

XIV.—THE FAUNA OF BRACKISH PONDS AT PORT CANNING, LOWER BENGAL

PART VI.—OBSERVATIONS ON THE POLYZOA, WITH FURTHER NOTES ON THE PONDS.

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Thanks to the kindness of Mr. D. Hooper, I am now able to give figures representing approximately the maximum and minimum salinity of the water of one of the ponds during the present year. A sample taken on May 25th (about three weeks before the beginning of the rainy season) from the pond in which the hydroid of *Irene ceylonensis* was found, contained 22·88 per thousand of saline residue, while one taken from the neighbourhood of the same pond on July 9th contained only 9·82 per thousand. At the latter date the whole area containing the ponds was flooded and the river embankment had broken down in their vicinity. It will be remembered that the water of the same pond contained 12·13 per thousand of saline constituents in December, and 20·22 per thousand in March. By an unfortunate mistake the former figure is misquoted as 0·22 per cent. on pp. 69 and 82 of pt. i of these "Records."

A factor in the distribution of the pond fauna to which attention was not paid in my preliminary account (pp. 35—43) is the bore on the Matla river. Mr. Hodgart, Zoological Collector in the Museum, tells me that at this time of year it is often so strong that people in the neighbourhood of breaks in the embankment are obliged to take refuge on its approach in the upper storey of the nearest brick house. The bore of course only affects the ponds when the embankment is broken and they are therefore put in communication with the river, but on such occasions it must bring into them many organisms from the neighbourhood of the open sea. Collections made in the ponds during the present month (July, 1907) include specimens of several forms not hitherto taken in the tanks, notably one of a species of the Sipunculid genus *Physcosoma*, which was found in the mud. They also include most of the forms already taken, notably *Metridium schillerianum* var. *exul* in great abundance and the Polyzoa *Victorella pavida* and *Bowerbankia caudata*, both in interesting stages; *Irene ceylonensis* was not seen.

POLYZOA.

Numerous statoblasts of *Plumatella* were found floating on the surface of the ponds in July, together with gemmules of *Spongilla alba*; but as a very careful search failed to reveal living colonies of Phylactolæmatous Polyzoa at any season in the ponds, it is probable that the statoblasts had been brought from freshwater tanks in the vicinity by wind or by flood. The only Polyzoa taken recently in the ponds in an active condition are Ctenostomes, *viz.*, *Victorella pavidata* and *Bowerbankia caudata*; but the type specimens of *Membranipora bengalensis*, which are still in the Indian Museum, were collected from brackish ponds in the neighbourhood by the late Dr. Stoliczka thirty-nine years ago. Miss L. Thornely (*Rec. Ind. Mus.*, i, p. 186) has recently examined specimens from Mergui, and I have nothing to add to her report, which is published in this number of the *Records of the Indian Museum*, except to say that I have been unable to identify in Stoliczka's types the "statoblasts" to which he refers (*Journ. Asiat. Soc. Bengal* (2), 1869, p. 58). It seems probable from his figures and description that what he saw were polypides in different stages of development from brown bodies, together with unripe gonads. In some species the gonads are well developed, after the formation of a brown body, while the new polypide is still in a very rudimentary condition.

Family PALUDICELLIDÆ.

Ctenostomes that die down in unfavourable conditions after the production of resting buds, which differ in form from the zoœcia and are enclosed in an impermeable substance resembling chitin. Zoœcia tubular, arising either directly from another zoœcia, or from tubular outgrowths from the sides of other zoœcia, or from a false stolon. The false stolon consists of tubular prolongations of the base of each zoœcium, neither the false stolon nor the tubular outgrowths being always present. Funiculus well developed; gizzard feebly muscular.

I follow Jullien (*Bull. Zool. Soc. France*, x, p. 174, 1885) in regarding *Paludicella* Gervais as the type of a family, to which, in my opinion, *Victorella* and, if it be generically distinct, *Pot-siella* also belong. I have, however, given a new definition of this family, in order to lay stress on the feature that seems to me most important, *viz.*, the production of the so-called hibernacula in unfavourable conditions. The term hibernacula is, however, misleading, for the structures it is intended to describe are formed in India in summer and spring. They do not appear to have been hitherto described in the case of *Victorella*, as the "winter buds" that several authors have noted in this genus are buds very much like the ordinary zoœcia. As regards the position of *Paludicella* and its allies, if they are to be regarded as a distinct family, they are intermediate between the Stolonifera and the astoloniferous families of the Ctenostomes. As I have already

indicated, their "stolon" is not a true stolon in the sense that the "rhizome" of a form such as *Bowerbankia* is one. It is not always distinguishable, and when it is definitely present is not sepa-

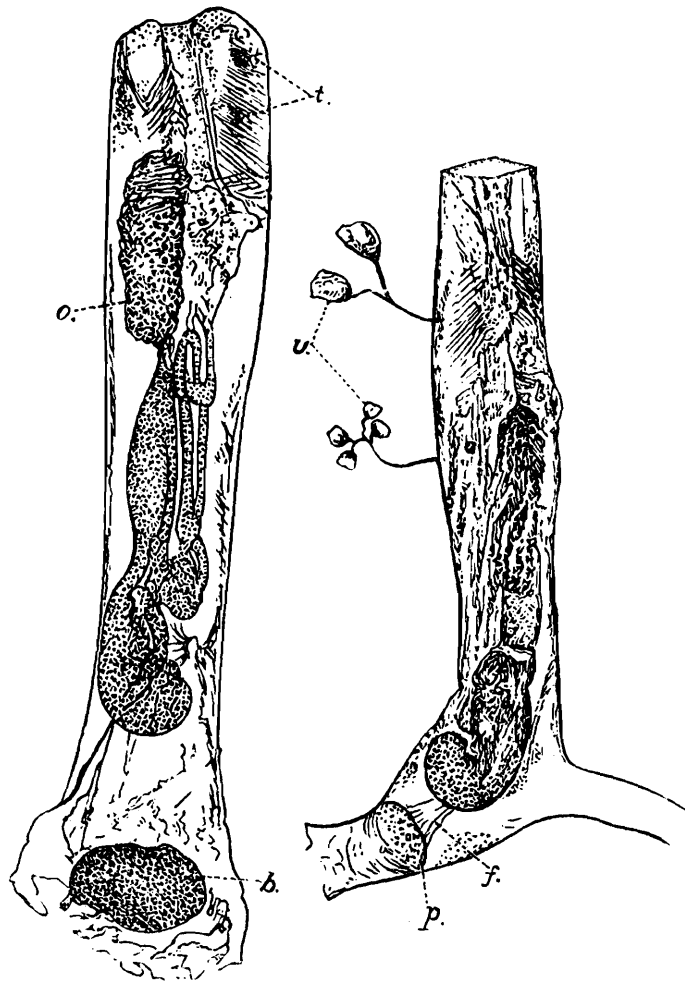


FIG. 1.

FIG. 2.

FIGS. 1 AND 2.—Zoecia of *Victorella pavidata* from Port Canning at the end of winter, $\times 70$. (From preserved specimens.)

b = young resting bud ; *f* = funiculus ; *o* = ovary ; *p* = plate separating the zoecia ; *t* = testes ; *v* = vorticellids growing on the zoecia.

rated off from the cavities in which the polypides rest, but consists of prolongations of the base of the zoecia, the separating plate occurring in the false stolon at some little distance from the base of the polypide (fig. 2). This is really what is meant by the statement of several authors that in *Victorella* the zoecia arise from swellings in a creeping stolon ; it would be more accurate to say that the creeping stolon consisted of the base of the zoecia produced in two or four directions. A rudiment of just such a false stolon is sometimes found in *Hislopia* (the type of another family of fresh-water Ctenostomes) and apparently occurs in a fully developed condition in the Arachnidiidæ. The family most closely allied to the Paludicellidæ is probably the Cylindroeciidæ, to which Pennington (in Bousfield, *op. post. cit.*, p. 406) thought that *Victorella* belonged.

The Paludicellidæ occur all over the world, but only in fresh and brackish water, in which they are exposed to the dangers of desiccation and violent changes of temperature. It is noteworthy, however, that the only other genus of Ctenostomes that occurs in fresh water in the Oriental Region, namely *Hislopia*, appears not to form resting buds and is capable of sexual reproduction at all times of year. This genus constitutes, according to Jullien, the type of a second family and appears to be sufficiently different from all other forms to merit this distinction. The family Hislopiidæ may be defined as follows:—

Perennial freshwater Ctenostomes in which the zoœcia are flat and recumbent and arise directly from other zoœcia in linear or ramifying series. The front of the zoœcium membranous, the sides and the rim of the aperture (which is more or less raised and tubular) thickened. Funiculus practically absent; gizzard furnished with thickened ridges internally.

The examination of numerous specimens of *Hislopia lacustris* from Calcutta, the United Provinces of Agra and Oudh,¹ and the Malay Peninsula convinces me that Jullien's *Norodonia sinensis* and *N. cambodgiensis* are merely phases or varieties of this species, which must therefore be widely distributed in the East. The form of the zoœcia and the method of budding would suggest a relationship with the Arachnidiidæ. Although *Hislopia* is not found in brackish water, the foregoing description and notes may be of use in distinguishing it from the Paludicellidæ.

Victorella pavida, Kent.

(*V. pavida*), Kent, *Quart. Journ. Micr. Sci.*, x, p. 34, 1870; Hincks, *Brit. Marine Polyzoa*, p. 559, pl. 79; Bousfield, *Ann. Mag. Nat. Hist.* (5), xvi, p. 401, 1885; Kraepelin, *Deutsch. Süßw. Bryozoen* (part i), p. 95, 1887.

It is unnecessary to give a formal description of this species, the anatomy of which has been described by Bousfield (*op. cit.*). Indian specimens agree fairly well with the descriptions of English ones, being readily distinguished from those of any other Ctenostome by their mode of budding. Possibly there are slight differences between the Bengal and the British races, but it is difficult to be sure that such differences are constant without examining a large number of examples from different localities, and this I have had no opportunity of doing. Bousfield refers to specimens he found in England in spring as having zoœcia that were "solitary, and semi-reptant, colourless, and in shape much like a violin with a straight elongated neck"; but he describes specimens he took in the same locality in the month of September in the following terms: "The polypidom consists of slender yellow or brownish tubes, on which at intervals are situated swellings in each of which

¹ See also Walton in *Rec. Ind. Mus.*, i, p. 177, 1907.

a zooid is developed

From each swelling arise two branches at right angles, and by the growth of these branches and the development of zoœcia, from which again other branches arise, the growth of the colony continues, always branching in a rectangular direction, so that a matted mass results."

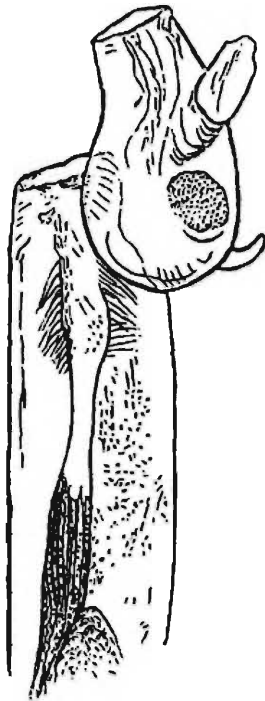


FIG. 3.

FIG. 3.—Distal extremity of zoœcium of *V. pavidus* from Port Canning, with bud, $\times 70$. (From preserved specimens.)



FIG. 4.

FIG. 4.—Resting buds (*b*) of *V. pavidus*, with remains of zoœcium, $\times 70$; Port Canning, July, 1907. (From preserved specimens.)

In the neighbourhood of Calcutta I have found specimens corresponding with both of the phases thus described. Specimens (fig. 1) obtained in winter from the ponds at Port Canning, represented a phase similar to that found in September in England, except that the whole of the zoarium was practically colourless. Many of the zoœcia bore lateral buds, which were situated in most cases near the distal extremity. From these buds (fig. 3) originated tubular outgrowths, which, in a few cases, gave rise to other zoœcia. I did not find, however, examples that could be compared in complexity with that figured by Kraepelin on plate iii, fig. 75, of the work referred to under his name. The buds in my specimens were, moreover, less distinctly cylindrical than those he describes, being shorter and more gradually rounded at the base. They were only produced on a relatively small number of zoœcia.

Other specimens, taken earlier in the season in a canal, the water of which was only slightly brackish, at Dhappa near Calcutta, had the zoœcia partially recumbent and of the same form as those of the specimens taken by Bousfield in England in spring. The

zoëcia were, however, closely packed together (the false stolon between them being very short) and in a few cases bore buds near the distal extremity. In these specimens, although the aperture was in most cases distinctly rectangular, it was occasionally almost circular. Kraepelin (*op. cit.*, p. 158, footnote) has described under the name *Paludicella mülleri*, a somewhat similar form, which he regards as intermediate between *Paludicella* and *Victorella*; but this form is stated never to produce buds on the distal part of the zoëcia, always to have this region circular in cross-section, and to possess a circular musculature.

Both the specimens from Dhappa and those from Port Canning that were taken in winter, bore ripe gonads, the testes and ovaries reaching maturity simultaneously in the same zoëcia. The ovary (fig. 1) consisted of a single mass, elongated in a vertical direction and situated on the inner wall of the zoëcium some little distance below the aperture. The testes, on the other hand, occurred as a number of small rounded bodies scattered over the greater part of the zoëcium, but particularly numerous near its distal extremity.

At the base of the zoëcia (fig. 1) of several colonies obtained from Dhappa and Port Canning during winter, small, mound-shaped masses of densely granular cells of a brownish colour were observed occasionally, taking the place of basal buds in the zoarium. In a few cases, in specimens taken both in November and January, these masses appeared to have secreted a thin chitinous investment, which was not, however, very distinct at the edges. In specimens taken in the ponds at Port Canning in July, shortly after the beginning of the rainy season, "resting buds" (fig. 4) were observed in the same position, and there could be no doubt that they represented a more perfect stage in the development of the same structures. The resting buds (fig. 4) were flattened, more or less oblong bodies of very variable size and outline, the upper surface being slightly arched and bearing a number of longitudinal ridges, which occasionally ramified; the sides were produced into several tubular projections, on which the chitinous coat was comparatively thin. The colour of the whole structure was dark brown. As a rule two resting buds were present at the base of each zoëcium that produced them, but sometimes there was only one and occasionally there were three; only a comparatively small number of zoëcia had produced them. Such zoëcia, and the majority of the others, contained at this season no polypides, but were either empty or contained brown bodies. Frequently even empty zoëcia retained their external form, except that the aperture was tightly closed and the adjacent region circular in cross-section, and in many cases the collar persisted as a wrinkled and pleated funnel-shaped membrane extended from the distal extremity of the zoëcium. A few polypides were active, some of them being long, thin and very transparent, while others were short and relatively stout; the latter occurring chiefly towards the periphery of the zoarium and being semi-recumbent. In a few cases it appeared that the long thin polypides had recently developed from resting buds at the base of

dead zoëcia, but none were found actually in the course of development. No sexually mature zoëcia were observed.

The form of the resting buds of *Victorella pavidā* is not without a certain systematic interest, for not only do they appear to exhibit very distinct differences from those of *Paludicella* and *Potsiella*, but their shape is not altogether dissimilar to that of the zoëcia of *Hislopia*. It is possible, judging from the analogy of other organisms found in stagnant water in Lower Bengal, that they are produced both at the end of autumn and the beginning of spring, both these seasons being critical periods in the life cycles of many of the lower invertebrates of the Calcutta tanks. If this is so, it is probable that they do not undergo further development in the one case until the cold weather is well established, and in the other until the rains have lowered the temperature very considerably. The dangers to be guarded against at the two periods are different. In spring the approach of the hot weather not only raises the temperature of the water but also, perhaps consequently, induces an enormous multiplication of aquatic bacteria. Whether these bacteria have any specific action on other organisms is not known, but their rapid increase is accompanied by a simultaneous disappearance or depauperation of many of the common aquatic invertebrates, while the scum they produce on the surface certainly prevents aëration of the water. In autumn, on the other hand, the risk of actual desiccation is great, for although evaporation is naturally more pronounced in summer, it is, at this season, to some extent counterbalanced by the heavy thundershowers that frequently fall; whereas in winter, during which there is usually very little rain, the temperature is quite high enough to evaporate the water of many of the smaller pools.

Family VESICULARIIDÆ.

The characters of this family have been discussed by all those who have dealt from a systematic point of view with the Ctenostomes as a whole, but the tropical species are still far from being well known. So far as they have been studied, they appear to be closely related to, or in many cases identical with European forms. In the East, as in Europe, members of certain genera are not averse to brackish water. It is worthy of note that *Victorella pavidā* was originally found in England in the same locality as *Bowerbankia imbricata*, a species allied to the one found with it in Lower Bengal.

Bowerbankia caudata, Hincks.

(*B. caudata*) Hincks, *Brit. Marine Polyzoa*, p. 521, pl. 75.

I am indebted in the first instance for the identification of this species to Miss L. Thornely. Mr. R. Kirkpatrick has also been kind enough to examine specimens and is of the opinion that they are identical with Hincks's species. A renewed search in the ponds has proved it to be at least as abundant as *Victorella pavidā*, the

two species frequently occurring together on the same stem or root and their zoaria being very closely interlocked. *B. caudata* is, however, generally more restricted as to the area it covers than *V. pavidata*, which as a rule surrounds it when the two are found in close contact. In such circumstances it is by no means easy, distinct as the species really are, to distinguish one from the other. The bases of the zoaria are almost invariably concealed by a dense growth of minute algæ and other organisms, and, except when buds are being produced on the zoœcia by *Victorella*, the distal ends of the zoœcia are extraordinarily alike. The basal portion of these structures, when it is visible or if it can be freed from external matter, affords the best means of diagnosis. The nature of this part of the organism has already been fully dealt with in the case of one species; in the other, *B. caudata*, the zoœcia adhere to the sides of the stolon and end in each case in a free conical "tail," which as a rule hangs down beneath the level of the stolon. This character is often to some extent obscured in old individuals, although very clear in some zoœcia of every zoarium.

If the polypides are alive and can be induced to expand their lophophores while under observation, the readiest way to distinguish *Victorella* from *Bowerbankia* is to note that whereas the gizzard is highly muscular in the latter, its walls are thin in the former. In living examples of the two forms this character is conspicuous when the tentacles are extruded, and can be detected with a little care even when they are retracted; but in preserved material it is often difficult to be sure as regards the nature of the gizzard, which is clearly present (as Bousfield noticed) even in *Victorella*.

My specimens of *B. caudata* agree fairly well with Hincks's figures, but the "tail" of the zoœcia is sometimes longer and occasionally forks at its free extremity, the alternate arrangement of the zoœcia is not quite constant, and the stolon is divided by partitions placed at irregular intervals. When the zoarium becomes much matted together, the "tails" appear to grow longer than is the case when the colony has plenty of room for expansion, and sometimes secondary adhesions are formed both between the "tail" and another loop of the stolon and between different parts of the stolon. When the tails adhere to the stolon in this way they do so either by their sides or by their tips.

The tentacles, which always number eight, bear at their base a long sensory bristle (which slopes backwards and downwards when the lophophore is expanded) and a series of three or four approximately horizontal, finer hairs on their external surface, as well as a bunch of still finer hairs at their tip.

Specimens taken during winter were sexually mature, the gonads closely resembling those of *Victorella*. In most cases, however, the testes became mature before the ovaries. Colonies kept through the hot weather in an aquarium in which the salinity of the water was maintained at an even level, continued to produce spermatozoa until the end of June and did not form brown bodies. I failed to observe the formation of ovaries in these circumstances. It is

evident, however, that in the ponds the polypides cease to be active and produce brown bodies during the hot weather. In colonies taken from their natural habitat in July, during the floods referred to at the beginning of this paper, only a few zoëcia were active, and these few appeared from their transparency to have recently been rejuvenated. In the majority of the zoëcia new polypides were in the course of development from brown bodies, the tentacles in most cases being already visible as short digitate processes. On the walls of zoëcia containing tentacles in this stage of rejuvenescence the gonads were already almost mature, both ovaries and testes being already far advanced and occurring together.

An interesting observation, possibly connecting the formation of brown bodies with that of the resting buds of the Paludicellidæ, was made as regards some of these zoëcia, namely that their walls were greatly thickened and had a brownish or greenish colour not due to the presence of minute organisms. Other zoëcia, however, in which the polypides were in exactly the same condition, resembled the empty zoëcia of *Victorella* at the same time of the year, having thin walls and the collar protruding from their distal extremity.

