opacity to space, and I do not imagine it to be very wide of the truth.

It is therefore with equal wisdom and goodness, that creative Omnipotence has given to space a high degree of translucidity, without, however, rendering this translucidity perfect, and that it has thus limited the range of our vision to a determinate part of this space. In consequence of this arrangement, we are placed in a condition to acquire some knowledge of the structure and arrangement of the universe, of which we should scarcely know any thing, had the most distant suns sent us a light which underwent no diminution.—*Bibliotheque Universelle, Feb.* 1826.

Observations on the Spontaneous Motions of the Ova of the Campanularia dichotoma, Gorgonia verrucosa, Caryophyllea calycularis, Spongia panicea, Sp. papillaris, cristata, tomentosa, and Plumularia falcata. By Robert E. Grant, M. D. F. R. S. E., F. L. S., M. W. S., &c *. (Communicated by the Author.)

THAT acute and indefatigable zoologist Mr Ellis, first observed in 1755 the spontaneous motions exhibited by the *ova* of the *Campanularia dichotoma* Lam., *(Sertularia dichotoma* Lin.*)*, for some time after their separation from the parent. Although this interesting fact is one of the most important and best established which has yet been discovered, connected with the generation of zoophytes, and one of very general occurrence in these animals, it has attracted so little attention for half a century past, that we find not the slightest allusion to it in the writings of Lamarck, Lamouroux, Cuvier, or almost any other modern zoologist. When in company with Dr Schlosser and Mr Ehret, on the coast of Sussex, Mr Ellis examined the *Campanularia dichotoma* alive, and found several vesicles on it, some of which contained ova attached to an umbilical cord. This cord was distinctly seen through the transparent coats of the vesicle, to take its origin from the fleshy central part of the stem. "In other vesicles (he observes) we discovered these ova beginning to exhi-

* Read before the Wernerian Natural History Society, 27th May 1826.

bit signs of life ; they appeared to us to be evidently young living polypi, which extended in a circular order, the tentacula proceeding from their head, as in other polypi. While examining them, some of the ova, after detaching themselves, fell to the bottom of the glass of water in which we had placed them ; they then began to move and stretch themselves out like fresh water polypi ;" (Ellis, Hist. Nat. des Cor., p. 116). This statement of Mr Ellis, though not altogether correct in its detail, is satisfactory as to the motions of the ova which he saw escape from the vesicles. As this species of *Campanularia* occurs abundantly on Leith rocks, and, at this time (May) presents the ova in a state of maturity, I have examined their singular motions under the microscope, in presence of some friends conversant with the structure of these animals. The moving ova which Mr Ellis observed, were not, as he supposed, the same with the polypi-like bodies he has represented (Pl. xxxviii. Fig. 3. B, B, B,) hanging from the mouths of the vesicles, but were ova which had fallen from these polypi-like bodies. The polypi-like bodies, viewed under the microscope, are found to be thin, transparent, motionless capsules, containing each three distinct ova, and presenting at their free extremities several stiff, straight, diverging pointed processes, which Mr Ellis mistook for the tentacula of a young polypus ; and was thus led to believe, that the polypus is the first formed part of a young zoophyte, which I have found by experiment to be contrary to fact. This mode of generation in *Sertularia*, by the detachment of numerous capsules, containing ova enveloped in a viscid matter, was known to Cavolini, who, forty years ago, detected the fallacy of Mr Ellis's statement regarding the polypi-like bodies, and suspected that the true ova contained in these exterior capsules, would be found to exhibit the same kind of motions which he had observed in the ova of other zoophytes ; but he did not succeed in obtaining the ova after their expulsion from the capsules, so as to verify or refute his conjecture. As I had already observed through the transparent vesicles of the *Plumularia falcata* the motions, and even the ciliæ, of the ova contained in them, I placed one of the polypi-like capsules hanging by umbilical cords, from the vesicles of the *Camp. dichotoma* entire under the microscope, and I could distinctly perceive the vortex-like cur-

rents along the surface of the contained ova, and that particular vibrating zone immediately around them, which we always observe along a ciliated surface, when the ciliæ are in too rapid motion to be distinctly seen. On allowing the three ova to escape into the water of the watch-glass, by tearing open the capsule with two needles, they immediately began to glide to and fro along the bottom, and I could now perceive the ciliæ vibrating on their surface as they moved forward. The ova of this minute zoophyte are very numerous, amounting to twenty or thirty in each vesicle, which is probably the reason of the polypi-like capsules, to allow so many ova sufficient space to develope themselves on the outside of the vesicles. I have never observed more than two ova in a vesicle of the *Plumularia falcata*, and they have space to arrive at full maturity within that vesicle. The ova of the *Camp. dichotoma* are very minute, regularly formed oval bodies of a semiopaque milk-white colour; the ciliæ distributed over their surface, propel them only in one direction; their motions and general appearance, like those of other ova, are so peculiar, that they are easily distinguished from animalcules, by any person who has once examined the mature vesicles of a zoophyte. The *ciliæ* on the surface of these and other ova are minute filaments, which may be compared to the small hairs covering the human body; they do not add to the internal organization of the ovum, nor render it as complex as that of the adult animal which possesses highly organized polypi; they are organs which exist in the adult zoophyte, and in the simplest known forms of animal matter, the motions of the simplest gelatinous animalcules being performed by them; and they are necessary to prevent the ova from falling by their own gravity like the seeds of plants, to be buried in the ever-moving sands.

Cavolini prosecuted for two successive years, 1784–5, his researches into the structure and economy of the *Gorgonia verrucosa* Lam., particularly with reference to the spontaneous motions and the development of its ova; and his observations on this animal form a model of patient and scientific inquiry, which has no equal in the history of zoophytology. He examined the position of the ovaria at the base of each polypus, watched the manner in which the ova were discharged through eight small oviducts, opening between the bases of the eight tentacula, and

has given enlarged representations of the forms which the ova assumed while swimming to and fro, and of their appearance when laid open. He observed, that the ova were all somewhat egg-shaped; that they passed through the oviduct with their tapering end pointed forward; and that, as soon as discharged, they turned up their rounded thick extremity, and continued to swim about with that extremity always forward (Cavolini, Abhand. uber Pflanzen-thiere, p. 48). On cutting off a small portion of the outer covering from the base of a polypus, he generally observed five ova of a flesh-red colour, like those he saw passing out through the oviducts. In the month of June, he observed the polypi of the *Gorgonia* in the act of discharging their ova; a portion of this zoophyte, only six inches high, discharged ninety ova in the space of an hour. The ova first mounted in a spiral direction to the surface of the water, then swam in a horizontal direction to the margin, without changing their forms. Under the microscope, he repeatedly observed the ovum change its lengthened form to that of a sphere, and when the microscope was perfectly steady, he was surprised to see the ovum bound off with rapidity from the place where it lay, and keep itself in a constant quick motion as long as he watched it (Abh. p. 48). "On looking again at the vessel in which the *Gorgonia* lay (he says) I found that all the ova had arranged themselves round the margin, with their rounded thick ends applied to the sides of the vessel, like a swarm of wood-lice on a branch; and when I pushed them off with a needle, they changed their forms in an extraordinary manner, while they continued to swim about in all directions."

In the *Caryophyllia calycularis* Lam. (*Madrepora calycularis* Lin.), Cavolini observed that the ova were, like those of the Gorgonia, in a state of maturity in spring, and were discharged, in the same manner, through small distinct openings between each of the tentacula. They were seen through the transparent sides of the polypi to occupy a similar situation at their base; they had the same ovoidal shape, but were of a darker red colour than those of the gorgonia, and somewhat larger. They exhibited the same singular phenomena; they glided about in the water; swam to the surface; changed their forms, in a variety of ways, on the slightest irritation; and, when torn under

the microscope, they exhibited the same granular structure (Cav. Abhand. p. 50.) The detailed account which Cavolini has given of the spontaneous motions of the ova in these two zoophytes, agrees so remarkably with what I have observed in other genera, that I have not the least doubt that they are produced in the same manner, by the rapid vibration of minute *ciliæ* distributed over their surface; and that the ciliæ have escaped his observation, and that of Mr Ellis (in the *Campanularia*) only from their not employing the high magnifying powers necessary to render them distinct.

In a memoir on the Structure and Functions of the Sponge, read to the Wernerian Society, in March 1825, I described the singular motions which I had observed in the ova of the *Spongia panicea* Lam., *Sp. papillaris*, *cristata*, *tomentosa*, between the time of their expulsion from the fecal orifices, and that of their permanently fixing themselves to develope on the surface of watch-glasses, and represented the appearance of the ciliæ which I had discovered by the aid of the microscope, vibrating on the surface of the ova as they moved about in the water, and even for a short time after they had fixed themselves (see Edin. Phil. Journ. vol. xiii. p. 382.) The details connected with the formation and detachment of these ova, their structure at the time of expulsion, and the changes they undergo during the fixing and developing of their bodies, are reserved for the continuation of my memoir on that animal; but, with reference to their spontaneous motions, I may here observe, that they are all somewhat egg-shaped, the ciliæ cover every part of their surface, excepting their posterior tapering extremity, where I have never distinctly perceived them. In swimming, they always carry their broadest extremity forward. They have a granular structure, and a rough surface, like the ova of the gorgonia; but spicula are distinctly discernible in those of the Spongia panicea, at the time of their expulsion. They do not change their forms, while swimming, like the ova of many other zoophytes, but glide along with a regular and smooth motion. After remaining some time in the water, they generally come to the surface, and collect round the margin. When one of them is placed in a drop of water, under the microscope, we often see the motions of the ciliæ gradually cease, and become again suddenly revived, without the ovum

undergoing the least change of form; on cutting an ovum of the Sp. papillaris transversely through the middle, its anterior half continued the motions of its ciliæ for 24 hours. The form of the ovum, and its general appearance, vary with the species, and are as easily distinguishable as those of the adult. Having now examined these ova during two successive years, and having varied my experiments in every possible manner, I consider the spontaneous motions of the ova in the above species as sufficiently established by direct observation, and by the analogy of other zoophytes.

The observations which I have lately made on the ova of the *Plumularia falcata* Lam., have not been less satisfactory than those so often repeated on the ova of the sponge. I have taken the mature ova from the vesicles of the plumularia, and examined their spontaneous motions, under the microscope, in the presence of experienced naturalists; and I now present to the Wernerian Society eight of these ova growing and branching on the side of a glass vessel, after their having remained three weeks in that situation. This species is very common in the deeper parts of the Frith of Forth; its vesicles are very numerous, and its ova are in full maturity at the beginning of May. The ova are large, of a light brown colour, semi-opaque, nearly spherical, composed of minute transparent granules, ciliated on the surface, and distinctly irritable. There are only two ova in each vesicle; so that they do not require any external capsules, like those of the campanularia, to allow them sufficient space to come to maturity. On placing an entire vesicle, with its two ova, under the microscope, we perceive, through the transparent sides, the ciliæ vibrating on the surface of the contained ova, and the currents produced in the fluid within by their motion. When we open the vesicle with two needles, in a drop of sea-water, the ova glide to and fro through the water, at first slowly, but afterwards more quickly, and their ciliæ propel them with the same part always forward. They are highly irritable, and frequently contract their bodies so as to exhibit those singular changes of form spoken of by Cavolini. These contractions are particularly observed when they come in contact with a hair, a filament of conferva, a grain of sand, or any minute object; and they are likewise frequent and remarkable at the time when the ovum is bu-

sied in attaching its body permanently to the surface of the glass. After they have fixed, they become flat and circular, and the more opaque parts of the ova assume a radiated appearance; so that they now appear, even to the naked eye, like so many minute grey coloured stars, having the interstices between the rays filled with a colourless transparent matter, which seems to harden into horn. The grey matter swells in the centre, where the rays meet, and rises perpendicularly upwards, surrounded by the transparent horny matter, so as to form the trunk of the future zoophyte. The rays first formed are obviously the fleshy central substance of the roots, and the portion of that substance which grows perpendicularly upwards, forms the fleshy central part of the stem. As early as I could observe the stem, it was open at the top; and, when it bifurcated to form two branches, both were open at their extremities, but the fleshy central matter had nowhere developed itself as yet into the form of a polypus. Polypi, therefore, are not the first formed parts of this zoophyte, but are organs which appear long after the formation of the root and stem, as the leaves and flowers of a plant.

From these observations it appears that the so-named *ova* of many zoophytes, when newly detached from the parent, have the power of buoying themselves up in the water, by the rapid motions of ciliæ placed on their surface, till they are carried by the waves, or by their own spontaneous efforts, to a place favourable for their growth, where they fix their body in the particular position best suited for the future development of its parts. How far this law is general with zoophytes, must be determined by future observation.

On the Noises that sometimes accompany the Aurora Borealis.

Having, many years ago, both in this country and in the Shetland Islands, heard very distinctly noises proceeding from the polar lights, we have always given full credit to the statements of those observers who have published accounts of this fact. It is true, that late observers, particularly our friends and former pupils