

X. A PELAGIC SEA-ANEMONE WITHOUT TENTACLES

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During a visit to Puri, on the Orissa coast of the Bay of Bengal, my assistant brought me (on February 1st, 1909) a number of small, more or less globular bodies which he had found on the beach at the edge of the waves. A careful search revealed many more. On examination these bodies proved to be Actinaria in a state of contraction. On being placed in clean sea-water they immediately changed their shape, becoming narrowly conical instead of globular; but no tentacles appeared. The oral extremity became nearly flat, the peristome being distinguished from the column by its greater translucency as well as its position. The mouth was conspicuous, forming a relatively long, narrow slit expanded at one end. The whole animal had a milky appearance, which concealed its internal organs; the exterior had a pale vinous colour, which deepened into brown at the aboral pole. A circular pore was easily seen at this pole.

As these Actinians evidently represent a form very different from any previously described, I propose to call them *Anactinia pelagica*, gen. et sp. nov., in allusion to their lack of tentacles and their pelagic habit. Although none of my specimens have gonads in a recognizable condition, I do not think that they represent a larval stage, for on the one hand the large number of mesenteries they possess, and on the other the fact that many Actinians only exhibit sexual activity at certain times of year, is evidence to the contrary. Several forms have, however, been described by van Beneden as larvæ which possess a considerable number of mesenteries. The following description is based on the dissection and sectioning of a number of specimens as well as on the superficial examination of living and preserved material.

STRUCTURE.

Column.—The column may be any shape between globular and conical, the aboral end being pointed in the latter case and the peristome nearly flat. These differences in form are due solely to the state of contraction or expansion of the muscles. My largest specimens measured, when fully expanded, about 12 mm. in length and 4 mm. in transverse diameter across the peristome, which met the walls of the column practically at a right angle. In such specimens the aboral extremity measured only 1 mm. in diameter, the

basal pore, which was circular, measuring about 0.75 mm. The external surface was smooth on the upper half of the column, longitudinally plicated to a slight extent on the basal half. Most or all of the mesenterial spaces appeared on the external surface as slightly elevated ridges separated from one another by narrow grooves, which represented the mesenteries. There were no apertures of any kind on the sides of the upper parts of the column; but near the base I have been able to detect a number of minutely microscopic circular pores. These have no swollen lips and do not appear to function as cinclides. The external cilia are short and feeble. There is no protective sheath, and the secretion of the ectodermal gland-cells is by no means profuse.

Peristome.—The most remarkable feature of the peristome is the almost entire absence of tentacles. An examination of living material failed to reveal any trace of these organs; but in specimens preserved in spirit they can be seen to exist as minute rudiments, which to the naked eye or under a hand lens appear as a single circle of white dots, one at the upper extremity of each mesenterial space, that is to say, 24 or 26 in all. These dots are situated round the periphery of the peristome. They are imperforate and so minute that it is barely possible to see them in profile with the aid of the most powerful hand lens. They are only visible owing to their greater opacity, which is due to the fact that each represents a reduplication of the body-wall, or rather a microscopic hollow outgrowth. Their structure appears to be in no way differentiated from that of the surrounding parts.

The peristome itself is nearly flat in fully expanded specimens, but when the muscles of the column are contracted it is usually concave; sometimes, owing to a partial evagination of the stomodæum, it becomes highly convex or even conical.

The lips of the mouth are by no means tumid and do not appear to be capable of very close juxtaposition. The upper extremity of the ciliated groove of the stomodæum is represented at one end by an expansion, which in some cases is nearly circular. The mouth occupies the greater part of the diameter of the peristome in one direction and is rather narrow in the other; its two ends are about equidistant from the edge of the peristome.

Body-wall.—In a transverse section through the body-wall the ectoderm is seen to consist of the elements commonly found in the ectoderm of the Actiniaria. The epithelial cells bear very short cilia. Gland-cells are, as usual, of two kinds, one more elongated than the other; but both are somewhat scarce. Sense-cells, each bearing a rather stout style, are numerous. Nematocysts are extremely abundant all over the surface of the column. They vary greatly in size but are fairly constant in shape and proportions. All are rounded at either end somewhat abruptly and most are curved; the length is about $\frac{1}{2}$ the breadth, and varies from 0.0162 mm. to 0.042 mm.

Immediately inside the ectoderm there is a ring of clear mesogloea, in which minute star-shaped cells and extremely slender

transverse nerve-fibres can be detected with some difficulty. This is clearly the so-called nervous layer.

Inside the nervous layer is a considerably broader one, which also consists fundamentally of mesogloea but is noteworthy for the fact that it contains numerous bundles of longitudinal muscle-fibres, which in cross-section appear as slightly oblique transverse bars or narrowly oval masses. Often they are arranged in such a way that two succeeding bars form an angle with one another. At the inner end of these longitudinal muscles is a narrow but very distinct ring of circular muscle-fibres. An examination of the body-wall from the inner surface shows that these circular muscle-fibres form a series of parallel rings extending from the upper end to the base of the column, at the two ends of which they are rather stouter than they are in the middle. There is not, however, a regular sphincter at either end.

The endoderm of the body-wall consists of rather long, highly vacuolated cells. The cilia with which they are provided are barely visible in my sections. At the base of many of these cells peculiar sausage-shaped bodies are present, each containing two or more round structures which take up eosin very strongly. Probably these bodies are micro-organisms of some kind.

In a transverse section of the body-wall, opposite the middle of the stomodæum of a fully expanded specimen, the ectoderm is the broadest of the apparent layers, occupying more than a third of the total thickness (*i.e.*, about 0.4 mm. out of a total of 1.06 mm.). The whole of the mesogloea is considerably narrower, occupying about 0.3 mm.; of this one-third is occupied by the nervous layer and two-thirds by the muscular layer. The endoderm is rather thicker than the mesogloea at some points, thinner at others.

Stomodæum.—The stomodæum extends in fully expanded specimens about a third of the way to the base of the column. It is much compressed but relatively broad, its two ends being nearly equidistant from the body-wall. A ciliated groove is present at one end only; in the middle part of the stomodæum it is of considerable size as compared with the remainder of the internal periphery. Its cilia are long and stout compared with those of the ectoderm on the external surface of the column. The musculature of the stomodæum resembles that of the body-wall in arrangement, but the longitudinal muscles are not so well developed and the circular muscle is very feeble.

Mesenteries.—In the smaller specimens I have examined there are 24 mesenteries, in the larger specimens 26. The mesenteries are not arranged in pairs, and have no muscle-banners (retractor muscles); all are entire. In transverse section each is seen to be considerably swollen in the middle and narrow at either end, *i.e.*, at the inner end, which is joined to the mesentery, and at the outer end, which is joined to the body-wall.

A band of mesogloea makes its way into each mesentery from either end, appearing in transverse section as a slender filament; at its outer extremity each band of mesogloea supports a few

transverse muscle-fibres. I have not been able to detect longitudinal muscles in the mesenteries at any point. The swollen appearance of the central part is due solely to enlargement and vacuolation of the endoderm cells which form the bulk of the mesentery. These cells have very minute nuclei, which are situated at their free edge.

The outlines of the mesenteries in transverse section are important in relation to the position of the mesenterial mesogloea. In few mesenteries does this occupy the middle line exactly, but in nearly all cases it is slightly nearer one surface than the other (plate ix, figs. 5, 6). Moreover, the surface from which it is most remote can in most cases be seen to be more broadly convex than that to which it is nearest. All the mesenteries, therefore, may be said to point in one direction. This direction is that most remote from the apex of the ciliated groove.

The mesenteries decrease in transverse length at either end of the stomodæum, those at the apex of the ciliated groove being not quite so short as those opposite them.

The mesenterial filaments are less strongly contorted than is the case in many Actinians. On some mesenteries they run almost straight from the lower end of the stomodæum to the base of the mesentery, while in others they are contorted only in the middle part of their length. The longitudinal groove running down the upper part of each filament is deep, and the corresponding ridge on the middle part high; otherwise the minute structure of the filament offers no particular feature of interest.

Some of the mesenterial filaments are continued at the lower extremity of the mesentery so as to form acontia, which can be thrust out of the basal pore or even of the mouth; but the acontia are much shorter than is usually the case in the Sagartiidæ, and, moreover, do not seem to be particularly well supplied with nematocysts, although those structures occur in them in considerable numbers. So far as I can find, neither the number of the acontia nor the exact mesentery to which each is attached is in any way a constant character. There are no acontia-like filaments on the upper part of the mesenteries.

There are no mesenterial foramina.

*Gonads*¹ are absent from all the specimens I have examined, but, as I have already pointed out, this may be due to the fact that my specimens were not collected during the breeding season.

BIOLOGY

Anactinia does not appear to have any means of independent progression, and my specimens exhibited no movements except

¹ In a specimen taken by Dr. J. Travis Jenkins on the surface of the sea about 10 miles off the Orissa coast on February 20th, 1909, immature testes are present. They occur on some of the mesenteries, not on all; there appears to be a tendency for fertile and infertile mesenteries to alternate, but this rule is not without exceptions.—*March 3rd*, 1909.

those implied in their change of shape. They were, however, practically of the same specific gravity as that of sea-water on the surface of the Bay of Bengal. There can be little doubt that they had been carried by the currents and the winds, so far as the latter affected the water on the surface. The individuals cast up on the beach at Puri had evidently been driven through the surf-line, probably by a stiff breeze acting on the surface of the water. It is noteworthy that though they were numerous on February 1st, not a single specimen was found on January 29th, 30th, 31st, or on February 2nd.

It is well known that surface animals without independent means of progression often occur in vast shoals of the same species. This fact was well illustrated at Puri on the occasion on which *Anactinia* was found. On January 29th and 30th large numbers of a species of *Porpita* were washed ashore. Among them were a few specimens of a species of *Velella*. On January 31st, however, the relative proportions of the two genera were reversed, *Velella* becoming abundant and *Porpita* scarce. On February 1st both were scarce, but *Anactinia* was abundant, while on February 2nd, after a sharp shower of rain during the night, very few surface organisms of any kind were found on the beach.

I can find no trace of food in any of the specimens of *Anactinia* I have dissected.

SYSTEMATIC POSITION.

The arrangement of the mesenteries, the position of the longitudinal muscles of the column and the presence of a single ciliated groove running down the stomodæum are all facts which link *Anactinia* with *Cerianthus*, and there can be no doubt that it should be placed in the same order as that aberrant form. The absence of tentacles, however, as well as other less important differences, point to a very distinct separation between the two genera. *Anactinia* in all probability is a member of the order Cerianthidea which has become modified in accordance with a pelagic life.

It is worthy of remark in this connection that the larvæ of *Cerianthus* are pelagic in habit but settle down at the bottom before they have developed many tentacles. The young of Actiniaria, however, as also those of some other Cœlenterates, appear to provide for their own distribution mainly in two different ways. Those of *Sagartia troglodytes*, *Actinia mesembryanthemum* and some other common viviparous species, for example, retract the tentacles with which they are provided at birth, close their mouths and, being of almost the same specific gravity as the water in which they live and not having any projecting structures on their surface, are rolled over and over by the slightest movement in the water and are so carried for considerable distances. The young of *Metridium schillerianum*, of *Cerianthus* and of some species of *Hydra*, on the other hand, expand their tentacles to the utmost (so as to cover as large a superficial area as possible) and float on

or near the surface, that is to say in a position in which external agencies act most readily on the water and therefore on the organisms which it contains. *Anactinia* appears to have adopted the former means of progression and to have become modified accordingly, probably in the course of evolution from a Cerianthid ancestor.

As regards described forms to which *Anactinia* may be allied, it bears a somewhat close external resemblance to the minute larva described by van Beneden (*Les Anthozaires de la "Plankton-Expedition,"* p. 107, pl. ix, 1898) as *Apiactis denticulata*, but, apart from other differences, exhibits no trace of the thickening of the mesogloea characteristic of that form. Possibly it is related to the same author's *Ovactis* (*op. cit.*, p. 56), but there are several important features wherein it differs from that genus. Both these forms are regarded by van Beneden as larval.

Considering the doubt which exists as to the maturity of my specimens and the resemblance they bear to some of van Beneden's genera, I think it best not to define the form they represent as the type of a new family, but the genus and species may be described as follows:—

Genus ANACTINIA, nov.

Pelagic Cerianthidea without tentacles or a protective sheath. The musculature of the column as in the Cerianthidæ. Mesenteries twenty-four or more; the membranous part of each mesentery strongly developed and forming in cross-section a protrusion directed away from the ciliated groove. Acontia but no (?) cinclides present. Column conical when fully expanded, the aboral pole being pointed. The external surface smooth, feebly ciliated. Ectoderm richly armed with large nematocysts at every point. The ciliated groove of great extent relative to the stomodæum. The mesenteries at both ends of the stomodæum very short. No foramina in the mesenteries.

Anactinia pelagica, sp. nov.

Peristome at right angles to the column when fully expanded. Mouth slit-shaped, with the ciliated groove always more or less patent at one end. A microscopic, imperforate tubercle (representing a tentacle) on the external surface above the upper end of each mesenterial interval. Mesenteries 24 or 26. External surface minutely plicated longitudinally at the aboral end. Colour pale, with a slight vinous tint, which deepens to light brown at the aboral pole; the external tissues somewhat feebly translucent, having a milky appearance in life. The basal pore relatively large, not provided with a sphincter.

