

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

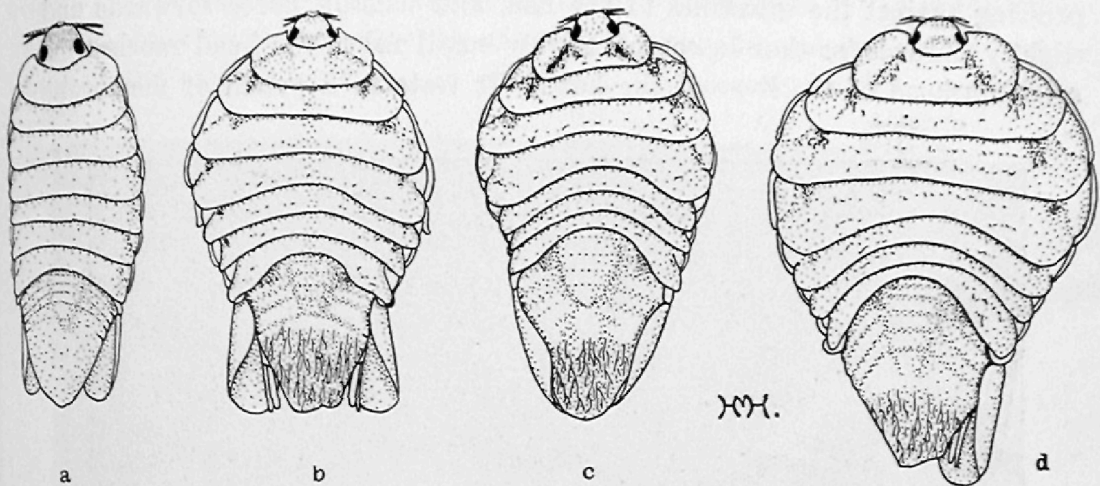


FIG. 264.—Variation in form of *Ourozeuktes owenii*; a is a young female ($\times 3\frac{3}{4}$); b and c, are egg-bearing females ($\times 1\frac{3}{4}$); and d is a large ovigerous female (nat. size).

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

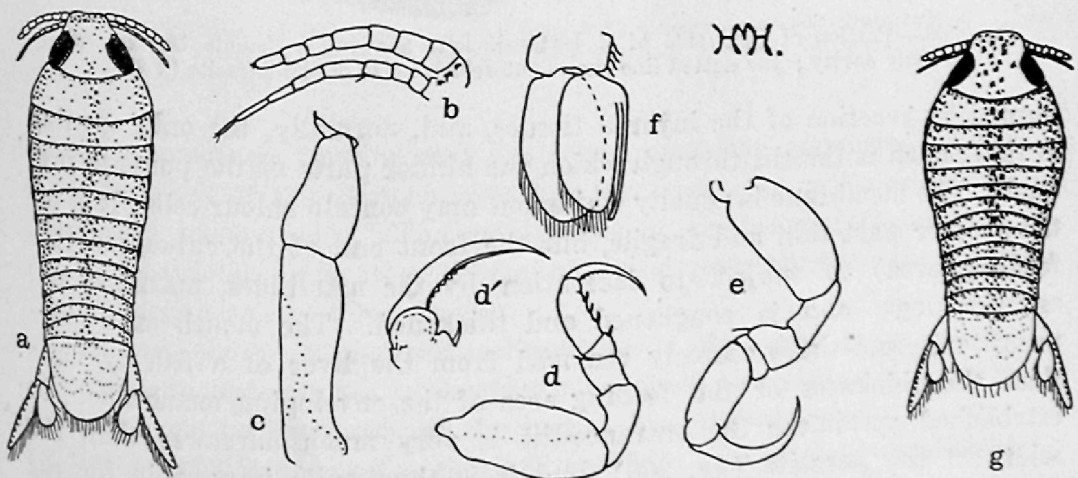


FIG. 265.—*Ourozeuktes owenii*; a, male ($\times 7\frac{1}{4}$); b, antennae ($\times 20$); c, maxilliped ($\times 40$); d and e, first and seventh legs ($\times 20$); d', dactylus of first leg ($\times 40$); f, second pleopod ($\times 20$); g, juvenile from brood-pouch ($\times 25$).

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 *Ourozeukes* 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

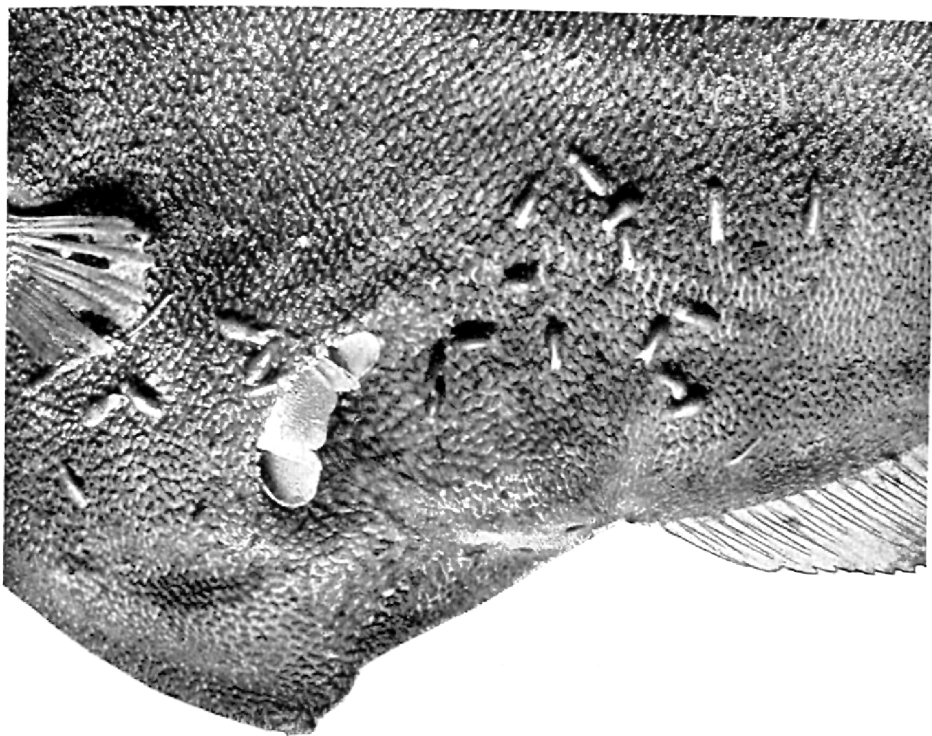


FIG. 267.—Portion of left side of same fish, with a second parasite (*Ourozeuktes*) ensconced; the juveniles clinging to the skin have recently vacated the brood-pouch of the crustacean (x 2).

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.)

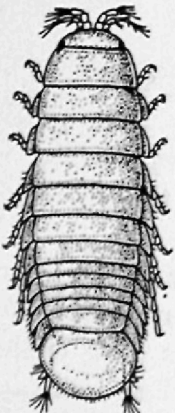


FIG. 268.—*Limnoria lignorum* (after Sars, x 20).

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

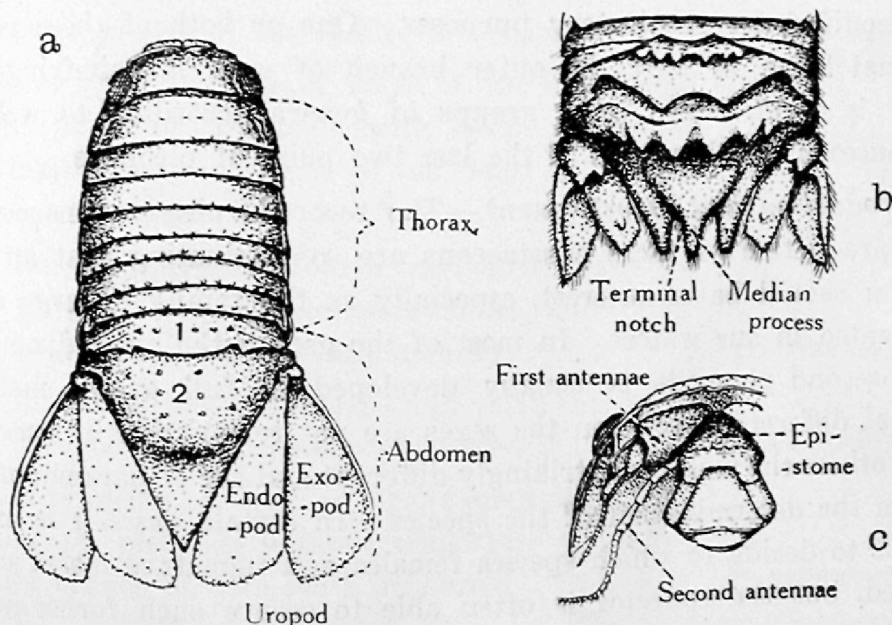


FIG. 269.—a, *Exosphaeroma alata*; b, abdomen of *Cymodoce aculeata*; c, underside of head of *Cymodoce aculeata*.

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 *Cilicæa*.
- 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 *Paracilicæa*.
- ff. Abdominal notch semicircular, with no vestige of a median terminal process . . *Cilicæopsis*.

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

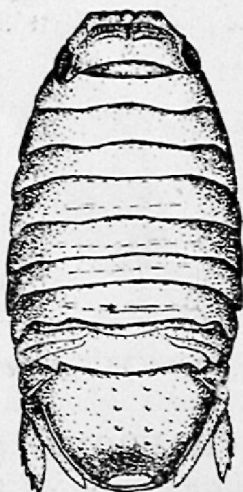


FIG. 270.—*Sphaeroma quoyana* (after Baker, x 4).

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 ⅝in. (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. Paradise 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