch of the telson is more open and the median posterior process reaches to the level of its lateral angles, and the two spines or tubercles on the epistome are smaller.

The female has the body smoother and lacks processes from the anterior part of the abdomen; the terminal portion of the telson is slightly upturned, and the posterior median notch is represented by two obscure incisions. The uropods are short, the endopod tipped with a tooth, and the exopod is slightly bifid apically. Length: 9 mm., or $\frac{3}{8}$in. (S.A.M.)

Cymodoce longicaudata (Baker). (long-tailed).

The body, unlike that of the preceding species, is not very convex, and in lateral view the animal is not so deep; also, the side-plates of the first to sixth thoracic segments are much more prominent, sickle-shaped, thin,

and projecting. The lateral parts of the second of the fused segments of the abdomen project like those of the aforementioned thoracic somites. The dome-shaped telsonic segment has an acute spine on each side above the uropods, behind which the submarginal areas of the telson are flattened out; the terminal notch has the lateral angles acute, and the overshadowing median process is very long, carinate above, spiniform, acute, and reaches much beyond the angles of the notch. The legs are fairly robust, sparsely armed with spines, and with soft hairs instead of the furry pads common in the family. The long male appendage of the second pleopods is very slender. The branches of the uropods are narrow and lanceolate, and are equal in length, or one or the other is a little the longer; they reach to or beyond the apex of the terminal median process of the telson; on the underside of the base of the uropods is a small spine. The female differs little in general appearance from the male. Length: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

A glance at the illustration enables one to readily recognise this distinct species, which is exceedingly common in shallow water on parts of our coasts. Some time ago, when collecting on the north coast of Kangaroo Island, two of us obtained a quart of specimens in half an hour by sweeping a hand dredge through short sea-grass (*Zostera*) growing in a few inches of water. The animal is not able to roll into a ball like some of our more convex forms.

PARACILICAEA (Stebbing).

This genus is by no means distinctly separated from *Cymodoce*. As mentioned in the key to the genera, the adult males of our species have the inner branch of the uropods small or tiny; in the one possible exception (which has been tentatively referred to this genus) the clothing is very distinctive.

a. Exopod of uropods subcylindrical without nick or tooth on outer edge . . . . . *hamata.*

aa. Exopod of uropods laminate, with at least one nick or tooth on outer margin.

b. Telsonic segment with tubercles and with three tiny notches on each side of terminal notch. Exopod of uropods with three teeth on outer margin *septemdentata.*

bb. Telsonic segment without tubercles and without notches alongside terminal notch. Exopod of uropods with one tooth or notch on outer margin.

c. Dorsum of body covered with scale-like pubescence . . . . . *pubescens.*

cc. Dorsum of body with very short, not scale-like pubescence . . . . . *gigas.*

Paracilicaea hamata (Baker). (hooked).

The body is moderately convex, suboval, and contracted to a slight "waist" between thorax and pleon. The surface is covered with fur intermixed with which are some longer hairs. The anterior part of the abdomen bears a pair of submedian dorsal tubercles and its side-parts project downwards much more than those of the narrower last thoracic somite; the dorsum of the telsonic segment is domed, with the surface granulate and with a pair of more or less spiniform submedian tubercles, between which is a shallow furrow. The legs are rather robust and are armed with the usual spines. The male appendage of the second pleopods is thick, apically rounded, and not much longer than the branches. The outer ramus of the uropods is long, curved, and cylindrical with a

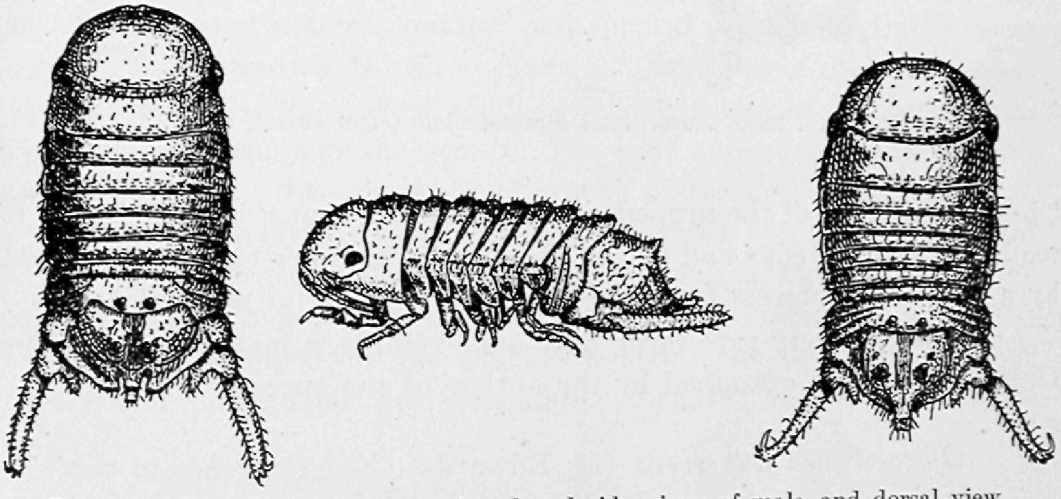


FIG. 287.—*Paracilicaea hamata*; dorsal and side views of male, and dorsal view of female (after Baker, x 5).

curved spine, and several smaller hooked spines, at the apex; the tiny inner branch has a subacute apex. As shown by the illustrations, the female does not differ markedly from the male, although the legs are rather more slender in the former. Length: 9 mm., or $\frac{3}{8}$in. (S.A.M.)

This species is found in sponges in our Gulfs and on the shores of Kangaroo Island. Mud and other fine debris becomes entangled in the furry clothing, so that the animal usually has a dingy coating of foreign material.

Paracilicaea septemdentata (Baker). (with seven teeth).

The very convex body is rather narrow, with the sides nearly straight and parallel. The surface of the head is slightly rough and each of the last three thoracic somites has a row of tubercles on the hinder margin, those of the seventh segment being spiniform. The abdomen is furnished with large tubercles. When viewed from above or from the side the telsonic segment appears abruptly truncate posteriorly, with the lower part (the apex) produced backwards; the terminal notch is moderately deep and the median process subtriangular; on each side of the latter there are three

tiny notches, so that the posterior end of the abdomen has six small teeth and one larger central tooth, hence the specific name. The robust legs lack the usual furry pads. The male appendage of the second pleopods is moderately wide, rounded apically, and is not much longer than the rami.

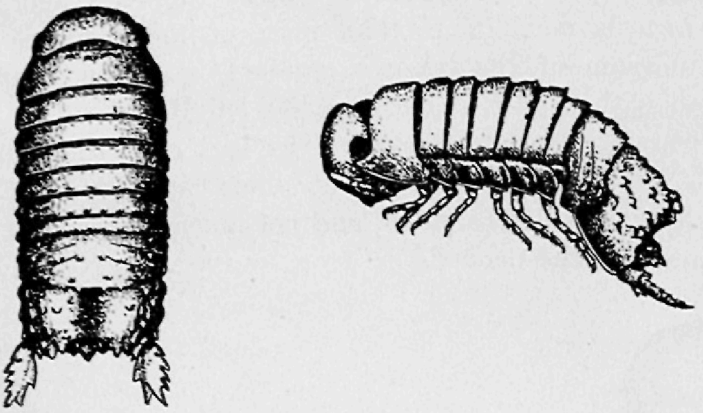


FIG. 288.—*Paracilicaea septemdentata* (after Baker, x 5).

The outer branch of the uropods is large, with the apex bifid, and with four teeth on the outer edge and one on the inner; the inner ramus is represented by a small bifid process from the peduncle. Length: 8 mm., or $^{3}/_{10}$in.

Apparently a very rare form, only one example, a male from St. Vincent Gulf, having been examined by the author of the species.

Paracilicaea pubescens (M. Edwards). (in reference to the peculiar clothing).

The strongly convex, suboval body is granulate and covered with unusual pubescence, to which the specific name alludes. Each "hair" is like a scale on a stalk. In the adult male the anterior part of the abdomen has two small submedian dorsal tubercles and the telsonic segment has two large, conical, dorsal bosses. The terminal notch of the abdomen is shallow, and the median projection is short. The male appendage of the second pleopods is narrow and is much longer than the rami. The outer branch of the uropods is twice as long as the inner and has a nick in the outer margin and the apex subacute. The female has a more ovate body than the male, the anterior portion of the abdomen is shorter, the bosses on the telsonic segment are smaller, and the branches of the uropods are subequal in length. Immature males, and even some small males which, judging by the development of the sexual appendage, are at least nearly mature, have the same appearance as the female. Length: 25 mm., or 1in. (S.A.M.)

Females, immature males, and the mature or nearly adult males resembling the females and mentioned above, are very much like females of *Cilicaea latreillei*, and may be easily confused with that species, but the scale-like character of the clothing of *P. pubescens* enables one to separate them.

Paracilicaea gigas (Baker). (very large).

The very convex suboval body is covered with exceedingly short pubescence. The upper surface of the head, epistome, and peduncles of the antennae are covered with large granules. The first three thoracic segments are smooth, or with small pearly granules; the last four (where not overlapped by the preceding somites) are studded with similar granules to those of the head, but on the fourth segment they are low and rather sparser. The anterior part of the abdomen is granulate and has the hinder margin broadly triangular, with the usual nick forming a tooth on each side. The telsonic segment has the dorsum strongly domed, with a median furrow, from the posterior end of which diverges a furrow running subparallel to the hinder margin of the telson on each side. The greater part of the telsonic segment is granulate, the furrows and an area on each side being smooth. The terminal notch is narrow and vertical and the median process is short, apically rounded in the adult male, and subacute in the young male. The legs are robust, with pads of small bristles in place of the furry pads often present in members of the group. The male appendage of the second pleopods is whip-like. The short inner branch of the uropods is somewhat ovate in shape, narrowly truncate, and with a small point at each apical angle. The outer branch has the apex acute, and a nick in the outer margin; it is much longer than the endopod in the adult male, but much shorter than the endopod in the immature male; the peduncle and the outer margin of the exopod are granulate. Length: 35 mm., or 1⅜in. (S.A.M.)

CILICAEOPSIS (Hansen).

This genus and the four preceding are closely allied. The absence of a median process in the terminal abdominal notch distinguishes *Cilicaeopsis*.

Cilicaeopsis granulata (Whitelegge). (granulate).

In the adult male the body is strongly convex and rather narrowly subovate, with the surface closely granulate; the granules on the abdomen and uropods are elevated and there are stiff hairs in the spaces between them. The anterior part of the abdomen has a large median process which reaches beyond the end of the telson and is truncate apically and with three small terminal projections. The telsonic segment has a well-defined semi-circular terminal notch, with a pair of small teeth at the side. The male appendage of the second pleopods narrows towards the apex and is about twice as long as the inner ramus. The outer ramus of the uropods is large and lanceolate, and the inner branch is represented by a small acute projection of the peduncle. In the female the median process from the anterior portion of the abdomen is absent (its place being taken by a short conical tubercle), and there is a pair of sub-

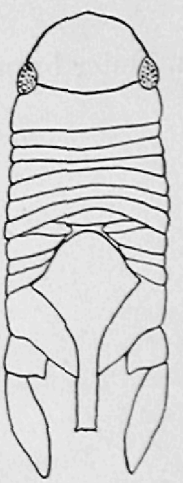


FIG. 289.—*Cilicaeopsis granulata* (after Whitelegge, x 4).

median tubercles on the upper surface of the telson. Length: 12.5 mm., or ½in. (S.A.M.)

This is the type species of the genus, and was originally found in New South Wales; it has been dredged in moderately deep water (75-100 fathoms) in the Great Australian Bight off South Australia.

Group **EUBRANCHIATAE.**

In some of the Eubranchiatae the wrinkles of the outer branch of the fifth pair of pleopods render the two-jointed condition of this ramus, referred to in the key to the groups, very obscure. The presence of branchial folds on the exopod of the fifth pleopods, however, at once shows that the species can belong to neither of the other two groups.

a. Outer branch of third pair of pleopods unjointed.
  b. First joint of second antennae of usual shape, not expanded, as a large free plate in front of the head.
    c. Male with processes from either sixth or seventh thoracic segments.
      d. Male with a pair of processes from the sixth thoracic segment, but no processes from the seventh segment . . . . . *Dynamene.*
      dd. Male with no processes from sixth thoracic segment, but with a broad, four-lobed process from seventh segment . . . . . *Dynamenopsis.*
    cc. Both sexes similar, without possesses from either sixth or seventh thoracic segments . . . . . *Dynamella.*
  bb. First joint of first antennae expanded, protruding as a large free plate in front of the head.
    e. Second joint of first antennae not expanded and plate-like . . . . . *Amphoroidea.*
    ee. Second joint of first antennae expanded like first joint . . . . . *Amphoroidella.*
aa. Outer branch of third pair of pleopods two-jointed.
    f. Seventh segment of thorax of male without median process.
      g. Second antennae unusually robust and modified as grasping organs, the last joint of the peduncle being bent at an angle to the preceding joint.
        h. End of abdomen with a distinct median notch . . . . . *Moruloidea.*
        hh. End of abdomen with no trace of notch (our one species) or only feebly emarginate . . . . . *Cassidinopsis.*

gg. Second antennae not so modified.
i. Body very convex and coxal plates not produced laterally .. *Cerceis.*
ii. Body much depressed and flat, with coxal plates greatly produced laterally.. .. .. *Platycerceis.*
ff. Seventh segment of thorax of male with a median process .. .. *Haswellia.*

DYNAMENE (Leach).

In this genus the usual male appendage of the second pleopods is not developed, even in adult specimens; the latter have a pair of backwardly directed dorsal processes from the *sixth* thoracic segment.

Dynamene ramuscula (Baker). (branching, like a twig).

The body of the male is rather narrow, strongly convex, and clothed with scattered, long hairs. The pair of processes from the hinder part of the sixth thoracic segment reach back nearly as far as the end of the abdomen; each is slightly sinuous, and is bifid apically, with one branch of the tiny fork directed downwards. The upper surface of the telsonic segment is convex and hairy, with a large tubercle in the centre, two smaller tubercles

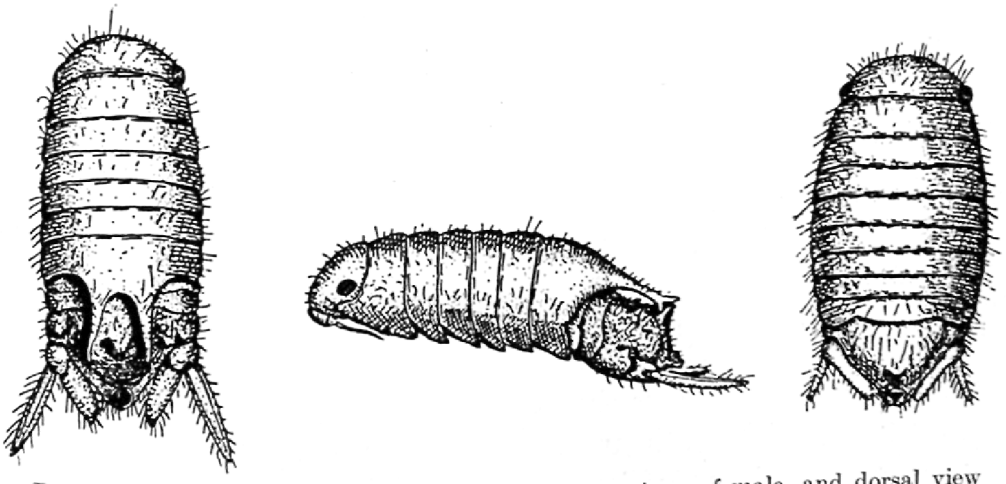


FIG. 290.—*Dynamene ramuscula;* dorsal and side views of male, and dorsal view of female (after Baker, x 8).

on each side, and one low tubercle above the base of each uropod. The terminal abdominal notch is circular, situated on a conical projection, and has the slit below completely closed. There is an extremely small median terminal processs. The outer branch of the uropods is lanceolate, narrower and longer than the inner ramus, which reaches a little beyond the end of the abdomen, and is rather obtuse apically.

The female is much more oval in shape, with the legs more slender, without a pair of dorsal processes on the thorax, and with the branches of the uropods subcylindrical, short and subequal in length. The posterior notch

of the abdomen is triangular, almost closed behind, and the hinder part of the pleon has only one low median tubercle. Length: 5 mm., or $\frac{1}{5}$in. (S.A.M.)

This form was found on sponges in St. Vincent Gulf.

DYNAMENOPSIS (Baker).

As the name implies, this genus is much like the preceding; it differs notably in the absence of processes from the sixth thoracic segment of the male, and the lobed condition of the posterior part of the dorsum of the seventh somite of the thorax.

Dynamenopsis obtusa (Baker). (blunt).

In the male the body is very convex, ovate, with the upper surface of the thorax smooth and that of the abdomen rather rough. The seventh thoracic segment is produced posteriorly so as to almost completely cover the anterior part of the abdomen, and its hinder margin is shallowly incised to form four short, rounded lobes. The telsonic segment is domed, and has a pair of submedian tubercles anteriorly, behind which is a single median

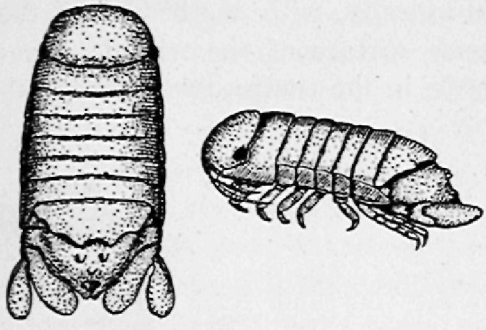


FIG. 291.—*Dynamenopsis obtusa* (after Baker, x 5).

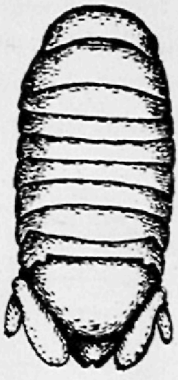


FIG. 292.—*Dynamenella parva* (after Baker, x 14).

tubercle. The posterior notch has the opening transversely ovate, closed behind and below; the sides of the abdomen are inturned below more than usual, forming an incomplete chamber for the pleopods. The legs are robust, sparsely spined, and with the usual furry pads. The branches of the uropods are subequal in size, plate-like, and suboval in shape; the outer ramus is slightly concave above. Length: 7 mm., or $\frac{9}{32}$in. (S.A.M.)

Apparently a rare species.

DYNAMENELLA (Hansen).

Another genus very like *Dynamene*. There are, however, no processes from any of the thoracic segments, and the second pleopods of the male have an appendix masculina.

Dynamenella parva (Baker). (small).

The body is convex, oval, and with the surface smooth and almost glossy. The first segment of the abdomen is very short. The telsonic segment is strongly domed, with indication of a median longitudinal depression or

groove. The posterior notch is small and simple. The legs are strong, sparsely spined, but with dense clothing of soft woolly hair. The male appendage of the second pleopods is thick, rounded at the apex, and reaches for one-third its length beyond the inner branch. The rami of the uropods are plate-like, with rounded apices; the inner branch reaches to about the level of the end of the abdomen, but the outer is small, less than half as long as the endopod. Length: 3 mm., or $\frac{1}{8}$in. (S.A.M.)

This tiny species was taken on the reef at Port Willunga.

AMPHOROIDEA (M. Edwards).

This and the following genus are easily separated from our other Eubranchiate genera by the expanded and enlarged first joint of the first antennae. The next genus has the second, as well as the first, joint of this pair of "feelers" thus expanded.

Two species, both described from male examples, have been recorded.

a. Body narrow. Both branches of uropods rounded apically. *angustata.*

aa. Body wide. Exopod of uropods acute, and endopod truncate, apically .. .. *elegans.*

Amphoroidea angustata (Baker). (narrow).

The moderately convex body is narrow, with the surface smooth; there are no dorsal projections from any of the segments, and the side-plates of the thoracic segments are nearly vertical. The telsonic segment is sub-

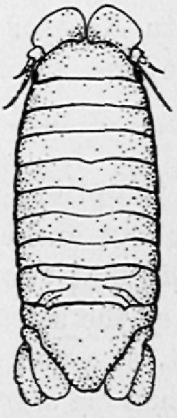


FIG. 293.—*Amphoroidea angustata* (after Baker, x 6½).

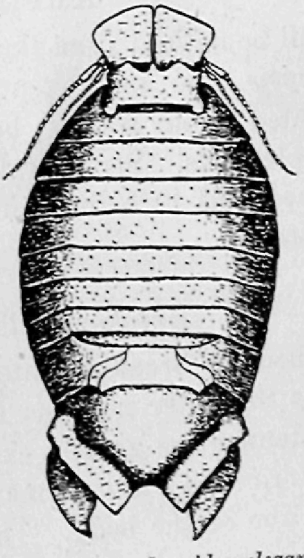


FIG. 294.—*Amphoroidea elegans* (after Baker, x 4).

triangular in shape, domed above, with the apex rounded, and, as seen from above, with a very obscure terminal notch. The enlarged basal joints of the first antennae take the form of ovate plates, projecting well in front of the head, and with the inner margins divergent one from the other; the second segment is slightly expanded, but is small, while the joints of the

peduncle of the second antennae are also a little flattened and expanded. The legs are hairy, but almost devoid of spines. The branches of the uropods are oval in shape, with the apices rounded, and are subequal in size. Length: 7 mm.. or $^{9}/_{32}$in. (S.A.M.)

Amphoroidea elegans (Baker). (dainty).

The not very convex body is broad and ovate, with the upper surface very faintly tuberculate down the middle; the side-plates of the thorax are nearly horizontal, scarcely at all directed downwards. The anterior margin of the head is trilobed, and none of the thoracic or pleon segments has dorsal processes. The broad telsonic segment is domed above, and has the lateral margins a little concave and the posterior notch very shallow. The plate-like first joints of the first antennae are somewhat quadrate, with the inner edges a little concave, leaving a slight gap between the two. The other peduncular joints of both antennae are slender. The legs are moderately robust, hairy, but with few spines; the first pair are the smallest and the second the longest. The outer branch of the uropods is longer than the inner, broad and suboval, with the apex tapering and acute; the inner ramus is obliquely truncate at the apex. Length: 14 mm., or $^{9}/_{16}$in. (S.A.M.)

This species has been taken only once, at Victor Harbor. The single-known specimen was found on green Algae, and was green during life, marked with minute dots.

AMPHOROIDELLA (Baker).

As will be noticed from the illustrations, this genus superficially resembles *Chitonopsis*, the only genus of the next group (the Platybranchiatae) represented in our waters; but it differs greatly, of course, in the structure of the pleopods. Structurally, it is very close to *Amphoroidea*, but, as mentioned, has both first and second joints of the first antennae enlarged and plate-like.

Amphoroidella elliptica (Baker). (elliptic).

The body is broadly ovate, moderately convex above and concave below, and has the outer margins fringed with hair. The first two joints of the first antennae are greatly expanded in front, and at the sides, of the head, the anterior and lateral margins of which do not, as usual, form part of the outline of the body. The side-plates of the thoracic segments and the lateral parts of the abdomen are also much expanded. The telsonic segment is convex, with a slight median hump near the anterior margin and with no trace of a terminal notch, the apex being rounded. The almost spineless legs are subequal in size. The endopod of the uropods is large, somewhat ovate, and tapers to the rounded extremity, which reaches to or beyond the end of the abdomen; the base is expanded laterally, and the small exopod is articulated in the incision below this peduncular extension.

Apparently the male is always much smaller than the female, which is figured, but the sexes are otherwise very alike. Length: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

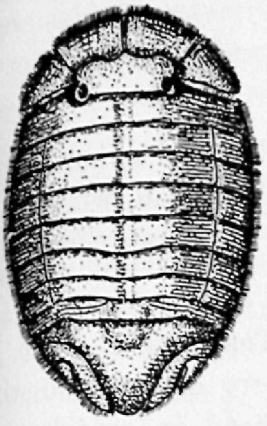


FIG. 295.—*Amphoroidella elliptica* (after Baker, x 3).

FIG. 296.—*Moruloidea lacertosa* (after Baker, x 4).

At the outer edge of the Port Willunga Reef, and in shallow water on Kangaroo Island and elsewhere, living sponges may be found attached to rotten limestone and other bases. This queer flattened crustacean is commonly found in small numbers on the smooth surfaces of these sponges. It much resembles a small chiton, and moves about with a similar, rather slow gliding motion.

MORULOIDEA (Baker).

In this and the following genus the peduncle of the second antennae is unusually stout, with the last joint bent at an angle, so that these appendages form grasping organs. The condition is shown in the illustration of the antennae of *Cassidinopsis* (fig. 297, b).

Moruloidea lacertosa (Baker). (brawny or robust).

The body is only moderately convex, oval in shape, and broad owing to the considerably expanded side-plates of the thorax and lateral parts of both portions of the abdomen; these expanded portions extend sideways at an angle from the body, leaving a shallow groove at their junction with the latter. The abdomen has scattered tubercles on the upper surface; the expanded sides of the anterior part end acutely. The telsonic segment is domed above and the margin of each thin lateral part is acute anteriorly, insinuate, and ends in a tooth on each side of the terminal notch, which is deep, subrectangular, and with well defined lateral angles. In a normal position the flagellum of the robust second antennae is turned at a right angle to the fifth peduncular joint, which is turned at right angles to the fourth joint. The first pair of legs are much more robust than the others. The peduncle of the uropods is acute laterally; the inner branch has the outer margin curved, forming an angle with the base. and the apex bifid, and

does not reach to the end of the telson. The exopod is shorter and narrower and ends acutely. Length: 9·5 mm., or ⅜in. (S.A.M.)

Known only from a few specimens found in St. Vincent Gulf. The female has rather smaller antennae than the male and has a median lobe in the posterior notch of the telson.

CASSIDINOPSIS (Hansen).

The second antennae are prehensile as in the preceding genus, but in our one species there is no trace of a posterior notch in the telson, whereas in *Moruloidea* a large notch is developed. In other respects the two genera are very alike.

Cassidinopsis tasmaniae (Baker). (after Tasmania).

The body is very faintly granulate anteriorly, not very convex, and with the side-plates of the thorax outstanding. The head is considerably narrower than the thorax, which has the sides nearly parallel. The short anterior part of the abdomen has the lateral parts projecting like the side-plates of the thorax. The telsonic segment is convex above with a

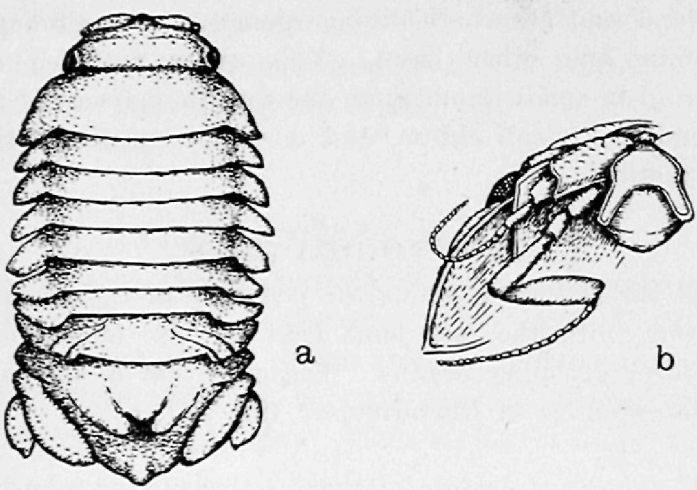


FIG. 297.—*Cassidinopsis tasmaniae* (after Baker); a, male (x 3); b, antennae, etc. (x 6).

large median hump; on each side of this, and closely approximate to it, is a more elongate lobe. The telsonic apex is slightly produced and rounded, and has no terminal notch; the inferior channel is shallow. The first pair of legs are more robust than the others and are unarmed; the remaining legs have the usual furry pads and only a few spines. The branches of the uropods are suboval in shape, with the apices subacute; the inner does not reach to the end of the abdomen and is larger than the exopod, which has a slight insinuation in the outer margin near the apex.

The female has the telsonic segment more rounded at the end than in the male, with only one median dorsal hump; also, the first legs have a few spines and the second antennae are slightly more slender. Length: 18 mm., or $^{11}/_{16}$in. (S.A.M.)

When alarmed the animal curls up, but does not form a really perfect sphere. Some of the very flat Sphaeromids fold like a book, a condition approached in *Cassidinopsis* and in *Moruloidea*, which show a distinct hinge at the middle of the length of the body when adopting this quiescent and presumably protective attitude. As indicated by the specific name, *C. tasmaniae* was first found in Tasmania; it has more recently been taken in shallow water in South Australia.

CERCEIS (M. Edwards).

At least six species of the genus occur. The typical forms have the body convex and ovate in shape, with the head elongate and triangular. The first two joints of the antennae are large.

a. Telsonic segment with three conspicuous humps on dorsal surface .. .. *trilobata.*

aa. Telsonic segment without three conspicuous humps.

b. Telsonic segment with a short median carina, ending in a backwardly directed spine.. .. .. .. *acuticaudata.*

bb. Telsonic segment without a carina ending in a spine.

c. Side-plates of seventh thoracic segment of male not ending in a hook. Female with only a small and rounded median tubercle on dorsum, or with surface smooth or granulate.

d. Head elongate. Telson with a single median tubercle on upper surface; exopod of uropods pointed apically .. .. *tridentata.*

dd. Head short. Telson without a median tubercle on dorsal surface. Exopod of uropods obtuse apically.

e. Telson with upper surface distinctly granulate, and with a deep terminal notch *obtusa.*

ee. Telson with upper surface not granulate, and with a shallow terminal notch .. .. *ovata.*

cc. Side-plates of seventh thoracic segment of male ending in a hook posteriorly. Female with a large triangular median tubercle on upper surface .. .. *trispinosa.*

Cerceis trilobata (Baker). (with three lobes).

The body is elongately ovate and the head is long. The anterior portion of the abdomen is slightly elevated in the middle. The telsonic segment has the lateral margins a little insinuate and its upper surface bears three elongate humps, which end abruptly at about the middle of the length; the posterior notch is nearly vertical, shallow as seen from above, and the median process is represented by a slight convexity. The branches

of the uropods are plate-like, not very wide, and are subequal in size; the end of each is subtruncate, with the outer angle (or apex) subacute and the truncate margin serrate.

As usual, the adult female has the body broader and the legs more slender. The uropods are much narrower than in the male, suboval in shape, with rounded apices. Nearly adult females resemble the males. Length: 8 mm., of $\frac{3}{10}$in. (S.A.M.)

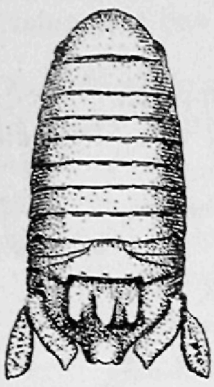


FIG. 298.—*Cerceis trilobata* (after Baker, x 5).

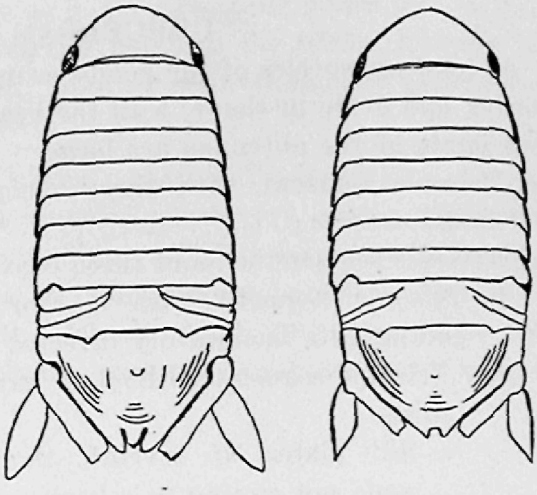


FIG. 299.—*Cerceis tridentata*, male and female (after Baker, x 3).

The species occurs on wooden jetty piles in St. Vincent Gulf. Young males and females are very much like those of *Haswellia emarginata*, but the male of the last-named form develops the distinguishing dorsal thoracic process quite early in life.

Cerceis acuticaudata (Haswell). (sharp-tailed).

This greatly resembles the next species (which is illustrated), but differs in the following characters:—On the anterior half of the telsonic segment is a median carina, which ends posteriorly in a sharp, backwardly directed spine; immediately behind this is a transverse patch of short hairs. The posterior notch of the telson is deep, rounded, and with prominent, acute lateral angles. The inner branch of the uropods is obliquely truncate at the end, with the inner apical angle rounded and the outer produced to a point, the ramus as a whole approaching an S-shape. The exopod is longer than the endopod, lanceolate with the apex acute, and with two spines at the middle of the length of the inner border, partly concealed by the short fringing hairs. During life the predominaing colour is dark green or dark olivaceous, with three somewhat indistinct bars on the body, the head, and the sides of the thorax, mottled and spotted with white. Length: 19 mm., or $\frac{3}{4}$in. (S.A.M.)

This is a common species, and numbers may be secured by sweeping a net through weed in shallow water, or by turning over stones on reefs at low tide. It is an extremely rapid swimmer, but crawls slowly on land. When

placed on a firm surface, such as the seat of a boat, the animal may surprise one by suddenly "flipping" itself back into the water. It springs by smartly snapping the pleopods downwards, the action producing a faint "click." When disturbed under stones at low tide, it occasionally makes for water in a series of short leaps, propelling itself with the aid of the pleopods as described, until finally, with a longer jump, it reaches its objective.

Cerceis tridentata (M. Edwards). (with three teeth).

The body is elongate ovate, and the head is long. The telsonic segment has a small, median dorsal tubercle, and the posterior notch is deep and narrow; the median terminal process is slightly elevated, subtriangular in shape, and does not extend back quite to the level of the rounded lateral angles of the notch. The inner branch of the uropods is transversely truncate at the apex, and reaches a little beyond the end of the abdomen; the exopod is slightly longer, narrowly oval in shape, and pointed apically.

The body of the female is more broadly ovate and more convex than in the male, while the telson is more domed, with the median tubercle less distinct. The posterior notch of the telson is simple, shaped like an inverted U. The uropods are similar to those of the male, but smaller, and the legs are less robust. Length: 16 mm., or $\frac{5}{8}$in. (S.A.M.)

Cerceis obtusa (Baker). (blunt).

The body is broadly oval and convex, and the head is short, not elongate, as in the preceding species of the genus. The surface of the thorax is slightly roughened with granules. The greater part of the dorsum of the telsonic segment is elevated and dome-like, with the surface distinctly granulate; the posterior notch is deep, narrower between the acute lateral angles than at its base, and with a V-shaped median process, which reaches

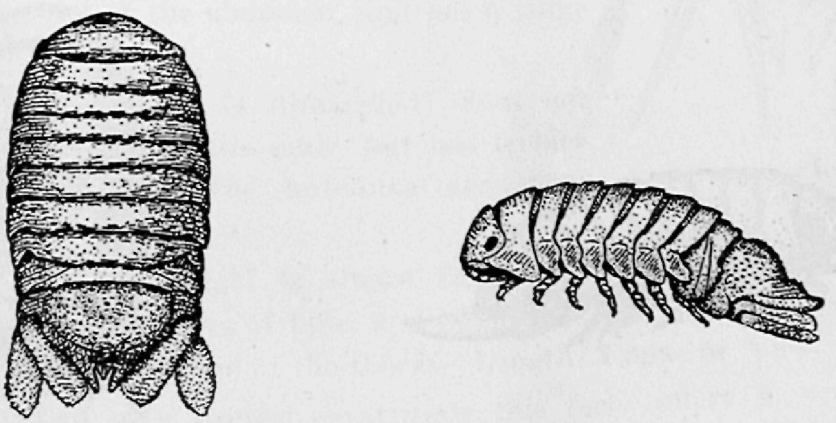


Fig. 300.—*Cerceis obtusa* (after Baker, x $4\frac{1}{2}$).

only to the middle of the length of the notch. The plate-like uropods are moderately broad; the inner branch is truncate at the end, which extends beyond the apex of the telson; while the exopod is subovate, and is a little longer than the endopod. Length: 9 mm., or $\frac{3}{8}$in. (S.A.M.)

As in the case of *C. trilobata* and *C. ovata*, this species has been taken only in St. Vincent Gulf.

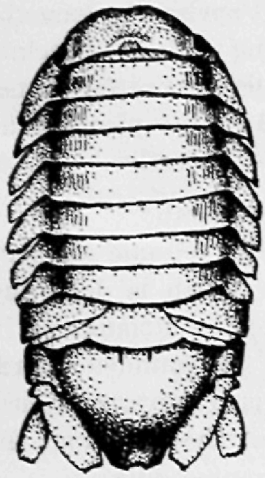


FIG. 301.—*Cerceis ovata* (after Baker, x 4).

Cerceis ovata (Baker). (egg-shaped).

The body is strongly convex, suboval rather than ovate in shape, and the head is short. The anterior portion of the abdomen has an indistinct median tubercle. The greater part of the upper surface of the telsonic segment is domed, the dome extremely obscurely divided into three lobes. The inner branch of the uropods reaches to the end of the telson, and is truncate distally, with the inner apical angle rounded and the outer pointed; the shorter outer branch narrows towards its base, and its obtuse apex is cut into small teeth.

The female, which is illustrated, is much larger than the male, lacks the obscure sculpture of the dorsal surface of the abdomen, and has the posterior notch shallower. Length: 12 mm., or ½in. (S.A.M.)

Cerceis trispinosa (Haswell). (with three spines).

The body is broadly ovate and convex, and the head is wide and rather short. The surface of the thorax is smooth, and each of the side-plates of the last segment is produced behind into a hook-like apex. The short anterior portion of the abdomen has a small median tubercle on the hinder margin. The telsonic segment is granulate, clothed with short hairs, and has a low dorsal elevation in the middle, just anterior to which is a pair of smaller tubercles; the posterior notch is deep, with the lateral angles produced and acute, and is overshadowed above by the conical median process, which

FIG. 302.—*Cerceis trispinosa* (after Baker); male (x 3) and female (x 4).

reaches nearly to the level of the angles of the notch. The inner branch of the uropods reaches nearly to the telsonic notch, and is truncate at the end, with the outer angle acute; the exopod is much longer, acute, and with the outer margin a little serrated near the apex.

The female is smaller than the male, and has the median dorsal tubercle of the telson triangular and much larger, and the exopod of the uropods

only a little longer than the endopod. Also, the side-plates of the last thoracic segment are pointed, not hooked, behind. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

A species which has been taken in Victoria, Tasmania, and South Australia. Its colour has been described as "uniform light red."

PLATYCERCEIS (Baker).

Distinguished from *Cerceis* by the more flattened body and the outstanding scythe-like side-plates of the thorax.

Platycerceis hyalina (Baker). (transparent).

The body is ovate, with the surface smooth, and the head is elongate, conical, and forms an acute lateral angle at each side of the eye. The side-plates of all the thoracic segments are produced and acute, but those of the last somite are much smaller than the others. The abdomen is only slightly convex; the lateral parts of the anterior portion are acute and outstanding. The terminal notch of the telson is deep and its sides form spiniform projections. The legs are slender, without the usual furry pads, and with strong spines on the propodi. The male appendage of the second pleopods is very long and reaches nearly to the end of the abdomen. The branches of the uropods are subequal in length; each is narrowly lanceolate, slightly curved, extends well beyond the end of the abdomen, and has a ridge above and below.

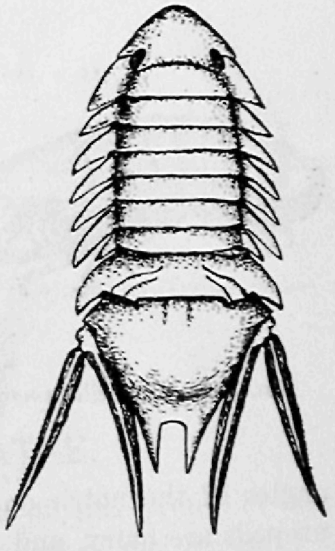


FIG. 303.—*Platycerceis hyalina* (after Baker, x 7).

The female (which is illustrated) does not differ strikingly from the male, but has feebler spines on the legs, the antennae are more slender, etc.

During life the animal is almost transparent, marked with brownish dots, and elongated spots of blue. and is mottled with brown and yellow on the abdomen and mid-line of the thorax. Length: 7 mm., or $\frac{9}{32}$in. (S.A.M.)

When curled in a protective attitude this form offers a very great contrast to the markedly convex species. such as *Exosphaeroma bicolor* (fig. 276). Owing to the much flattened body, *Platycerceis* folds like the leaf of a book, with the hinge at the middle of the length.

Even with a cursory examination *P. hyalina* cannot well be confused with any of our other Sphaeromids with the possible exception of *Cymodoce longicaudata*. In that species, however, the telson has a long terminal process, the head is of different shape, and the body is less flattened.

HASWELLIA (Miers).

The male has a *large* dorsal process from the seventh thoracic somite, a character separating this from the preceding Eubranchiate genera.

a. Branches of uropods of male subequal in size, the outer ramus plate-like and suboval in shape . . . . . *emarginata.*

aa. Branches of uropods very unequal in size, the outer ramus much longer than the inner and subcylindrical in shape . . *cilicioides.*

Haswellia emarginata (Haswell). (with notched margin).

In the adult male the body is ovate and smooth, with a few hairs near the sides. The great dorsal proces of the seventh thoracic segment extends beyond the end of the abdomen and tapers to the end, which is truncate with the apical edge notched or incised. All but the sides of the anterior part of the abdomen is concealed by the thoracic process. The telsonic segment is somewhat flattened dorsally, with the surface granulate; the posterior notch is deep; the median process extends well beyond the lateral

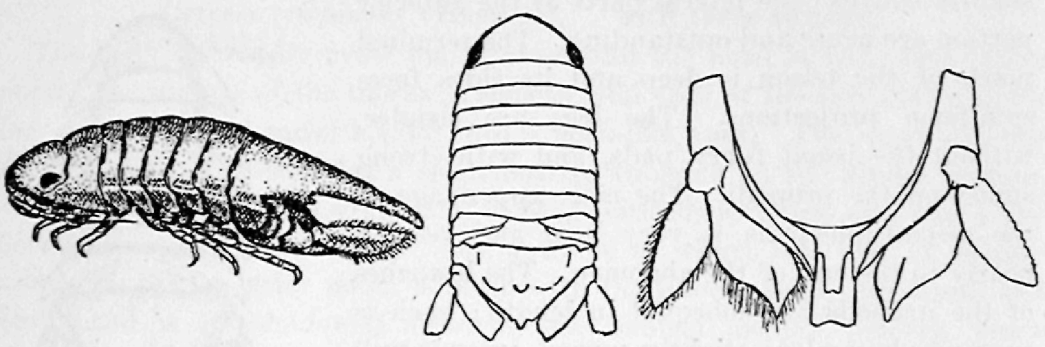


FIG. 304.—*Haswellia emarginata* (after Baker); male and young female (x 4); ventral view of abdomen of male (x 5).

angles of the notch and has the apex truncate and faintly notched. The uropods are hairy, and the margins of both branches are fringed with hair; the inner ramus is slightly broader and longer than the outer and is somewhat S-shaped and apically acute; the outer branch is suboval with the inner margin more convex than the outer.

The female lacks the large dorsal thoracic process and the uropods are of different shape (see figs.). Young males resemble the females, but the dorsal projection commences to develop early.

The colour is reddish-brown, with the thorax spotted with darker colour. Length: 13 mm., or ½in. (S.A.M.)

A species very common in St. Vincent Gulf.

Haswellia cilicioides (Baker). (resembling *Cilicaea*).

The body is very convex, ovate, with the surface of the head and thorax smooth. The great process of the seventh thoracic segment reaches beyond the end of the abdomen, is rather broad, and is rounded apically. The

upper surface of the abdomen is granulate; the hinder part of the dorsum of the telsonic segment bears three lobes, behind which the surface descends abruptly to the posterior notch, which is shallow; the median terminal process is subtriangular and extends beyond the lateral angles of the notch. The uropods are granulate; the inner branch is very small with the apex

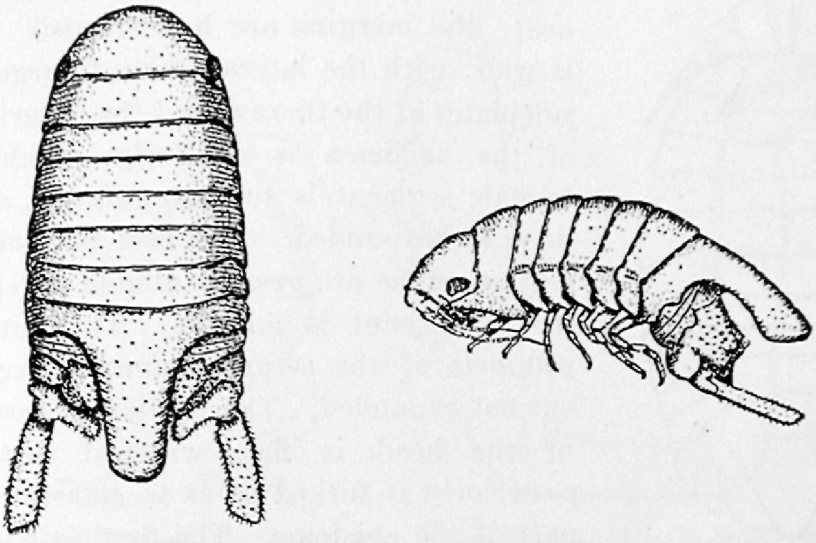


FIG. 305.—*Haswellia cilicioides* (after Baker, x 4½).

acute, and the outer is large, subcylindrical, slightly curved inwards, fringed with fine hairs, and is obliquely subtruncate at the apex. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

The adult males of this species may be easily separated from those of the preceding by the above characters.

Group **PLATYBRANCHIATAE.**

So far we have found only one representative of this group in South Australian seas, but it must be remembered that most of our dredging has been carried out in the two Gulfs. Much of the sea-bottom of our waters is as yet by no means thoroughly investigated, and when fresh fields are conquered it is certain that much additional material, in all invertebrate groups, will be discovered.

CHITONOPSIS (Whitelegge).

This genus does not even superficially resemble any other of our Sphaeromid genera excepting the Eubranchiate *Amphoroidella*. The resemblance here, moreover, is not very marked, for the antennae of *Chitonopsis* are very different, and the septum separating them at the base is produced anteriorly in the form of a large dilated process, which is not developed in *Amphoroidella*. As in the case of the last-named, *Chitonopsis* resembles a small chiton, hence the generic name.

Chitonopsis spatulifrons (Whitelegge). (with spatulate front).

The body is much depressed, smooth, and is convex down the middle. The basal joints of the first antennae, the aforementioned process in front of the head, the side-plates of the thorax, and the uropods are all flattened, expanded, and fit one against the other so as to form a wide, thin border to the body, with the general outline broadly oval; the margins are hair-fringed. The head is wide, with the lateral parts enlarged like the sideplates of the thorax, and the anterior portion of the abdomen is similarly expanded. The telsonic segment is subtriangular in shape, and its apex is rounded. The first two joints of the first antennae are greatly dilated anteriorly, but the third joint is minute. The joints of the peduncle of the second antennae are flattened but not expanded. The median process in front of the head is flat, widened distally, and posteriorly is forked so as to embrace the front part of the epistome. The first pair of legs are slender, and the others successively increase in size backwards; some of the joints are armed with comb-like spines. The base of the uropods is expanded outwards and slightly downwards, and below this peduncle plate the short truncate exopod is hinged; the inner branch reaches almost or quite to the end of the abdomen. Examples recently dredged amongst sea-grass were green in colour.

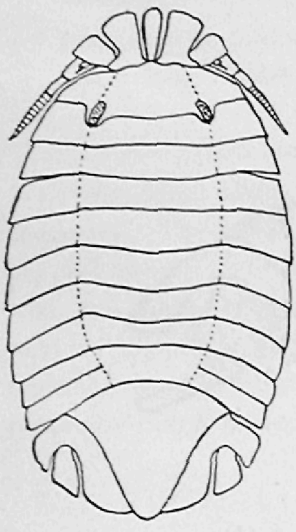


FIG. 306.—*Chitonopsis spatulifrons* (after Whitelegge, x 3).

The female, which is illustrated, differs little from the male, but has the second antennae a little shorter. Length: 15 mm., or $\frac{3}{5}$in. (S.A.M.)

Family SEROLIDAE (Sand-lice).

The Serolids somewhat resemble the extinct Trilobites, but are not closely related. The body is usually exceedingly depressed, and the thoracic segments are furnished with long, sickle-shaped side-plates, which add greatly to the width of the body. The head is large, and has a small beak, or rostrum. As is usual in the order, the first segment of the thorax is coalesced with the head, but here the first *free* somite has also been included in the fusion to form a short cephalothorax, as in *Tanais* (see also p. 341). The head is partly surrounded by the expanded lateral parts of these two thoracic segments, and its outline is defined by a furrow. The abdomen consists of three short segments, and a large caudal shield, or tail segment. In the male the first two pairs of legs are subchelate (fig. 307), but in the female only the first pair is so modified. It has been said that during mating the male "in grasping his partner by the front rim of the carapace with the claws of his second gnathopods sometimes drives his over-affectionate nails through the tender chitinous integument of his beloved."

In our species there is no transverse line on the first body segment (indicating the fused suture between the first free somite and head segments); the dorsal part of the penultimate thoracic segment is very narrow, and that of the last thoarcic segment is absent or united with the abdomen.

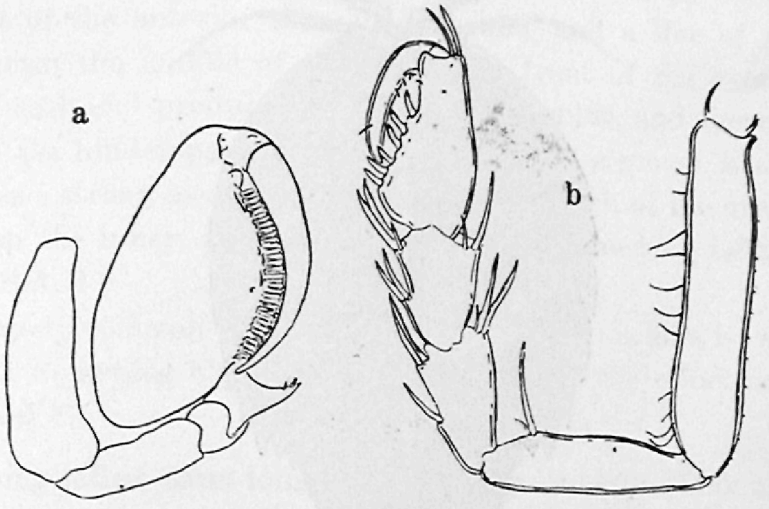


FIG. 307.—a, First and (b) second legs, or gnathopods, of male *Serolis tuberculata* (after Chilton).

SEROLIS (Leach).

Our sand-lice live on sand, and, like the flat-fishes, have a habit of partially burying themselves therein. Five species have been collected in from four to thirty fathoms off the South Australian coasts. The illustrations show essential differences not mentioned in the necessarily short descriptions.

a. Upper surface of body wholly covered with a great number of small tubercles . . . . . *australiensis.*

aa. Upper surface of body not wholly covered with tubercles.

b. Apex of abdomen truncate and concave. Rostrum moderately long.

c. First four free segments with a row of large tubercles on each side. Body nearly oval, with the tail segment wider than long . . . . . *tuberculata.*

cc. Upper surface without rows of lateral tubercles. Body pear-shaped; the tail segment longer than wide . . . . . *longicaudata.*

bb. Apex of abdomen rather narrowly rounded, not truncate or concave. Rostrum short and stout.

d. Posterior margin of each segment of body with a conspicuous median tubercle . . . . . *minuta.*

dd. Posterior margins of segments without median tubercle, excepting on head and on third segment of abdomen . . . . . *bakeri.*

Rough Sand-louse. *Serolis australiensis* (Beddard). (Australian).

The body is covered with an immense number of tubercles, more or less distinctly arranged in rows, the projections being most distinct on the

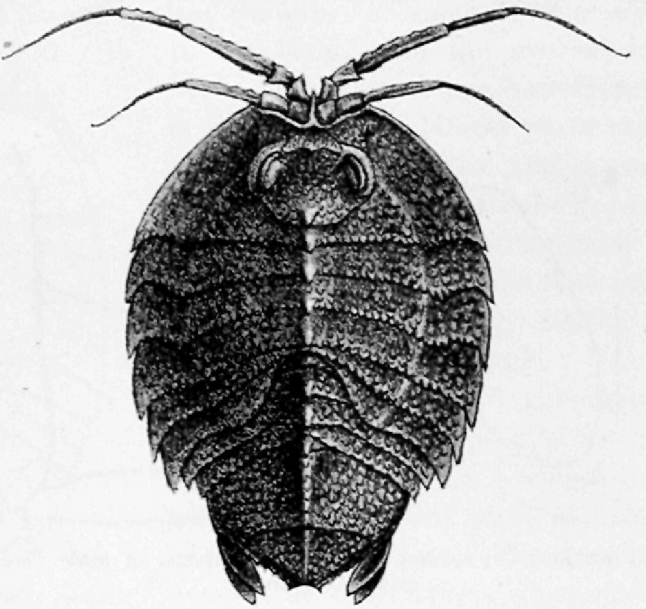


FIG. 308.—*Serolis australiensis* (after Beddard, x 4).

caudal shield and on the hinder margins of the other segments. This feature is not found in our other sand-lice. The head and each of the body segments

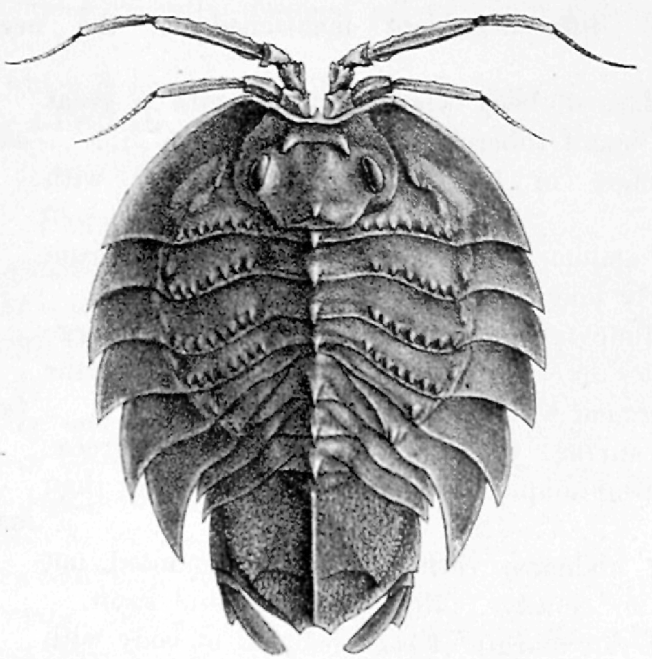


FIG. 309.—*Serolis tuberculata* (after Beddard, x 3).

(with the exception of the last two thoracic segments and the caudal shield) have a larger tubercle at the middle of the hinder margin. The tail segment

is apically truncate and concave, and bears a strong median ridge. The rostrum in this and the two following species is comparatively long. Length: 14 mm., or $^{9}/_{16}$in. (S.A.M.)

Serolis tuberculata (Grube). (with tubercles, or small elevations). There is a series of seven to nine pointed tubercles on each side of the hinder part of the anterior thoracic segments, and a line of rather larger tubercles down the middle of the back. In front of the eyes is a curved ridge, with each end produced to form a short spine, and there is a pointed tubercle on the hinder part of the head. The tail segment is apically truncate, and has a strong median ridge; the outer branch of the uropods is much shorter than the inner, and has the hinder end concave. Length: 19 mm., or $^{3}/_{4}$in. (S.A.M.)

A moderately common form in our gulfs. The colour is white to pale brown, with numerous black dots in imitation of the sand on which the creature lives.

Long-tailed Sand-louse. *Serolis longicaudata* (Beddard). (long-tailed).

Distinguished from our other sand-lice by the pear-shaped body. As in the two preceding species, the apex of the abdomen is truncate, but the tail segment is relatively longer than in these. The upper surface is

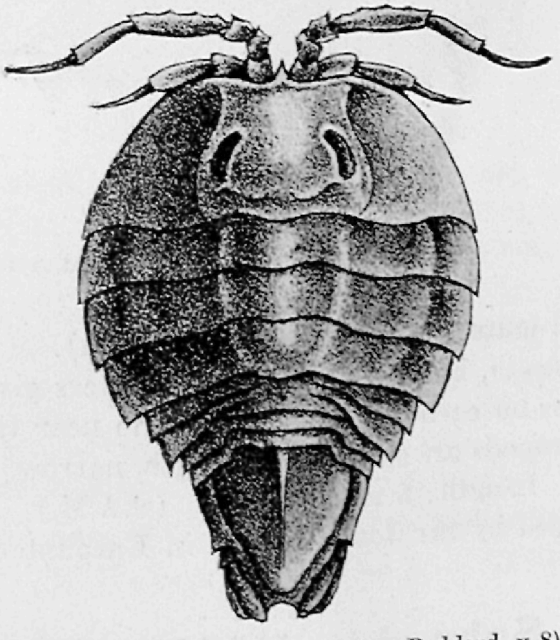


FIG. 310.—*Serolis longicaudata* (after Beddard, x 8).

smooth, sometimes with fairly distinct median tubercles on the three free segments of the abdomen, and similar less distinct projections on the thorax. The branches of the uropods are of about equal length. Length: 8 mm., or $^{3}/_{10}$in. (S.A.M.)

Serolis minuta (Beddard). (very small).

The body is almost circular. The head has three rounded tubercles on the posterior margin, and the following segments have a blunt median tubercle on their hinder edges. Each thoracic segment also has a projection on each side near the coxal plate. The tail segment is keeled; the branches of the uropods are narrow and elongate, not of equal length, and the posterior margin of the inner ramus is toothed. Pigmentation is not markedly developed. This and the following species are readily separated from the three described above by the shape of the terminal segment of the body, this being narrowly rounded and not truncate. Length: 8 mm., or $\frac{3}{10}$in. (S.A.M.)

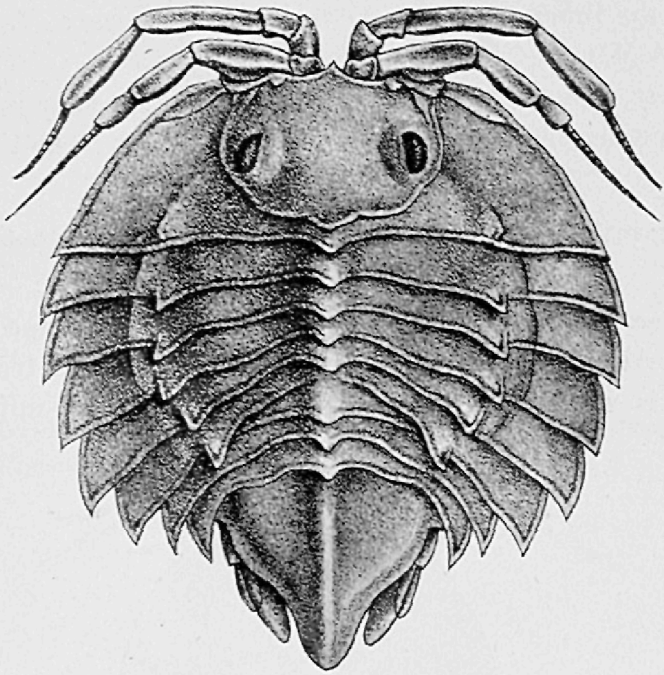


FIG. 311.—*Serolis minuta* (after Beddard, x 14).

Baker's Sand-louse. *Serolis bakeri* (Chilton). (personal name).

Very like *S. minuta*, but differs in the characters given in the key; also, there is no process on each free thoracic somite near the coxal plate. The branches of the uropods are subequal in length, narrow, and have the hinder margins toothed. Length: 6 mm., or $\frac{1}{4}$in. (S.A.M.)

A species dredged by Sir Joseph Verco in Encounter Bay.

Suborder VALVIFERA.

In the key to the suborders of the Isopoda the salient feature of the Isopoda-Valvifera is referred to, viz., the uropods are remarkably modified and form a pair of folding doors which close over and protect the pleopods. The apparatus is described and illustrated in Chapter II. of this handbook (fig. 10). It has been pointed out comparatively recently that the Valvifera

differ from other Isopoda in that the vasa deferentia of the male do not open on the seventh thoracic segment, but are situate on the first abdominal segment. The suborder embraces two distinct groups.

a. Body very elongate and often cylindrical. First four pairs of thoracic limbs slender, ciliated, and with terminal joint minute, or rather stout, flattened, and armed with strong setae; last three pairs ambulatory. Second antennae long and strong .. .. *Astacillinea.*

aa. Body narrowly oval or oblong. Legs usually nearly alike in structure. Second antennae not enlarged as a rule.. .. *Idoteinea.*

Group **ASTACILLINEA.**

Family ASTACILLIDAE.

The bizarre, slender-bodied crustaceans of this family are often very difficult to distinguish in their natural surroundings, so closely do they resemble the algae, or weed, amongst which they live. Two genera are represented.

a. Second antennae very stout and massive. First four thoracic limbs stout, flattened, and armed with spine-like hairs .. *Parastacilla.*

aa. Second antennae moderately stout. First four thoracic limbs slender and fringed with long, fine hairs .. .. *Neastacilla.*

PARASTACILLA (Hale).

The body is cylindrical, and the second antennae are raptorial, with the peduncle large, massive, and compressed; the flagellum is tiny. The first free segment of the thorax is fused with the head, and its lateral parts are expanded forwards and fused with the underside of the head; the fourth free segment of the thorax is much longer than any of the others. The segments of the abdomen are all fused together, and there are indications of three fused sutures. Two species are known:

a. No large spines on thorax .. .. *truculenta.*

aa. Third and fourth segments of thorax each with a large dorsal spine .. .. *bakeri.*

Warty Skeleton-louse. *Parastacilla truculenta* (Hale). (ferocious).

The surface of the cylindrical thorax is ornamented with some large and small, scattered, low warts. During life the animal was pinkish-brown in colour, with the legs and antennae pale. Length: 18.5 mm., or ¾in. (S.A.M.)

A single example was dredged in a mass of cylindrical algae, which it greatly resembled in form and colour; it was in the position shown in the

figure, clinging to the weed with the three pairs of ambulatory legs. The specific name alludes to the pugnacious appearance of the animal.

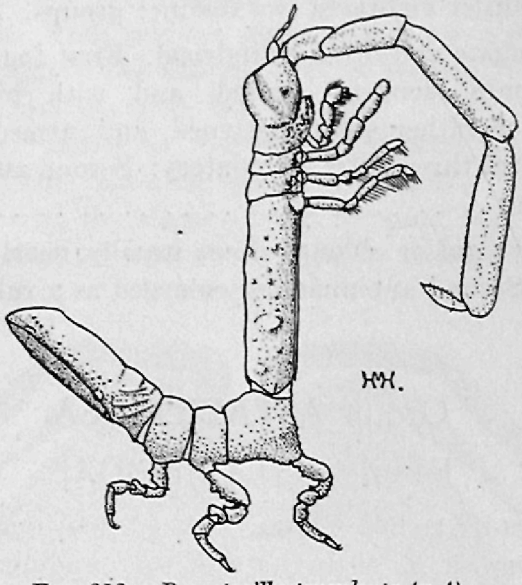


FIG. 312.—*Parastacilla truculenta* (x 4).

Spined Skeleton-louse. *Parastacilla bakeri* (Hale). (personal name).

The illustration shows the essential differences between this and the preceding species. The large second antennae are of different shape, and bear raised bosses furnished with sensory hairs. The third thoracic segment and the long fourth segment each bear a large, blunt, spine-like process; the

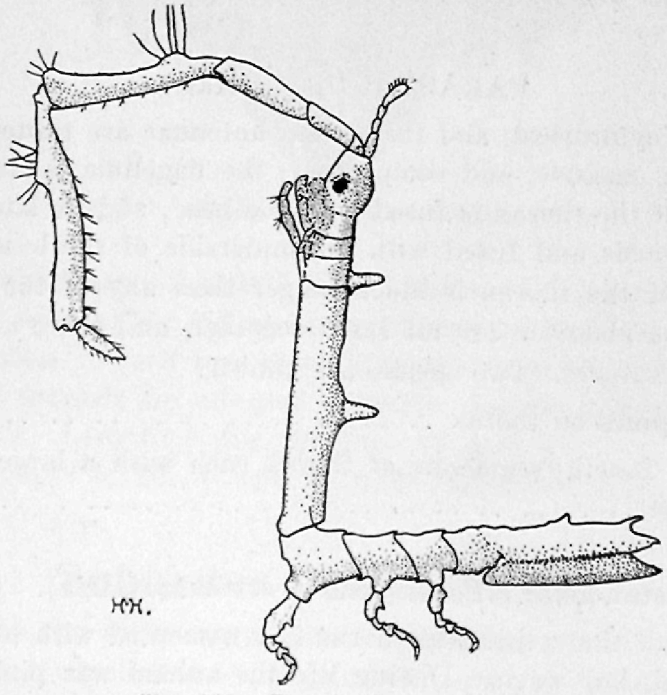


FIG. 313.—*Parastacilla bakeri* (x 9).

abdomen is armed wih a conical projection just behind the middle of its length, and with a backwardly produced spine on each side near the terminal end. Length: 9.5 mm., or $\frac{3}{8}$in. (S.A.M.)

NEASTACILLA (Tattersall).

Easily separated from *Parastacilla* by the characters mentioned in the key. Two species occur:

a. With a tubercle on upper surface of head . . . . . *algensis.*
aa. Without tubercle on upper surface of head . . . . . *deducta.*

Capped Skeleton-louse. *Neastacilla algensis* (Hale). (living in weed).

An attenuated species, with the fourth free thoracic segment very long and slender. The head is elongate, and bears a prominent, conical tubercle between the eyes. The second antennae are subcylindrical, and scarcely compressed. The animal lives in green weed (*Cymodocea antarctica*) in St. Vincent Gulf, and during life is green in color, marked with tiny brown dots, and with brown markings on the uropods. Length: 12.25 mm., or ½in. (S.A.M.)

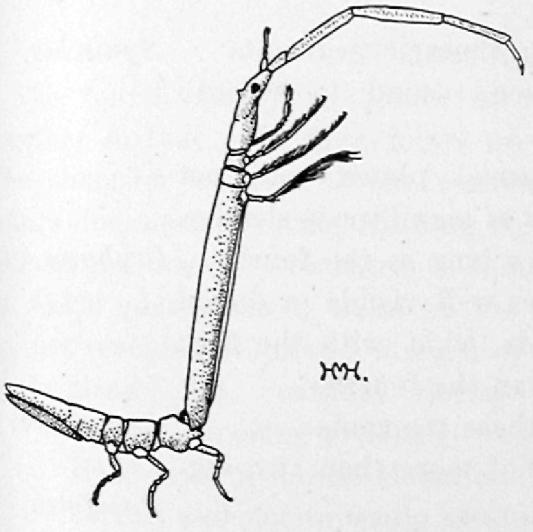


FIG. 314.—*Neastacilla algensis* x 5).

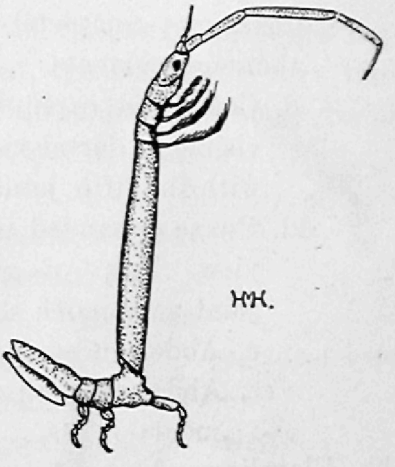


FIG. 315.—*Neastacilla deducta* (x 5).

Smooth Skeleton-louse. *Neastacilla deducta* (Hale). (drawn out).

Very like the foregoing species, but has no tubercle on the head. The joints of the second antennae are of different proportions, and the walking legs are a little stouter. This species, which was taken from a buoy in the Port River, was green in colour during life. Length: 12 mm., or ½in. (S.A.M.)

Group **IDOTEINEA.**

Family IDOTEIDAE. (Sea-centipedes.)

The fusing together of parts is a common feature in this family. For instance the number of joints in the palp of the maxillipeds varies in the different species, two or more segments being sometimes coalesced, thus reducing the number to less than the normal five. Then, the head may be fused with the normally first free thoracic segment, or the coxal plates of the second to seventh thoracic segments may be coalesced with their segments. Again, the number of segments in the abdomen is very often

reduced owing to fusion. These characters are largely used in the following key to the genera represented in South Australia. To determine with certainty the number of joints present in the palp of the maxilliped, it is usually necessary to remove the appendage, an operation which is easily accomplished with a pair of needle-pointed forceps. Our species, however, are so readily separated by other well-marked external characters that identification without dissection is not at all difficult. It is hardly necessary to state that the popular name for the Idoteids—"Sea centipedes"—does not imply that the crustaceans are in any way directly connected with the true centipedes, but was bestowed merely because of a fancied resemblance.

a. Palp of maxillipeds four-jointed . . . . . *Euidotea.*

aa. Palp of maxillipeds five-jointed.

b. Flagellum of second antennae well developed, with many joints.

c. Coxae completely fused with thoracic segments . . *Synischia.*

cc. Coxae not completely fused on second to seventh thoracic segments.

d. Coxae not expanded as coxal plates, and not visible in dorsal view. Palp of maxillipeds slender, with the fifth joint about as long as the fourth. . *Crabyzos.*

dd. Coxae expanded into plates well visible in dorsal view. Palp of maxillipeds wide, with the fifth joint very much shorter than the fourth.

e. Abdomen composed of three segments . . . . . *Pentidotea.*

ee. Abdomen composed of not more than two segments . . . . . *Paridotea.*

bb. Flagellum of second antennae very short, composed of only one to three joints . . . . . *Zenobiana.*

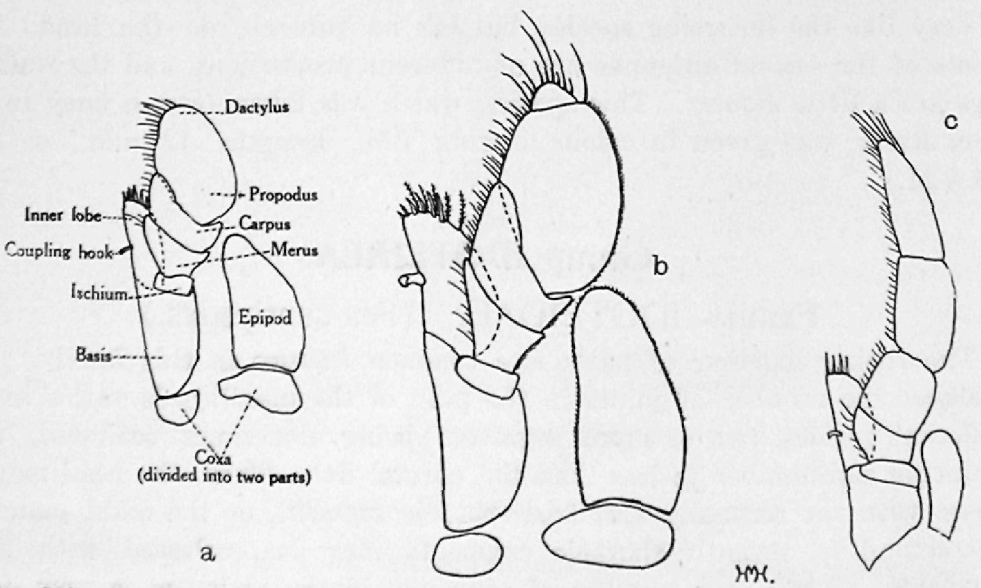


FIG. 316.—Maxilliped of (a) *Euidotea peronii*, (b) *Synischia levidensis* and (c) *Crabyzos longicaudatus* (x 16-40).

The basal joint, or coxa, of each maxilliped is divided into two parts (fig. 316, a); above the outer portion of the coxa is a large plate, the epipod. The basis joint is large and is expanded on the inner side to form an inner lobe which carries one or more coupling-hooks which link together the pair of maxillipeds; the apex of this lobe usually bears spines and stiff hairs. The remaining five joints form the palp. As mentioned above, all the articulations of the palp may not be apparent owing to fusion, and in *Euidotea* the two terminal joints (propodus and dactylus) are coalesced, reducing the number of palp segments to four. In all our other genera the palp is five-jointed, and, excepting in *Crabyzos*, similar to that shown in fig. 316, b; as indicated in the above key to the genera, the maxilliped of *Crabyzos* is slender, with the dactylus as long as the preceding joint (fig. 316, c).

EUIDOTEA (Collinge).

The fourth and fifth joints of the palp of the maxillipeds are fused together so that only four joints are apparent, the last being very large. The abdomen consists of one segment only, although there may be one suture line, near the base, running right across the abdomen.

Our species may be separated as follows:—

a. Coxal plates small, those of the last thoracic segment not reaching to hinder margin of their segment.
  b. Head flat, without dorsal elevation. Abdomen narrow, tapering gradually to an acute apex . . . . . *caeruleotincta.*
  bb. Head with a dorsal elevation. Abdomen not very narrow and not tapering gradually to apex . . . . . *stricta.*

aa. Coxal plates large, those of the last thoracic segment reaching back behind the hinder margin of their segment.
  c. Head without dorsal elevation; thorax not longitudinally ridged . . . . . *peronii.*
  cc. Head with a dorsal elevation. Thorax longitudinally ridged . . . . . *bakeri.*

Blue-spotted Sea-centipede. *Euidotea caeruleotincta* (Hale).
(spotted with blue).

The body is slender and much depressed; its surface is slightly rough and is dull, not shining. The thorax has a median ridge and each segment is rather angular; the coxal plates are distinctly separated on the second to seventh segments, but are all very small. The abdomen is narrow and flat, tapers to an acute apex, and has a low median ridge. Length: 23·5 mm., or $^{15}/_{16}$in. (S.A.M.)

The flat body and the elongate, pointed abdomen lends this species some resemblance to *Crabyzos longicaudatus*—the Green Sea-centipede of St. Vincent Gulf and Kangaroo Island. The animal is variable in colour, being bright green, yellow, or rich purplish-brown. Some examples when

alive were beautifully mottled with the last-named colour, the dorsum of the abdomen had four irregular pale bars across the surface and the second antennae were broadly banded with purplish-brown. In one respect, however, all specimens agree; there is an iridescent blue spot at the middle of the hinder part of each thoracic segment, and one at the first third of the abdomen.

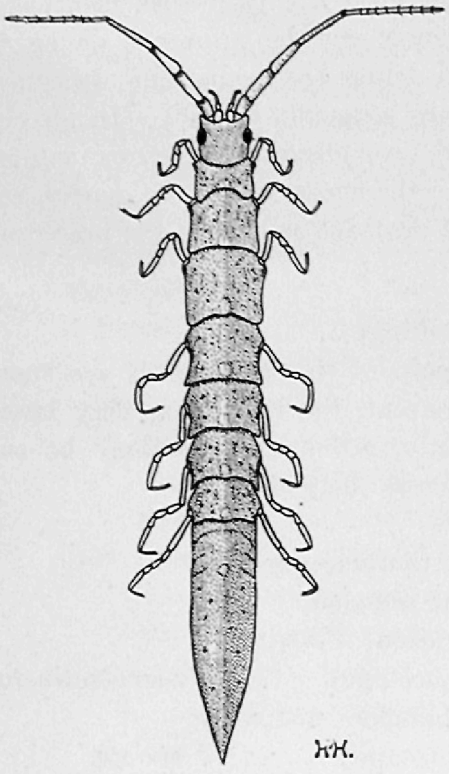


FIG. 317.—*Euidotea caeruleotincta* (x 3).

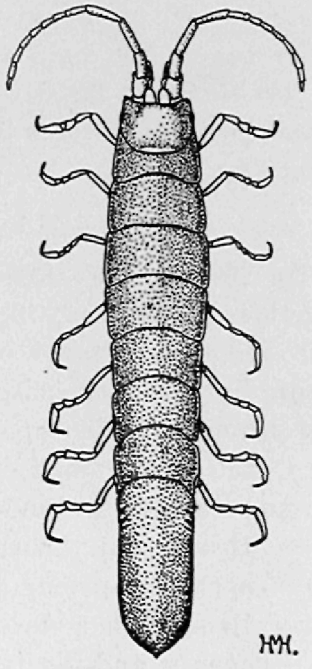


FIG. 318.—*Euidotea stricta* (x 4).

The Blue-spotted Sea-centipede lives on the broad, strap-shaped weed (*Posidonia australis* var.) growing in shallow water near the north shore of Kangaroo Island. Its flat form enables it to cling closely adpressed to the leaves of this plant; the Green Sea-centipede occurs in the same situation.

Euidotea stricta (Dana). (brief).

A species allied to the Common Sea-centipede but easily recognised by the short coxal plates and the presence of a dorsal elevation on the head. Also, the flagellum of the second antennae is composed of a lesser number of joints and the abdomen has three pairs of short lateral sutures near the base, none running across from side to side. Length: 22 mm., or ⅞in. (S.A.M.)

Apparently somewhat rare in our waters.

Common Sea-centipede. *Euidotea peronii* (M. Edwards). (personal name).

Somewhat closely resembles the Ridged Sea-centipede, but is usually more slender; it is readily separated by the apically angulate posterior coxal plates, the absence of a ridge on the thorax and abdomen, the smoother

and flatter head, the more slender second antennae, and the usually relatively narrower abdomen. A suture line runs right across the base of the abdomen and there are two pairs of short lateral sutures. Length: 44 mm., or 1¾in. (S.A.M.)

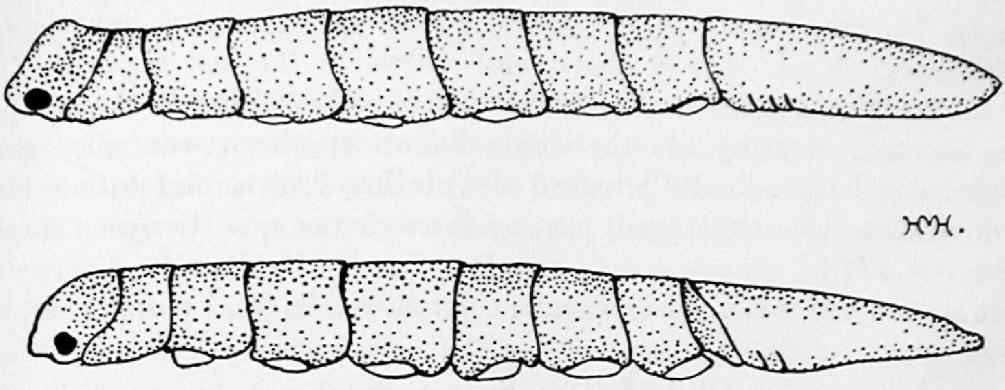


FIG. 319.—Side views of *Euidotea stricta* (upper fig.) and *E. peronii* (x 7).

An exceedingly common species, and, like the following form (in the company of which it is often taken), is extremely variable in colour.

Ridged Sea-centipede. *Euidotea bakeri* (Collinge). (personal name). There is a large elevation on the dorsal surface of the head, and the second antennae are thick. Each of the thoracic segments is strongly ridged medianly, and has an oblique elevation, overhanging a depression on each side. The last pair of coxal plates are rounded posteriorly. The abdomen is wide, longitudinally ridged, and is marked with three pairs of short lateral sutures near the base. The colour is very variable, ranging from black to pink, more or less spotted, and marked with brown. Length: 21 mm., or ⅘in. (S.A.M.)

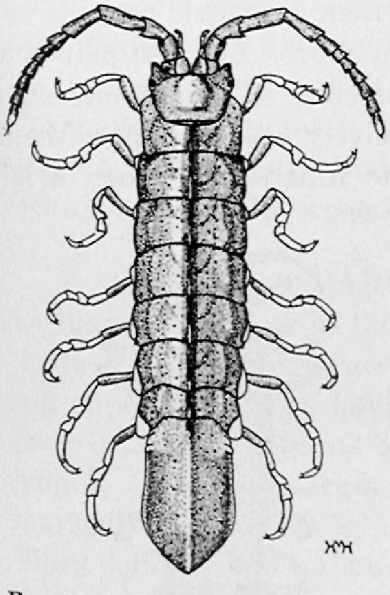


FIG. 320.—*Euidotea bakeri* (x 5).

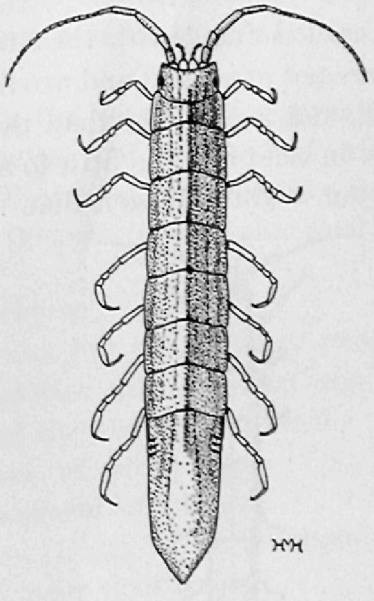


FIG. 321.—*Synischia levidensis* (x 3).

The species has been taken in Victoria as well as in South Australia.

SYNISCHIA (Hale).

The palp of the maxilliped is composed of five segments, the last of which is very much smaller than the fourth. The abdomen consists of a single segment, with three pairs of short lateral sutures near the base. The coxal plates are all perfectly fused with their segments.

Delicate Sea-centipede. *Synischia levidensis* (Hale). (of light build).

The thorax is roof-shaped above, and widest at the last segment. The legs are not strong, and successively increase in size backwards, the first pair being shortest. During life the single known specimen was pale brown, speckled and longitudinally streaked wth darker brown, and with a black streak on each side of the head, passing through the eye. Length: 21 mm., or ⅘in. (S.A.M.)

The species was taken from amongst *Cymodocea*, in St. Vincent Gulf.

CRABYZOS (Spence Bate).

There are five joints in the palp of the maxillipeds, the fifth being as long as the fourth. The abdomen consists of a single segment, with faint lateral sutures. In at least the male the form is very elongate. Two species have been recorded:

a. Abdomen sharply pointed at apex . . . . . *longicaudatus.*
aa. Abdomen incised at apex. . . . . *elongatus.*

Green Sea-centipede. *Crabyzos longicaudatus* (Spence Bate). (long-tailed).

The head is fused with the first "free" thoracic segment, and the coxal plates are not expanded and are not visible from above. The first pair of legs are long, and are stouter than the others; the second to fourth successively decrease in size; and the fifth to seventh successively become longer, the last pair being slightly longer than the first. The illustration shows a large

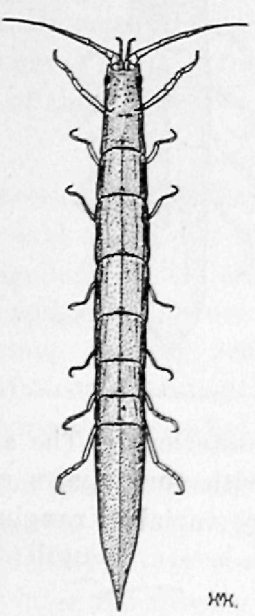


FIG. 322.—*Crabyzos longicaudatus* (x 1¼).

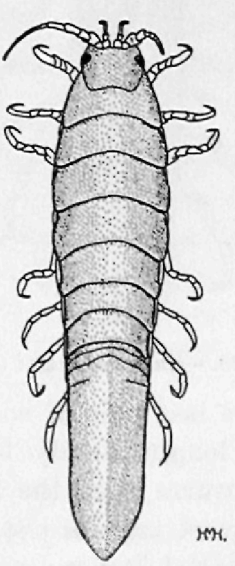


FIG. 323.—*Pentidotea australis* (x 1 ¼

ovigerous female; in smaller examples the thorax is relatively narrower, and the abdomen is even more acuminate. Length: 50 mm., or 2in. (S.A.M.)

This crustacean is invariably brought to light when the dredge is dragged through the sea-grasses of our gulf. The animal is bright graminaceous in colour (rarely banded with brown), and admirably matches the weed on which it dwells. The species has been taken in South Australia and Victoria.

Brown Sea-centipede. *Crabyzos elongatus* (Miers). (elongate).

The male is very elongate in form, but the ovigerous female becomes considerably dilated at the middle of the body. There is a rounded, rather shallow notch at the apex of the abdomen. Length: 50 mm., or 2in.

Originally described from New Zealand, this species has been recently recorded from South Australia, but is seldom met with here. It is stated that the animal is brown during life, and is found only on brown seaweeds.

PENTIDOTEA (Richardson).

The maxillipeds are much as in the preceding genus. The coxal plates, however, are quite free and distinct on the second to seventh thoracic segments, and the abdomen consists of three separate segments.

Deep-bodied Sea-centipede. *Pentidotea australis* (Hale). (southern).

A narrow and elongate species, with the dorsal surface very convex in transverse section, so that the coxal plates are scarcely visible from above. The abdomen is as long as the first six thoracic segments together, and consists of two short segments and one long segment, with a pair of short lateral sutures. Length: 51 mm., or 2in. (S.A.M.)

The type specimen, a male, was taken on the coast of Kangaroo Island. This example unfortunately has the greater part of the second antennae missing. A second individual, the female illustrated, was recently collected in Victoria; one of the second antennae of this specimen is abnormal.

PARIDOTEA (Stebbing).

The characters are as in the foregoing genus, but the abdomen consists of not more than two segments. Our two species are somewhat similar in general appearance, both having the apex of the abdomen notched.

a. Second and third joints of first antennae of about same length. Anterior margin of terminal segment of uropods markedly oblique . . . . . *munda.*

aa. Third joint of first antennae distinctly longer than second. Anterior margin of terminal segment of uropods not, or scarcely oblique . . . . . *ungulata.*

Little Sea-centipede. *Paridotea munda* (Hale). (neat or elegant).

The surface of the body is smooth, and dull when dry, not shining, as in most other sea-centipedes. The inner lobe of the first maxilla bears only three setiferous spines. The abdomen consists of a single segment, with a

very faint complete suture line near the base, followed by two pairs of short and indistinct lateral sutures. The apex of the abdomen is evenly, concavely incised, with the lateral angles rounded, not produced into points, as in the following species. Length: 22 mm., or ⅞in. (S.A.M.)

This species is common near the Gull Rock at Port Willunga, where it lives amongst an olivaceous alga, and is of precisely the same colour as the vegetation to which it clings. The majority of the large series of specimens so far collected were of this olivaceous colour, but a few were pinkish-brown, with a pale, elongate spot, outlined in black, at each side of the segments of the thorax. When swimming, the animal carries the first three legs directed forwards, and the last four pairs backwards. The legs do

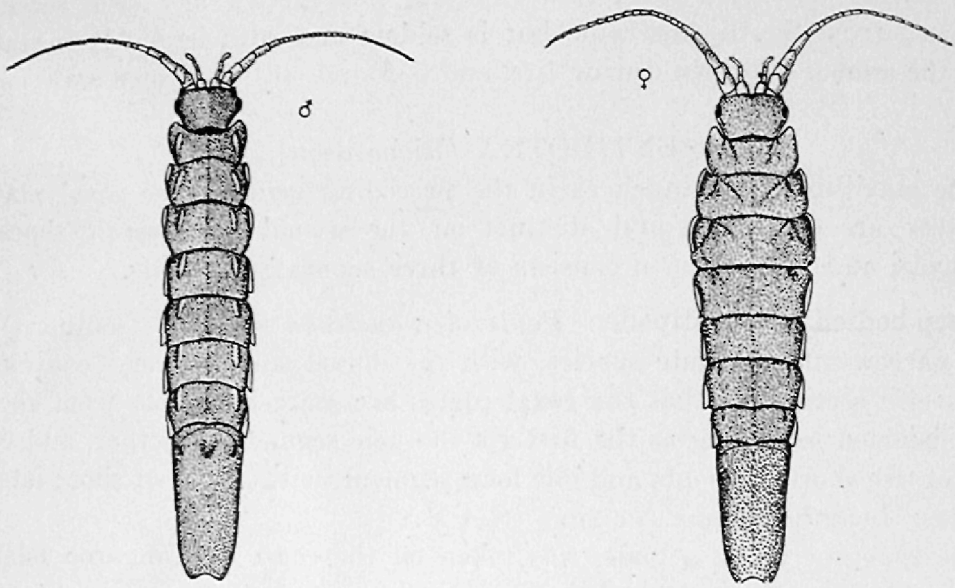


Fig. 324.—*Paridotea munda*, male and female (x 3½).

not assist in swimming at all; the uropods are opened downwards, and do not move, but swimming is accomplished solely by rapid movements of the pleopods. Immediately the last-named cease their rapid vibrations, the uropods close and the creature sinks, with legs extended outwards in readiness to clasp the weed over which it swims.

The Little Sea-centipede has been found in South Australia, Victoria, New South Wales, and Tasmania.

Sharp-tailed Sea-centipede. *Paridotea ungulata* (Pallas). (clawed).

The inner lobe of the first maxilla bears four setiferous spines. A suture line runs across the base of the abdomen and is followed by two pairs of short lateral sutures; the apical notch of the abdomen is broadly angulate or sinuate, with acute postero-lateral angles. Females with eggs are often much wider at the middle of the body than are males and non-ovigerous females. Length: 44 mm., or 1¾in. (S.A.M.)

The popular name refers to the two sharp points at each side of the apex of the abdomen. The coxal plates, viewed from the side, are of

different shape to those of the preceding form (fig. 325). This widely distributed species is common in our shallow waters and under rocks on beaches. It is very variable in colour, but specimens taken from *Ulva* and

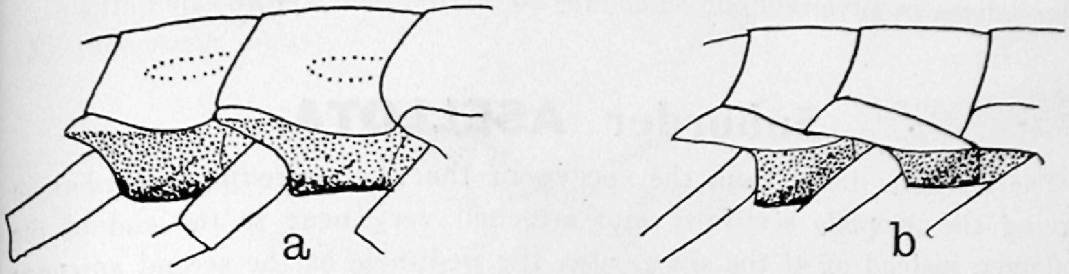


FIG. 325.—Side view of sixth and seventh thoracic segments of (a) *Paridotea munda* and (b) *P. ungulata* (x 8-10).

other green vegetation on our reefs are usually graminaceous in colour. When removed from the water and placed on a moderately smooth surface the animal sometimes progresses by humping the body in the same way as do the looper caterpillars.

ZENOBIANA (Stebbing).

The small sea-centipedes referred to this genus have the flagellum of the second antennae greatly reduced in size and composed of, at most, three joints. Coxal plates are free on the second to seventh thoracic segments.

Tube-dwelling Sea-centipede. *Zenobiana phryganea* (Hale). (a stick—the name of the typical genus of Caddis-flies).

The body is narrow and elongate, sub-cylindrical, with the upper surface shallowly pitted. The flagellum of the stout and short second antennae consists of but a single joint. There is a notch at the apex of the abdomen, which is divided into four segments, the third being very short; the longest fourth segment is marked with a pair of lateral sutures. A glance at the illustration shows that the last four pairs of legs are considerably less robust than the anterior limbs. The creature is brown, with faint vermiculations and a line down the middle of the thorax and abdomen is black, as are the lateral margins of the thorax. There is a pale stripe on each side of the mid-line of the thorax, and the coxal plates, legs, apex of abdomen, and the flagella of both pairs of antennae, are pale yellow, almost white. Length: 11 mm., or 7/16 in. (S.A.M.)

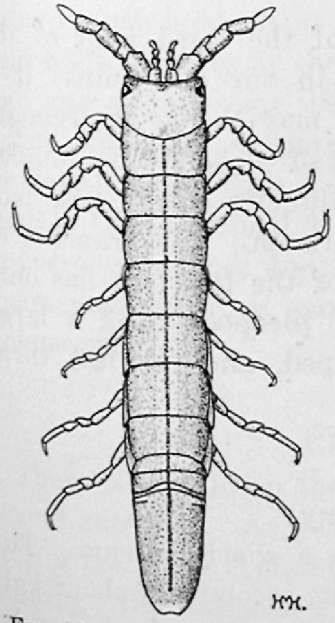


FIG. 326.—*Zenobiana phryganea* (x 5).

This curious species lives in short, hollow pieces of marine plants, broken just below a node so as to form a tube with one end closed. At least two species of Amphipods found on our coast have this habit also, and some of our Caddis-worms, found in the fresh-water creeks, utilise portions of plant-stems in precisely the same way.

Suborder ASELLOTA.

The Asellota differ from the species of the two preceding suborders in having the uropods styliform and attached very near to the end of the abdomen instead of at the sides; also, the peduncle of the second antennae is six-jointed. The abdominal somites are solidly fused together in most genera. The coxae of the legs are small, and are movable on the second to seventh thoracic segments. The second pair of pleopods is wanting in the female.

The creatures are fragile, and it is somewhat difficult to secure and preserve perfect examples. Some of the species live in fresh-water; one such form has been recorded from Victoria, and, although so far none has been noticed in our creeks and rivers, careful searching may yet reveal the presence of some tiny member of the group.

Two families are represented:—

a. First pair of pleopods in male coupled with second pair, and with peduncles elongate .. .. JANIRIDAE.

aa. First pair of pleopods in male not coupled with second pair, and with peduncles short .. .. STENETRIIDAE.

Family JANIRIDAE.

There is usually a small scale on the outside of the third joint of the peduncle of the second antennae; sometimes (as in our one genus) it is absent. The first pair of legs may be prehensile, or may be like the remaining walking limbs. In the male the first two pairs of pleopods are coupled together to form a compound operculum; the peduncles of the first pair are long, fused together, and each has only one branch. The branches of the third and fourth pairs are narrow, and each of the last pair has only a single branch. In the female the first pair of pleopods form a large undivided operculum; the second are not developed, and the last three pairs are as in the male.

IAIS (Bovallius).

Iais pubescens (Dana). (downy).

The head is subquadrate, wider than long, with a short rostrum. The eyes are small. The first antennae are short, and the second are about half as long as the body, with a flagellum considerably longer than the peduncle.

The uropods are somewhat variable in length, small, but distinct. Usually the rami are subequal in length, each about as long as the peduncle, and fringed with stiff hairs. The legs are all much alike. Length: 2.5 mm., or $\frac{1}{10}$in.

This tiny species is a companion, or commensal, of one of our Sphaeromids (*Exosphaeroma gigas*).

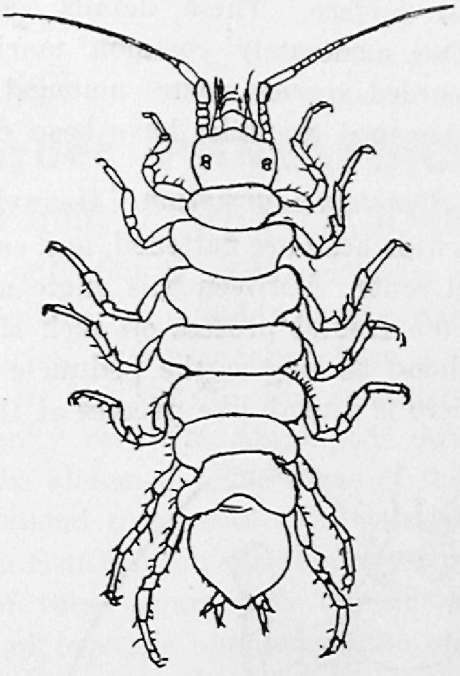


FIG. 327.—*Iais pubescens* (after Stebbing, x 20).

Iais pubescens var. *longistylis* (Chilton). (with long stalk).

This variety differs little from the typical form, but has the uropods longer than is usual (hence the varietal name). They are about half as long as the abdomen, and have the branches longer than the peduncle. The outer branch is about as long as the inner, but is rather more slender, with long hairs, usually at the apex only; the other ramus has long hairs at the end, and also at some distance from the apex. Length: 2.5 mm., or $\frac{1}{10}$in.

The variety associates with the Burrowing Pill-louse (*Sphaeroma quoyana*), in the same way as the typical form associates with *Exosphaeroma gigas*. "This animal is generally found on the ventral aspect of the *Sphaeroma*, among the bases of the legs, and should rather be called a commensal than a parasite, as it derives no sustenance from the *Sphaeroma*."

Family STENETRIIDAE.

There is a scale on the outside of the third joint of the peduncle of the second antennae. As shown in fig. 328, the first pair of legs is subchelate in both sexes. The remaining legs are similar in structure, and are used for walking; the dactylus of each ambulatory limb terminates in two claws. The pleopods of the first pair are completely fused together in the female

to form a small plate. In the male each of the first abdominal appendages has only one branch, and the bases of these pleopods are fused with each other. Thus, the first pleopods of the male are represented by a short plate, to which are attached two branches, and those of the female are represented by a short plate only. The outer branches of the third pair of pleopods are expanded, and together form a cover for the greater part of the lower abdominal surface. These details can be seen with the appendages *in situ*. One moderately common marine form is recorded below. Another unrecorded species occurs amongst weed in St. Vincent Gulf, but only a few damaged examples have been dredged.

Weed-louse. *Stenetrium armatum* (Haswell). (armed).

The side parts of the wide head are flattened, and each of the front lateral angles is produced and acute. Between this angle and the blunt rostrum is a short and very acute frontal process on each side. The flagellum of the first antennae is almost as long as the peduncle in adult males, much shorter in females. There is a tooth-like process at the antero-lateral angle

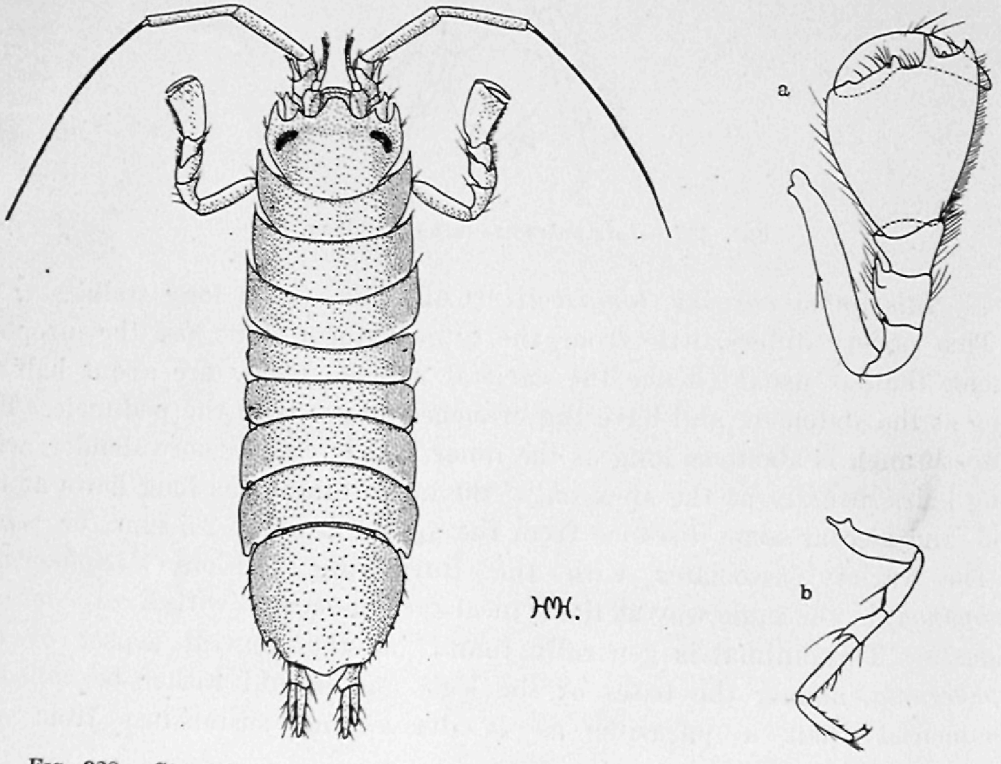


FIG. 328.—*Stenetrium armatum*, female; a, first leg of an adult male; b, one of the six pairs of walking legs (all x 11).

of the first joint of the second antennae. In the female the hand (or propodus) of the first legs is about one and three-fourths times as long as wide, with the edge on which the dactylus, or finger, folds nearly straight. The hand of the adult male is relatively very much larger than in the female, and is not much longer than wide; the edge on which the finger closes is jagged. Length: 13.5 mm., or ½in. (S.A.M.)

In the illustration of a female the subchelate first legs are shown, but the six pairs of ambulatory limbs are not indicated. The first leg of an adult male, showing the shape, armature, etc., of the hand, is figured at (a), and one of the third pair of legs (second walking limbs) of the same male at (b). The type specimens, which were taken in Port Jackson, New South Wales, are described as being half an inch in length, but the largest of the South Australian examples so far collected barely exceeds three-tenths of an inch.

Suborder PHREATOICIDEA.

Family PHREATOICIDAE.

The species of the only family of the suborder live in "fresh" water, on land in damp situations, or in subterranean waters. The first form to be described has no eyes, and was taken from a pump in New Zealand. As already indicated in the key to the suborders of the Isopods, the Phreatoicids superficially resemble Amphipods owing to the lateral compression of at least the abdomen. The coxae of the legs are usually small and movable on the second to seventh thoracic segments, but in the single species described from South Australia they are all absent, probably owing to complete fusion of these joints with the sides of the body segments. The last three pairs of legs are opposed to the others, as in most of the Amphipoda. The inner branch of the five pairs of pleopods acts as a gill, and the outer ramus is fringed with hairs; there are sexual stylets on the second pair of the male. In this and the succeeding pleopods the outer branch is two-jointed. The abdomen has six distinct segments, the sixth being more or less fused with the telson. The uropods are subterminal, and each has two styliform, spine-armed branches. The peduncle of the second antennae is five-jointed.

Dr. Chas. Chilton, who first drew attention to these remarkable Isopods, wrote recently:—"The characters and distribution showed that the family must be an ancient one, and in 1918 this was proved by the discovery of a fossil species [*Phreatoicus wianamattensis*] from the Triassic beds of New South Wales. The fossil form is not very different from some of the existing species, and, apparently, members of the family have been living in fresh waters on some part of the Australian continent from Triassic times up to the present" The same author also stated that "it is perhaps worth while calling attention to the fact that in Tasmania species of *Phreatoicus* are found in the same waters as the peculiar fresh-water shrimps *Anaspides tasmaniae* and *Paranaspides lacustris*. These shrimps have been shown by Calman to be nearly related to *Palaeocaris*, *Praeanaspides*, etc., from the Permo-carboniferous of Europe and North America, the whole forming a group, which Calman has named Syncarida. [See pp. 13, 25, and 26 of this handbook.] Another living member of this group, *Koonunga*, was found in

fresh-water near Melbourne by Sayce in 1907; as yet no fossils belonging to the group have been recorded from Australia."

Anaspides, Paranaspides, and *Koonunga* are the living representatives of a primitive and generalised group of Crustacea, the Syncarida, and similarly the members of the Phreatoicidea, a primitive group of the Isopoda, have continued to exist in the fresh waters of Australia, Tasmania, New Zealand, and South Africa from early secondary times."

When describing a species from South Africa, Dr. K. Barnard remarked that its discovery was "of great interest as being one more fact in support of the existence of an ancient land-mass connecting the southern continents (Gondwana land)."

PHREATOICUS (Chilton).

Phreatoicus latipes (Chilton). (with wide legs).

Eyes are rather well developed. The thorax is broad, and not compressed. Its first "free" segment is fused with the head, but the pleural, or lateral, parts are free; the suture is deep and distinct. The remaining thoracic segments are free. The sixth abdominal segment is united with the telson, but the suture between the two is well defined. The first legs are subchelate, and the last three pairs have the posterior part of the basis greatly expanded

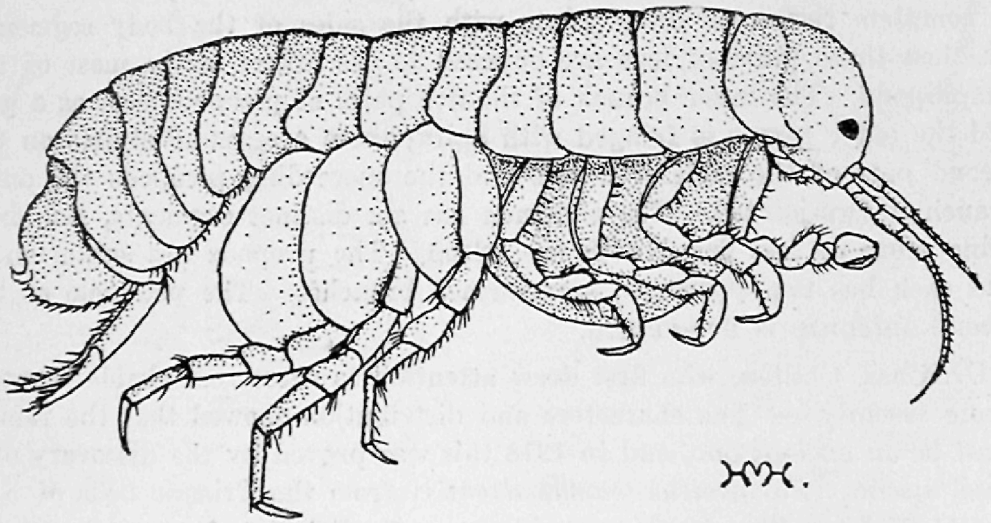


FIG. 329.—*Phreatoicus latipes* (x 8).

—a character referred to in the specific name. As indicated above, only six joints are apparent in the legs, the coxae having disappeared. The body of the adult is dark, slaty-grey, but "in some young specimens the surface of the body is lighter in color, with dark pigmented spots much more widely separated from one another than in the adult." Length: 15 mm., or $\frac{3}{5}$in. (S.A.M.)

The first recorded examples were taken by Prof. F. Wood Jones from artesian water at Marree, where "the creatures were in thousands swimming in the hot water near the bore head," all swimming against the current.

The temperature of the water was not taken at the time, but steam was rising from it. A female taken by Prof. Wood Jones (one of the paratypes) is here illustrated. The animal has well-marked eyes, and it is evident that it is not a subterranean species which came up the bore from underground. Further, specimens were later collected from natural springs near Coward, to the west of Lake Eyre South. These springs, which range over an area of 30 miles, vary in salinity and temperature.

Suborder EPICARIDEA.

No attention has been paid to our representatives of this suborder. It comprises small Isopods, which, when adult, live as parasites on other crustaceans. Mature females usually become more or less distorted and degraded, but the small males are symmetrical. The last-named are often found associated with the females, but in some cases are free-living. The animals are apparently not abundant off our coasts, and at this stage it is possible to do little more than call attention to the group.

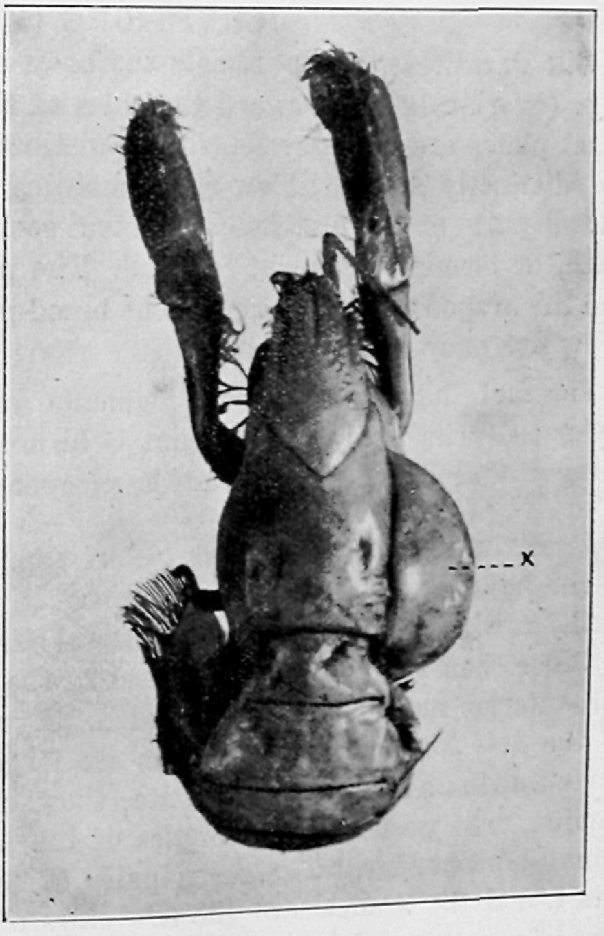


FIG. 330.—Sponge Shrimp, with an Epicarid (*Cryptione bakeri*) beneath right branchiostegite (x 4).

Two pairs of much reduced antennae are usually present; the mouth-parts are reduced, only mandibles and maxillipeds being developed, although rudiments of the maxillae may be present. The legs, if present, are prehensile, and the pleopods of the adult, when developed, are all branchial, none being sexually modified in the male; in some species they are altogether absent in one or both sexes.

The suborder is divided into two tribes. In the first of these (Cryptoniscina) the species are probably all protandrous hermaphrodites, like certain members of the related fish-lice (Cymothoidae) already described. As with other parasitic Crustacea, a relatively enormous mass of eggs is produced. The species of the Cryptoniscina are tiny creatures, which parasitize

Cirripedes (Barnacles), Mysids (Opossum-shrimps), Ostracods (small water-fleas), Amphipods, and other Isopods.

The second tribe, the Bopyrina, comprises species in which the sexes are probably always distinct. The members of this tribe are found lodged in the gill-chamber, or under the abdomen, of crabs and prawn-like crustaceans. Occasionally a prawn or shrimp is collected which has a large swelling on one side of the thorax (fig. 330); this lump is due to the presence of a female Bopyrid which, if the branchiostegite be lifted, will be seen ensconced in the gill-cavity, in company with her small husband.

Tribe **BOPYRINA.**

Family BOPYRIDAE.

The members of this family are parasitic upon Decapod Crustacea.

CRYPTIONE (Hansen).

Gill Parasites. In the female the body is somewhat twisted, with swellings (ovarian bosses) toward the sides of the first four thoracic segments; coxal plates are well developed and distinct on these four somites, but are not distinctly separated on the remaining three thoracic segments. The lateral parts of the first five abdominal somites are well developed, but the sixth, or terminal, segment is small. The pleopods are each two-branched, and the uropods are uniramous. The brood-pouch is almost completely closed in by five pairs of oostegites.

The male has seven distinct segments in the thorax and six in the abdomen. The last pleon segment is bifurcate (the postero-lateral angles being produced backwards) and the pleopods are uniramous.

Shrimp-louse. *Cryptione bakeri* (sp. nov.). (personal name).

The body of the female is asymmetrical, very broadly pear-shaped, five-sixths as wide as long, and has the dorsal surface slightly concave. The head is wider than long, deeply immersed in the first thoracic segment, and has the anterior margin broadly rounded. Eyes are absent. The coxal-plates of the first four thoracic segments are large; those of the third are about three-fourths as long as the somite; those of the fourth are as long as the somite. The postero-lateral angles of the last three thoracic segments are slightly prominent. The seven pairs of legs are small; the uropods are short, and the branches of the five pairs of pleopods are subequal in size, leaf-like, and tapering at the apex. Length: 6.6 mm., or $\frac{1}{4}$in. (S.A.M.)

The male is relatively much narrower than the female, being only half as wide as long. The head is wide, rounded in front, and is not deeply immersed in the first thoracic segment. The lateral parts of the seven thoracic segments and of the first four abdominal segments are produced, but those of the fifth segment are scarcely produced; the postero-lateral angles of

the sixth abdominal segment are produced backwards, the processes possibly representing the uropods. The seven pairs of prehensile legs are strong and relatively much larger than in the female. The five pairs of pleopods are simple, sac-like, and somewhat pear-shaped. Length: 2.2 mm., or $\frac{1}{10}$in. (S.A.M.)

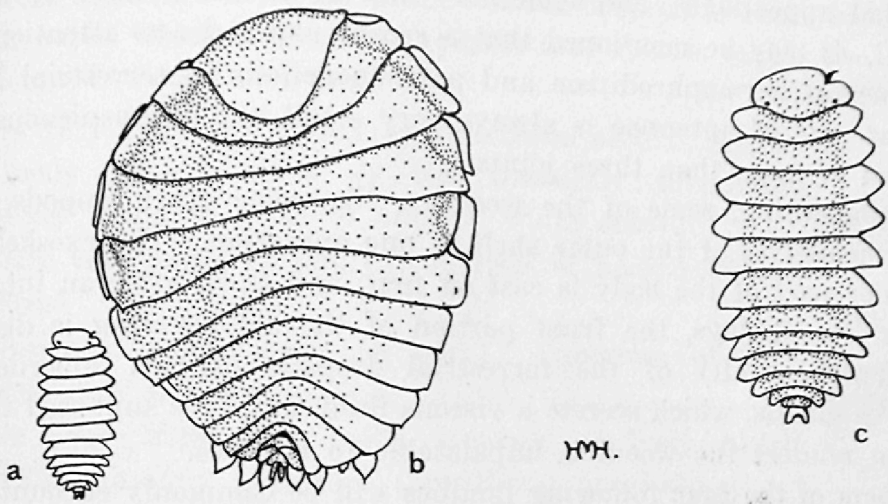


FIG. 331.—*Cryptione bakeri;* a and b, male and female (x 8); c, male (x 18).

The female was taken beneath the branchiostegite of a Sponge-shrimp (*Upogebia bowerbankii,* see p. 85), collected by Mr. Walter H. Baker in St. Vincent Gulf. The parasite was lying with the concave back against the gills, and the brood-pouch, filled with eggs, distended the gill-cover of the shrimp, as shown in the photograph. The tiny male was lodged transversely across the abdomen of his consort, immediately behind the marsupium; the front margin of its head is slightly abnormal. (The types, male and female, are in the Museum, Reg. Nos. C.1780 and C.1781).

Suborder ONISCOIDEA. (Woodlice and Pill-bugs.)

With very few exceptions, the Oniscoidea live on the land, and their respiratory organs are adapted for breathing air. Most of the species described below are moderately or very common, but a number of forms more rarely met with have yet to be recorded.

Land Isopods are found almost everywhere, from the centre of the Continent to the shores of the sea. Some species shelter under stones, leaves, and bark of trees, or in caves, while others occur on spray-wet rocks at the margin of the sea and on the white sands of our extensive beaches. One aquatic species has been taken in South Australia, and this, curiously enough, lives in salt-water lagoons. Some of the woodlice live in the nests of ants, and possibly there act as scavengers—at any rate, the insects tolerate the presence of their crustacean guests. In these myrmecophiles the colour is almost or wholly lost, and the eyes are rudimentary, or absent.

The legs are usually all formed for walking. The abdomen is composed of six distinct segments, and the uropods are terminal, slender, and style-like, composed of a peduncle and two branches. The outer branches of at least the first two pairs of pleopods (sometimes of all five pairs) contain air-tubes in most cases. In the male the inner branch of the second abdominal appendages, and sometimes that of the first also, is sexually modified. It may be mentioned that a recent paper draws attention to the occurrence of hermaphroditism and parthenogenesis in terrestrial Isopods. The first pair of antennae is always very small and inconspicuous, never composed of more than three joints.

When moulting, some of the woodlice, like some other Isopods, do not relieve themselves of the outer shell in one operation. The exoskeleton of the hinder part of the body is cast off first, and then, after an interval of perhaps several days, the front portion of the old covering is discarded. Many (perhaps all) of the terrestrial Isopods of this suborder have cutaneous glands, which secrete a viscous fluid, and it is supposed that this secretion renders the woodlice unpalatable to enemies.

Members of the four following families will be commonly encountered by the collector. The mouth-parts referred to in the key are detailed in fig. 233.

a. Flagellum of second antennae very short, with not more than six joints. Mandibles without distinct molar process, there being brush-like, stiff hairs in its place. Inner lobe of first maxilla with two plumose bristles.
  b. Terminal joints of maxillipeds very small.
    c. Uropods not projecting beyond edge of last abdominal segment (woodlice capable of rolling into a perfect sphere when alarmed) . . . . . ARMADILLIDAE.
    cc. Uropods projecting beyond edge of last abdominal segment (woodlice which do not roll into a perfect sphere when alarmed) . . . . . ONISCIDAE.
  bb. Terminal joints of maxillipeds large . . . . . SCYPHACIDAE.
aa. Flagellum of second antennae long, with many joints. Mandibles with well-developed molar process. Inner lobe of first maxilla with three plumose bristles LIGIIDAE.

Family ARMADILLIDAE.

The body is usually convex, and the animals roll themselves into a perfect ball when disturbed—hence the popular name, pill-bugs. The uropoda are usually very short and not produced past the margin of the terminal abdominal segment.

CUBARIS (Brandt).

There is usually a posterior cleft or groove in the edge of each lateral part of the first thoracic segment, sometimes in that of the second also; the antero-lateral edge of the following segment fits into this cleft. The first

pair of antennae are very small, composed of only three segments; the second antennae are rarely more than one-third as long as the body, with a two-jointed flagellum. The outer branches of all the pleopods contain air-tubes. The base of the uropods is flattened and expanded to fill the space between the produced lateral portions of the fifth abdominal segment and the telsonic segment; the inner branch of the uropods is small, but is larger than the outer, which is minute. At least four species occur; two are commensals and two are free-living.

a. Eyes very small with only two or three ocelli. Surface of body usually more or less distinctly tuberculate (species living in nests of ants or white ants).
  b. Size very small (2 mm.). Tubercles of body relatively large . . . . . *minuta.*
  bb. Size moderately large (8 mm.). Tubercles of body relatively smaller . . . . . *commensalis.*
aa. Eyes larger with many ocelli. Surface of body nearly smooth, minutely granular (free-living species).
  c. Second joint of flagellum of second antennae more than twice as long as first . . . . . *ambitiosus.*
  cc. Joints of flagellum of second antennae subequal in length . . . . . *claytonensis.*

Termites' Pill-bug. *Cubaris minuta* (Baker). (very small).

The upper surface of the body is covered with large compressed tubercles, most of which are regularly arranged in transverse series. On the head the tubercles are smaller and more rounded. There is a small cleft at the posterior angles of the first thoracic segment, which is longer than any of the other segments. The first antennae are minute; the second are short, with a thick peduncle and a small flagellum, the first joint of which is very short. The animal is white in colour with pale brown markings. Length: 2 mm., or 1/13 in. (S.A.M.)

FIG. 332.—*Cubaris minuta* (after Baker, x 20).

This species was found in a termites' nest.

Ant-nest Pill-bug. *Cubaris commensalis* (Baker). (living with another).

The upper surface of the body usually bears distinct tubercles, which are smaller and more numerous than in the preceding species; this sculpture, however, varies considerably, and in some specimens the tubercles are strong, in others they are practically absent. The postero-lateral margins of the first thoracic segment are cleft, the nick not being visible from above; the side parts of the second segment have a strong tooth on

the inner surface near the anterior margin. The antennae are much as in *C. minuta*. The colour is pale slate or pale brown. Length: 8 mm., or $\frac{3}{10}$in. (S.A.M.)

This form is moderately common in nests of ants, and, like other myrmecophiles, may often be taken in company with the insects, by turning over large stones covering the nests.

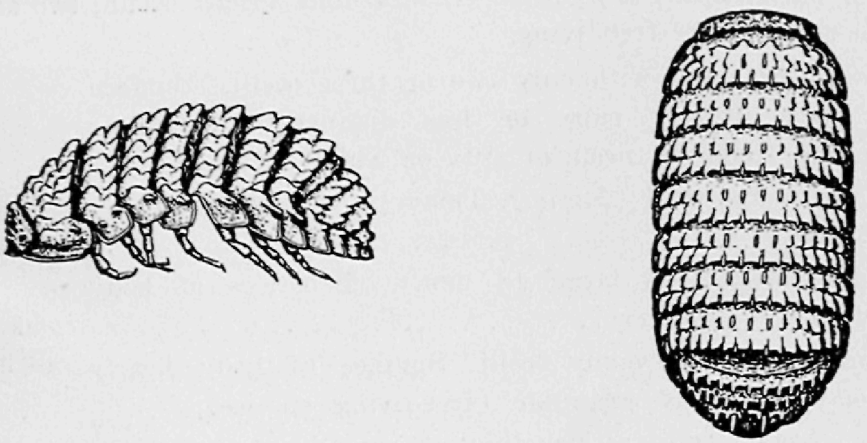


FIG. 333.—*Cubaris commensalis* (after Baker, x 7).

Common Pill-bug. *Cubaris ambitiosus* (Budde-Lund). (admired).

The head is wide and short, with a strong ridge at the anterior margin; this ridge projects slightly above the dorsal surface at the sides. The head and body are finely granular with low lateral rugosities on the upper surface. There is a cleft in the postero-lateral margin of the first thoracic segment. The anterior portion of the coxal part of the second segment is thickened on the inner (or lower) surface, the swelling terminating in a small tubercle before it reaches the lateral margin. The telsonic segment is widest anteriorly and its posterior margin is truncate or slightly rounded. The second antennae bear tiny hairs and have the second joint of the flagellum about two and one-half times as long as the first. The colour is brown, or slaty-brown above, usually with pale markings on each side. Length: 15 mm., or $\frac{3}{5}$in. (S.A.M.)

This pill-bug is common in damp situations in the Mount Lofty Ranges and elsewhere. It rolls into a perfect ball when alarmed and cannot be confused with the extremely abundant Common Woodlouse (*Porcellio laevis*) which has a less convex body, the uropods projecting well beyond the posterior apex of the body, the telson subacute, etc.

Central Australian Pill-bug. *Cubaris claytonensis* (Chilton). (after Clayton Creek).

The head is wide with the frontal ridge not produced above the dorsal surface. The body is minutely granular. The postero-lateral margin of the first thoracic segment is cleft, the inner tooth produced by this nick being very small; there is a tooth on the inner surface of the coxal part

of the second segment also, near the anterior margin. The two joints of the flagellum of the second antennae are subequal in length. The colour is "dark slatish with light brown markings along the lateral and hind margins of the segments." Length: 15 mm., or $\frac{3}{5}$in. (S.A.M.)

This species was collected in the interior and was found at Higgins Dam and near the Clayton Creek, which flows into Lake Eyre.

Family ONISCIDAE.

The body is in general much less convex than in the species dealt with above and the animals do not roll into a perfect sphere. Further, the uropods always extend beyond the margin of the terminal segments of the abdomen. In our genera the flagellum of the second antennae never has more than three joints.

a. Flagellum of second antennae composed of three joints.
   b. Surface of body granulate or tuberculate. Telsonic segment narrow, with lateral portions not developed; apically subacute . . . . . *Oniscus.*
   bb. Surface of body smooth. Telsonic segment wide, with lateral parts well developed; apically rounded . . . . . *Haloniscus.*

aa. Flagellum of second antennae composed of two joints.
   c. Abdomen not abruptly narrower than thorax, with the lateral portions of some of the segments large and outstanding . . . . . *Porcellio.*
   cc. Abdomen abruptly narrower than thorax, with lateral portions of segments small . . . . . *Porcellionides.*

ONISCUS (Linnaeus).

The body is broad and flattened. The antero-lateral angles of the head are produced, but there is no median (or rostral) projection at the front margin. The abdomen is not suddenly narrower than the thorax and has the side portions of the third, fourth, and fifth segments produced and expanded. The telsonic segment is subconical in shape. One species has been recorded.

Ant-nest Woodlouse. *Oniscus myrmecophilus* (Baker). (dwelling with ants).

The head is about three times as wide as long and has the antero-lateral angles moderately projecting; the eyes are small, and consist of less than ten ocelli. There are tiny hairs on the upper surface, which is dull and otherwise almost smooth. The first antennae are small; the second have the last joint of the peduncle almost as long as the flagellum, the third joint of which is as long as the first two together; the second segment of the flagellum is shorter than the first. The first legs are partially prehensile.

During life the animal is pale slate, or slaty-brown, in colour, with paler markings. Length: 8 mm., or $\frac{3}{10}$ in. (S.A.M.)

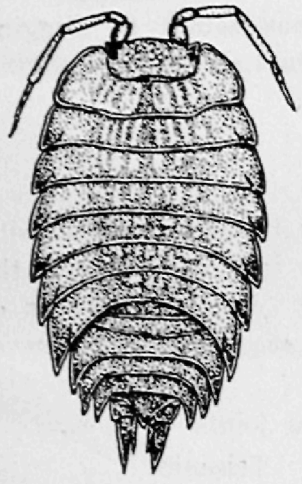


FIG. 334.—*Oniscus myrmecophilus* (after Baker, x 5).

The illustration shows well the general characters of this species, which is common in the nests of various species of ants and is sometimes taken in company with *Cubaris commensalis*, in the same nest. Often quite a number of specimens may be secured from a nest exposed by turning over a stone or log. Some years ago I observed numerous examples under flat stones in the Northern Flinders Ranges. One evening a large beetle (individuals of which had also been noted under stones in the daytime) flew to the camp-fire, and clinging between its legs were two young specimens of this Isopod. The presence of the crustaceans on the beetle may have been more or less accidental, but, nevertheless, the occurrence shows that individuals might easily be transported from the nest of one species of ant to that of another by similar agencies.

HALONISCUS (Chilton).

The body is moderately convex, and the lateral portions of the thoracic segments are not greatly expanded. There are no antero-lateral or median projections on the anterior margin of the head, which is almost evenly rounded. The abdomen is a little narrower than the last thoracic segment, and has a wide basal portion, in addition to the triangular terminal part.

Salt-lake Louse. *Haloniscus searlei* (Chilton). (personal name).

The body is oval and rather narrow, and in general appearance the animal superficially resembles *Ligia* (fig. 341), which, however, differs in having a much longer second antennal flagellum, and in other marked characters. There are tiny hairs on the upper surface, which is smooth. The eyes are moderately large. The first antennae are minute. The first three joints of the peduncle of the second antennae are subequal in length; the fourth is longer than any of the first three, and the fifth is longer than the fourth. The flagellum is slightly longer than the fifth joint of the peduncle, and has the first and third joints subequal in length, each a little longer than the second segment. There are two series of legs, the first four pairs being prehensile and the last three ambulatory. In the female the fourth legs do not so closely approach a subchelate character as in the male. The outer plate-like branch of each pair of pleopods is very large, delicate, and without air-tubes or cavities; the inner branch is small. As in other members of the family, the endopods of both the first and second abdominal appendages are modified in the male. During life the upper surface of South Australian examples was pale slaty-grey in colour, with numerous tiny

black spots, irregularly arranged in longitudinal groups, producing a faintly striped appearance. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

Haloniscus searlei was discovered in 1918, in the salt water of Lake Corangamite, Victoria. Two years later specimens of a similar species were collected from the Pool of Siloam, at Beachport, South Australia. The Beachport specimens were described by Mr. W. H. Baker under the name *Philoscia salina*, but are undoubtedly congeneric with *Haloniscus searlei*, and are so close that I have listed our form as Dr. Chilton's species. Further comparison may show that South Australian specimens are worthy of specific distinction, in which case they are referable to *Haloniscus salina* (Baker).

The animal is apparently common in the aforementioned Pool of Siloam at most times of the year, and residents of the South-Eastern districts state that they have seen similar crustaceans in other salt-lakes. It is quite probable that further investigation will show that the creature lives in other of the numerous South Australian salt-lakes. In the Pool of Siloam some specimens were obtained on the bottom, or slightly buried in the fine sand, well away from the shore, in about six feet of water; others were taken on the limbs of bathers. The water in this small lake is always very saline, and when the creatures were first observed therein, was over three times salter than the sea.

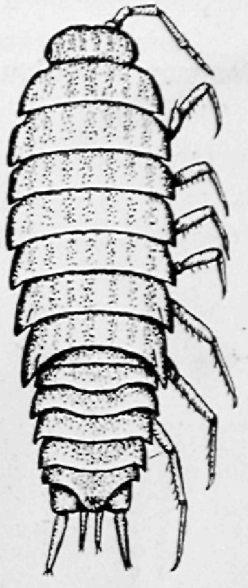


FIG. 335.—*Haloniscus searlei* (after Baker, x 5).

Haloniscus presents an anomaly, for all other members of the family are of strictly terrestrial habit. It may be mentioned that three exotic species of the related Trichoniscidae are aquatic. It has been pointed out that there is little doubt that *Haloniscus searlei* is a land form which has become re-adapted to an aquatic life. Professor Nicholls, of the Western Australian University, collected a further species of the genus (*H. stepheni*, Nicholls and Barnes) in the bed of Kokatea Creek, Western Australia, "which had been strongly salt for several years." Where the specimens were collected "the creek at this time was dry, but the surface crust, thickly spread with salt crystals, covered a viscid mud beneath. . . . : They were quite active, and a number succeeded in making good their escape down tiny burrows into the softer mud beneath."

PORCELLIO (Latreille).

The body is not very convex, and the lateral parts of the thorax are expanded. The anterior margin of the head is trilobed, the antero-lateral lobes and a median lobe being developed. The abdomen is not abruptly narrower than the last thoracic segment, and the lateral parts of the third,

fourth, and fifth segments are well-developed and produced. The telsonic segment is subconical in shape.

a. First joint of flagellum of second antennae longer than second .. .. *laevis.*

aa. First joint of flagellum of second antennae shorter than second.

b. Whole surface of body covered with small tubercles.. .. *scaber.*

bb. The three anterior segments of thorax with irregular tubercles; posterior thoracic segments and abdomen almost smooth .. .. *strzelecki.*

These species have been placed in different subgenera, but for the present purpose these need not be considered.

Common Woodlouse or Slater. *Porcellio laevis* (Latreille). (smooth).

The body is suboval in shape, about twice as long as wide; the upper surface is almost smooth, without tubercles. The head is about twice as wide as long; its anterior margin is trilobed, the antero-lateral lobes being prominent and rounded, and the median projection triangular. The eyes are well developed, and the first antennae are tiny. The second and third joints of the peduncle of the second antennae are subequal in length, each longer than the first; the fourth joint is twice as long as the third, and two-thirds as long as the fifth; the first joint of the flagellum is slightly longer than the second. The uropoda are prominent; the outer branch of each reaches for almost the whole of its length beyond the apex of the telsonic segment. During life the colour is slaty-grey, with wavy pale markings on each side, massed to produce an effect of two broad, longitudinal stripes on the thorax. Length: 15 mm., or $\frac{3}{5}$in. (S.A.M.)

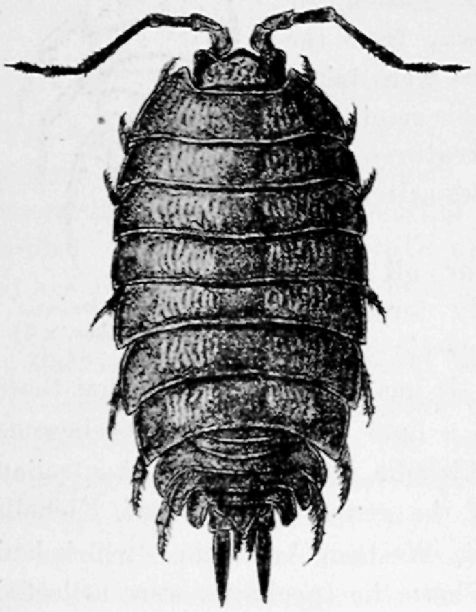


FIG. 336.—*Porcellio laevis* (after Sars, x 4).

This is the "Slater" which occurs so plentifully under debris in our gardens and elsewhere. It is so abundant that the student need suffer from no lack of material for the purpose of gaining a knowledge of the general structure of an Isopod. Unlike the pill-lice (*Cubaris*, etc.), the Slater does not roll into a ball when disturbed, but runs to the nearest shelter. It feeds largely on vegetable matter, and, under damp conditions, is certainly injurious to some garden plants. On the other hand, it is of some importance as a scavenger, devouring decaying vegetation, or insect eggs, dead insects, and other animal matter. If it be considered

necessary, woodlice may be destroyed by dusting the soil with arsenical compounds, or by spraying their food material with arsenate of lead.

P. laevis is the most widely distributed member of the family, being almost cosmopolitan. It was evidently introduced at a very early period of the colonization of Australia and is now found practically all over the continent.

Beaded Slater. *Porcellio scaber* (Latreille). (scurfy, or rough).

Somewhat resembling the Common Slater, but readily distinguished from it by the following obvious features:—The upper surface of the body is roughened with transverse rows of tubercles. The joints of the peduncle of the second antennae are approximately as in *P. laevis*, but the first joint of the flagellum is shorter than the second. The uropoda are relatively shorter, the outer branch reaching for only about half its length beyond the apex of the telsonic segment. The colour is somewhat variable, being dark grey with dark mottlings, or blackish margined with pale yellow. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

FIG. 337. *Porcellio scaber* (after Sars, x 5).

While this introduced species is far more rarely met with than the preceding, it is apparently widely scattered over at least the southern parts of South Australia, and, like *P. laevis*, has been observed in unlikely places (near salt-lakes, on the Coorong, etc.), as well as in gardens, shade-houses, and so on. It is very common in New Zealand.

Central Australian Slater. *Porcellio strzelecki* (Chilton). (after Strzelecki Creek).

The body is of the usual suboval shape and is covered with tiny stiff hairs; there are some irregular tuberculations on the upper surface of the head and first three thoracic segments; the remaining segments of the thorax, and those of the abdomen, are smooth. The anterior margin of the head is trilobed, the lateral lobes being conspicuous and the rostral projection broadly triangular. There is a distinct carina (or ridge) on the fifth joint of the second antennae; this joint is nearly half as long again as the fourth, which is about one and two-third times as long as the third. The first segment of the flagellum is only half as long as the second. The uropoda are moderately stout, with about two-thirds of the length of the outer branch extending beyond the apex of the telsonic segment. In colour

the animal is "light brown with marblings and median stripe dark brown." Length: 6 mm., or ¼in. (S.A.M.)

As the specific name implies the species was found near Strzelecki Creek in the interior.

PORCELLIONIDES (Miers).

The body is flattened and little convex. The antero-lateral angles of the head are not much produced and there is no rostral projection as in *Porcellio*. The abdomen is abruptly and decidedly narrower than the thorax and the lateral parts of its third, fourth, and fifth segments are small and not much expanded. The telsonic segment is short and triangular. One common species occurs.

Delicate Woodlouse. *Porcellionides pruniosus* (Brandt). (frosty).

The surface of the body is very slightly roughened with granules. The head is twice as wide as long, with the front margin a little convex and the antero-lateral lobes small. The fourth joint of the peduncle of the second antennae is two-thirds as long as the fifth and twice as long as the third, which is equal in length to the second; the first joint of the flagellum is twice as long as the second. The uropoda are prominent, the outer branch extending for the whole of its length past the apex of the telsonic segment, which is short, twice as wide as long. The life colour is bluish grey, tinged with a rusty bloom in the female, or various shades of reddish-brown. There are often wavy, pale yellow markings on each side of the upper surface. Length: 9.5 mm., or ⅜in. (S.A.M.)

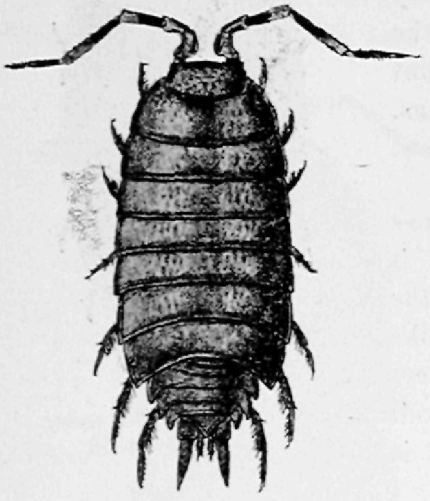


FIG. 338.—*Porcellionides pruniosus* (after Sars, x 6).

A somewhat fragile woodlouse which runs much more rapidly than the two Porcellios described above. It has been remarked that "this is another species which has been carried by navigation to all parts of the world." Like the Slaters it lives under debris and stones in damp situations.

Family SCYPHACIDAE.

The flagellum of the second antennae is composed of four joints. The abdomen is not abruptly narrower than the thorax and the uropods extend well beyond the tip of the telson. The maxillipeds have the terminal joints fairly well developed, not very small as in the two preceding families. At least two species live on our beaches or rocky coasts.

a. Animal not capable of rolling itself into a ball. Uropods produced, reaching beyond the outline of the body . . . . . *Deto.*

aa. Animal capable of rolling itself into a ball. Uropods short, not, or scarcely, reaching beyond the outline of the body . . *Actaecia.*

DETO (Guerin).

The body is somewhat depressed, and the animal cannot roll itself into a perfect ball. The lateral parts of the thorax are expanded, and the third to fifth segments of the abdomen have well-developed side portions.

Rock Louse. *Deto marina* (Chilton). (marine).

The body is suboval, a little more than twice as long as wide. The front margin of the head is trilobed, the antero-lateral projections being very broad, and the median lobe triangular. There are tubercles on the upper surface of the head and thorax. In the male these elevations are numerous, acute, and in general much more pronounced than in the female, in which they are more irregularly arranged, sparser, and not very conspicuous. The second antennae are about one-third the length of the body in the female; somewhat longer in the male; they are slender in both sexes, with the fifth joint rather longer than the third and fourth joints together. The flagellum has the fourth joint much smaller than any of the other three, which are subequal in length. In the female the protopod of the uropods reaches to the level of the apex of the telson, and the outer branch is not longer than the protopod. The uropods are much more elongate in the male, their bases extending well beyond the apex of the telson. The outer branch in this sex is twice as long as the protopod. The third, fourth, and fifth segments of the abdomen have the lateral parts prominent, with acute apices. A young female is illustrated. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

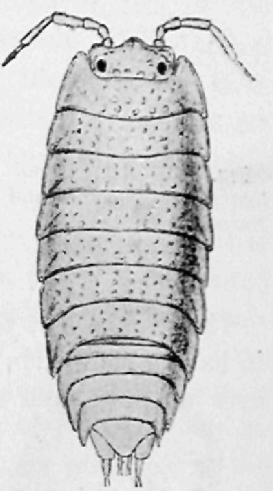


FIG. 339.—*Deto marina* (after Chilton, x 8).

This species is found on the underside of stones, etc., at about high-tide level, on rocky and exposed portions of our coasts. When disturbed, it is slow and sluggish in movement, and is thus easily captured. On the south coast of Kangaroo Island the Rock-louse is found in the same haunts as the very active *Ligia*.

ACTAECIA (Dana).

Beach Pill-bug. *Actaecia pallida* (Nicholls and Barnes). (pale).

The body is convex, suboval in shape, and twice as long as broad, and is covered with small, scattered spines. The front margin of the head is rounded, with the edge slightly elevated. The second antennae are not very long, and are well armed with small spines; the four-jointed flagellum is a little shorter than the last joint of the peduncle. The peduncle of each uropod is flattened, broad, and rectangular in shape; the small outer ramus is inserted on the upper surface of the peduncle, and projects slightly beyond its posterior margin; the short and slender inner branch is situated on the underside of the base. The colour is white, with brown markings. Length: 7 mm., or $\frac{9}{32}$in. (S.A.M.)

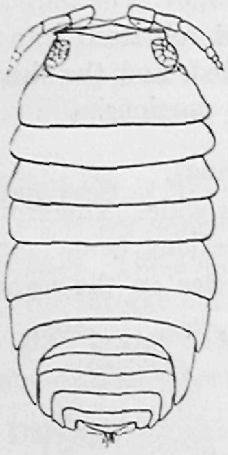


FIG. 340.—*Actaecia pallida* (after Nicholls and Barnes, x 7).

This species is not uncommon on the coasts of southern, south-western, and south-eastern Australia, where it is found on clean, sandy beaches; its colour harmonises perfectly with the white or grey surface over which it moves. On the south coast of Kangaroo Island, in places where the damp sand has compacted, I have noticed numbers of examples retreating into small burrows when alarmed, but whether the animals were responsible for the holes was not ascertained. When disturbed, the creature commonly curls itself into a ball, and often is then rolled away over the smooth beach by the wind. Owing to the small size of this Pill-bug, and its protective colouration, it is very difficult to rediscover a specimen which has thus eluded capture.

Family LIGIIDAE.

The members of this family differ from all our other terrestrial Isopods in having more than six joints in the flagellum of the second antennae. The eyes are large, and the molar process of the mandibles is well developed.

LIGIA (Fabricius).

Swift Beach Louse. *Ligia australiensis* (Dana). (Australian).

The body is suboval, more than twice as long as wide. The head is large, with the anterior margin not lobed, and the eyes are conspicuous. The second antennae are very long and slender, with the flagellum longer than the peduncle, and composed of many elongate articles. In the male, which is illustrated, each antenna is much longer than the body, exclusive of the uropods. The hinder margin of the telson is triangulate, and there are two small, acute processes on each lateral margin. The uropods are very long, each with two slender branches. The colour is slaty-grey. Length: 12.5 mm., or ½in. (S.A.M.)

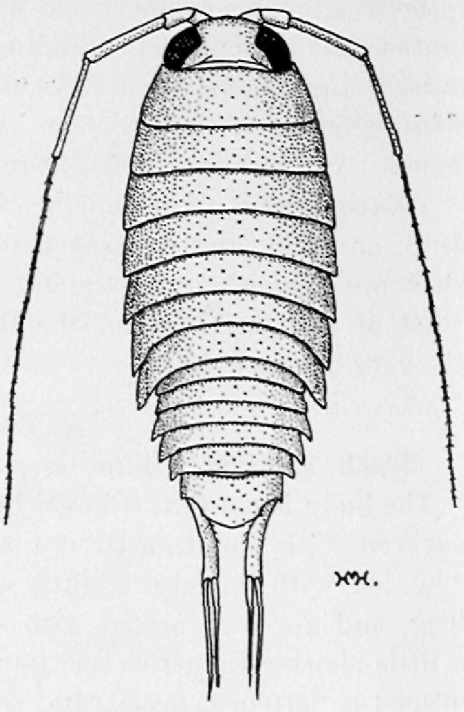


FIG. 341.—*Ligia australiensis* (x 5).

This easily recognised species lives on the sea-shore, on mud flats, or amongst rocks by the sea. On the south coast of Kangaroo Island, and on other rocky coasts, scores of individuals are disturbed when large stones are overturned. The creatures are difficult to capture, as they travel very quickly to the nearest cover when alarmed.

Chapter IX.—Order TANAIDACEA.

The small species included in this order were at one time classed as Amphipods and, more recently, as Isopods, but are now placed in a separate order of the division Peracarida. The body is as in the majority of the Isopoda, that is to say, it is flattened from above or is somewhat cylindrical. As indicated in the key to the orders (pp. 25-26), our representatives of this order have a small carapace formed by the uniting of two of the thoracic somites with the head, leaving free only six segments of the thorax. Isopods of the family Serolidae, and some of the family Idoteidae, also have only six free thoracic somites, but in many other respects are quite unlike the Tanaidacea. In the last-named the eyes, if developed, are generally elevated on short immovable stalks; the first pair of thoracic appendages are modified as maxillipeds, and the remaining seven pairs as legs with a small coxal joint. The first maxillae have a bent-down one or two jointed palp, and the second maxillae have a small palp (Apseudidae) or the whole appendage is rudimentary (Tanaidae). The first legs almost always have a complete pincer, or chela, and are larger than the others. The telson is fused with the last abdominal segment. All five pairs of pleopods may be present or some or all may be absent. The uropods are attached at the end of the abdomen and have thin thread-like branches.

Respiration.—The sides of the small carapace shut in a gill-chamber on each side, in which is accommodated a more or less developed epipod of the maxilliped. This approaches the respiratory apparatus described for the next order—the Cumacea—but in the Tanaidacea the exopod, or outer branch, of the maxilliped is not developed or at most is represented by an infinitesimal projection. The sides of the carapace are supplied with blood-vessels and the epipod of the maxilliped fans water through the branchial chamber; tiny exopods which are developed on the first two pairs of legs of some species assist in maintaining this current.

Reproduction and Development.—The sexes often differ considerably. The chelae of the first legs are commonly larger in the male than in the female, and are of different shape. Sometimes the pleopods, while well developed in the male, are reduced or absent in the female.

The eggs and young are carried in a pouch formed of one or five pairs of brood-plates; the juveniles commence independent life with the seventh pair of legs undeveloped.

The order includes two very different families, a representative of each of which is described below. One or two other unrecorded species occur in St. Vincent Gulf.

a. First antennae with two flagella or lashes . . . . . APSEUDIDAE.

aa. First antennae with only one lash . . . . . TANAIDAE.

Family APSEUDIDAE.

The carapace usually has a distinct rostral projection and the body is depressed, with the abdomen narrower than the thorax. The first antennae have two lashes and the second pair a long flagellum and often a small scale or exopod. The first legs are large and chelate, and the second have the last three joints flattened for burrowing; exopods are commonly developed on one or both of the first two pairs of legs.

APSEUDES (Leach).

Apseudes australis (Haswell). (southern).

The depressed body has the segments wider than long. The cephalothorax is produced in front to form an acute, triangular rostrum. The side-plates of the thorax and abdomen bear long, rather sparse hairs, many of which are plumose. The basal joint of the first antennae is large, three times as long as the second, and the third joint is very small; the main lash is about as long as the peduncle and the accessory flagellum is two-thirds as long.

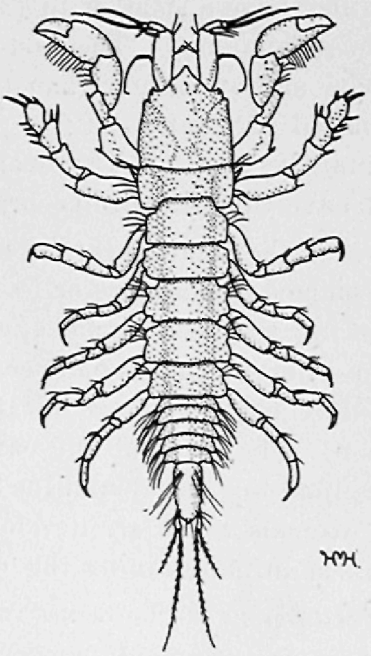


FIG. 342.—*Apseudes australis* (x 3).

The second antennae are about half as long as the first, and have an ovate exopod and a slender flagellum. The basis of the chelate limbs is wide, with a spine on the outer edge, the merus has one spine and the carpus two spines and some smaller serrations on the outer edge; the hand is somewhat swollen. The second, or digging legs, are flattened and armed with spines, and the five remaining pairs are ambulatory in character. The life colour is white. Length: 13 mm., or ½in. (S.A.M.)

This species is not uncommon on the white sand of our Gulfs and often appears in the dredge.

Family TANAIDAE.

The carapace is truncate in front and has only a tiny rostral projection, and the body is somewhat cylindrical, with the abdomen usually as wide as, or wider than, the thorax. The first antennae have only one lash, which is many-jointed in the male but often poorly represented or even absent in the female. The large first or chelate legs become enormously developed in the adult males of some species and all the mouth parts excepting the maxillipeds disappear. The first two pairs of legs lack exopods and the second pair are, like the following five pairs, modified for walking.

PARATANAIS (Dana).

Paratanais ignotus (Chilton). (strange).

The cephalothorax tapers towards the front, which has an inconsiderable rostral projection between the bases of the first antennae. The first segment of the last-named is stout, about three times as long as the second, which is a little longer than the third. The second antennae are about as long as the first but are more slender; the first three joints of the peduncle are subequal in length, each about half as long as the fourth, which is longer

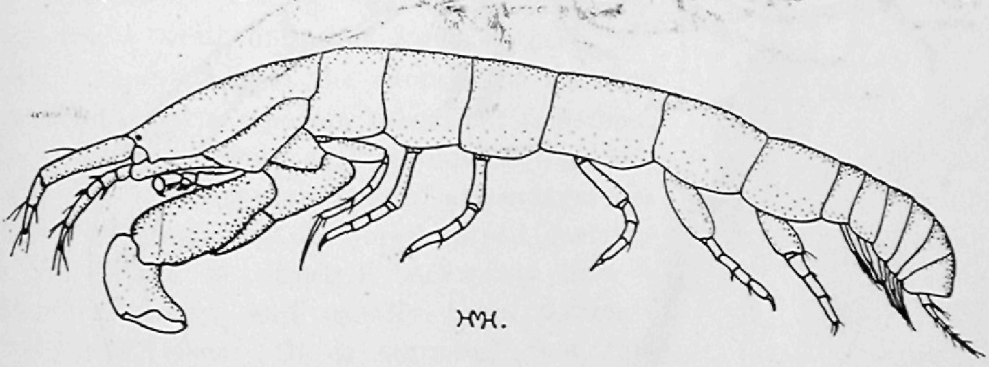


FIG. 343.—*Paratanais ignotus* (x 22).

than the fifth; the second joint has two spines at the distal end and the third has one distal spine. The first legs are moderately massive, with the hand curved; the second pair are long and slender, with a very narrow, tapering dactylus. The remaining legs are similar, but the basis becomes successively wider in the last three pairs. The end of the abdomen is truncate. The uropods are slender, with a short, single-jointed exopod and a five to seven-jointed inner branch. The life colour is white. Length: 5 mm., or $\frac{1}{5}$in. (S.A.M.)

This little crustacean is, like the foregoing, found on the sandy bottom of our Gulfs; specimens may be secured by carefully examining weed and other debris brought up in the dredge.

Chapter X.—Order CUMACEA.

The species of this order are marine. The name of the group is derived from *cuma*, a wave, but it should be mentioned that this appelation, which was applied for more than half a century to the order, has been discarded by some systematists owing to certain rulings governing scientific nomenclature, and the alternative name Sympoda is sometimes used. Three of the forms described below are ¾in. or more in length, and, comparatively speaking, are giants, for many of their relatives are very much smaller.

The Cumacea have a moderately well-developed carapace, fused with the first three or four thoracic somites, overhanging at the sides to protect the gills (which are described later), and towards the front produced into a plate on each side: these two plates often meet in front of the head to form a somewhat beak-like projection, or "pseudorostrum" (fig. 344). As a rule,

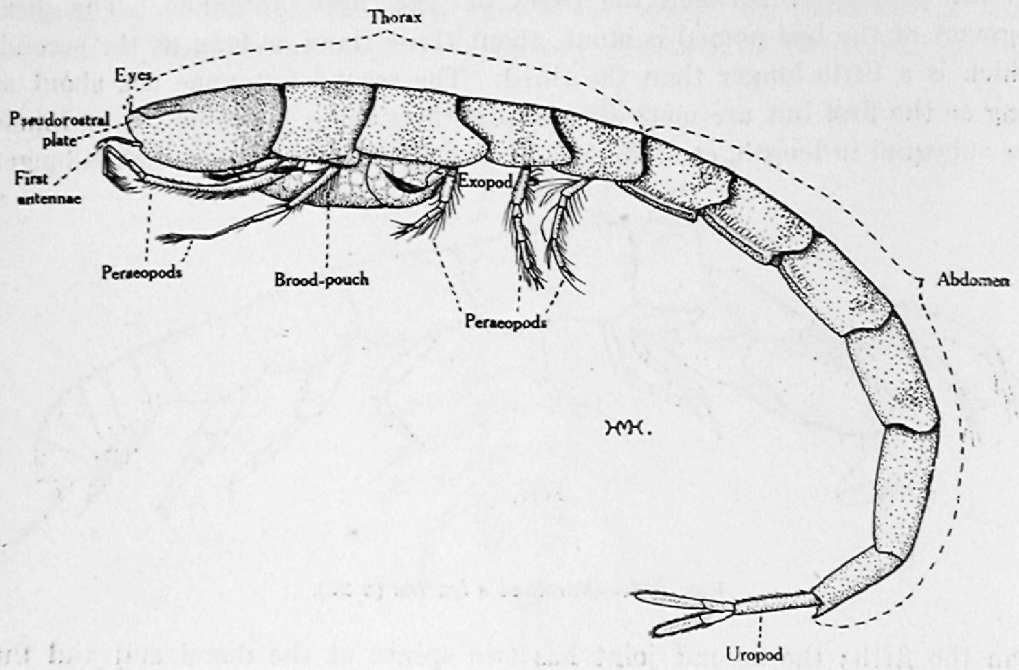


FIG. 344.—*Leptocuma pulleini* (x 6).

five distinct thoracic somites are visible behind the carapace, but further coalescence may lessen the apparent number. The cephalothorax is inflated, and the creatures have rather a headless appearance. The abdomen is long and slender, and terminates in style-like uropods, which almost always have an elongate peduncle; the telson is sometimes fused with the sixth abdominal segment, and is rarely large and conspicuous. The eyes, when present, are usually coalesced to form a single median organ. In some species each of the first antennae has two tiny lashes but in others only one flagellum is apparent. The exopod of the second antennae is not developed. The mandibles are much as in the other orders of the division Peracarida, but never have a palp. The maxillae are also similar, but the first pair have a bent-down palp, as in the preceding order (Tanaidacea). The first three

pairs of thoracic limbs are modified as maxillipeds. The first peraeopods, or legs, are slender and prehensile, and the second pair may have less than the normal number of joints. The third to fifth pairs are similar in structure.

According to all accounts, these animals are commonly found burrowing in mud or sand, and apparently the last three pairs of legs are used for digging. The males of some species, and more rarely the females also, are good swimmers.

Respiration.—The Cumacea are of unusual interest in that their respiratory apparatus is highly specialised and distinctive. It has already been mentioned that there is an anteriorly directed process on each side of the carapace; these lateral plates together form a channel, which extends forwards from the branchial cavities covered by the side-flaps of the carapace. Within this anterior channel lie a pair of tubes formed of the terminal parts of the exopods of the first maxillipeds. The outer branches of these appendages are expanded and membranaceous distally, and this thin portion rolls like a scroll, and thus forms a trasparent tube. In some cases the exopods of the first maxillipeds form separate tubes, but sometimes they unite to produce a single siphon (fig. 345, ex.). Each of the same pair of appendages has a very large and well-developed epipod, forming a gill, which is directed backwards into a branchial cavity, and usually bears flattened respiratory lobes. It is supposed that this unusual arrangement enables the animals to breathe without discomfort while buried in sand, as the tube or tubes protruding from the front would then carry the exhalant tube well forward; the ends of the tubes close while clean water is being drawn into the gill-chamber so that vitiated water cannot re-enter. It seems possible that, as in some Decapods (for instance, *Gomeza*), the respiratory current is reversed while the animals are buried.

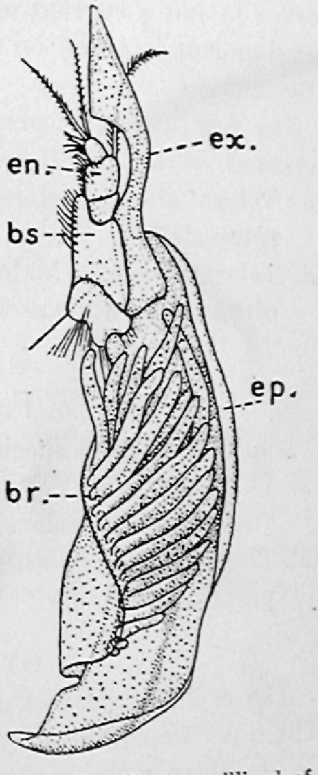


FIG. 345.—First maxilliped of *Diastylis*; en., endopod; ex., exopod; ep., epipod; br., gill lobes; bs., basis.

Reproduction and Development.—The sexes, when adult, differ most strikingly, and may be separated by some of the following characters. In general, the carapace of the male is smoother than in the female. The second antennae are very long; the lobes of the gill may be large and numerous, one to five pairs of swimmerets, or pleopods, are usually developed, and well developed exopods, modified for swimming, are generally present on the second to fourth pairs of legs, as well as on the first pair. The female commonly has spines and tubercles on the carapace; the second antennae are small and insignificant; the lobes of the gill are often smaller and less

numerous than in the male; pleopods are never present, and swimming branches are not well developed or more than three pairs of legs, the first and one or two of the succeeding pairs.

As a rule, the males are more active swimmers than the females, and are commonly taken swimming freely near the surface. Females have a more sedentary disposition, and are usually found on the bottom.

The young are protected in a brood-pouch formed of four pairs of oostegites or brood-plates, as in most of the Isopods, and (also as in the last-named) the young leave the marsupium with the last pair of legs undeveloped. The second maxillipeds of the egg-bearing female have a small basal scale, fringed with setae, which extends back into the marsupium and serves to fan a current of water over the eggs or young therein; a similar development is found on the preceding pair of appendages of some Isopods (fig. 253).

The few species at present known from our waters may conveniently be referred to two families:—

a. Telson absent. Male with not more than two pairs of pleopods . . . . . DIASTYLIDAE.

aa. Telson present. Male almost always with five pairs of pleopods, and never with less than three pairs . . . . . BODOTRIIDAE.

Family DIASTYLIDAE.

South Australian species of two genera have been described.

a. Third maxilliped of female without exopods. No pleopods developed in male . . . . . *Gynodiastylis.*

aa. Third maxilliped with exopod in both sexes. Male with two pairs of pleopods . . . . . *Anchicolurus.*

GYNODIASTYLIS (Calman).

The cephalothorax is markedly more massive than the slender abdomen. The inner branch of the uropods has one to three joints; there is no exopod on the third maxillipeds of the female, and the male lacks pleopods. The first and second legs bear exopods, and sometimes, in the male only, these branches are developed on the third and fourth legs also. The side-plates of the third and fourth leg-bearing thoracic somites are more or less expanded. In the adult female the third legs are attached to the posterior part of the backward expansion of the segment, leaving a wide gap between these limbs and the second legs. The telson is blunt and tubular. The representatives of the genus are small, our *G. truncatifrons* being the largest so far recorded.

a. Carapace with numerous longitudinal ridges on each side. Inner branch of uropods with first joint not longer than second . . . . . *turgidus.*

aa. Carapace with only one curved ridge on each side. Inner branch of uropods with first joint longer than second . . *truncatifrons*

Gynodiastylis turgidus (Hale). (swollen).

This form is known only from the adult female. The carapace is robust, more than one-third the total length, and about two-thirds as deep as long. There are numerous ridges on each side, the uppermost or dorso-lateral ridge being distinctly crenulate and more prominent than the others. The pseudorostral lobes are acute apically and project in front of the eye-lobe. The five free leg-bearing segments are together shorter than the carapace and the abdomen is nearly as long as the cephalothorax. The stout first legs do not extend much beyond the apices of the pseudorostral lobes, and have

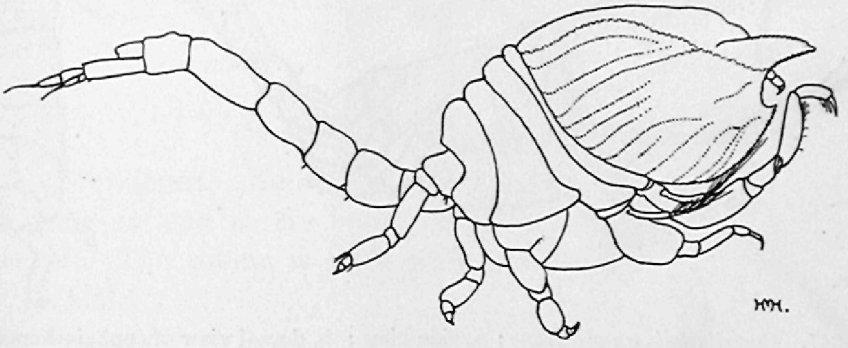


FIG. 346.—*Gynodiastylis turgidus* (x 36).

the basis as long as the three following joints together. The basis of the second legs is wide and about as long as the remaining joints together; the other legs are short and stout. The peduncle of the uropods is twice as long as the telson, and the outer branch is not much more than half as long as the inner, which is two-jointed, with the first joint slightly shorter than the second. Length: 2·7 mm., or $\frac{1}{10}$in. (S.A.M.)

Gynodiastylis truncatifrons (Hale). (with mutilated front).

The carapace of the adult female is one-third the total length, subcylindrical, and about twice as long as vertical height; each side has a low ridge, curving upwards and backwards from the antennal notch, and the back has a pair of shallow grooves on the hinder half. The pseudorostral lobes are acutely pointed, and meet in front of the wide and short eye-lobe for a distance equal to about one-third the length of the rest of the carapace; they are oblique and slightly concave in front and fringed with fine hairs. The five leg-bearing segments are together three-fourths as long as the carapace, and the abdomen is only about two-thirds the length of the cephalothorax. The stout first legs extend well beyond the apex of the pseudorostrum, and the basis is shorter than the remaining joints together. The basis of the second legs is longer than the remaining joints together, and the ischium-joint of these limbs is not distinctly developed. The third to fifth legs are stout, with the basis shorter than the remaining joints together. The uropods have a peduncle little longer than the telson and the

outer branch nearly as long as the two-jointed endopod, which has the first joint longer than the second. The colour of this and the preceding species is white. Length: 7.2 mm., or $\frac{2}{7}$in. (S.A.M.)

The specific name alludes to the shape of the pseudorostral lobes.

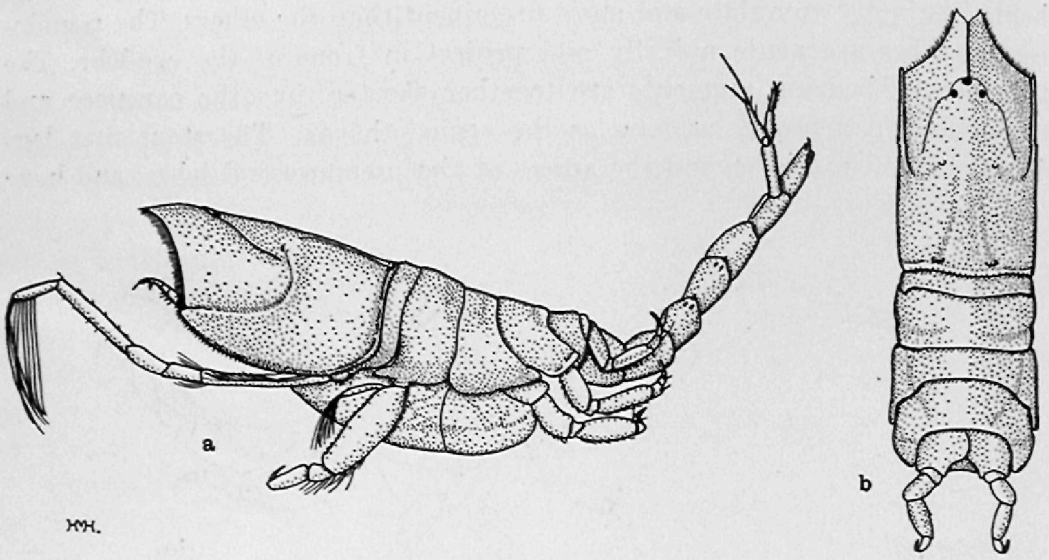


FIG. 347.—*Gynodiastylis truncatifrons*; a, side view; b, dorsal view of cephalothorax (x 12).

ANCHICOLURUS (Stebbing).

Differs from the preceding genus in that the male has two pairs of pleopods, the third maxilliped of the female bears an exopod, and the first four pairs of legs have exopods in both sexes, those of the third and fourth pairs being rudimentary in the female. The inner branch of the uropods is three-jointed.

Anchicolurus waitei (Hale). (personal name).

In the adult female the carapace is less than one-third the total length, with the surface pitted; on each side, at the antennal border, is a shallow depression, from the edge of which a low ridge curves backward and up to the back. The apically subacute pseudorostral lobes are not very long, and the eye-lobe is short and wider than long. The first and second leg-bearing segments are short, and the side-plates of the third are greatly produced behind and overlap the second somite in front. The abdomen is a little shorter than the cephalothorax. The first legs reach a little beyond the level of the apex of the pseudorostrum and the basis is about one-fifth as long again as the rest of the limb. The basis of the second leg is rather stout, a little shorter than the distal joints together. The third to fifth legs are robust, with the merus as long as, or longer than, the basis. The uropods have the peduncle less than twice as long as the telson; the inner margins of the peduncle and inner branch are armed with slender spines; the first joint of the inner branch (which is slightly longer than the outer

ramus) is nearly twice as long as the second, which is not quite twice as long as the third joint. The adult male differs from the female in having the form slightly more slender, the third legs not widely separated from the second, and the exopods of the legs stouter, those of the third and fourth

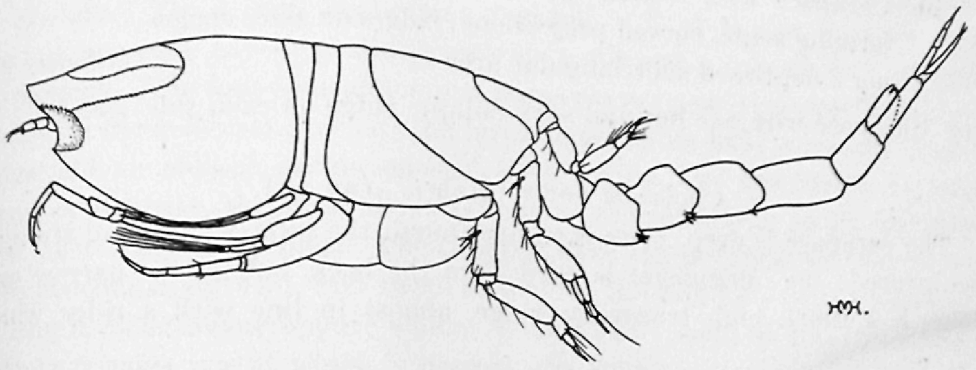


FIG. 348.—*Anchicolurus waitei* (x 30).

being well-developed. Both pairs of antennae are longer, the lash of the second being as long as the body, the spines on the uropods are more distinct, etc. The colour is pure white. Length: both sexes 3·7 mm., or $\frac{1}{7}$in. (S.A.M.)

Family BODOTRIIDAE.

In the species here dealt with the pseudorostral lobes are short, and do not project prominently forwards beyond the eye-lobe as in the three Diastylids discussed above; three genera are represented.

a. Legs with well developed exopods on first pair only. Endopod of uropods one-jointed .. .. *Cyclaspis.*

aa. Legs with well-developed exopods on at least first three pairs. Endopod of uropods two-jointed.

b. First four pairs of legs with exopods in both sexes, those of fourth pair rudimentary in female, or in both sexes. Carapace practically smooth, without dorsal crest *Leptocuma.*

bb. First three pairs of legs with exopods in both sexes. Carapace with a distinct dorsal crest .. .. *Sympodomma.*

CYCLASPIS (Sars).

The carapace is swollen and rarely slender, often approaching a globular shape, and is commonly sculptured. The first leg-bearing somite is usually indistinct, and in both sexes only the first of the pairs of legs bear exopods. The inner branch of the uropods is unjointed. This genus is well represented in tropical and southern seas, and there is no doubt that other species than the three mentioned below will be found in South Australia.

a. Carapace with two transverse ridges on back; with very strong ridges and projections, so that the dorsal outline (as seen from the side) is elevated and uneven.

b. Carapace with second dorsal carina elevated to form a pair of large curved spines behind middle of length; ridges on sides not enclosing a depressed subtriangular area . . . . . *bovis.*

bb. Carapace with second dorsal carina elevated but not forming acute, curved projections; ridges on sides enclosing a depressed subtriangular area . . . . . *tribulis.*

aa. Carapace with one low and very oblique ridge on each side *spilotes.*

Cyclaspis bovis (Hale). (an ox).

The carapace is deep, more than one-fourth the total length, and strongly sculptured; the integument is hard. On the back, behind the narrow eye-lobe, is a short, high transverse ridge, almost in line with a ridge which

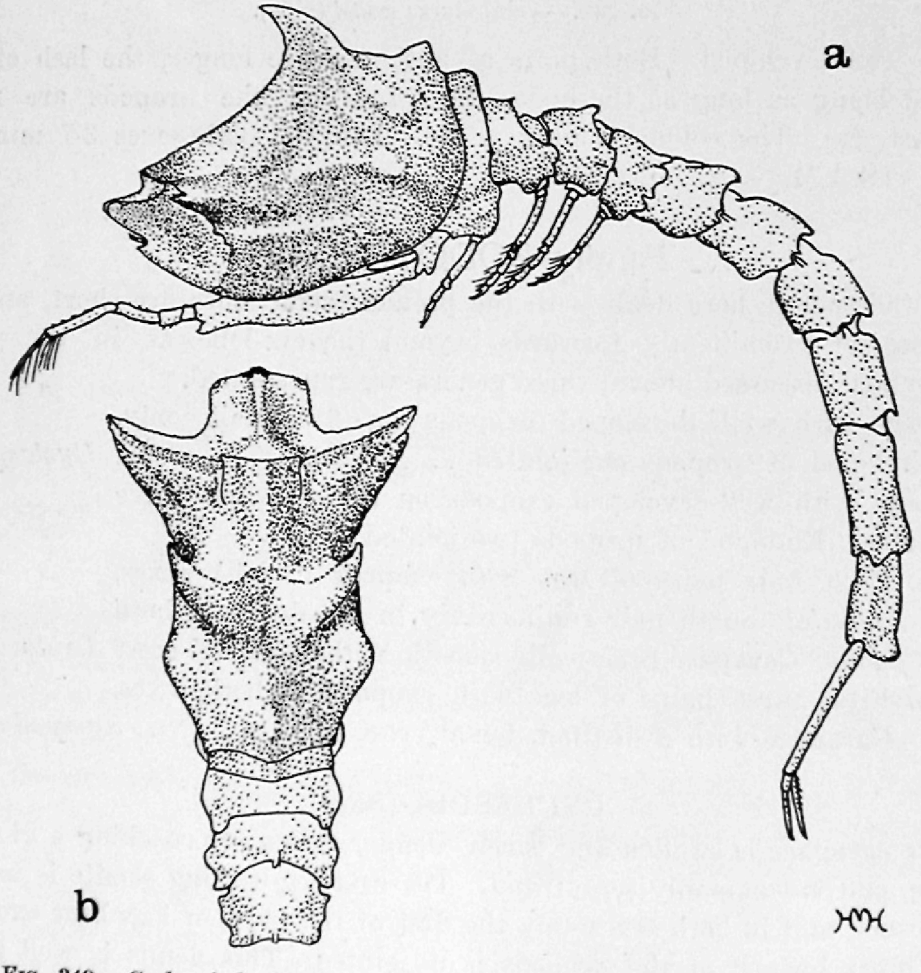


FIG. 349.—*Cyclaspis bovis*; a, side view; b, dorsal view of cephalothorax (x 8).

crosses each pseudorostral lobe and forms the dorsal edge of a deep, flattened projection on each side. A little behind the middle of length of the carapace is a pair of large flattened thornlike spines, which are connected by a median

ridge to the anterior carina. Behind these large teeth is a small median tooth or tubercle. On the sides are two low elevations and some faint ridges. The large dorsal spines are much more prominent than the anterior lateral projections when the animal is viewed from the side, but when seen from above the condition is reversed. Pseudorostral lobes just reaching to apex of eye-lobe. The second leg-bearing segment is fixed to the carapace and the last two each have a median posterior tooth and a pair of dorso-lateral projections. The first four abdominal segments are nearly square in section, each with dorso-lateral carinae; the last two segments have a median dorsal ridge and an oblique carina on each side. First legs one-fourth as long again as carapace, the basis about as long as the remaining joints together. The other legs are all short. The uropods have the peduncle as long as the fifth abdominal segment, and twice as long as the rami, which are subequal in length. The colour is pure white. Length: 19·5 mm., or ¾in. (S.A.M.)

Only females, one of which is figured, are known.

Cyclaspis tribulis (Hale). (a tribesman).

The carapace is about one-fourth the total length, is pitted and tuberculate, and strongly sculptured. At the base of the eye-lobe is a very short high ridge, and immediately behind this is the first large ridge, which

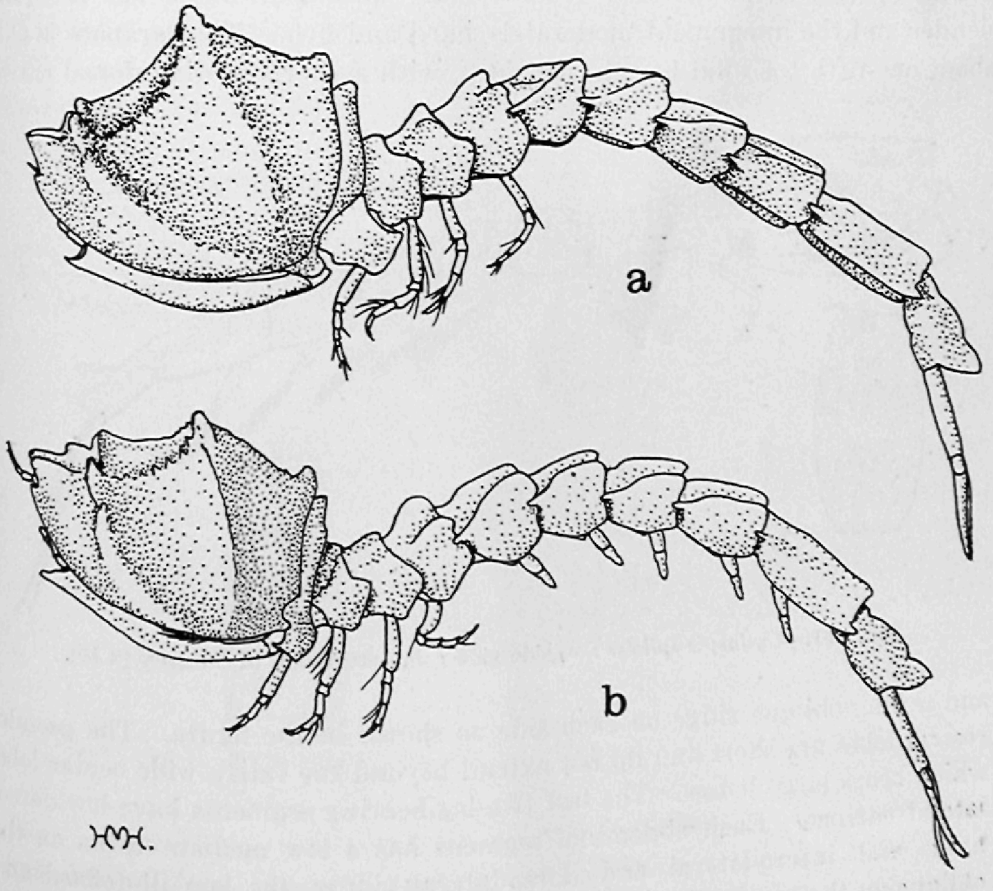


Fig. 350.—*Cyclaspis tribulis*; a, female; b, male (x 11½).

crosses the back transversely and runs obliquely down and back on the sides to meet the second large carina near the infero-posterior angle of the carapace. The first large ridge is deep and cut into five rounded lobes, one on the back and two on each side, and when viewed from the front resembles a rosette partly enfolding the animal. The second large carina is elevated dorso-laterally forming a pair of lobes, and the two ridges are connected on the back by a median carina, on each side of which is a feeble dorso-lateral crest. At the hinder end of the back is a conical elevation. The pseudorostral lobes nearly reach to the apex of the narrow eye-lobe. The last two leg-bearing segments each have a median dorsal ridge and feeble dorso-lateral elevations. Each abdominal segment has a median carina on the back, and infero-lateral and dorso-lateral carinae, the last-named almost obsolete on the last two segments. The uropods are nearly as long as the fifth and sixth abdominal segments together, and have the peduncle about as long as the subequal branches. The colour is pure white. As shown by the illustrations the sexes are much alike excepting for the usual differences; the sculpturing of the carapace is slightly less marked in the male. Length: 12 mm., or $\frac{1}{2}$in. (S.A.M.)

Cyclaspis spilotes (Hale). (stained or soiled).

This species is known only from a male specimen, which has the form slender and the integument moderately hard and firm. The carapace is only about one-fifth the total length, not deep, with a sharp median dorsal carina

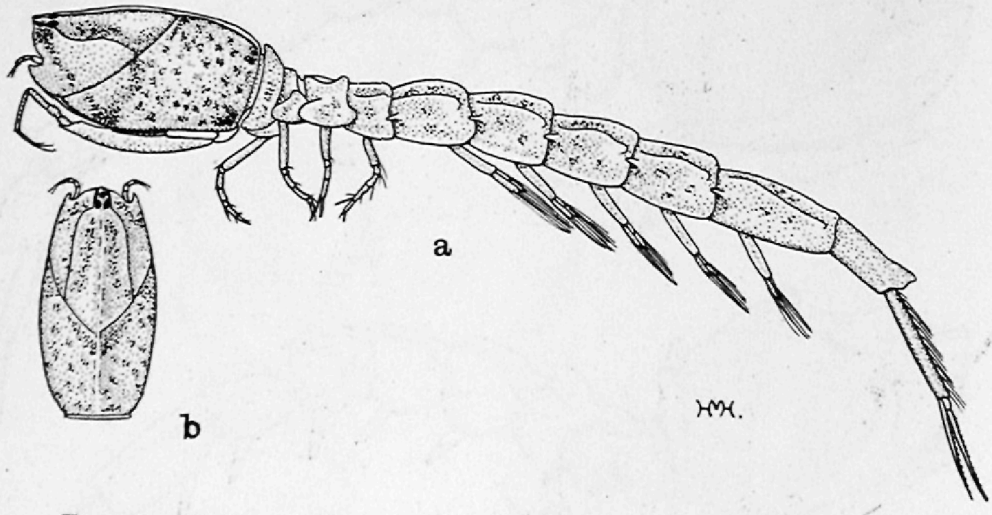


FIG. 351.—*Cyclaspis spilotes*; a, side view; b, dorsal view of carapace (x 10).

and a fine, oblique ridge on each side as shown in the figure. The pseudo-rostral lobes are short and do not extend beyond the fairly wide ocular lobe, which bears large lenses. The last two leg-bearing segments have low dorso-lateral carinae. Each abdominal segment has a low median carina on the back, and infero-lateral and dorso-lateral ridges, the last ill-defined and oblique on the last somite. The first legs are little longer than the carapace

and the basis is slightly longer than the remaining joints together. The other legs are small. The uropods are longer than the last two abdominal segments together and have the peduncle a little longer than the outer branch, which is slightly longer than the inner ramus; the inner edge of the peduncle is fringed with hairs, that of the inner branch finely serrate and armed with spines, and the inner margin of the exopod is furnished with about a dozen spines; both branches are lanceolate. The colour is pale brown, with splashings and mottlings of dark brown—hence the specific name. Length: 11 mm., or $^{7}/_{16}$in. (S.A.M.)

The type male, which is shown in the figure, was taken on a white sand bottom in St. Vincent Gulf.

LEPTOCUMA (Sars.).

The form is slender and elongate, and the carapace is not swollen, and is almost smooth. The first leg-bearing somite is exposed only on the back, the greater part being concealed by the second thoracic segment. There are exopods on the first four pairs of legs, those of the fourth pair very small in both sexes, or in the female only. The inner branch of the uropods is two-jointed.

Leptocuma pulleini (Hale). (personal name).

The sexes are much alike, but the male is a little more slender than the adult female (which is illustrated), and has five pairs of abdominal appendages. The species is very worm-like in appearance, the body being

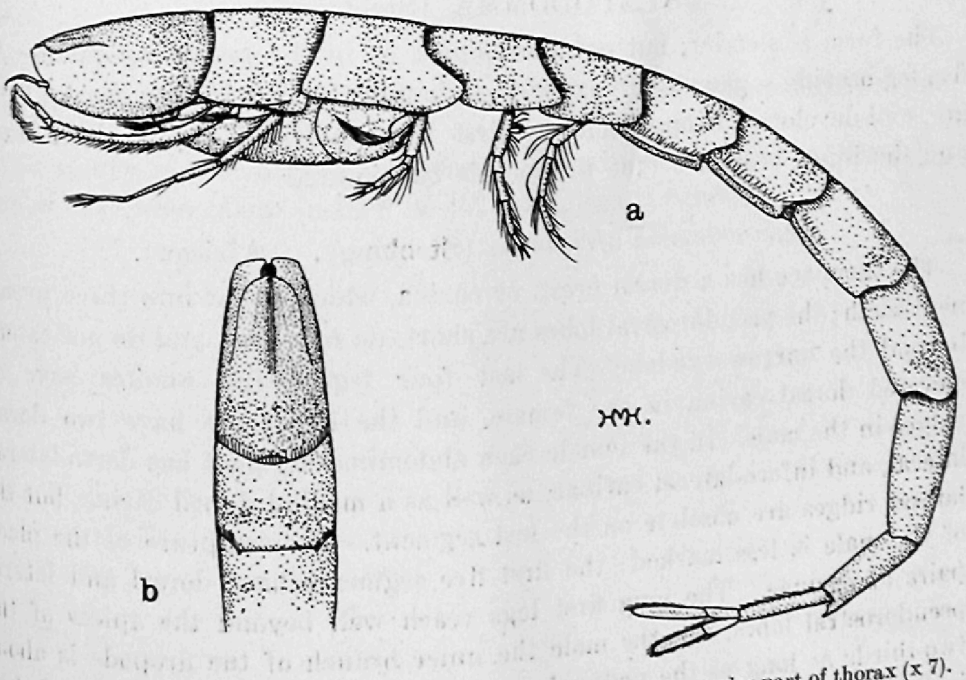


FIG. 352.—*Leptocuma pulleini*; a, side view; b, dorsal view of anterior part of thorax (x 7).

subcylindrical, very slender and tapering evenly and gradually from head to tail. The small carapace is only about one-seventh the total length, and is smooth, excepting for a very inconspicuous median ridge on the anterior part. The pseudorostral lobes are short and truncate, extending beyond the eye-lobe for a short distance, but not quite meeting in front. The eye-lobe is semicircular in shape and the eye is pigmented. The second to fifth leg-bearing somites are subequal in dorsal length, but at most only a tiny dorsal portion of the first is visible. The side-plates of the second segment overlap the first segment, and the base of the carapace, while those of the third are greatly expanded, overlapping the second somite in front and the fourth behind. The abdominal segments are long, the first two with inconspicuous infero-lateral ridges, the third with obsolete ridges. The margins of the last four leg-bearing segments and of the first four pleon segments are fringed with short adpressed bristles. The slender first legs extend beyond the apices of the pseudorostral plates, and have the basis nearly half as long again as the remaining joints. The second legs are long and slender, and the third to fifth pairs stouter and shorter and rather densely fringed with long hairs. The uropods are furnished with spines and hairs; the peduncle is nearly as long as the last abdominal segment, and nearly as long as the branches which are subequal in length; the first joint of the inner ramus is three-fourths as long as the second. The creature is cream in colour, with a faint brown bar on each body segment. Length: 24 mm., or $^{15}/_{16}$in. (S.A.M.)

SYMPODOMMA (Stebbing).

The form is slender, but not so elongate as in the preceding genus. All five leg-bearing segments are exposed, although the first is very short. There are well-developed exopods on the first three pairs of legs in both sexes, and the inner branch of the uropods is two-jointed.

Sympodomma africanum (Stebbing). (African).

The carapace has a dorsal crest, or carina, which is cut into three prominent teeth; the pseudorostral lobes are short, do not meet, and do not extend beyond the narrow eye-lobe. The last four leg-bearing somites have an elevated dorsal carina in the female, and the last three have two dorsal ridges in the male. In the female each abdominal segment has dorso-lateral, lateral, and infero-lateral carinae, as well as a median dorsal carina, but the lateral ridges are obsolete on the last segment. The sculpture of the pleon of the male is less marked; the first five segments have dorsal and lateral pairs of carinae. The long first legs reach well beyond the apices of the pseudorostral lobes. In the male the inner branch of the uropods is about two-thirds as long as the peduncle, and a little longer than the exopod, but in the female the peduncle is scarcely longer than the exopod, which is longer

than the endopod; the peduncle is carinate in both sexes, and the first joint of the endopod is about twice as long as the second. The colour of South Australian females is light biscuit brown, mottled, and spotted with dark brown. Length: 18 mm., or $\frac{3}{4}$in. (S.A.M.)

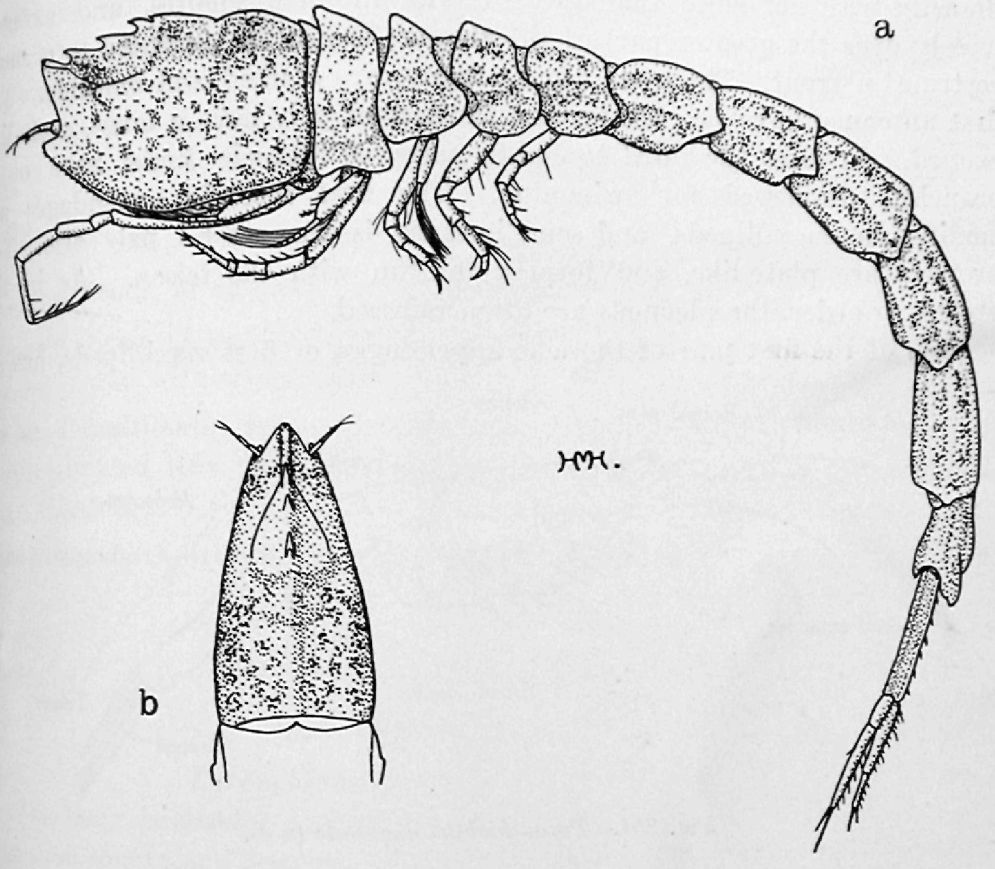


Fig. 353.—*Sympodomma africanum*; a, lateral view; b, dorsal view of carapace (x 12).

This species was originally described from a male taken off Africa. Two females have been taken in St Vincent Gulf, South Australia.

Chapter XI.—Order MYSIDACEA. The Opossum Shrimps.

These little creatures have a shrimp-like form and exhibit, in general, the characters of the more primitive Decapoda (fig. 354). The carapace is fused dorsally with not more than three of the thoracic somites, and extends loosely over the greater part of the thorax; it may be produced to a small rostrum in front. The eyes, when present, are stalked and movable. The first antennae have two lashes, and the second pair have a large, scale-like exopod. At least the third to eighth pairs of thoracic limbs have outer branches developed for swimming. The first thoracic appendages are modified as maxillipeds, and sometimes so is the second pair also. The uropods are plate-like, and form a tail-fan with the telson. As in the preceding order, the pleopods are often reduced.

Each of the first pair of thoracic appendages, or first maxillipeds, has an

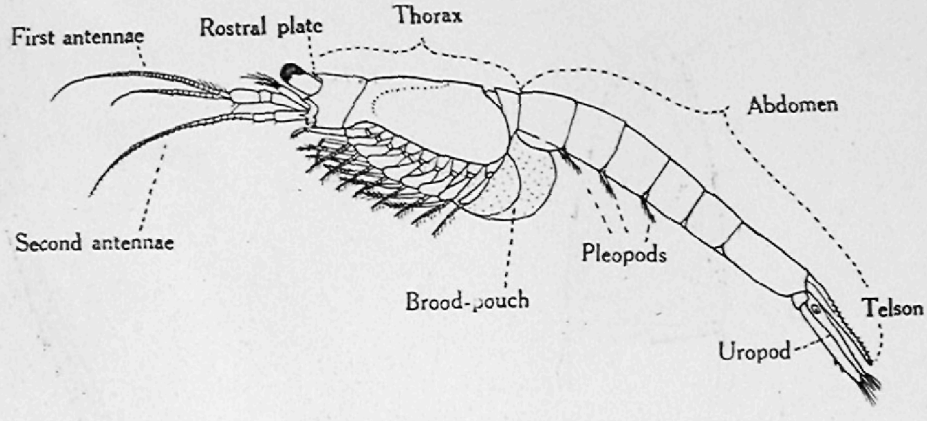


FIG. 354.—*Paranchialana angustata* (x 8).

epipod which projects backwards beneath the branchiostegite. Branched gills may be attached to the body near the articulation of the thoracic limbs.

There is an "auditory organ" in the inner branch of the uropods of most species (fig. 355, b); this consists of a comparatively large cavity, or statocyst, connected with a nerve, and containing a limy, discoidal body (statolith), which is attached to the tips of setae emanating from the bottom of the cell.

The Opossum-shrimps of South Australia have received little attention. As a matter of fact, the whole of the recorded material was collected by the writer during the last few years, and was dealt with by Dr. W. M. Tattersall, who has made a special study of this order.

Reproduction and Development.—The brood-pouch is formed of from two to seven pairs of oostegites or plates attached to the coxae of the legs. The young hatch at a stage corresponding to the Nauplius, and undergo the whole of the metamorphosis within the brood-pouch, relying on the protection of the mother until all the appendages are developed. The pleopods are sometimes well developed in both sexes, sometimes reduced in both; in certain families they are vestigial in the female and large in the male, and in the males of some species some of them are specially modified.

Family MYSIDAE.

The pleopods are usually vestigial in the female but are commonly well developed in the male. The Mysidae are sometimes found crowded together in shoals, but in our waters have not yet been noted in any great number. The recorded genera may be placed in their subfamilies with the aid of the following key:—

a. Pleopods large and natatory in the male.
  b. Penultimate joint (propodus) of legs either subdivided into at least three joints or divided into two joints by an *oblique* articulation.
    c. Scale, or exopod, of second antennae very small GASTROSACCINAE.
    cc. Scale of second antennae not small, lanceolate, and with setose edges . . . . . MYSINAE.
  bb. Penultimate joint of legs either undivided or divided into two joints by a transverse articulation . . . . . SIRIELLINAE.
aa. Pleopods rudimentary in male as well as in female . . HETEROMYSINAE.

Family GASTROSACCINAE.

PARANCHIALINA (Hansen).

Paranchialina angusta (Sars). (narrow).

The body is slender and the short carapace leaves uncovered the last thoracic somite and portion of the penultimate segment; the front margin is produced medianly to form an acute triangular rostrum, on each side of which is a similar triangular projection; the antero-lateral angles are rather prominent and acute. The scale of the second antennae is small and only half the length of the peduncle of the first antennae. The terminal part of each leg is very slender and the propodus of each is subdivided into seven joints. The telson is narrow, about three and one-half times as long as its basal width; the apex is cleft by a deep, narrow incision, and the two terminal lobes thus produced are each tipped with a spine which is longer than the spines fringing the lateral margins and the edges of the cleft. The branches of the uropods are subequal in length and are fringed with feathery hairs; the inner edge of the inner branch is armed with numerous unequal spines arranged in irregular series; the outer branch has only two spines, situate at about the middle of the length of the outer margin. The first three pairs of pleopods of the female are styliform, the last two pairs broad and short. The first and last pleopods of the male are uniramous. Length: 10 mm., or $\frac{2}{5}$in. (S.A.M.)

This species and *Australomysis incisa* were originally found in Port Phillip, but also occur in South Australian seas.

Subfamily MYSINAE.

Three genera are represented:

a. Telson entire, not cleft apically.

b. Telson long. Outer branch of fourth pleopod of male with more than one apical bristle . . . . . *Leptomysis.*

bb. Telson short. Outer branch of fourth pleopod of male with only one apical bristle . . . . . *Anisomysis.*

aa. Telson cleft, the cleft armed with teeth . . . . . *Australomysis.*

LEPTOMYSIS (Sars).

Leptomysis australiensis (Tattersall). (Australian).

The short carapace leaves the last thoracic segment completely uncovered and is produced in front to a large subtriangular rostrum with the apex narrowly rounded. The scale of the second antennae is narrow and very long, eight times as long as broad, and extends for half its length beyond the peduncle of the first antennae. The legs are robust, with the propodus subdivided into three or four joints. The telson is tongue-shaped, twice as long as its width at base, with the apex rounded and not cleft; the margins are armed with many closely-set spines not arranged in series, and there is a pair of slightly longer spines at the extreme apex. The inner branch of the uropod is one-fourth as long again as the telson, has a blunt, spine-like dorsal projection on the statocyst, and a row of spines (four of them on the statocyst) ventrally; the outer branch is one-third as long again as the inner. The outer branch of the fourth pleopod of the male is longer than the inner, has two long, stout apical setae on the last joint, and a single strong bristle on each of the three preceding joints. Length: 12 mm., or ½in. (S.A.M.)

ANISOMYSIS (Hansen).

Anisomysis australis (Zimmer). (southern).

The front margin of the carapace is not markedly produced and is very obtusely angular. The scale of the second antennae is eight times as long as broad; in the female it extends slightly beyond the apex of the peduncle of the first antennae, and in the male reaches for the length of its very short second joint beyond the end of this peduncle. The short tongue-shaped telson reaches only a little beyond the statocyst of the uropod, is three-fourths as wide as long, and bears ten to thirteen short spines on the posterior half of each lateral margin. The outer branch of the uropod is longer than the inner, which is more than twice as long as the telson. The outer branch of the fourth pleopod of the male is very elongate, with an apical bristle on each of the last two joints, and the inner branch is rudimentary. Length: 6 mm., or ¼in. (S.A.M.)

AUSTRALOMYSIS (Tattersall).

Two species have been taken:

a. Rostral plate short and rounded apically; antero-lateral angles of carapace rounded .. .. *incisa.*

aa. Rostral plate large and acute apically; antero-lateral angles of carapace acute .. .. *acuta.*

Australomysis incisa (Sars). (incised, or divided).

The body is moderately slender. The small carapace leaves the last two segments of the thorax uncovered and is only slightly produced to a rounded rostral plate in front; the antero-lateral corners are likewise rounded. The eyes are short and flattened. The scale of the second antennae is rather narrow, four times as long as broad, and is distinctly longer than the peduncle of the first antennae. The propodus of each rather feeble leg is subdivided into three joints by two transverse articulations. The telson

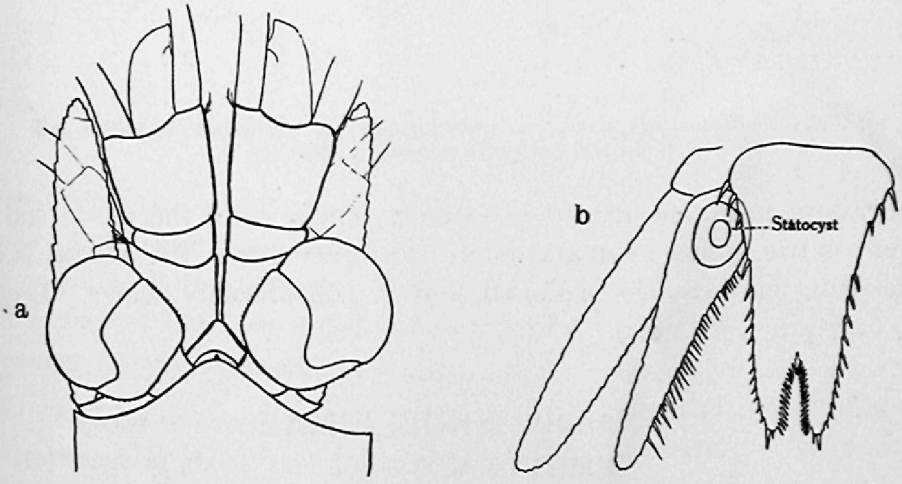


FIG. 355.—*Australomysis incisa*; a, anterior portion of body; b, telson and uropod (after Tattersall, x 38).

is subtriangular in shape, more than half as long again as its basal width, and is deeply cleft apically, the incision being one-fourth of the total length; the lateral margins are armed with spines, three near the base being separated from the others by a slightly longer interspace; the inner margin of each apical lobe is fringed with closely set spines and the apex of each lobe bears a spine slightly larger than those of the lateral edges. The branches of the uropods are narrow, the outer a little longer than the inner, which reaches a little beyond the apex of the telson; the inner edge of the endopod is armed with spines arranged in series of two or three. Length: 8 mm., or $\frac{3}{10}$in. (S.A.M.)

Australomysis acuta (Tattersall). (acute).

This may be distinguished from the preceding species by the following characters:—The front margin of the carapace is produced to form a large, acutely pointed rostral plate, below which is a prominent pseudorostral

process; the antero-lateral angles of the carapace are acute. The eyes are more elongate and not flattened. The propodus of each leg is divided into two parts by an oblique articulation. The telson is nearly twice as long as its basal width and has an apical cleft occupying one-fifth of the length; the spines of each lateral margin are arranged in one continuous series.

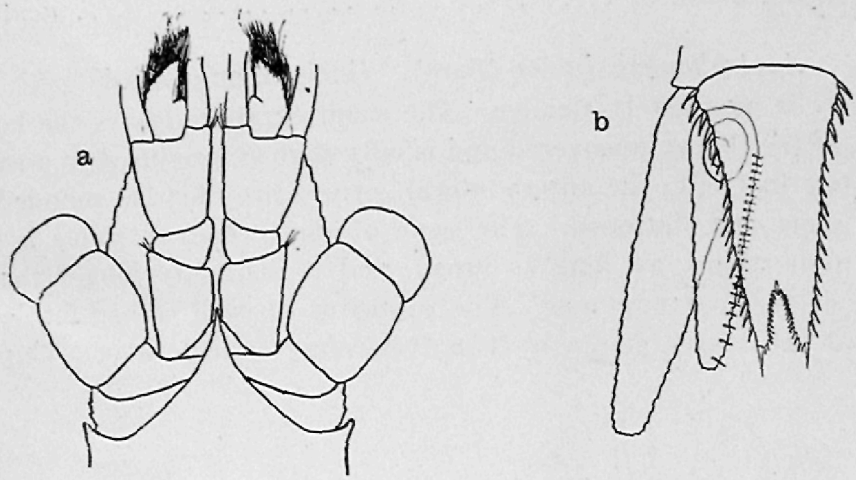


FIG. 356.—*Australomysis acuta*; a, anterior portion of body; b, telson and uropod (after Tattersall, x 39).

The inner branch of the uropod is scarcely longer than the telson and has a row of ventral spines submarginal to the inner edge; the exopod is one-third as long again as the endopod and is considerably wider. Length: 8 mm., or $\frac{3}{10}$ in. (S.A.M.)

Subfamily SIRIELLINAE.

SIRIELLA (Dana).

A genus including many species; the three described below were dredged off the Semaphore. The differences mentioned in the key are shown in the illustrations.

a. Carapace produced into prominent pointed shoulders over the eyes . . . . . *halei.*

aa. Carapace not produced into shoulders over the eyes.

b. Rostral plate scarcely produced but broadly rounded. Telson broad, with three pairs of spines on the apex. Penultimate joint of legs not divided . . . . . *vincenti.*

bb. Rostral plate produced, triangular with acute apex. Telson narrow, with two pairs of spines on the apex. Penultimate joint of legs divided into two segments . . . *australis.*

Siriella halei (Tattersall). (personal name).

The short carapace covers all but the last thoracic somite and the middle of its front margin is scarcely at all prominent, but is broadly rounded; as indicated in the key, near the rounded antero-lateral corners the carapace

is produced into acute shoulders. Below the rounded rostral projection is an acute spine, or pseudorostral process. The scale of the second antennae does not reach quite to the end of the peduncle of the first antennae. The thoracic limbs are robust; the propodus in the third to eighth pairs is divided into two segments. The telson is twice as long as its basal width and has eighteen lateral spines on each side, three near the base being

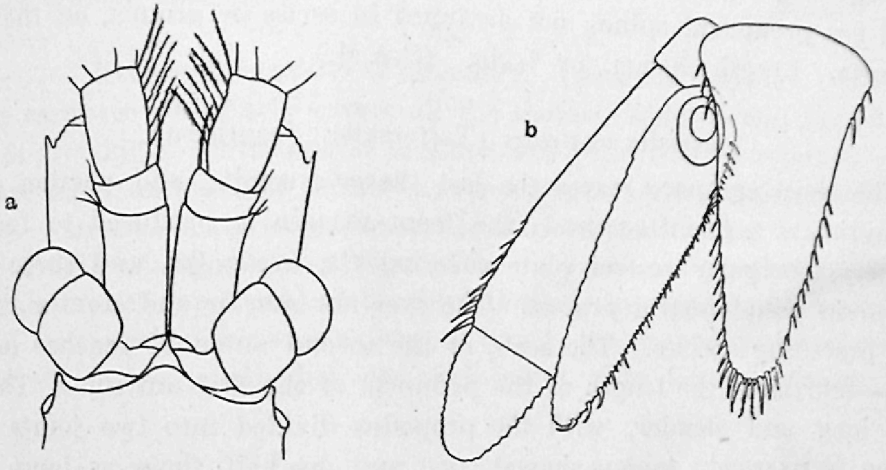


FIG. 357.—*Siriella halei*; a, anterior portion of body; b, telson and uropod (after Tattersall a, x 26; b, x 31).

separated from the others; at the apex are two long spines, between which is a pair of plumose setae and three very short spines. The outer branch of the uropods has the first joint four times as long as the second; the inner branch is shorter than the outer, longer than the telson, and has the spines on the inner margin arranged in series. Length: 12 mm., or ½in. (S.A.M.)

Siriella vincenti (Tattersall). (after St. Vincent Gulf).

The carapace is short and leaves the last thoracic segment exposed; the middle of its front margin is slightly produced to form a rounded rostrum, from beneath which projects a prominent pseudorostral spine. The scale of the second antennae almost reaches to the end of the peduncle of the first

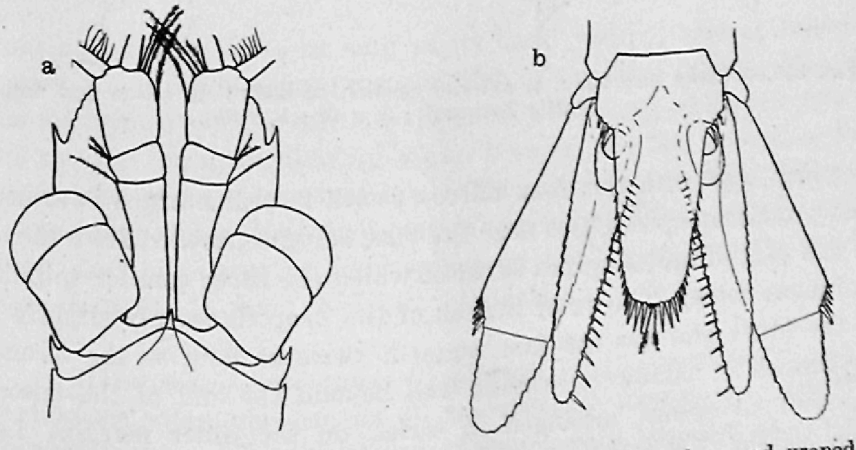


FIG. 358.—*Siriella vincenti*; a, anterior portion of body; b, telson and uropod (after Tattersall, x 35).

antennae. The legs are rather slender, with no apparent subdivision of the propodus. The telson is twice as long as its basal width, and has the apex broadly rounded; the margins are armed much as in the preceding species. The outer branch of the uropods is longer than the inner, and has its first segment two and one-half times as long as the second; the inner branch extends well beyond the apex of the telson, is much narrower than the outer, and has prominent spines, not arranged in series or groups, on the inner margin. Length: 8 mm., or $\frac{3}{10}$in. (S.A.M.)

Siriella australis (Tattersall). (southern).

The short carapace leaves the last thoracic somite, and portion of the penultimate segment exposed; the front margin is produced to form an acutely triangular rostral plate covering the eye-stalks, and there is no apparent pseudorostral process. The eyes are shorter and stouter than in the preceding species. The scale of the second antennae reaches only to three-fourths of the length of the peduncle of the first antennae. The legs are long and slender, with the propodus divided into two joints. The telson is narrowly tongue-shaped, two and one-half times as long as its

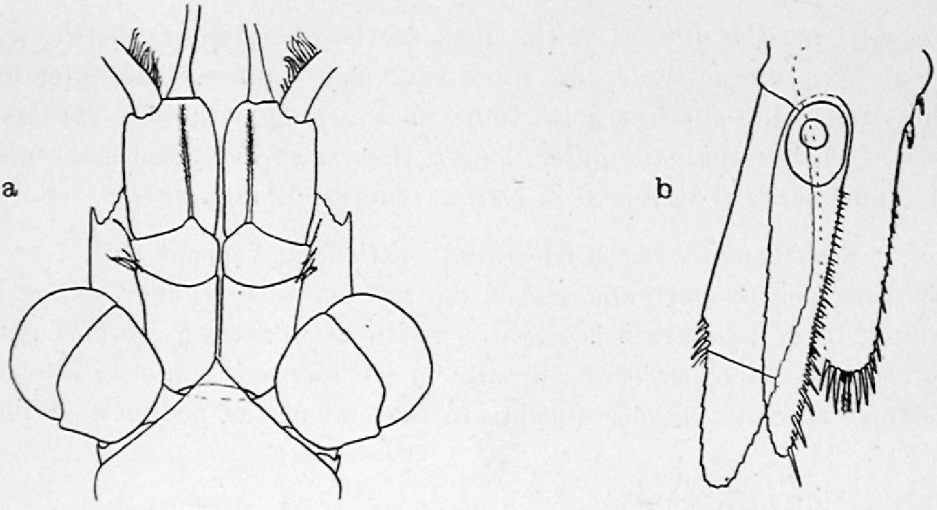


FIG. 359.—*Siriella australis*; a, anterior portion of body; b, telson and uropod (after Tattersall; a, x 22; b, x 39).

basal width, and with the apex narrow; each lateral margin is armed with sixteen prominent spines, two near the base being separated from the others; there is a pair of apical spines between which are three smaller spinules and two plumose setae. The outer branch of the uropods is only slightly longer than the inner and has the first segment twice as long as the second; the inner branch is narrower, extends well beyond the end of the telson, and has prominent spines, arranged in series, on the inner margin. Length: 10 mm., or $\frac{2}{5}$in. (S.A.M.)

Family HETEROMYSINAE.

HETEROMYSIS (S. I. Smith).

Our two species may be separated thus:—

a. Eye with a short, stout spine on inner edge overhanging the cornea . . . . . *waitei.*

aa. Eye without such spine . . . . . *tasmanica.*

Heteromysis waitei (Tattersall). (personal name).

The carapace completely covers all the thoracic somites, and the rostral plate is prominent, subtriangular in shape, and with the apex rounded. The eyes are small, and each of them has an acute spine on the upper (or inner) border. The scale of the second antennae is broad, and reaches to the middle of the length of the terminal joint of the peduncle of the first antennae. The main branch (endopod) of the third thoracic appendages is robust, with a stout merus, which is twice as long as broad; the propodus of each of the rest of the legs is subdivided into nine joints. The telson is rather wide

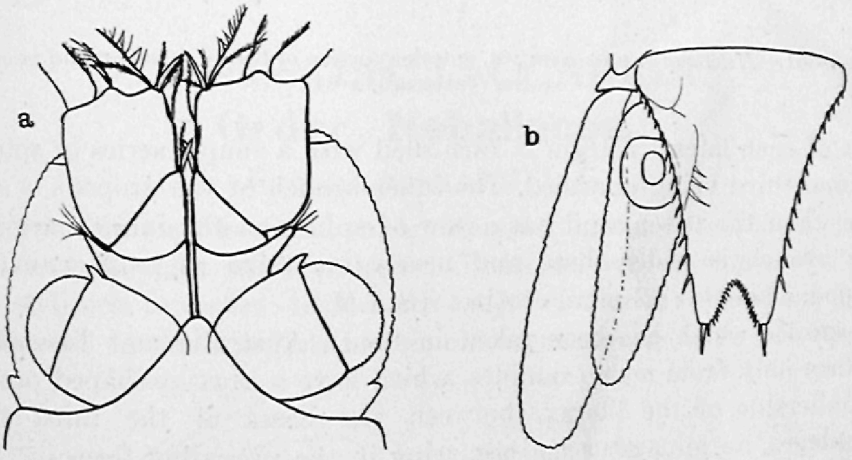


FIG. 360.—*Heteromysis waitei;* a, anterior portion of body; b, telson and uropod (after Tattersall, x 32).

(only one and a half times as long as its basal width), and is deeply cleft at the apex, the incision occupying one-fifth of the total length. The lateral margins are armed with a continuous series of spines, which extends from the base to near the apex, leaving a gap between the last lateral spine and the apical spine of each terminal lobe. The outer branch of the uropods is much longer and wider than the inner, which is one-fourth as long again as the telson, and has three or four spines on the inner margin near the statocyst. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

Heteromysis tasmanica (Tattersall). (Tasmanian).

The carapace completely covers all the thoracic somites, and the rostral plate is prominent and subtriangular in shape, with the apex rather acute. The eyes are small, and have no spine on the inner margin. The scale of

the second antennae is rather broad, and is almost as long as the peduncle of the second antennae. The main branch (endopod) of the third thoracic limbs is robust, with the merus two and one-half times as long as broad; the propodus of each of the remaining legs is subdivided into seven joints. The wide telson is about one and one-third times as long as its basal width, and the deep apical cleft occupies one-fifth of its length. The distal two-

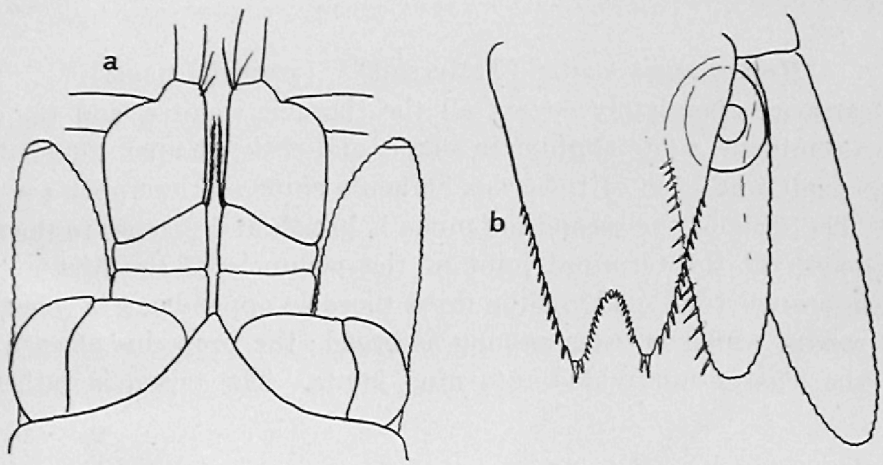


FIG. 361.—*Heteromysis tasmanica ;* a, anterior portion of body ; b, telson and uropod (after Tattersall, x 64).

thirds of each lateral margin is furnished with a simple series of spines, the proximal third being unarmed. The inner branch of the uropods is scarcely longer than the telson, and has a row of spines on the inner margin. The outer branch is wider than, and nearly one-third as long again as, the endopod. Length: 12 mm., or ½in. (S.A.M.)

A species which has been taken in South Australia and Tasmania. It is known only from male examples, which have a sausage-shaped process on the underside of the thorax, between the bases of the third thoracic appendages, an apparatus not occurring in the preceding form.

Chapter XII.—Series LEPTOSTRACA. The Leaf-legged Sea-fleas.

As previously mentioned (p. 12), the series Eumalocostraca and Leptostraca together form the important subclass of the Crustacea, known as Malacostraca; the species dealt with in Chapters II. to XI. belong to the Eumalacostraca. The Series Leptostraca includes numerous fossil species (some of which are a foot or more in length), and a few small, primitive living forms, which are referred to a single family.

The members of this series are very easily distinguished from those of the Eumalacostraca, for they have the abdomen divided into eight segments —seven somites and a telson. The seventh abdominal segment does not bear appendages and the telson terminates in a pair of movable rods, forming a fork with the telson. The thoracic somites are very short, and are not fused together; the whole thorax and part of the abdomen are loosely enclosed in a thin bivalve shell, or carapace. A rostral plate is hinged to the front of the carapace.

Division **PHYLLOCARIDA.**

Order Nebaliacea.

Family NEBALIIDAE.

The following may be added to the characters given above. The eyes are stalked, and the eight pairs of thoracic limbs are well developed, with leaf-like or styliform branches; these limbs are all similar in each of our genera. The pleopods of the first four abdominal segments are large two-branched

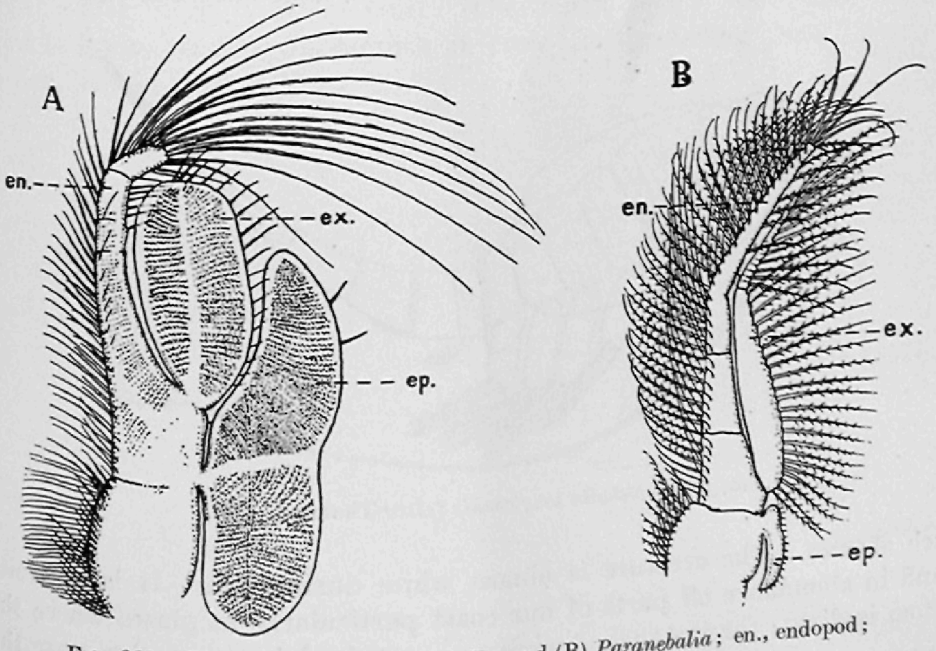


Fig. 362.—Thoracic limb of (A) *Nebalia*, and (B) *Paranebalia*; en., endopod; ex., exopod; ep., epipod (after Claus and Sars).

appendages; the inner branch of each bears a small basal lobe, furnished with hooked spines, which serve to link these swimming organs together in pairs. The appendages of the fifth and sixth abdominal segments are small, and each has only one ramus. These simple features and a reference to the illustrations, will enable the reader to recognise a member of the family.

Reproduction.—The flagellum of the second antennae is much longer in the male than in the female, and in adult males is sometimes nearly as long as the body. The male openings are situated on small elevations on the coxae of the last thoracic limbs; the oviducal apertures are inconspicuous. The eggs are packed in between the thoracic limbs, and are thus further protected by the bivalve carapace. The young hatch in this brood-pouch, and there remain until they have acquired all the general characters of their parents.

Two genera are represented in our waters:

a. Thoracic limbs not or scarcely projecting beyond edge of carapace; each with a narrow endopod, a wide, flattened exopod, and a large expanded epipod . . . . . *Nebalia.*

aa. Thoracic limbs projecting well beyond edge of carapace; each with endo- and exopod long and slender, and a tiny epipod . . . . . *Paranebalia.*

The differences in the character of the thoracic limbs are shown in fig. 362.

NEBALIA (Leach).

Leaf-legged Sea-flea. *Nebalia longicornis* (Thomson). (long-horned).

The original figure of this species is here reproduced. In a series of ovigerous females from St. Vincent Gulf the second antennal flagellum is

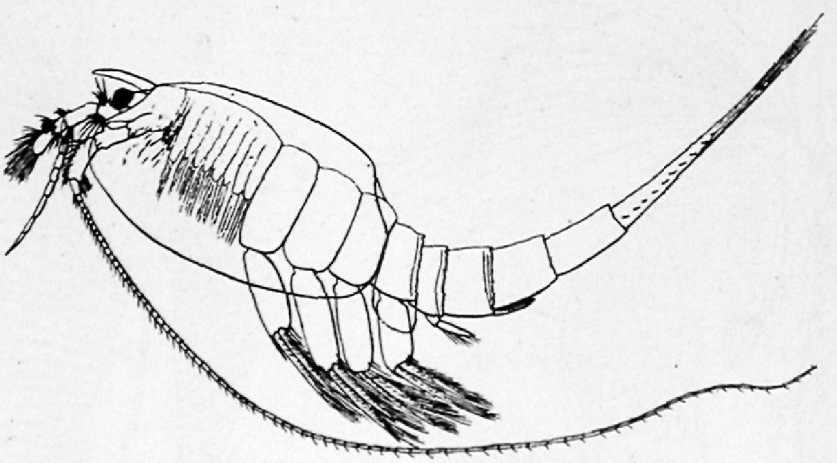


FIG. 363.—*Nebalia longicornis* (after Thomson, x 8).

much shorter. The creature is almost white during life. It is at times found in abundance off parts of our coast particularly in places where the bottom is dirty; for instance, during a recent dredging excursion near the

Outer Harbour, a number of hauls were made over sand which was odorous owing to the presence of decaying seaweed, and here the little crustacean occurred in great numbers. Length: 11 mm., or $\frac{7}{16}$in. (S.A.M.)

PARANEBALIA (Claus).

Slender-legged Sea-flea. *Paranebalia longipes* (Sars). (long-legged).

A specimen which is referable to this, or a closely allied species, was taken in very shallow water at Marino Rocks, and others have been dredged in

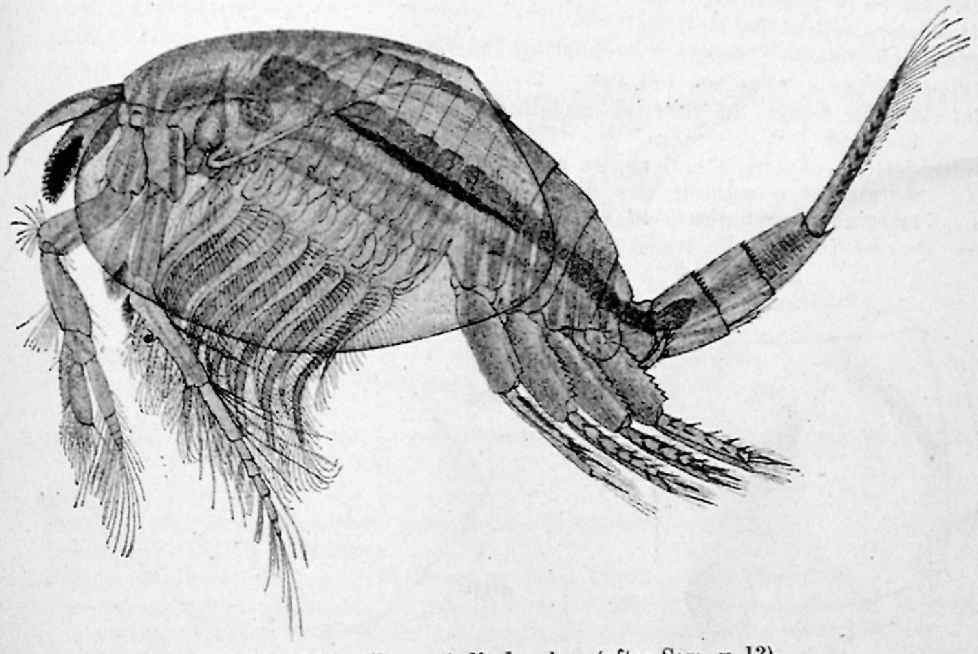


FIG. 364.—*Paranebalia longipes* (after Sars, x 13).

deeper water in St. Vincent Gulf. The much longer and more slender thoracic limbs readily distinguish it from the preceding form. Length: 9.5 mm., or $\frac{3}{8}$in. (S.A.M.)

GLOSSARY.

Abdomen.—The usually distinctly jointed "tail," or hinder part of the body. The pleon.

Acicle.—A scale or lobe from the base of the second antennae of long-tailed Decapoda (fig. 26).

Acuminate.—Ending in a prolonged point.

Aestivate.—To pass drought periods in a state of torpor.

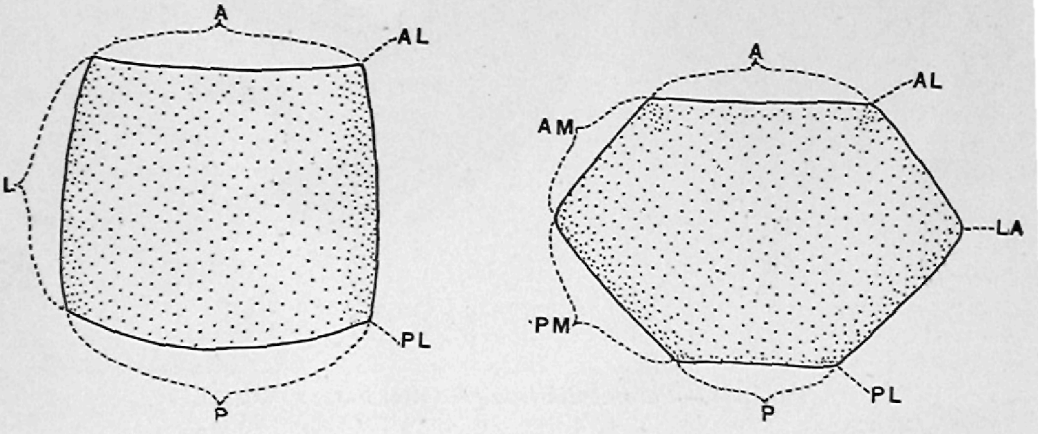
Ambulatory.—Used for walking.

Antennae.—Jointed "feelers" situated on the head.

Ante-penultimate.—The last but two.

Anterior.—In front; the anterior margin of a segment is the margin nearest the head.

Antero-lateral.—Antero-lateral angles are at the junction of the front and side margins of a segment (see diagram). Antero-lateral margins are sloping margins between the front margin and the side margins or angles.



These simple diagrams may be taken to represent outlines of the upper (dorsal) or lower (ventral) faces of segments, bodies, or parts, and indicate the designation of relative portions of the margin. In the case of a lower surface the angles and margins of the outline are often described as "inferior antero-lateral angles," "inferior anterior margin," etc., in contradistinction to the antero-lateral angles and anterior margin of the upper face.

A. Anterior (or front) margin; L. lateral (or side) margin; P. posterior (or hinder) margin; AL. antero-lateral angle; PL. postero-lateral angle; LA. lateral angle; AM. antero-lateral margin; PM. postero-lateral margin.

Appendix masculina.—A male appendage, or style, on the pleopods of certain Crustacea (fig. 233, e).

Arm.—The merus of a cheliped.

Arthrobranch.—A gill attached to membranes joining limbs to the body.

Basis.—The second joint (from the body) of a thoracic appendage (fig. 7).

Bidentate.—Having two teeth.

Bifid.—Cleft into two parts by a deep notch.

Bilobed.—Having two lobes; divided into two lobes.

Biramous.—Having two branches.

Branchiae.—Gills, or breathing organs, of aquatic species

Branchial regions.—Large lateral areas of the carapace overlying the gills (fig. 95).

Branchiostegites.—Side-flaps of the carapace or shell, which protect the gills (fig. 6).

Brood-pouch.—A marsupium; a pouch in which eggs and young are carried by the mother (figs. 104, 255, 344, 354, etc.).

Buccal frame or cavity.—The frame of the mouth or mouth cavity.

Carapace.—A shield or cover, composed of the head segments fused with one or more of the thoracic segments, and covering the head and all or part of the thorax; the cephalothorax (fig. 6).

Cardiac region.—An area of the carapace overlying the heart (fig. 95).

Carina.—A ridge, or elevated line.

Carinate.—Having a carina or longitudinal elevated ridge.

Carpus.—The fifth joint (from the body) of a thoracic appendage (fig. 7).

Caudal.—Pertaining to the tail, or abdomen.

Cephalon.—The head, which see.

Cepholothorax.—See carapace.

Cervical, or branchial, groove.—A groove or series of grooves separating the anterior regions of the carapace from the hinder regions (fig. 95).

Chela.—A pincer formed by the last two joints of a limb (propodus and dactylus).

Chelate.—Having a chela, which see.

Cheliped.—A pair of limbs terminating in a chela, or pincer (figs. 6, 95, etc.).

Chitin.—The substance of which the hard outer "shell" and other parts of Arthropods is largely composed.

Ciliate.—Fringed with hairs.

Coalesced.—Or fused; grown together or united to form one body.

Commensal.—An animal living with another but not at the expense of, or interfering with, its host.

Compressed.—Flattened as if by lateral pressure; deeper than wide.

Coxa.—The first or basal joint of a limb (fig. 7).

Coxal plate.—The expanded basal segment, or coxa, of a leg.

Crenulate.—Cut into tiny blunt teeth or small rounded notches.

Dactylus.—The seventh, or terminal joint, of a thoracic appendage; in a chela this is the movable finger (fig. 7).

Deflexed.—Bent down.

Dentate.—Toothed; furnished with tooth-like prominences.

Denticulate.—With tiny teeth.

Depressed.—Flattened as if by pressure from above; wider than deep.

Dimorphism.—The producing of two different forms of the same species; in some cases the male and female are strikingly different (sexual dimorphism).

Distal.—Furthest from the centre of the body (opposed to proximal).

Dorsal.—Pertaining to the back or upper surface; *dorsum*, the back.

Ecdysis.—The moulting, or casting, of the shell (fig. 11).

Endopod.—The inner branch of an appendage (fig. 5).

Endostome.—Or palate; the roof of the mouth cavity (fig. 96).

Epipod.—An appendage often attached to the coxa of a limb (fig. 7).

Epistome.—A small plate immediately in front of the mouth cavity (fig. 96).

Exopod.—The outer branch of an appendage (fig. 5).

Fingers.—The digits of a chela or pincer; the immovable finger, or thumb, is a process of the propodus; the movable finger is the dactylus (fig. 6).

Flagellum.—The usually flexible and many jointed "lash" of an antenna or feeler; as a rule narrower than, and distinct from, the stouter peduncle or base.

Fossettes.—Small cavities into which the first antennae of crabs fold (fig. 96).

Frontal region.—A small median area behind the front margin of the carapace (fig. 95).

Gastric region.—A large median area of the carapace; subdivided into epi-, proto-, meso-, and urogastric regions (fig. 95).

Gastroliths.—Tiny masses found in the stomachs of fresh water crayfishes (fig. 69).

Geniculate.—Bent like a knee.

Genital openings.—The ends (opening to the exterior) of the tubes from the testes or ovaries.

Gnathopods.—The first and second legs, when chelate, sub-chelate, or prehensile, are so called in certain groups (fig. 205).

Granules.—Very tiny elevations.

Head.—The anterior part of the body, bearing the eyes, antennae, and mouth parts; it usually consists of one somite composed of fused segments.
Hepatic region.—A small area between the gastric and branchial regions (fig. 95).
Hermaphrodite.—Having both male and female sexual organs.

Inferior.—Lower, such as the inferior, or lower, margin.
Intestinal region.—A small area behind the cardiac region (fig. 95).
Ischium.—The third joint (from the body) of a thoracic appendage (fig. 7).

Keeled.—Having a longitudinal keel or ridge, particularly a carina on the underside.

Lamella.—A thin plate.
Lanceolate.—Flat and tapering to a point; lance-shaped.
Larva.—Any one of the early stages, before the general form of the adult is reached.
Lateral.—Pertaining to the side.
Lobate.—Divided into parts with convex margins, which recede from one another.

Mandibles.—The biting jaws; the pair of appendages following the antennae; the first pair of mouth appendages (figs. 7, c; 204, b; 233, a, etc.).
Marsupium.—A brood-pouch, which see.
Maxillae.—Two pairs of usually leaf-like mouth appendages following the mandibles (figs. 7, d and e; 204, c and d; 233, b and c, etc.).
Maxillipeds.—One or more of the anterior pairs of thoracic appendages which are modified as mouth parts and lie close to the mouth (figs. 7, f and h; 204, e; 233, d; 253, etc.).
Membranous, or membranaceous.—Thin or parchment-like; resembling membrane, or thin tissue.
Merus.—The fourth joint (from the body) of a thoracic appendage (fig. 7).
Metamorphosis.—The transformation of a species, through larval stages, to the perfect or adult state (fig. 99).

Natatory.—Used for swimming.

Obtuse.—Having a rounded termination; blunt, not acute, or pointed.
Ocellus.—A small simple eye. An eye-like spot of colour enclosing a central spot.
Oostegites.—Scale-like plates which enclose a pouch (under the thorax) in which eggs and young are carried by the mother (figs. 255, 344, 354, etc.).
Operculum.—A lid or cover.
Orbiculate.—Globe-like in form, and depressed.
Orbit.—The cavity in which the stalked eyes of some crustaceans are ensconced.
Orbital region.—The narrow area bordering the upper margin of the orbit, or eye-cavity (fig. 95).
Ovaries.—The parts of the female in which eggs are formed.
Ovate.—Egg-shaped.
Oviducts.—The tubes from the ovaries of the female.
Oviparous.—Bringing forth eggs or bearing eggs.
Ovum.—An egg.

Palate.—The endostome, which see.
Palm.—The part of a chela exclusive of the fingers (fig. 6).
Palp.—Part or all of the endo- or exopod of some much modified appendages (see figs. 7, 40, etc.).
Parasite.—An animal which lives in, on, or at the expense of the substance of another.
Penes.—A pair of male appendages; a continuation, through the body wall, of the vasa deferentia.
Pentagonal.—Having five angles.
Penultimate.—The last but one.
Peraeon.—The thorax.
Peraeopods.—Legs.

Petasma.—A term applied to the sexually modified portion of the pleopods of males of some prawns (fig. 28).

Pleon.—The abdomen, which see.

Pleopods.—The appendages of the first five abdominal segments; in most Malacostraca they are all different in character from those of the sixth segment.

Pleura.—The lateral part of a segment.

Pleurobranch.—A gill attached to the walls of the thorax (fig. 9).

Podobranch.—A gill attached to the base of an appendage or leg (fig. 9).

Posterior.—Behind. The posterior margin of a segment is the margin nearest the tail end.

Postero-lateral.—Postero-lateral angles are at the junction between the side and hinder margins of a segment. Postero-lateral margins are the margins between the hinder and side margins.

Postorbital.—Behind the eye cavity.

Prehensile.—Adapted for grasping or holding (figs. 15, 205, etc.).

Preorbital.—In front of the eye cavity.

Propodus.—The sixth, or penultimate, joint of a thoracic limb (fig. 7).

Protandrous hermaphrodite.—Having at one stage the function of one sex, and later that of the other.

Proximal.—Nearest the centre of the body (opposed to distal).

Pterygostomian region.—An area on each side of the mouth cavity (fig. 96).

Pyriform.—Shaped like a pear.

Quadridentate.—With four teeth.

Quadrilateral.—With four angles.

Ramus.—A branch, such as the two rami, or branches, of a pleopod.

Raptorial.—Adapted for seizing prey, as a raptorial limb (fig. 15).

Receptaculum seminis.—An external or internal pouch or pocket of the female in which the male sperm is deposited prior to the fertilization of the eggs (figs. 17, 28).

Reniform.—Kidney-shaped.

Retractile.—Capable of being extended and withdrawn.

Rostrum, or *rostral projection.*—That part of the "shell" of the head which projects forward between the eyes; not always developed (fig. 6, etc.).

Scaphognathite.—A plate or fanlike part of the second maxilla of Decapods (fig. 7).

Segments.—The large joints or somites of the body. Sometimes applied to joints of limbs.

Serrate, serrated.—Having an edge or margin notched like a saw.

Sessile.—Without a stalk.

Seta.—A stiff bristle or hair.

Sinuate.—A margin with a rounded incision, or incisions.

Somite.—A segment.

Spermatozoa.—The sperm-cells or sexual cells of the male.

Statocyst or otocyst.—A small cavity in the integument of some Malacostraca; the organ of balance (fig. 355).

Statolith or otolith.—A tiny limy body, or grain or sand, in the statocyst.

Sternum.—The segmented underside of the thorax.

Striations.—Or striae; impressed lines like scratches.

Stridulatory organs.—Apparatus which produce a grating or squeaking noise by friction of two surfaces.

Styliform.—In the form of a style, namely, long, narrow, tapering and pointed.

Stylocerite.—A spine on the outer side of the basal joint of the first antennae of prawns (fig. 26).

Sub.—Literally under; commonly used as a qualifying prefix to express an imperfect state; for instance, suboval—approaching an oval in shape.

Subbranchial regions.—The areas covering the gill-chambers below (fig. 96).

Subchelate.—A limb or appendage having one or more of the terminal joints folding back on the enlarged preceding joint like the blade of a pocket-knife (see figs. 15, 26, 205, etc., for subchelate limbs).

Subhepatic regions.—The areas on the underside immediately beneath the hepatic regions (fig. 96).

Suborbital.—Below the eye.

Supraorbital.—Above the eye.

Suture.—A dividing line, or space, such as at the junction of two segments.

Tail-fan.—A swimming paddle or fan formed by the terminal abdominal segment and the flattened branches of the last abdominal appendages (fig. 8).

Telson.—The last or terminal segment of the abdomen.

Testes.—The (internal) sexual glands of the male.

Thelycum.—A term applied to the receptaculum seminis (which see) of some prawns (fig. 28).

Thorax.—The middle, and often the greater, part of the body. The segments between the head and the abdomen.

Thumb.—The immovable finger, or process, of the propodus of a chela; see fingers (fig. 6).

Transverse.—Running across from side to side; or wider than long.

Tridentate.—Having three teeth.

Trilobate.—Having three lobes.

Trisinuate.—A margin with three rounded incisions.

Truncate.—Abruptly cut across in a straight or nearly straight line.

Tubercles.—Small sharply defined elevations of various shapes.

Uropods.—The last pair of abdominal appendages; the three posterior pairs in Amphipods are often termed uropods, being different from the three preceding pairs.

Vasa deferentia.—Tubes leading from the testes (or sexual glands of the male).

Ventral.—Below; pertaining to the underside.

Wrist.—The carpus of a cheliped (fig. 6).

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