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Notes on living Polyzoa. By J. R. Y. Goldstein.

[Read 23rd November, 1878.]

In penning the following notes of observations on living *Polyzoa*, my chief desire was to illustrate how easily any person possessed of a microscope can be of use to the world of science by jotting down, as they occur, whatever incidents he may consider peculiar in the appearance, habits, and general life-history of the various forms of minute life to be met with during quiet hours with the microscope.

It is true, many such notes will be repetitions of what has previously been observed by others, but it is equally true that just as many of them will be new. None can study closely any rare form of microscopic life without observing something never before recorded. When the student, conversant with the work done by others on the subject under examination, first discovers a new truth, he feels a joy equal to that which rewards the philosopher upon gaining the object of his researches after years of toil; and when he renews his pleasure by narrating the result of his observations to a society like ours, he experiences the full benefit of association, through having his work lovingly criticised, and being encouraged to further labours in the same direction.

While on this topic, I may be allowed to express wonder that men with valuable instruments, and all the costly appliances thereto belonging, will persistently fritter away their time in mere gazing, say at the beautiful markings on the frustules of diatoms. Diatoms are certainly beautiful, but they are by no means the most beautiful of nature's fashionings. I dare assert that the lovely forms of cell architecture to be met with among the *Polyzoa* will run them close on comparison, while any one of the species of this family, alive, would leave the much-loved diatoms far behind in any contention for a prize.

Then the desire to accumulate slides is too frequently little better than evidence of the mere love of having. In many cases approaching to the mania for tulip bulbs, or for old china. The general run of men with microscopes require to be lifted out of a groove and forced to enjoy the pleasures of observation and thought, soon opened out for their delectation in the study of any

one branch of microscopical science. As has been remarked by one of our members, on a previous occasion, "The observer who works out and records the life-history of any one of the simplest forms of minute animals, will have done more for science than a whole host of Diatomaniacs." And again, when we consider that here in Australia the scientific observer has at his feet whole worlds of undescribed life, where everything is new and strange, nothing can be advanced to excuse him from setting to work steadily and usefully to record his observations by means of papers for publication by this or kindred societies. He will find helping hands around him, and soon discover that his work is useful, and that it will be eagerly accepted and acknowledged by more able and learned workers in other parts of the world.

I fear that I have allowed myself to run too far in the direction of a homily, and that my *few* opening remarks will be considered anything but introductory to the subject of this paper. I will only say further that it must not be supposed that, in collecting the *Polyzoa* here described, I met with no other objects of interest, each haul of the dredge or scraper brought up literally myriads of minute forms of life, consequently the pages of my note-book, scant though they be, are not wholly occupied by notes on *Polyzoa*, but embrace observations on a variety of other objects well worth the attention of any student. From these notes I have, however, selected only such as refer to the favourite object of my study, the *Polyzoa*.

The most of the species, some twenty, which I was so fortunate as to secure alive, were obtained from the piles of the jetty at Portland some thirteen years ago. And, as evidence of the wealth of life in these waters, I may instance a piece of *Retepora*, in size about the bulk of two fists, which comprised within itself a veritable museum of curiosities. It contained tiny starfishes of lovely hues, *serpulæ* and *terrebellæ* of different sorts, *nerides*, *sponges*, two *sertularians*, several minute crustaceans, and a variety of molluscs, besides other things I had not time to identify. Why, here alone was work for a week! But *Polyzoa* was my chief object, so I placed a small piece of the *Retepora*, with a little sea water, in a common watch glass under the microscope. What a sight was there! No diatoms were ever half so lovely. Fancy a

field of animated flowers of most graceful shape—that of the lily—whose tiny petals curved and twisted, and waved themselves about as if in the most intense enjoyment of life. These tiny petals, like living threads of silver, were the expanded tentacles of the occupant of each cell, and were in number from sixteen to twenty, their motion rendering them difficult to count. Each tentacle was clothed with minute cilia, the rhythmic motion of which was well displayed under a power of fifty diameters. Words fail me to describe the scene. The cells were close together, and from each was extended the vase-like bunch of tentacles arranged in a circle on the lophophore or crestbearer, as this organ is styled. The whole was in constant motion, seeking food, which the currents caused by the cilia soon brought within their power. One or two tentacles might be noticed curling or gliding as if searching for some dainty, which, when obtained, was speedily secured by the contraction of the tentacles, when immediately the whole would disappear as if by magic; so quickly would the closed tentacles recede within the cell that the motion could not be discerned; they were simply gone, how, I could not even guess. After a little while the tentacles would be gradually thrust out and slowly expanded to their full beauty.

The whole field presented a busy, pleasant scene, that charmed beyond description. Each *Polyzoon*, as the animal is called, seemed to act independently of its neighbours; some would be fully extended, while others were in the safe recesses of their cells. If one was touched by a needle or a hair, it would instantly vanish without alarming the others, and when it again ventured forth, from the cautious manner in which it gradually expanded its tentacles, seeming half afraid, yet anxious, one could not avoid fancying the creature possessed intelligence of no mean order.

Irregularly scattered among the cells I noticed another form of *Polyzoon*, altogether different, which I afterwards ascertained was a *Pedecellina*, a genus of *Polyzoa* belonging to the order *Ctenostomata*.

This *Polyzoon* is invested with a thin transparent covering so slight as to make the animal appear to be naked, and grows on a pedicle, which starts from a creeping, adnate, tubular stem. The tentacles are very short and curled inwards. On these the ciliary

motion is well displayed, while the whole animal frequently bends and waves itself about on its pedicle as if moved by some fairy wind. This *Polyzoon* having no cell to retreat to, and being exceedingly transparent, affords a fine opportunity for studying its internal economy. The currents caused by the cilia were easily seen, and were strong enough to draw within reach objects floating at some distance, which, if nutritive, were immediately engulfed. The course of each particle of food was easily observed throughout the operations of mastication and digestion. The motion of the stomach was constant, food being continually pouring in, not in great quantities, truly, but still with such regularity that its powers of feeding seemed enormous. It is probable that at times there must be a dearth of food in the surrounding water, else it were impossible to understand how this constant absorption failed to cause a fracture somewhere, to say nothing of the minor ailments of dyspepsia.

The next species to describe was a *Diachoris*, the tentacles of which, twenty or more, were well displayed. This species possesses that truly wonderful appendage called an avicularium. In general appearance it is just like a parrot's head with rather long beak, the lower mandible open to its widest extent, occasionally shutting with a snap, and then re-opening slowly. Sometimes the avicularium moves sharply on its stalk, as if pouncing on some prey. It moves independently, whether the *Polyzoon* be extended from its cell, or not. The use of this strange organ is unknown. Various surmises have been offered by different observers, but nothing is certain. I regret to say my observations did not help much to elucidate the mystery. On another species—*Bugula dentata*, tentacles, sixteen—the avicularium has a motion peculiarly bird-like, and almost continuous. On one occasion I saw one with the mandibles closed, grasping a tuft of confervoid-like substance, just like a bird with a wisp of hay in its beak. This it retained for some days, while the peculiar waving motion was still kept up. The only explanation seemed to be that the decaying conferva would attract minute infusoria, which would thus be brought within easy reach of the tentacles of the *Polyzoon*. Busk says they are organs of prehension, but I confess my inability to understand exactly what this means.

On *Scrupocellaria scrupea*, another genus of the *Cheilostomatous Polyzoa*, there is another organ, the use of which in the economy of the *Polyzoa* is also uncertain. It is called a vibraculum, and consists in this species of a long spine attached to a socket joint, on which it can move in any direction, and with considerable force. Busk asserts that, in the majority of cases observed, this organ is mainly defensive in its character. In the few instances that came under my notice, they seemed to be used purely for cleansing. In *Scrupocellaria*, the motion of the vibraculæ was continuous, rising upwards and outwards with a slow, steady motion, and then back with a sudden jerk, as if by the snap of a spring, the jerk being downwards across the cells at back or front, sometimes alternately, thus apparently sweeping the surface of the cells free from any particles whose presence might disturb the comfort of the *Polyzoon*. This species was not so liberal in the display of its beauties as others had been, the tentacles being seldom fully extended, but I was enabled to ascertain that their number was invariably twelve.

Emma crystallina had also twelve tentacles. This is a very difficult species to make out, owing to the peculiar way in which the branches of the *Polyzoary* curl inwards. The cilia on this species are very short, so that it requires a power of about one hundred diameters to observe them with any clearness.

In most species of the *Cheilostomata*, the polyzoon only extends from its cell the lophophore or collar bearing the tentacles. In *Eucratea chelata*, however, tentacles twelve, nearly the whole animal would be extended. Not only the gullet, but almost the whole of the stomach could be observed outside the cell mouth. From this circumstance, and also owing to its extreme loveliness, this species is very interesting and well worth further study.

Although the genus *Catenicellæ* comprises so many species, twenty-four at least being found on this coast, I was only able to find one alive. This was *C. formosa*, a very lovely species, but like all true beauties, it seemed chary of displaying its charms.

On one occasion I sat constantly for five hours vainly endeavouring to ascertain the number of its tentacles. There seemed to be more than twelve, probably sixteen; but during the whole of that time not one polyzoon would remain motionless

sufficiently long to satisfy me on this point. Although frequently moving out and in, the animals seemed to be exceedingly cautious and shy. While other species would seem oblivious to severe shaking of the table or the microscope, this one would instantly vanish from view on the merest movement of the fine adjustment, so sensitive was it to external influences. The avicularia in this species affords a good sight of the muscles and their action in closing and opening the mandible. This snaps upwards sharply, and re-opens just as quickly.

Bicellaria ciliata is another lovely species, but difficult to make out, owing to the long spinous processes that form a sort of cage about the cells, thus interfering with definition. As well as I could make out there seemed to be about twenty tentacles on each polyzoon. The spinous processes seemed to be immovable.

Of *Caberea lata* I got a fine specimen, but unfortunately it got so covered with dirt while bringing it home in a bottle with other objects, that it never could, or never would, display its tentacles. The only motion to be seen was in the vibraculæ, which, in this instance, were very busy; certainly they had a heavy job of cleansing to do. On this specimen the ovicells were numerous, and very transparent. The ova were granular, and of a bright scarlet colour.

This species is specially interesting to me as being the first Polyzoon I had ever seen alive. On a previous occasion, some years before, I had got a fine branch of it, and was of course charmed. The motion of the vibraculæ was strong, and the animal fairly extended. Being anxious that others should share my pleasure, I sent for two friends, gentlemen of scientific tastes. They were very anxious to verify my remarks, and watched the specimen carefully for about an hour, but to my intense chagrin, could not observe the slightest sign of life. All was quiet. Five minutes after they had left every spine was in rapid motion, waving and jerking in every direction in the most excited manner, as if amused at my disappointment.

Of *Membranipora pilosa*, a very common species, found encrusting seaweeds of various sorts, I may remark that for liveliness it presents a strong contast to *Catincella formosa*. Every polyzoon fully extended; tentacles, twelve; movements very

rapid. Ciliary motion beautiful and very distinct, the cilia being much longer than in any other species observed by me.

In most of the above species the colours were dull, and of sober hues, such as light browns and creamy whites. *Bugula dentata* was of bluish green, deeper in shade towards the tips of the branches, while the colour of the polyzoon was a light brown; but even here the colour was not brilliant. If nature seems to have denied to these moss-like Polyzoans the additional beauty of varied colours, she seems to have gone to the other extreme with the calcareous kinds. Of *Lepralia* I found three species; of *Cellepora* four. The colours in all being simply magnificent.

In the scarlet *Lepralia, L. Ellerii* (?), the colour is very bright, and seems to be located in a fleshy epidermis, with which the stony polyzoary is coated. This epidermis is granular and of considerable thickness, as plainly seen by strong daylight, while on the points of many of the older spines or bosses this epidermis is thin, as if rubbed or worn, showing the usual crystal clearness of the calcareous base.

In other species the colours were intense and beautiful. One had an olive green epidermis minutely and irregularly spotted with pure white. In another the colour was a bright black, with a golden tracery of yellow spots connected by fine lines. Another had crystal walls, spotted with opal white, while the polyzoon was a bright brick red. There were sixteen tentacles on this species, and inside of some of the cells I noticed small masses of intense crimson near the aperture, seemingly unaffected by the motions of the animal, similar in appearance to the contents of the ovicells.

Lepralia punctata (?) * is a lovely species, and very interesting. Tentacles, twenty; lophophore fully extended from cell; outer cell wall widely perforated. In some instances the perforations run into each other, forming large apertures, showing the thin wall of the inner cell, between which and the outer cell there is an open space, affording free access for the water. This was evident upon seeing a tiny Rotifer swim in and out. Through these perforations almost the whole length of the animal can be clearly seen; the cell walls being also very transparent. The polyzoon is coloured yellowish brown.

* Probably *L. monoceros*.

The spines on this species, a solitary one on one side of each cell near the aperture, seem to be only on the newly-formed cells, those near the edge of the polyzoary. In the newest cells, or rather in those being formed, can be seen the immature polyzoon, like a bunch of short fingers closed together, the thick outer cell being still unformed. This outer cell seems to grow up gradually from the outer edges until the various irregular projections meet and coalesce, forming a reticulated pattern. I thought I could discern a small sessile avicularium on the front margin of the aperture of cell. There are no spines to be seen on the old cells, but I could see the places where they had been. On turning over the polyzoary, the back of the cells was seen to be very thin and transparent, showing the whole of the polyzoon, in some cases seemingly free, and in others attached to the cell by a muscle at the base. Altogether this is a lovely and highly interesting species.

I feel a regret that the few notes I have here recorded have been put together so hurriedly as to merit the charge of meagreness, but I crave indulgence, and trust that the work I have set myself to do, in conjunction with my friend, Mr. Maplestone, to prepare a full list of all Australian Polyzoa, will prove of more real use than could be expected from the poverty of this paper. We propose to describe and figure all species observed, giving particular attention to their characteristics when alive, and will deposit at the National Museum a complete collection of type specimens and duplicate slides. We have a goodly number of new species.

In conclusion, I would again urge upon the junior members of this society, each of them, to take up one branch of study, and work it out regularly and consistently. Books on natural history are plentiful, and nowadays they are so low in price that anyone may speedily get together such books as may tell him what work has been already done in the subject of his choice. He will then know what to look for, what problems require to be worked out, and his note book will afford ready means of jotting down his own observations; only let him not observe without noting, it is waste of time. This society will be glad to have such recorded observations when it publishes its transactions, and will

then have something valuable to exchange for the transactions of other kindred societies throughout the world. And so our library may become a valuable aid to future explorers in the realms of microscopic science.

On the Use of Carbolic Acid in Mounting Microscopic Objects.

By J. R. Y. Goldstein.

[Read 28th August, 1879.]

The mounting of objects in Canada balsam, by means of turpentine, has long been a serious difficulty to students, and a nuisance even to practised hands. Turpentine evaporates so slowly that the hardening, or baking, and finishing of slides becomes a serious obstacle where time is concerned, while the previous preparation of objects saturated by water is exceedingly troublesome, and a general characteristic of messiness pervades the whole operation.

The members of this society have for some years adopted, with advantage, a method suggested by the President, Dr. Ralph, in 1874, by which much of the unpleasantness of mounting in balsam is avoided, and the time occupied considerably shortened. Now that the process has stood the test of years, and has proved so decidedly beneficial, it is considered advisable to publish in the journal of the society a detailed description of the process, in order that microscopists generally may know and use what may properly be called "Ralph's carbolic process."

When first calling attention to the subject, Dr. Ralph suggested the use of glycerine as a means of withdrawing water from objects before using the acid, but experience has shown that this is not necessary, as by the use of heat carbolic acid will readily absorb, and eventually replace the water in any object saturated therewith.

The carbolic acid used should be the purest that can be obtained, and it will be well to keep the greater portion as stock in a dark-blue glass-stoppered bottle, so as to prevent it being discoloured by exposure to light. From this can be transferred, as required, a small quantity to a working bottle of about two drachms capacity. If the acid is so pure as to be crystalized, melt what is in the smaller bottle, and add a few drops of spirits of wine, which will