V.—*Statoblasts of Fresh-water Polyzoa.*

By C. F. ROUSSELET.

(*Exhibit and Demonstration, January 19, 1916.*)

STATOBLASTS are the most characteristic structures in the reproduction of fresh-water Polyzoa. Their form is very stable (except in closely allied species), and each group has characters of its own by means of which it can readily be recognized, even when no trace of the adult polyp or the zooecium has been preserved. Statoblasts are confined to the phylactolæmatous Polyzoa; the other fresh-water species, such as *Victorella*, *Paludicella*, *Pottsiella*, *Urnatella* and *Hislopia* do not produce them, nor do they occur in any of the marine species.

The statoblasts are essentially non-sexual resting buds formed in a structure called the "funiculus" to tide over the rigour of the winter. In most cases they consist of a central capsule surrounded by air-cells or swimming-ring, which renders the structure buoyant, and enables the statoblast to float on the surface of the water when liberated by the decay of the zooecium. In this way a wide distribution and preservation of the species is secured at the same time.

On the appearance of warmer weather the young polyp, in an advanced stage of development, splits open the cellular envelope at the edges. This is effected in different ways in different species.

Cristatella has a circular statoblast with numerous hooked spines attached to both the surfaces. In emerging the embryo lifts the lid, like a pill-box with a flange attached, and the hooks are then seen to be attached, some to the lid and some to the base of the box.

In *Pectinatella*, which has fewer but larger hooked spines, the opening takes place along the margin of the statoblast, and even the spines are divided and split horizontally.

Lophopus crystallinus has a statoblast pointed at both ends, whilst in *Lophopus capensis* the ends are prolonged into elongated hooked structures; in opening the splitting takes place through the length of these structures, leaving the hooks partly adherent to the upper and partly to the lower half.

In *Lophopodella*, also, the splitting takes place through the length of the finger-like processes, with the hooks attached to each half of the processes.

Fredericella differs from the other forms in that its statoblasts

are bean-shaped, and devoid of a swimming-ring; these, therefore, do not float, but fall to the bottom of the pond or lake.

Paludicella is a gymmolæmate Polyzoan, and has therefore no statoblasts. It produces, however, small winter buds, or "hibernacula," which serve the same purpose. The hibernacula are soft when first formed, and adhere to submerged stones, or rootlets of trees and reeds, when the zoecium dies down, to start life again in the spring by budding. Examples of these are also shown.

Some Polyzoa, besides statoblasts, produce also from fertilized ova ciliated and free-swimming larvæ. Some of these, derived from *Plumatella fungosa*, have been beautifully mounted by Mr. Hurrell, of Great Yarmouth, and show the double embryo growing within the larval form before it becomes fixed. I have also here a slide of young *Plumatella fungosa* emerging from the statoblasts, and these are always single polypides.

I have here brought together the statoblasts of all the species I have in course of time come across. Of these there are eight British species, one comes from Cape Colony, one from Rhodesia, one each from America and Germany, two from India, and three from Japan.

LIST OF STATOBLASTS OF FRESH-WATER POLYZOA.

1. <i>Lophopus crystallinus</i>	.	From	England.
2. <i>L. capensis</i>	.	"	Cape Colony (Valkenburg Vlei).
3. <i>L. carteri</i>	.	"	India (Bombay Presidency).
4. <i>Lophopodella Thomasi</i>	.	"	Rhodesia.
5. <i>Cristatella mucedo</i>	.	"	England.
6. <i>Pectinatella magnifica</i>	.	"	Hamburg.
7. <i>P. burnanica</i>	.	"	India (Igatpuri Lake).
8. <i>P. Davenporti</i>	.	"	Japan.
9. <i>P. gelatinosa</i>	.	"	Japan.
10. <i>Stephanella hina</i> (Oka)	.	"	Japan.
11. <i>Plumatella repens</i>	.	"	England.
12. <i>P. fruticosa</i>	.	"	England.
13. <i>P. punctata</i>	.	"	Dundee.
14. <i>Plumatella</i> sp. (?)	.	"	South Australia.
15. Ditto	.	"	Surrey Commercial Docks.
16. <i>P. tanganyikæ</i>	.	"	Lake Tanganyika.
17. <i>P. fungosa</i>	.	"	Hadley Wood.
18. Ditto	.	"	Surrey Canal. Young emerging.
19. Ditto	.	"	H. E. Hurrell. Free-swimming ciliated larvæ.
20. <i>Fredericella sultana</i>	.	"	Great Yarmouth.
21. <i>Paludicella articulata</i>	.	"	Winter buds, or "hibernacula."
22. <i>Plumatella</i> or <i>Alcionella</i>	.	"	Sessile statoblasts.
23. <i>Paludicella articulata</i>	.	"	"Hibernacula" bursting open.

Dr. S. F. Harmer, F.R.S., who, on the invitation of the President, opened the discussion, said that, in the first place, it might be noted that fresh-water Polyzoa were a very difficult study, because of the great variability which occurred in them. If one collected a number of samples of fresh-water Polyzoa from different localities, great difficulty would be experienced in sorting them into their species. And one thing which had added to the difficulty was the divergence of opinion with regard to their proper nomenclature. In a comparatively recent monograph, Professor Kraepelin, of Hamburg, had, rather gratuitously, added to the complication by summarily throwing overboard all the old names. On the ground that *Plumatella repens* and certain other names had been used in such a variety of senses that it was almost impossible to know what was meant by them, Kraepelin proposed that they should be rejected in favour of new names of his own. Unfortunately, Dr. Harmer had noticed a tendency on the part of recent writers to adopt the names suggested by Kraepelin, which are contrary to all the recognized principles of nomenclature.

The statoblast is essentially an adaptation to fresh-water, and, as Mr. Rousselet said, is quite unknown in marine representatives of the group. Here and there in literature one found statements to the effect that objects comparable to statoblasts had been discovered in marine Polyzoa. But, so far as he knew, not one of those statements would bear critical examination; and he thought it might safely be assumed that statoblasts were structures entirely confined to the fresh-water members of the group. Perhaps their nearest analogues were the gemmules of fresh-water sponges. Their object was, in one respect, a very obvious one; they were (in these latitudes) for the purpose of enabling the organism to get through the winter, and to germinate in the following spring. Physiologically, they bore considerable resemblance to the seeds of flowering plants. One of their great peculiarities, as Mr. Rousselet had said, was that they floated on the surface of the water, and that led to one or two somewhat remarkable results.

He thought it was true of fresh-water Polyzoa that they were not, as a general rule, found in water which was flowing swiftly, if indeed they were found in such water at all. Anything floating on the surface of the water was liable to be carried down stream, and it would be difficult for a fresh-water Polyzoon to maintain itself in a stream in which the current flowed rapidly in one direction. He might refer to a locality where there was a pond which formed a lateral diverticulum of a river which always flowed in one direction; and he knew that if he went to that pond in any ordinary summer he could find fresh-water Polyzoa, whereas he did not find any in the river a few yards distant.

There was another point which had struck the attention of various observers. Statoblasts are liberated in the autumn, and float on the surface of the water, where they remain till the spring, at which season they germinate. They were thus exposed to the rigours of the winter; and if the water froze, the statoblasts would naturally be included in the ice. This point had been investigated by Braem, who had published evidence tending to show that the germination of statoblasts was distinctly improved by frost. This is probably not a universal rule about statoblasts; it was possible for them to germinate without having under-

gone this process. Still, it seemed reasonable to suppose that any structure such as statoblasts which floated on the surface must be adapted to this particular possibility; hence it is reasonable to believe the general correctness of Braem's results, that the fact of statoblasts having been enclosed in ice might have a beneficial effect on their germination in the following spring. It is probably not unlike what happens in a seed or a bulb, which becomes dry, and has to be left in a dormant condition before it is in a position to germinate.

There is no doubt that statoblasts are structures of the greatest importance for the distribution of the species. Streams would naturally wash the statoblasts towards the sea, and this could be counteracted by statoblasts being brought into the upper reaches of the river. That was a point on which further evidence was needed. There were one or two isolated records of statoblasts having been recovered from the mud attached to the legs, feet and beaks of aquatic birds; and all such records were of interest, and should be carefully preserved. This seemed one of the most probable ways in which a new place could be colonized with statoblasts.

There was a further point to which he would like to draw the special attention of Fellows. Fresh-water Polyzoa were, as far as he knew, unique in respect of the number of their reproductive processes. It was common in the animal kingdom to find two different methods of reproduction occurring: one the sexual method, by fertilized eggs; and the other the asexual method. And there were many cases in which there was a distinct alternation of generations, such as the Hydrozoa, by eggs and by budding. As a general rule, budding resulted in an increase in the number of individuals of a colony, but not in the production of a new colony. In fresh-water Polyzoa one found a remarkable phenomenon. Mr. Rousselet said that some of the Polyzoa produced ciliated larvæ; and he thought that gentleman might have made the statement general. In addition, there was the asexual production of statoblasts taking place simultaneously with the production of other buds which increased the number of individuals of the colony. These statoblasts, when they germinated, also gave rise to new colonies.

There was one further complication, namely, that there were two distinct kinds of statoblasts: ordinary statoblasts, which had a ring of air-cells enabling them to float; and sessile statoblasts (without the ring), which were produced at the base of the colony, and remained adherent to the substratum on which the colony had been growing when the colony disintegrated in the autumn. So there were three distinct kinds of reproductive body: ovum, ordinary summer statoblasts, and winter statoblasts. One of the things about which one would like more information was, What was the relationship between these various reproductive bodies? Was there any difference between the colonies which were produced by the fertilized ovum, and those which were produced by statoblasts? Also, was there any difference between colonies produced from sessile statoblasts, and those produced from floating statoblasts? It seemed to him that this was a subject which would well repay careful experimental work; and he did not think the difficulty of the investigation would prove at all insuperable. It would be possible to isolate particular statoblasts, and to expose them to conditions of various kinds,

and to find out exactly what happened. To take a particular case, there were two forms, which had been referred to distinct genera, *Plumatella* and *Alcyonella*. *Plumatella* grew in a diffuse way, with large spaces between the branches, and it could frequently be found under the leaves of water-lilies. *Alcyonella* formed large compact masses on the object on which it was growing, and its tubes were closely packed, standing vertically to the surface and in close lateral contact. It had been said that if cut in half old colonies presented a structure similar to that of an onion, due to the presence of several annual rings; and that this was due to the fact that at the end of the season the soft parts disintegrated, leaving the tubes, which contained a number of statoblasts. In the following spring the statoblasts which were left in the old tubes germinated, the junction of the new growth and of the old tubes forming an annual ring.

It has been considered that *Plumatella* and *Alcyonella* are different forms of one and the same species; that if one statoblast germinates on a leaf it grows out into the diffuse pattern which generally occurs in *Plumatella*; while, if a number of statoblasts are deposited close together in one place, the new colonies produced by their simultaneous germination have not sufficient room and the tubes are crowded, thus giving rise to an *Alcyonella* colony. The doubt that exists in this case (and in others) might be resolved by experimental work.

He would like to call attention to a point of some practical importance, namely, that there might be danger in throwing away in a sink living statoblasts. There were cases on record in which Polyzoa had made their way into pipes for the supply of water, where they had flourished in an extraordinary way, causing all kinds of difficulties which it was extremely difficult to get over. The Polyzoa are animals which can grow well in pipes containing unfiltered water in which there are diatoms. In Hamburg and other places they have given rise to serious trouble in the pipes supplying the houses with water. He did not suppose there was much danger of introducing them into the pipes of waste-systems, but as there was a possibility of infecting surface-water systems, it would be well to exercise care on this point.

Mr. Earland said that no one could look at such a collection of statoblasts without recognizing that some, at any rate, bore a strong superficial resemblance to the mysterious bodies known as Xanthidia, which were found in flints. Was it anything more than similarity of form? Years ago he had been interested in Xanthidia and made a collection of them. He came to the conclusion that they had originally been of a horny nature because many specimens were ruptured and showed ragged edges at the fracture. Did Dr. Harmer think there was any connexion between the objects other than the similarity of form, which was especially noticeable in *Cristatella* and *Pectinatella*? Of course, the fact that the chalk flints were of marine origin was a strong argument against any such connexion, but, on the other hand, he had himself found fresh-water statoblasts in marine shore-gatherings from the Clare Island area, and the bodies in chalk flints might conceivably have been derived from a cretaceous fresh-water polyzoon.

Mr. D. J. Scourfield expressed his gratitude to Mr. Rousselet for bringing before the Society such a fine collection of statoblasts,

embracing, as it did, nearly all the known forms. There was one specimen exhibited which was not really a statoblast but the hibernaculum of *Paludicella*, and it was a very interesting point as to whether there was any connexion between hibernacula and true statoblasts. In a paper dealing with the Polyzoa of water-works, published in the Proceedings of the Zoological Society three years ago, Dr. Harmer went into this question, and concluded that there was ground for thinking that both might be looked upon as internal buds which had evolved along somewhat different lines. His own contribution to the exhibition was a mass of statoblasts of *Cristatella*, which were taken from one of the reservoirs of the East London Water-works, where enormous numbers had occasionally been found floating at the margin. The specimens shown had remained in the bottle since 1900; he did not know whether they still retained their vitality, but proposed to test them before long. London water, he believed, was remarkably well filtered and free from microscopic organisms, but in some parts of the country this was not always the case, and under those circumstances Polyzoa being provided with the necessary pabulum were enabled to develop in the pipes.

The President made some observations on the Auxiliary Polypides discovered by Metchnikoff and Nitsche, and the account given of them by Hincks. He asked Dr. Harmer whether he regarded the record of statoblasts of marine Polyzoa by Joliet to be a sound observation.

Dr. Harmer, in replying, admitted his ignorance of Xanthidia, but he thought the answer to Mr. Earland's question was the one which he gave himself; that it was very improbable he would find, in a marine deposit like chalk, anything comparable with statoblasts of fresh-water Polyzoa, even making allowances for the possibility of the remains of fresh-water organisms being included in a marine deposit. Chalk is a deposit in which one would not expect to find fresh-water organisms; and if any organism were common in flints, one would find very great difficulty in supposing it had anything to do with essentially fresh-water Polyzoa.

In answer to the President's remarks, he confessed he had never himself found anything in marine Polyzoa which there seemed the least reason for associating with statoblasts. Conceivably there might be something which was homologous with these bodies, but he did not know of anything of the kind.

With regard to the possibility of comparing anything in the nature of polypides with statoblasts, that in itself seemed to him improbable. The polypide is the alimentary canal *plus* the tentacles and other organs of an individual unit of the Polyzoa colony. The rest of the individual is the outer body-wall surrounding the body-cavity containing the polypide. The statoblast has, in its early stages, no trace of polypide, but it is comparable with the body-wall of a single individual of the colony.