Observations on the structure and nature of flustrae [Part 2] / by R. E. Grant.

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Observations on the Structure and Nature of Flustræ. By R. E. GRANT, M.D. F.R.S.E. F.L.S. M.W.S. Fellow of the Royal College of Physicians of Edinburgh, Prof. of Zoology in the University of London, &c. (Continued from p. 118.)

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IN examining the anatomy of the other species of Flustræ above mentioned, more care is required than in the examination of the *F. carbasea*, as the two plains of cells composing the branches of the *F. foliacea* and *F. truncata* require to be carefully separated from each other, and the sessile species, *F. telacea*, *F. dentata*, and *F. pilosa*, require to be removed from the surface of the fuci, or other substances to which they adhere, in order to render them sufficiently transparent to allow their minute structure to be perceived through the reflecting microscope. The *Flustra foliacea*, Lam., like the *F. carbasea*, already described, is an inhabitant of deep water, and is very rarely met with in a fixed situation near the shore, or in places accessible at ebb tide, though, from the immense quantities of it which I have found drifted alive on our eastern and western coasts, and constantly brought up by the dredges from oyster-beds, it appears to be the most abundant species on the British shores. It generally adheres to shells or stones, on the surface of which it first spreads like a sessile species with a single plain of cells, then rises up in the centre of the expanded base in a branched form, when its branches are always composed of a double plain of cells. It is a very large species, its branches often amounting to many hundreds, and presenting on their two surfaces some hundred square inches of cells. It has a strong and pleasant odour of violets, which it retains for some time after being taken from the sea, and it is probably the species which the inhabitants of Iceland are said to chew as a substitute for tobacco. The branches have a thick, opaque, and coarse appearance, gene-

rally a yellowish-grey colour, and a rough surface covered with minute reverted spines; they are variously subdivided, but most frequently present a broad palmate form, terminated by numerous rounded and expanded digitations. The sides of the stems and lower branches do not present the thickened, opaque, and compact margins we find in the *F. truncata* and *F. carbasea*, which are much more delicate species. The tips of the branches are thin, soft, and transparent, as in other branched species, and as in the anterior margin of sessile species, from their containing little calcareous matter, and from the polypi in that situation being young, colourless, and translucent. The boundaries of the cells on the opposite plains do not coincide, nor have they any determinate relation to each other in their position. The broad rounded extremity and the aperture of the cells are always above, the contracted and flat base always below. The cells are arranged on each surface, as in the *F. carbasea*; the opaque sides of the cells form continuous ramified lines from the base to the apex of the branches; and the first cell of a new series in the middle of the branch is always smaller than the cells which surround it, being confined to a small angular space, formed by the bifurcation of the opaque lateral wall of a perfect cell. The tips of the branches are never bounded by a smooth continuous line, as we observe them in the *F. carbasea* and *F. truncata*, but are terminated by the round bulbous extremities of the last two rows of cells; this remarkable difference is observable by the aid of a common lens.

The cells are shorter and proportionally broader than in the *F. carbasea*, being about the sixth of a line in length, and a little more than half as much in breadth. By tearing the two plains of cells asunder, we render them nearly as transparent as in the *F. carbasea*, and can distinctly perceive the structure of the parts within. The aperture of the cells is formed by a semicircular lid, convex externally and concave internally, which folds down when the polypus is about to advance from the cell. The opening of this lid in the *F. truncata*, where it is very long, appears through the microscope like the opening of a snake's jaws, and the organs by which this motion is effected are not perceptible. The lid of the cells opens and shuts in *flustræ*, without the slightest perceptible synchronous motion of the polypi. We

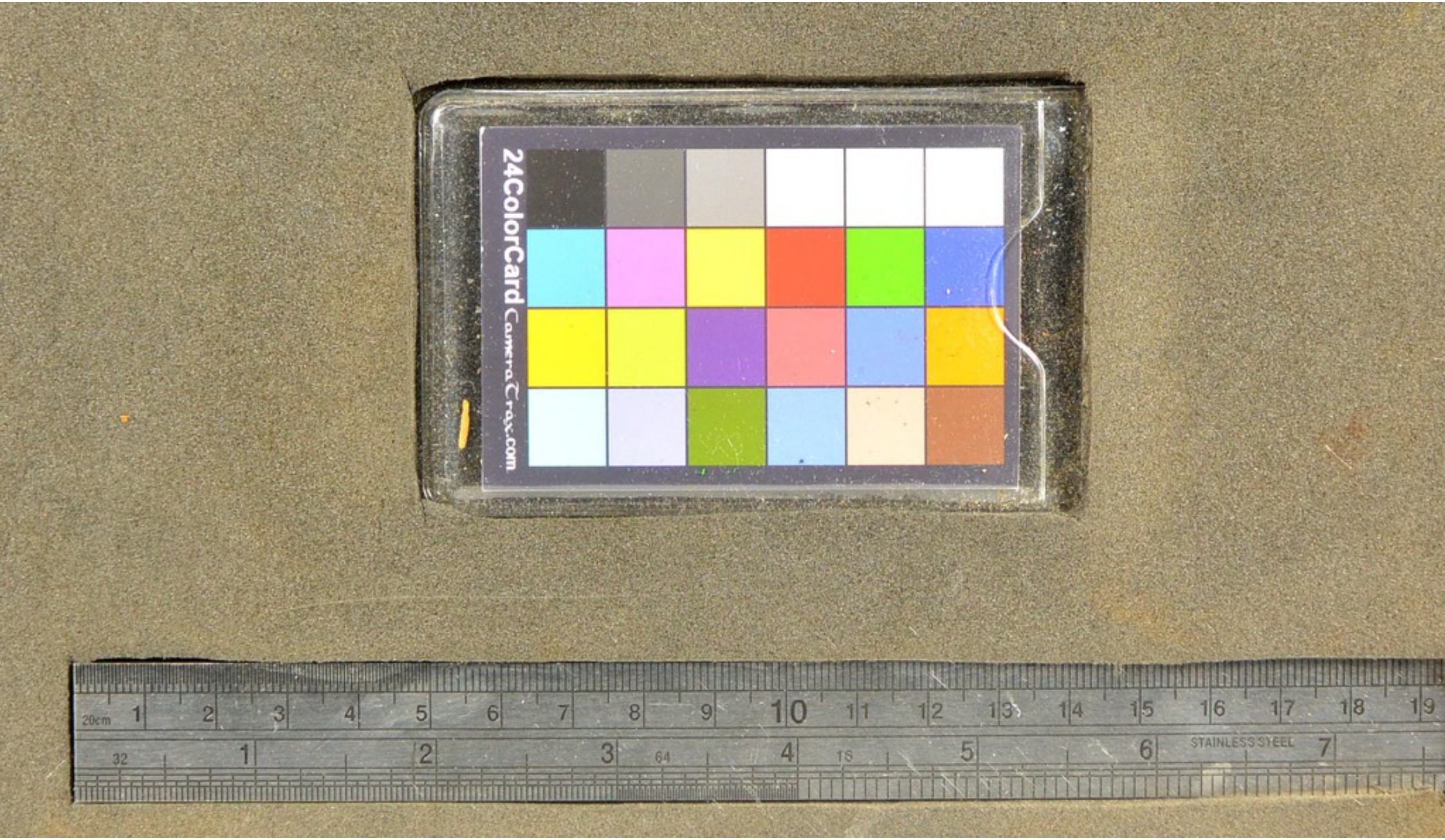
sometimes observe parts, in other calcareous zoophytes, possessing distinct power of motion, though apparently unconnected with the body of the polypi; thus in the *Cellaria avicularia*, Lam. whose polypi have the same structure, and the same connection with the cells as in *flustræ*, I have observed in living specimens a constant motion of flexion and extension in the remarkable testaceous processes shaped like a bird's head, and attached by peduncles to the outside of all the cells. These processes or organs are likewise provided with lateral folds, like the valves of a shell, which have a distinct and regular motion corresponding with the flexion and extension of the entire process. The aperture of each cell of the *F. foliacea*, is defended by four projecting spines, which arise from the calcareous margin of the cell. There are two spines on each side of the aperture, and the upper two are more than twice the length of the lower pair, and slightly curved upwards. When we look transversely on the surface of a branch, the spines appear to be arranged in very regular transverse curved rows, and when we observe the surface longitudinally, they appear to be arranged in very regular longitudinal straight lines. The spines are calcareous, tubular, cylindrical, shut at their extremity, and appear obviously destined to protect the expanded polypi. The two pairs of spines belonging to each cell are placed only on the upper half of the cell, although, from the contiguity of the cells, the lower half of each is likewise defended by the spines of the adjacent cells, so that they serve also to protract the polypi when in a retracted state. No projecting spines of this kind are found in the *F. carbasea*, and they form the most obvious character of the *F. foliacea*. The bundles of minute spicula pointing horizontally inwards from the margins of the cells in the *F. carbasea* are not present, nor apparently required in this species. By the aid of the microscope, we perceive the same vascular appearance of the thin membranous covering of the cells as in the *F. carbasea*, the same dark round spot in the center of those cells which have lost their polypi, the same imperfectly formed empty cells along the margins of the branches, and similar rudimentary polypi in the last two or three rows of cells at the free extremities of the branches.

The polypi of the *F. foliacea* are about twice as long as

the cells, have their body coiled up in a spiral turn, and bifurcated near its lower extremity, and they have the same attachment by bundles of soft loose fibres to the aperture and base of the cells, as in the species already described. They have only fourteen tentacula, sometimes thirteen, which are very long, slender, and ciliated on their two lateral margins. The expanded tentacula form a bell-shaped cavity, into which there is a constant current of water, produced by the incessant rapid vibration of the *ciliæ*, and in the center of this cavity is the circular prominent retractile mouth of the polypus. The tentacula remain in this expanded and regular form, when the polypi are found hanging dead from their cells; and the same is observed in many other zoophytes, which enables us to observe their number and form with more ease through the microscope. The head of the polypus is small, the body comparatively strong, the continuation of the body below the bifurcation very thick, conical, and tapering to its posterior termination, the globular appendix of the body, and its tubular cervix, are smaller than in the *F. carbasea*, and the same opaque matter is found in the cavity of the globular sac. A distinct and constant revolution of particles is seen in the whole of the tube leading from the body of the polypus into the round sac, as if produced by ciliæ placed within; there is no pulsation or contraction of the part, nor can we perceive any fluid passing from that cavity into the vessels so extensively ramified on the coats of the cells. A similar continued vibratory motion is seen within the mouth in most polypi, which is undoubtedly produced by ciliæ in that situation; these minute processes appear to be the only active organs in the circulation of the fluids in zoophytes. The body of the polypus has the usual red colour, while the head and arms are nearly colourless. The long cylindrical and curved body of the polypus is tubular to its posterior termination, which is shut; and we can sometimes perceive a small bolus of food moving to and fro in the conical part of the body below the bifurcation. The globular sac in this species does not appear to be connected with the formation of the ovum, nor with the regeneration of new polypi in the old cells.

The ova of this species of flustra begin to appear early in autumn, and continue to be generated in the cells during the whole winter; those of the *F. carbasea* make their appearance later in

the season; and I have elsewhere shewn, that, in other zoophytes, different species of the same genus vary much in their season of generation, though residing together on the same rock. The ova first make their appearance at the narrow base of the cells as very small, pale-red, gelatinous spheres, and the polypi of such cells are generally removed, and only a small round dark brown spot is seen in their stead, in the center of the cells. There is but one ovum in each cell, as in other *flustræ* and calcareous *cellariæ;* and, as it enlarges in size, it advances higher in the cell, till, in its mature state, it occupies the broad upper part of the cell. When the mature ovum is found at the summit of the cell, we observe a distinct wide helmet-shaped capsule surrounding it, and separating it from the cavity of the cell. By examining the ovum within this capsule, with the microscope, we perceive its ciliæ in rapid motion; and I have frequently observed the ovum, in this situation, contract itself in different directions, shrink back in its capsule, and exhibit other signs of irritability before its final escape. The helmet-shaped capsule of the ovum is open at the top, and connected with the aperture of the cell, so that the ovum readily escapes, by contracting its body and moving its ciliæ. On escaping from the cell, the ovum glides to and fro by the action of its ciliæ, and, after fixing, it is converted into a single complete cell, from which new cells shoot forward. Polypi make their appearance in shut sacs, at the bottom of the new cells, when they are sufficiently formed to protect them. When the ovum has escaped from the cell, the dark round spot in the center of the cell enlarges, and a new polypus shoots out from that point, so that, at this season, we observe young polypi, in every situation, on the branches, the whole of the old cells are thus never found entirely deserted, the same cells may repeatedly produce ova and polypi, and the whole zoophyte retain its energy for several seasons.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