ON THE ADULTS OF *ZOANTHELLA* AND *ZOANTHINA*.

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In a short note published in the *Records of the Indian Museum* in 1914 and again in a paper read at the second meeting of the Indian Science Congress held at Madras in 1915 the author communicated certain observations on the metamorphosis of *Zoanthella*. He has on subsequent occasions made further observations on this and other forms of Semper's larvæ and can now add to the information already published.

The species of *Zoanthella*, the metamorphosis of which was described in the preliminary note published in the *Records*, can be easily recognised by its small size and slender vermiform shape. The length of the larva is about 2½ to 3 mm. and its breadth as measured on the side about ½ mm. The body is roughly cylindrical, has rounded aboral and truncated oral ends and is slightly bow-shaped, the concavity being ventral. The band of cilia extends from the oral to the aboral end on the concave side. The general colour is yellowish white. The larva often swims rapidly through the water and, when it does so, develops a corkscrew-like twist and progresses by executing a rapid rotatory motion. The young Zoanthid into which the larva is metamorphosed is attached and the attached condition may last some months, the animal growing slowly all the time. As grown in the laboratory, the animal is free from incrustations of any kind, though when sand is supplied the bodywall builds up the characteristic incrustation. The examination of older specimens makes it clear that the animal is a species of *Sphenopus*. The deep siphonoglyph with the thick mesoglœa in its walls, the depressed body, the oral disc slightly elongated in the transverse direction, the dorso-ventral slit-like mouth and the arrangement and disposition of the tentacles are among the more obvious macroscopic characters pointing to this identification. The author was fortunately able, however, to place the identity of the animal beyond the possibility of doubt when in January 1924 he obtained a brood of very early stages from a specimen of *Sphenopus* living in his laboratory. These early stages were reared into the stage of *Zoanthella* obtained in the plankton. The author has preserved several stages and hopes to give an account of the early development of *Sphenopus* before long. The larva of *Sphenopus* is thus a species of *Zoanthella*.

A second species of *Zoanthella* found in Madras is much larger and has an elongated pyriform body with the mouth at the narrow end. The length varies from about 6½ to about 10 mm.; the greatest diameter is near the aboral extremity, being about 2½ mm., the diameter at the oral end being about ½ mm. or a little more. The ciliated band extends from the mouth to about a third or fourth of the body length from the aboral end, and the posterior termination of the band is pointed. The larva has a grey colour, having a light ground colour with an irregular net-work of streaks and patches of dark brown pigment, the pigmentation being dense near the aboral end. The living larva is straight or very slightly curved. In preserved specimens the shape of the living larva is often

retained, but generally the oral portion shows a strong curvature towards the ventral side where it is rolled into a short spiral, the aboral end becomes truncated and the whole surface of the larva becomes strongly puckered. The detailed comparison of the larva with the several species described has not been made but, judged by its external characters, it seems to be identical with *Zoanthella galapagoensis* Heath. The second larva also has been reared in the author's laboratory and advanced specimens with as many as 46 tentacles have been obtained. The specimens are devoid of incrustation but occasionally sand-grains are found embedded in the body-wall. The animal is undoubtedly a species of *Gemmaria*, or, as this genus has latterly been merged by some authors in the genus *Palythoa*, of the latter genus.

One of the Madras species of *Zoanthina* has been reared into a species of *Zoanthus*. The identification of the adult in the present case is quite easy, as the capitular fossa, *i.e.*, the ectodermal groove between the two portions of the sphincter muscle, which is usually seen in contracted specimens of *Zoanthus*, is very clearly visible externally and the double sphincter muscle, which is the diagnostic feature of the genus *Zoanthus*, can be readily made out in longitudinal sections of the animal. The ectoderm of this species of *Zoanthus* is continuous. There is a species of *Zoanthus* common in Madras which in its translucent and delicate body-wall and in other features resembles *Z. pulchellus* described from the West Indies. The specimen reared from the *Zoanthina* appears to be identical with this Madras species, though its specific identity can only be settled when older laboratory-grown specimens are available for comparison.

A second species of *Zoanthina* also occurs in Madras. It differs from the first in having a longer body and by its somewhat tougher build. This larva also has been reared into the parent form which presents very interesting features. The ectoderm of the parent form is discontinuous and contains zooxanthellæ. The condition of the ectoderm in the young larva has not been noted. The oral disc and tentacles of the parent form are always drawn in, and though individuals with as many as 36 tentacles have been reared and a few specimens have been living in the laboratory for over a year they have never been seen with the disc or tentacles expanded. The body of the parent animal is smooth, slightly curved to one side, and has a circular flat, thin or thick base for attachment ; often a few individuals are found stuck together by their base forming clusters. Longitudinal sections show the existence of a well-developed sphincter muscle. The muscle cavities are numerous and in the region of the sphincter occupy the whole of the mesogloea, extending from the ectoderm to the endoderm, and give a vacuolated appearance to the mesoglœa. All these are characteristic features of the genus *Isaurus* with which genus the specimen also agrees in minor histological details. The genus *Zoanthus* has a double sphincter muscle and in contracted specimens there is an ectodermal groove between the muscles. The genus *Isaurus* has a single sphincter muscle. In the specimen in question the muscle is single but is indented by a deep ectodermal groove which occurs in the same position as the capitular fossa of *Zoanthus*. The muscle is neverthe-

less single, the two major portions being connected together by a narrow bridge of muscle which lies below the groove. The only young specimen of naturally-growing *Isaurus* that the author could obtain for comparison was much larger and presumably older than the laboratory-grown specimen, but it also shows a corresponding groove, though the groove is broader and more shallow in this case. It is hoped to investigate this point further in suitably fixed material of *Isaurus*, but appearances seem to indicate that the groove is a natural structure, in the single specimen examined. The description of the adult *Isaurus*, given by various authors does not mention any such groove, and if the groove occurs in the young but disappears in the adult it would be interesting to ascertain the manner of its disappearance. The most striking peculiarity of the fully-grown *Isaurus* is the occurrence of irregular rows of tubercles on the body. Young individuals, however, have a smooth body and are devoid of tubercles. The absence of tubercles in the laboratory-grown specimens which are obviously young does not therefore militate against the identification of the latter as *Isaurus*. The validity of the author's identification can be simply and conclusively tested by rearing the tuberculate forms from the larvæ or by obtaining the larvæ from *Isaurus* ; both these lines of investigation will be taken up as soon as the necessary living material can be obtained. In the meantime the author considers that the form, structure and habit of the laboratory-grown specimen justify its identification as *Isaurus*.

The larvæ of *Zoanthus*, *Isaurus*, *Palythoa* (in which genus *Gemmaria* is included) and *Sphenopus* are thus known. These are the four brachycnemic genera of the Zoanthidæ. *Zoanthus* and *Isaurus* differ from all the other Zoanthidæ in having an unincrusted body-wall, and it is worthy of note that they are both descended from the same type of larval form, *Zoanthina*. With regard to the macrocnemic genera, from Carlgren's description of the young of *Isozoanthus* it appears that the special characteristics of *Zoanthella* and *Zoanthina* are absent. It is not known whether these larvae occur in the other macrocnemic genera, and it will be premature to estimate the value of these larval forms in settling the inter-relationships of the genera of the Zoanthidæ. We may note, however, that two different larval forms give rise to the same, brachycnemic, group of adults.

It is well known that both macrocnemic and brachycnemic types of mesenterial arrangement may occur in the same individual. These facts seem to suggest the possibility that the usual classification of the Zoanthidæ into the Brachycneminæ and Macrocneminæ may not after all be the best expression of phylogenetic relationship. Can it be that the unincrusted forms, *Zoanthus* and *Isaurus*, are fundamentally distinct from the incrusted genera? While the question seems to be perfectly legitimate in the light of known facts, it would be impossible to answer it without further knowledge of the development of the group.

The results of rearing zoanthid larvæ and of keeping zoanthid colonies alive in the laboratory are not without some bearing on zoanthidean technique. The greatest difficulty in the study of the group is presented

by the incrustation of the body-wall. Specimens collected from coral seas are described as containing calcareous deposits ; these can be easily removed by ordinary acids. All the specimens which the author has procured from various localities in South India are incrusted with ordinary sand and the only method which he has so far found useful in dealing with them is the application of hydrofluoric acid. The most satisfactory way, however, of getting specimens without sandy inclusions is to rear them from their larvæ in clean sea-water. *Sphenopus*, a very thickly incrusted genus, and *Gemmaria*, also an incrusted form, can be obtained in this way. In colonies of *Gemmaria* kept growing in the laboratory in clean sea-water the fresh individuals which develop have thin and transparent body-walls and are not so heavily incrusted as the older individuals. What seems to take place is this. The crust of the part of the cœnenchyme or body-wall of a zooid from which a new bud sprouts is distributed in the growing bud. Apparently there is no transport of foreign material from one part of the colony to another and as the developing bud does not obtain sand or other particles from outside, it grows into a thin-walled form without the usual incrustation. This habit suggests the possibility of obtaining individuals practically free from foreign matter by keeping the colonies alive for long periods, though the practical value of the method has yet to be established. The method of rearing soft-walled adults from larvæ is no doubt tedious but is well worth the trouble and the time.

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