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On the Propagation, Structure, and Classification of the Family Sphæromidæ.

By

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With Plate 7.

I. INTRODUCTORY REMARKS.

THREE years ago H. F. Moore ("Rep. Porto Rican Isopoda," in 'U. S. Fish Comm. Bull.' for 1900, vol. ii, p. 172, 1901) wrote on the Sphæromidæ: "No attempt is made to furnish a key to the genera, owing to the extreme confusion that exists in this family, and it is doubtful if the following two species are properly assigned generically. The dissimilarity of the sexes has frequently misled authors into placing them in widely separated genera, and, while this has not been done in the present case, the limitations of the genera are so indefinitely established that the author has not been able to satisfy himself of the generic affinities of the species described." It may be added that Moore, in reality, refers both his species to genera to which they do not belong. But his critical remarks quoted are correct, and convey an idea on the state of things; other authors have complained in a rather similar way, and the extreme difficulty in arriving at some clearness has probably been felt by every carcinologist who has attempted to name or describe a number of animals belonging to the family Sphæromidæ.

During a stay in Messina and Siracusa in 1893 I collected

especially marine animals of various orders and classes; of Sphæromidæ I gathered a large number of specimens, most of them belonging to the genera Sphæroma (Bosc) and Cymodoce (Leach). In attempting to name the material of Cymodoce, I soon felt that the first thing to be done was to separate the adult males, which proved to belong to three species, then to refer immature males and the females to their respective adult males. The literature could not help me, but, fortunately, the number of specimens of nearly all stages of all species was so rich that the task could be carried through. During this examination I observed that the adult females had neither eggs nor young in the marsupium, but that the brood could be discerned through the skin of the ventral surface of the thorax; the young occupied internal pouches, as had been shown by Leichmann to be the case in Sphæroma rugicauda (Leach). Furthermore, I observed that in the same adult females of Cymodoce the proximal half of the maxillipeds is strongly expanded, forming large ciliated plates not found in immature specimens or males, and that the end of the mandibles is light-coloured, while it is dark-brown or black in other specimens; a subsequent dissection showed that the three anterior pairs of mouth-limbs and the distal half of the maxillipeds in egg-bearing specimens of Cymodoce have been so strongly reduced that the animals cannot eat, while the proximal half of the maxillipeds has been exceedingly expanded; in Sphæroma the mouth-parts are similar in both sexes and in young animals.

These facts and other features were discovered ten years ago, but a publication was postponed. During a stay in London in 1902 I looked through the large collection of Sphæromidæ in the British Museum, wrote numerous notes, and figured some details; most of the specimens examined being types or co-types for species established by Leach, Say, White, Miers, and Haswell, this perusal has been of great importance for my study. The next year I began to work out a revision of the genera of Sphæromidæ. The U. S. National Museum, and especially Dr. Chas. Chilton in New Zealand, favoured

me—as loan or present—with a good number of forms, for which I am most grateful. I have drawn more than a hundred figures, but seeing that further material must be procured, and that for this reason and other obligations, years must pass away before I can finish a more detailed paper, I think a preliminary abstract of the main results, together with brief diagnoses of the genera, and notes on reference of species, may be useful to my fellow-students. Nearly every year new species are described and new genera established; the latter are, in most cases, imperfectly defined, and the species are frequently referred to genera to which they do not belong. Though most preliminary communications—to put it very mildly—contribute more to the swelling of the literature than to advancement of science, I hope yet that this paper may be considered by zoologists as an exception from the rule.

During the preparation of this paper I received further aid from other sides. From the authorities of the Zoological Museum in Berlin I obtained some forms of much interest; Professor E. L. Bouvier, Director of the Entomological Department of the Museum in Paris, lent me an important typical specimen; Mr. A. Viré, the ardent explorer of the cave-fauna in France, has presented me with two valuable forms; Dr. Joh. Thiele, at the Berlin Museum, and especially my friend Dr. W. T. Calman, at the British Museum, answered queries on certain structural features in various animals. I beg the authorities of the Zoological Museums in London, Washington, Berlin, and all the gentlemen named, to accept my sincere thanks for their aid.

The number of forms seen by me is very large. Twenty-eight genera (not counting mere synonyms) have been established by earlier authors; of these I have been able to examine material preserved in spirit of all but three; of one (*Ancinus*) of these three I saw an exsiccated specimen, and the two genera not seen by me seem to be of slight importance. That I have seen numerous new species is a matter of course; many of them have been inspected, but not being able to give illustrations here, I establish as few as possible,

describing in all only two new species as types for new interesting genera and adding some remarks on an old quite imperfectly known form. For various reasons I cancel two genera; some of those still maintained are of slight value, but I did not think it proper to withdraw more than absolutely necessary. I must establish seven new genera, six of which are types of importance. Most of the species hitherto established are enumerated, but I did not wish to mention every species of *Sphæroma* and *Cymodoce* scattered in the vast literature. The enumeration is undertaken in order to refer the species to the genera to which they really belong; a perusal of my notes on such genera as *Sphæroma*, *Cymodoce*, *Næsa*, *Cassidina* will convey an idea of the extreme confusion as to classification in nearly the whole literature. Rather frequently the descriptions—especially when accompanied with figures—of species unknown to me are sufficient for reference, but in several cases this must be doubtful; in too numerous cases—especially when the species in question differ as to shape of the proximal joints of the antennulæ or of the end of abdomen from the type of that genus to which they have been referred in the literature—is it unfortunately impossible to say anything on the real relationship, because figures and especially descriptions are too incomplete.

Only in very few cases titles of papers are given; if such references to literature had been inserted everywhere in the systematic "notes" the bulk of this paper would have been very much increased. The synonymy of several species of *Sphæroma* and *Cymodoce* is extremely intricate, and is omitted. It is scarcely necessary to say anything on my treatment of characters and classification; every student who will take the trouble to read the three following chapters and look through the diagnoses of sub-families, groups, sections, and genera may easily perceive the principles of classification. Yet it may be added that in Isopoda—and in other orders of Arthropoda—I dislike a modern tendency manifesting itself in splitting up orders into a very large number of families; wishing to procure a view of the relationships, I collected at

an earlier occasion Cirolanidæ, Ægidæ, etc., as sub-families of the Cymothoidæ (sens. lat.), and to-day I cancel the family Limnoriidæ, referring it as a sub-family to the family Sphæromidæ.

II. ON THE PROPAGATION.

Even among a very large material of *Sphæroma* (Bosc) and *Cymodoce* (Leach) it is next to impossible to find a single specimen with eggs or young in the marsupium, though it is generally easy to find numerous specimens with the marsupium well developed. It is, in my opinion, a testimony of the want of study of the family that this curious feature has been overlooked by all authors excepting Leichmann, who observed and explained it in one species of *Sphæroma*, but did not examine any other form of the family. I shall now give a very brief abstract of some selected points of Leichmann's paper, adding a few remarks, and then proceed to my own observations on numerous other genera of the family; it may, however, be added that some interesting questions I am certainly able to point out, but, for want of sufficient material, not to solve in any satisfactory way.

Leichmann published a preliminary note in 'Zoologischer Anzeiger' for 1890—the chief paper, "Beiträge für Naturgeschichte der Isopoden," in 'Bibliotheca Zoologica,' 1891. He studied specimens of *Sphæroma rugicauda* (Leach) gathered near Dantzig. He describes and figures the marsupial lamellæ as so small that the lamellæ from the two opposite sides do not touch each other with their margins. This statement is quite incomprehensible. I have examined specimens of the same species from the coasts of Denmark, even from Vordingborg at the Baltic, and in animals carrying brood the lamellæ from the two halves always overlap each other considerably. An erroneous determination is excluded, as *S. rugicauda* is the only species of the Sphærominæ known from the Baltic and even from Denmark; furthermore, in *S. serratum* (Fabr.) and in the other species of the genus in its restricted sense (see below) I have always found the

lamellæ overlapping each other. But Leichmann has made the important discovery that the eggs are enclosed and developed, not in the marsupium itself, but in four pairs of pouches; the openings to these pouches are rather large transverse slits found on the lower surface of thorax at some distance from the mesial line between the sternites, the first pair of slits between the second and third, the last pair between the fifth and sixth sternites. According to Leichmann these pouches are large, elongated, two-branched invaginations of the ventral skin of the animal; they proceed upwards and a little inwards, terminating beneath the tergites near the mesial line. The eggs are laid in the usual way; from the marsupium they must instantly be transported into the internal pouches, because it is impossible to find any specimen with eggs in the marsupium. The eggs are proportionately large, their diameter being .44 mm., but the young ready for leaving the pouches are exceedingly large, measuring 1.44 mm. in length, .65 mm. in breadth, and .22 mm. in depth; the volume of such a young one is therefore between four and five times (Leichmann thinks five times) larger than that of an egg; the mother measures only 5.2 mm. in length and 2.9 mm. in breadth. Leichmann states that the larvæ perform lively movements within the pouches a long time before they leave them, which takes place through the eight slits. He has observed that generally two larvæ slip out, not simultaneously, but shortly after each other; they remain a short time, rarely more than an hour, in the marsupium. But frequently a considerably longer time passes away before the birth of the two next larvæ, so that the entire act takes up some days. This abstract may be sufficient; the question as to the nutrition of eggs and larvæ is omitted in this preliminary paper.

In nearly one third of the genera of the family adult females are unknown to me; of a few genera I have seen only a single female with the marsupium well developed; but, at least without dissection, no brood could be detected. Marsupial plates I have seen in representatives of the two small sub-families, and in all sections of the large sub-family Sphærominæ but

one, viz., Cassidinini. Their number is always three pairs; they belong to the second, third, and fourth pairs of legs. In three genera—*Exosphæroma* (Stebb.), *Isocladus* (Miers), and *Zuzara* (Leach)—all belonging to the hemibranchiate Sphærominæ, they are so small that they are far from reaching each other from the two opposite sides; in all other genera they overlap each other at least somewhat, and generally considerably, or sometimes very much along the mesial line. In the forms with brood of the section Cassidinini seen by me the marsupial lamellæ are wanting; this curious feature is discussed in the sequel.

Of the sub-family *Limnoriinæ* *Limnoria lignorum* (Rathke) has been examined. The number of eggs is rather moderate (twenty-nine were found in one specimen); the eggs are enclosed in the marsupium itself. The volume of each full-grown young one is very considerably larger than that of an egg; the marsupium containing such larvæ is accordingly exceedingly distended, more than twice as deep as in a female with eggs recently laid. The marsupial lamellæ are exceedingly large; the marsupium covers the whole lower surface of thorax.

Of the sub-family *Plakarthriinæ*, a single small female of *Plakarthrium typicum* (Chilt.) has been examined. The marsupium reaches nearly to the base of abdomen, but its lamellæ overlap each other only very moderately. It contains in my specimen five very large eggs still nearly circular; there is plenty of room for their development in the flat marsupium. Judging from the shape and the biology of the animal, this shape of the marsupium is scarcely much altered during the development of the brood. The third sub-family, the Sphærominæ, present various modes of development of the brood.

Of the hemibranchiate Sphærominæ I have seen adult females of eight genera; of two genera, *Hemisphæroma* (n. gen.) and *Cassidinella* (Whitel.), they are unknown, but the former genus is closely allied to *Sphæroma* (Bosc); *Cassidinella* seems to be only a sub-genus of *Cymodoce*

(Leach) and it is therefore most probable that, as to propagation, they agree respectively with *Sphæroma* and *Cymodoce*. *Sphæroma rugicauda* (Leach) is mentioned above; *S. serratum* (Fabr.) has the same number of pouches with large slits, and all species of the genus in its restricted sense (see below) probably agree closely with each other. I examined a rather large specimen of *S. serratum* with the young nearly full-grown, being greyish with black eyes; I counted ninety-one young, which occupied by far the largest part of the inner space of thorax and, besides, a good deal of abdomen, as the internal organs of the body, excepting musculature, were scarcely discernible. In the other genera of hemibranchiate *Sphærominæ*, as in *Sphæroma*, the brood is developed in internal pouches; but, nevertheless, various deviating features are observed. In *Cymodoce pilosa* (M.-Edw.) five pairs of large slits—first pair between first and second, last pair between fifth and sixth sternites—are observed; the slits are placed at some distance from the mesial line. Of *Bregmocerella Grayana* (Woodw.) I have seen two females with the marsupium well developed, and the mouth-parts metamorphosed as in *Cymodoce*. One of them has no eggs; on the lower surface of thorax I found five pairs of small, very low sub-cylindrical tubercles placed, as are the slits in *Cymodoce*, at some distance from the mesial line, each tubercle with a minute aperture on the end. In the other female the black eyes of a rather small number of young are visible through the quite membranous ventral skin, on which it is possible, with some difficulty, to find the same thickenings with their central hole. That these tiny apertures correspond with the slits in *Sphæroma* and *Cymodoce* is certain, but it is difficult to understand how the eggs can pass in, and quite incomprehensible how the young are able to pass out through them. I suppose that at the birth of the young the skin must split at the apertures, but perhaps some other resource may exist. As mentioned above, the marsupial lamellæ are small and far from reaching each other at the mesial line in *Exosphæroma* (Stebb.),