

Isocladus (Miers); and *Zuzara* (Leach). In a specimen with marsupium, but without brood, of an undetermined species of *Exosphæroma* from Victoria, I find, very distant from the mesial line and rather near the base of the marsupial lamellæ, four pairs of low tubercles at the hind margin of second to fifth sternites; each tubercle has a small longitudinal slit at its outer side. Being acquainted with this structure, it was possible with 30 degrees of enlargement to find in *Zuzara integra* (Hasw.) at least three pairs of nearly microscopical rounded apertures in the same situation as the small slits in the *Exosphæroma* mentioned, but in some specimens with brood of *Exosph. lanceolatum* (White) and *Isocladus spiniger* (Dana) it was impossible to discern apertures with any reasonable degree of certainty, though they must be present. While the structure and the wandering of eggs and young are easily understood in *Sphæroma* and *Cymodoce*, the minuteness of the apertures of the pouches in the other genera mentioned is a serious difficulty, perhaps connected with some undiscovered structural feature.

Among the eubranchiate *Sphærominæ* some genera, viz. *Scutuloidæa* (Chilt.), *Paracerceis* (n. gen.), and *Cassidinopsis* (n. gen.) have their brood in internal pouches, but the number and position of the apertures has not been examined. Of *Dynamene* (Leach) (sens. strict)¹ I have seen three females of two European species. The marsupium, which covers the entire lower surface of thorax, is filled either with eggs or with young not arrived at maturity; the marsupial lamellæ, especially the posterior pair, are exceedingly large. The whole arrangement is nearly as in *Limnoria lignorum* (Rathke); the number and size of eggs and young evidently differ little from those in the last-named species. *Næsicopea*

¹ Not being able to decide whether *Næsa* (Leach) or *Dynamene* (Leach) ought to be used for the European genus, I applied to my friend the Rev. T. R. R. Stebbing, who is specially versed in such questions. He sent me, most courteously, a very detailed exposition, but as he added that he was working on *Sphæromidæ*, and his results are to be published, I accept his decision that *Dynamene* must be preferred, and refer the reader to the proofs to be found in his future paper.

(Stebb.) (*N. abyssorum* [Bedd.]) is so closely allied to one of my European species of *Dynamene* that the same arrangement is to be expected. In *Cerceis* (M.-Edw.) (an undescribed species rather allied to *C. tridentata* (Hasw.) has been examined) the marsupium and the development of the brood is completely as in *Dynamene*; *Haswellia* (Miers) is so closely allied to *Cerceis* that the development is in all probability quite similar.—In *Cymodocella* a somewhat different arrangement is found; some specimens of *C. egregia* (Chilt.) have been examined. The marsupial lamellæ are only so long that they overlap each other rather little with their ends. The brood is developed anteriorly in the marsupium, posteriorly in an enormous external pouch; the upper wall of this pouch is the ventral surface of thorax behind the origin of fourth pair of legs, while its lower wall is a rather thin lamella fixed inside the base of the four posterior pairs of legs and in front of abdomen, with its free margin extended between the base of the two legs of fourth pair. That this wall is a folding of the skin from behind goes without mention. At least one half of the eggs or young are found in this pouch; the other portion is covered by the marsupial lamellæ, which also, seen from below, overlap the front part of the wall mentioned. In a female I counted thirteen rather large oblong eggs. From want of females with brood of *Amphoroidea* (M.-Edw.) and *Dynamenella* (n. gen.) nothing can be stated on the propagation in these genera.

Of the twelve genera belonging to the platybranchiate *Sphærominæ* I have been able to study the propagation in only five genera; but these are fortunately representatives for the four sections constituting the group.

Of the section *Campecopeini* *Parasphæroma prominens* (Stebb.) has been examined. The marsupial lamellæ overlap each other somewhat at the mesial line; the marsupium is empty, the brood being enclosed in pouches, the entrances to which are longitudinal slightly oblique slits situated at the base of first and second pairs of marsupial lamellæ. As far

as could be ascertained with transmitted light the number of young is very low—about eight; one of them was removed and proved to be large.

Of the section Monolistrini *Vireia berica* (Fabiani) has been examined. The marsupial lamellæ are very large, but not quite as large as in *Dynamene*; the brood is formed in the marsupium itself; the eggs are very large, the young nearly ready for birth exceedingly large, and their number very low. The genera *Monolistra* (Gerst.) and *Cœcosphæroma* (Dollf.) are so closely allied to *Vireia* that their propagation is in all probability completely as in the latter genus. Of the section Ancinini, *Ancinella profunda* (n. gen., n. sp.) has been studied; the structure is nearly as in *Cymodocella*. An enormous external pouch occupies the lower side of the four posterior thoracic segments; its aperture, which is directed forward, is as broad as the marsupium, and its front end is near the posterior margin of third segment. The space of this pouch is somewhat larger than that occupied by the brood in the marsupium itself. The marsupial lamellæ not only overlap each other very considerably, but also cover about the front half of the wall of the pouch. In one female I found fourteen, in another eleven large oblong eggs.

Of the section Cassidinini I have seen two females with brood and three adult females without brood of *Cassidinidea ovalis* (Say), besides one specimen with brood of a new species of *Leptosphæroma* (Hilg.) The structure met with in these forms differs in the most astonishing degree from that observed in any other section, but as it is very difficult to understand and the animals very small my material is insufficient, and I can make out only a part of the features. With transmitted light it is easily seen that the specimen of *Leptosphæroma* has eight oblong somewhat curved eggs (or rather half-developed young) apparently enclosed in a marsupium, which occupies almost the whole area between the thoracic legs, but is slightly vaulted and not visible from the side, because the lower side of the animal is rather concave; in *Cassidinidea* the "marsupium" is somewhat more

vaulted than in *Leptosphæroma*, in the two specimens mentioned with about ten or twelve large half-developed young. In the females of these two genera it is, however, impossible to detect even the slightest vestige of marsupial lamellæ. In *Cassidinidea* a transverse lobe is observed occupying nearly the area between third and fourth pairs of thoracic legs; its free anterior margin is situated about in the transverse line between the two legs of third pair, while laterally it is curved backwards, originating at the insertion of fourth pair; in *Leptosphæroma* this lobe is somewhat shorter. This lobe is the front end of the lower wall of an external pouch occupying, as in *Ancinella*, somewhat more than the posterior half of the lower surface of thorax, but the wall is much thicker than in the last-named genus, in accordance with the fact that it is not overlapped by marsupial lamellæ. The anterior part of the incubatory chamber seems to be a rather similar pouch, which is smaller, closed in front, and without any free lobe behind. But now we come to a serious difficulty. I lifted the free lobe mentioned, which at its base seems to be rather firmly connected with the posterior margin of the lower wall of the front part of the incubatory chamber; I could not with any certainty discover apertures in the junction between the two walls, but pulling more vigorously on the free lobe, the junction named was broken, and a broad entrance to the incubatory chamber was formed. The posterior half of this chamber is a pouch formed as in *Cymodocella* and *Ancinella*, but what may the anterior half be? Is it formed by a folding of the skin from in front backwards—as the posterior half is formed by folding in the opposite direction—or by the fusion of the marsupial lamellæ with each other and with the lower surface of thorax along the insertions of the legs? I think the first alternative to be the right interpretation, but I cannot understand the fact that the posterior margin of its wall seems to be connected with the upper surface of the lower wall of the posterior pouch at the base of the free lobe. The animals examined are very small, and my material quite insufficient

for solving the problem ; I suppose, however, that the same structure is found in *Chitinopsis* (Whitelegge) and in *Cassidina typa* (M.-Edw.), and the latter form being comparatively large, a study of a rich material of females in various stages will be the best material for a future study of the anomalous and interesting mode of construction of the incubatory chamber in the section Cassidinini.

The perusal of the preceding pages will convey an idea of the astonishing variation met with not only in the family Sphæromidæ but even in the sub-family Sphærominæ as to the structure of the chamber for the development of the brood. Let us give a brief abstract. In some genera, as *Limnoria*, *Dynamene*, and *Vireia*, the room is formed only by the usual lamellæ, which are very or exceedingly large ; in *Plakartrium* the same arrangement is found, but the lamellæ are of moderate size. In *Sphæroma* and *Cymodoce* the brood is developed in four or five pairs of pouches proceeding into the animal and opening with rather long transverse slits at some distance from the mesial line, while the marsupial lamellæ overlap each other ; in *Bregmocere* la we find the same arrangement, but the openings of the pouches are minute ; in *Exosphæroma*, *Isocladus*, and *Zuzara* the marsupial lamellæ are small and far from reaching each other at the mesial line, while the apertures of the inner pouches are small or minute, situated near the base of the lamellæ, or even impossible to discover. In *Parasphæroma* two pairs of apertures of internal pouches are longitudinal slits at the base of the lamellæ. In *Cymodocella* and *Ancinella* the major posterior part of the incubatory chamber is formed by a single external exceedingly large pouch with a very broad aperture directed forwards, while the anterior part of the chamber is formed by the marsupial lamellæ. In *Cassidinidea* and *Leptosphæroma* the marsupial lamellæ are wanting and the chamber is formed by a posterior and an anterior external pouch united with each other.

But the structure is still more complicated and varied. In the following chapter it is shown that in a little more than

two thirds of the genera the mouth-parts are similar in both sexes and in immature specimens, but in nearly one third of the genera the adult females have the basal half of the maxillipeds exceedingly expanded, being adapted for producing a current of water through the marsupium, while the distal part of the same appendages and all other mouth-parts are strongly reduced. One is apt to suppose that this metamorphosis must be associated with one of the modifications of the incubatory chamber, but it is far from being so. Some instances may be enumerated. *Vireia* and *Dynamene* have a normal chamber formed only by the very large lamellæ, but the mouth-parts are normal in the females of the former, exceedingly metamorphosed in those of the latter genus. *Sphæroma* and *Cymodoce* have marsupial lamellæ of the same size, but in the former genus the mouth-parts are normal, in the latter metamorphosed. The metamorphosis or non-metamorphosis of the mouth-parts is, on the contrary, connected with and even dependent on the shape of the end of abdomen, as will be shown in Chapters III and V.

III. METAMORPHOSIS OF MOUTH-PARTS IN FEMALES OF SEVERAL GENERA.

In all genera the mouth-parts in adult males and immature specimens of both sexes of the same species are always completely alike. In the sub-families *Limnoriinæ* and *Plakarthriinæ* and in the major part of the genera of the sub-family *Sphærominæ* the mouth-parts in females with brood are similar to those in the males, but in some genera the mouth-parts in such females are metamorphosed in a very peculiar way. In *Limnoria* (Leach), *Sphæroma* (Bosc), *Exosphæroma* (Stebb.) *Isocladus* (Miers), *Zuzara* (Leach), *Cymodocella* (Pfeff.), *Cassidinopsis* (n. gen.), *Parasphæroma* (Stebb.), *Vireia* (Dollf.), *Cassidinidea* (n. gen.), *Leptosphæroma* (Hilg.), *Ancinella* (n. gen.), and *Plakarthrium* (Chilt.), the mouth-parts of females carrying eggs or young are—according to my investigations—shaped as in immature speci-

mens or males; of four other genera, viz. *Dynamenella* (n. gen.) *Amphoroidea* (M.-Edw.), *Campeopea* (Leach), and *Tecticeps* (Richardson), I have seen females with the marsupium well developed but no brood was perceived, and in all the mouth-parts did not deviate from those in the males. I venture to state that among the genera of which females with brood or marsupium are unknown to me, at least *Hemisphæroma* (n. gen.), *Monolistra* (Gerst.), *Cæcosphæroma* (Dollf.), *Cassidina* (M.-Edw.), *Chitinopsis* (Whitelegge), and probably *Spelæosphæroma* and *Ancinus* (M.-Edw.), have the mouth-parts similar in males and in females with brood. Of *Cymodoce* (Leach), *Cilicæa* (Leach), *Cilicæopsis* (n. gen.) and *Bregmocerella* (Hasw.), *Dynamene* (Leach), *Paracerceis* (n. gen.), and *Cerceis* (M.-Edw.) the females carrying brood have the mouth-parts metamorphosed; I have examined at least one species of each of these genera, of some genera two, three, or more species, always with the same result. I am confident that in *Cassidinella* (Whitelegge), *Næsicopea* (Stebb.), and *Haswellia* (Miers), the female mouth-parts will in the future be found to be altered in the same way.

Let us now look at the differences between the mouth-parts of an egg-bearing female and a male (or an immature specimen) of one of the European species of *Cymodoce*. In the male the major distal portion of the incisive process of the mandibles (fig. 1 *a*) is dark brown or black, lacinia mobilis is well developed, with a plate on the left mandible, the molar process is thick and moderately long (fig. 1 *b*). In the egg-bearing female the incisive process is rounded and yellowish, which shows that it is less hard, lacinia mobilis has disappeared (fig. 2 *a*), while the molar process is very low, scarcely developed, and without equipment for trituration. The female maxillulæ (fig. 2 *b*) have been altered in a corresponding way; the distal half of the inner lobe is much narrower than in the male (fig. 1 *c*), its end rounded and the stiff setæ lost; the outer lobe has gained a number of fine hairs, but its end is rounded and of the strong terminal spines at most a rudi-