

## **Observations on the generation of the lobularia digitata / by R. E. Grant.**

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For the Roy. Coll. of Physicians  
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Observations on the Generation of the *Lobularia digitata*,  
Lam. (*Alcyonium lobatum*, Pall.) By R. E. GRANT, M. D.,  
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IN various observations and experiments on the structure and economy of Zoophytes found inhabiting the Frith of Forth, I have already shown that in many *silicious*, *calcareous*, and *horny* species, the minute reproductive gemmules by which these animals propagate, are highly organized portions of the gelatinous substance of the parent, which possess the power of swimming freely to and fro, for a considerable time after their separation, by the rapid vibration of very small ciliæ covering their surface. Although I had not an opportunity of observing this singular phenomenon in any zoophyte which discharges its ova through the bodies of polypi, I was induced from analogy to believe that the motions observed by Cavolini in the ova of the *Caryophyllia* and *Gorgonia*, which are discharged through polypi, were produced by similar organs, and that these organs in the same situation are probably of much more general occurrence in this class of animals than has yet been observed. During the month of October I procured some specimens of the white variety of *Lobularia digitata* from the Frith of Forth, with their ova in a state of maturity, which afforded me the means of observing the process of generation, not only in a species whose ova pass through polypi of a very complicated structure, but also in a zoophyte with a *fleshy* and contractile axis,



differing much from those I had already examined. Both the red and white varieties of this animal of various shades of intensity, are found in every part of the Frith of Forth from this to the opposite shore, adhering in large masses to stones, shells, and fuci. At low water we observe it hanging in numerous fleshy lobes from the under and sheltered surface of rocks; after storms, quantities of it are often left on shore, adhering to marine plants and animals which have been torn from their seat; and by accompanying the dredgers daily employed in the Forth we constantly find it brought up by the dredges from deep water, spreading on all kinds of solid substances lying at the bottom, as broken bottles, glasses, shells, &c.

Jussieu examined the structure of this animal with the microscope, on the coast of Normandy, more than eighty years ago, and has given accurate representations of many parts of its structure (*Mem. de l'Ac.* 1742.). Mr Ellis, who mentions it as occurring in great plenty round all the coasts of the British islands, has given many excellent figures illustrating its internal structure, the appearance and situation of its ova, and their mode of passing out through the bodies of the polypi (*Phil. Trans.* liii. Pl. XX.). He has placed groups of 5 — 8 loose ova in each of the canals below the polypi, and similar groups in the transparent bodies of the polypi below the stomach, which are represented passing up one after another towards the mouth. It is to be regretted that he has not left a full description of the interesting appearances represented in these figures. Dr Spix of Bavaria, without noticing the accurate and elegant plates of Mr Ellis, and with a low estimation of the labours of our distinguished countryman, has given several figures to illustrate the mode of generation of the *Lobularia* (*Ann. du Mus.* t. xiii. Pl. XXXIII.), which differ as much from nature as they do from the plates of his predecessor. He has represented the head of the polypus as consisting of a large round vesicle or stomach, to the sides of which are closely applied eight thick cylindrical claviform tentacula covered with minute papillæ; descending from the stomach he has represented a long narrow tapering tube, and the ova are placed in a single line, inclosed in a small curved canal, like a string of beads. His observations correspond

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with his figures. He states that the tentacula appear to be filled with globules of air; that the polypus can withdraw the tentacula into its mouth; that the body of the polypus is not thicker than a hair; and that the polypi die contracted. He mentions also that each of the round red globules which are discharged through the mouth, is an *ovarium*, containing, within a distinct capsule, a multitude of small eggs like those of a fly, an appearance which he has represented in the figures, and he is thence led to inquire whether all zoophytes may not in the same manner be oviparous. It is singular that this author commences his observations by stating that Mr Ellis generally mistook the ova of zoophytes for ovaria, an error which he has not shown to belong to the great British zoophytist, but which he has himself obviously committed with regard to the *Lobularia*. Lamouroux has corrected some of the errors of Spix, and has given elegant magnified figures to illustrate the anatomy of the polypi of this animal, (*Hist. des Pol. Pl. XIII.*); but as he examined the *Lobularia* only in spring, he could detect no trace of ova or ovaria in its structure, and was therefore unfortunately prevented from throwing any light on this interesting part of its economy.

On laying open the white *Lobularia* in the direction of its canals, I found in all these cavities numerous small red-coloured spheres of a regular form and soft consistence, and about the fifth of a line in diameter. Many of them much smaller, and of a white colour, adhered to longitudinal white lines at the upper end of the canals. There were several of these longitudinal rows of ova at the base of each polypus, and most of them were connected by peduncles or tubes to the white longitudinal folds of the canals. The smallest had the strongest connection, those of a larger size were connected only by a slender filament, and the largest red ova were quite free. The white folds to which the ova adhere, are continuous with the eight longitudinal folds seen within the polypi. There were generally about twenty small white ova in each canal, besides ten or twelve perfectly formed, and of a red colour. Most of the mature ova were collected together near the basis of the polypi, where they were quite loose, of a deep red colour, and of a larger and more equal size than those attached to the



folds of the canals. Their appearance closely resembled the figures of Mr Ellis; they were quite visible to the naked eye, and when a section of the animal was placed in water the red ova fell out separately, and sunk slowly to the bottom. The red colour of these ova is mentioned by Dr Spix, the ova of the *Gorgonia* and *Madrepore* have a red colour, and the ova of the *Medusa aurita*, Lin. are described by Dr Rosenthal (*Zeitsch. für Phys.* i. B. s. 328.) as round bodies of a red colour, and somewhat lengthened form, which "in their mature state move backwards and forwards in a lively manner without altering their form." The ova of the *Lobularia* exhibited various shades of colour, from white to deep red, according to their size and maturity. By pressing the red ova between the forceps they were found to consist of a distinct transparent membranous capsule, filled with a gelatinous matter, which appeared under the microscope to be composed of the same small globules or monade-like bodies which compose the ova of other zoophytes, and almost all the soft parts of animals. They did not produce the slightest effervescence in nitric acid, although every part of the fleshy substance of the adult *Lobularia* contains calcareous matter. By remaining a few days in spirits, or in fresh water, the ova entirely lost their red colour, and assumed a yellowish-white appearance even in the centre of entire lobes.

After a specimen of the animal had remained for some hours suspended in its natural vertical position in a crystal jar filled with pure sea-water, and its polypi had fully extended themselves, I was delighted to find the large red ova beginning to descend from the interior of the canals into the transparent bodies of the polypi, where I could easily observe their progress with the aid of a lens, through the sides of the glass vessel. They advanced slowly and only when the polypi were distended. In the space of twenty-four hours ova were seen in the bodies of most of the polypi; some polypi had only one, several had two or three, and in others groups of four or five ova were observed together placed without any regular order. Many of the polypi had no ova, in others the mouth was seen distended with a single ovum in the act of being discharged, and a few ova were found lying separate at the bottom of the jar. All



those which had descended into the bodies of the polypi, and those found loose in the jar, were of the full size and deep-red colour. None of the imperfectly formed white ova were detached from the sides of the canals, or seen in the polypi. I collected carefully the loose ova from the bottom of the jar, and on placing them in a watch-glass with sea-water I could perceive with the naked eye that they continually changed their situations, gliding to and fro with an almost imperceptible motion. Viewed with the aid of a lens, their motions were obvious; they were seen to contract themselves frequently during their progressive motions, and sometimes they appeared revolving round their axis. When placed under the microscope, and viewed by transmitted light, they appeared as opaque spheres surrounded with a thin transparent margin, which increased in thickness when the ova began to grow, and such of the ova as lay in contact united and grew as one ovum. A rapid current in the water immediately around each ovum, drawing along with it all loose particles and floating animalcules, was distinctly seen flowing with an equal velocity as in other ciliated ova, and a zone of very minute vibrating ciliæ was perceptible, surrounding the transparent margin of all the ova. The progressive motion of the ova, always in a direction contrary to that of the current created by their ciliæ, was very obvious, though less rapid than in any other zoophyte in which I have observed the same remarkable phenomenon. The specimen suspended in the glass jar filled with pure sea-water I now brought so close to the transparent side of the vessel, that I could examine through it, with the assistance of a powerful lens, and without disturbing the animal, the motions and progress of the groups of ova passing through the colourless bodies of the polypi. To the naked eye at first sight all appeared motionless. The deep vermilion hue of the small round ova, and the colourless transparency of the outer covering of the polypi, formed a beautiful contrast with the pure white colour of the delicate longitudinal folds, the central open canal, and the slender filaments which wind down from its sides towards the clusters of white ova at the base; but the living phenomena discovered within were even more admirable than the beautiful contrast of colours, the



elegant forms, and the exquisite structure of all the parts. When observed with a lens the ova were seen to be in constant motion, and quite free within the bodies of the polypi. They moved themselves backwards and forwards, and frequently contracted their sides, as if irritated or capable of feeling. I could observe none passing upwards between the stomach and the sides of the polypi. They never assumed the appearance of a string of beads inclosed in a narrow shut curved tube, as represented by Spix, but swam freely in the water which distended the polypi, as figured by Ellis. Their motions in the polypi, though circumscribed, were so incessant, that by watching attentively I could observe them with the naked eye, and they became more conspicuous as the ova advanced to the open base of the stomach. From their restlessness, as they approached that last passage which separates them from the sea, they seemed to feel the impulse of a new element, which they were impatient to enjoy, and by following the direction of that impulse they appeared to find their way into the lower open extremity of the stomach, without any organic arrangement to lead them into that narrow canal. In their passage through the stomach, which was effected very slowly, the spontaneous motions of the ova were arrested, unless some imperceptible action of their ciliæ, or some contractions of their surface, might tend to irritate the sides of that canal, and thus direct or hasten their escape.

The clusters of ova found in autumn at the base of the polypi of the *Lobularia*, have no relation to the ovaria of higher animals. They are true gemmules or buds which grow from the sides of the internal canals; they are nourished by umbilical cords; they fall off and escape when mature; and, as in other zoophytes, they leave no trace of their existence behind. Their spontaneous motion establishes the existence of this remarkable property in a tribe of zoophytes with a fleshy axis, where it had not before been observed, and opens to our contemplation a new and singular arrangement for aiding and directing the passage of these delicate reproductive globules, through the complicated bodies of animals where irritability is nearly extinct. It would be highly interesting to trace how far up in the scale of animals this simple arrange-



ment takes place to facilitate the exit of the embryo from the inert body of the parent. The above remark of Dr Rosenthal respecting the Medusa, shows that it takes place in the class of Radiated animals; and I have shown in a former number of this *Journal* (No. xiii. p. 121.), that in the class of Molluscous animals, the escape of the fœtus from highly complicated ovaria, as those of the Buccinum, is effected in like manner by the rapid vibration of ciliæ placed on the surface of the young. The transformation of the ova above described, from their moving, irritable, and free condition of animalcules, to that of fixed and almost inert zoophytes, exhibits a new metamorphosis in the animal kingdom, not less remarkable than that of many reptiles from their first aquatic condition, or that of insects from their larva state. Ulvæ and confervæ have been seen to resolve themselves into animalcules, (*Schweigger's Beobacht. auf N. R.* s. 90.), and Professor Aghard has seen these animalcules reunite to construct the plants. Mosses and Equiseta are found to originate from confervæ, (*Mém. du Mus.* tom. ix. p. 283.), and all the land confervæ with radicles appear to pass into the state of more perfect plants. The Oscillatoriæ which cover the stones in our fresh water pools with a green and velvety crust, resolve themselves into animalcules and lively moving filaments, whose motions have been described by Saussure, Vaucher, and others. The globules of our blood have been seen to arrange themselves into fibres, (*Phil. Trans.* 1818. p. 172.), and the densest fibres have been resolved into their regular component globules. But few known changes in the vegetable or animal kingdom are more singular than that which the ova of zoophytes present in passing from the state of lively, free, and spontaneously moving bodies, to that of fixed horny roots, or equally inert calcareous cells.















