XXII.—*On the Morphology of the different Organs of Zoophytes.*

By R. Q. Couch, M.R.C.S.L.*

[With a Plate.]

The subject which I have to bring under the notice of the Society today is, if it proves true, one of great beauty and unusual interest, inasmuch as the lowest forms of animal life will in the development be found to be governed by the same laws that govern the growth of flowering plants. The vegetable law to which I refer is the metamorphosis of the leaf into the various organs which constitute the perfect plant. This law is now so well established and so generally allowed that nothing is required to be said of it; on the present occasion I shall therefore proceed to discuss its application to the animal kingdom. To Professor E. Forbes belongs the merit of first promulgating the theory of the morphology of the reproductive system of the Sertularian Zoophytes and its analogy with the reproductive organs of flowering plants. This he did at the late meeting of the British Association held at York†. It is an opinion I have long entertained, and in elucidation of which I have for some time been examining almost all the species found on our shores. The views were so new that I hesitated to adopt them, and had I not found that they were held and published by others, I should not now have brought them before this meeting. I do so to show how far the theory of Professor E. Forbes is supported by inductive observations; and that though we pursued in a great measure different paths, we yet arrived at similar conclusions. As Professor Forbes confined his observations to the genera *Sertularia* and *Plumularia*, they are the ones which will be referred to here, though the same observations may be extended to several genera of the Ascidian Zoophytes; *Crisia* and *Cellularia* for instance. In making these observations I shall refer to their growth *ab ovo*, and trace the different parts through their development to the fully formed character. These creatures resemble plants in their arborescent appearance, rooted character, and the transient nature of their reproductive organs. The Sertularian genera have an external horny, elastic and irritable sheath, and this incloses a central granular pulp which extends into all the ramifications and from which all the other parts are formed. On the branches are numerous variously shaped and variously arranged cup-like cells; but their arrangement and shape are always alike in the same, but different in different species. These are the polype cells, in

* Read before the Natural History Society of Penzance, Dec. 3, 1844, and communicated by the author.

† As reported in the Athenæum. The entire paper, illustrated by a plate, was inserted in our Number for December 1844.

which the polypes or prehensile portions are situated. The polypes are attached inferiorly to the central granular pulp which ramifies through the centre of the trunk and branches, and are indeed formed of it. These are the only portions of the creatures exposed to the influence of the surrounding water, and by these the food is taken, digested, and the nourishment distributed to all the other parts. In many species the polypes are exceedingly numerous, but though they are entirely independent of each other as regards their individual life and nourishment, yet they cannot be considered as distinct animals; for the whole production seems to be but one compound creature, derived from the same source, the pulp and all tending to carry out the same object. In this respect they resemble trees; each branch is independent of all the others and may be cut off without injury to the whole, and yet all together they constitute the perfect polypidom. At particular seasons, extending from the middle of summer to autumn, and in fine weather to the early parts of winter, there are other and differently shaped cells developed, which are larger than those previously mentioned as containing the polypes. These are the ovigerous vesicles, which after having performed their function drop off and disappear. In this they differ from most other animals, in which the reproductive organs are, in duration, coextended with the lives of the creatures, and offer a remarkable analogy to similar parts in plants both in their decay and periodical re-appearance. "These organs," Professor Forbes says, "in their nature, have often been discussed but never explained." By their nature the Professor cannot mean the function they perform in the œconomy of the creature's existence, since that is established by numerous and accurate observations; but rather I presume the *nature of the type* from which they have undergone their *ideal* metamorphosis. In this he is certainly correct, and the present observations are intended to elucidate this, and in some measure to extend it. The reproductive gemmules are very minute globular bodies, surrounded by numerous vibratory cilia which are in constant action. The mode in which they are formed will be briefly described hereafter. As soon as they have escaped from the ovigerous capsule into the surrounding water, they move about with great rapidity in a revolving manner, like the earth on its axis. While examining them in a bottle I could perceive that they occasionally stopped, and then again would rapidly move from spot to spot. In this way they move about from one hour to nearly two days, depending apparently on the temperature and the nature of the surrounding surfaces. They would occasionally rest on the glass for a few minutes, and then, as if the spot was an unfavourable one, again start off and revolve as rapidly as before, frequently changing their form from the circular to the oval; sometimes acquiring an hour-glass contraction,

and at others assuming the appearance of having an enlarged head and a narrow and contracted tail. But having once fixed itself, it remains rooted ever after. From the period it first becomes fixed it speedily undergoes a change in tint, but this however would hardly be perceptible except to a practised eye. When this has taken place small fibres are given out from the base, or all that portion in contact with the glass. These constitute the roots by which the creature becomes fixed. From this point it quickly rises into the arborescent form of the adult. This is a remarkable change; for here we see a creature in its youngest form moving about with almost the irregularity of voluntary motion, yet in a short time becoming rooted and taking on so much of the vegetable form and appearance, as to have required, at the hand of Ellis, repeated observations and accurate demonstrations to persuade us to the contrary. The seed being fixed, the upper portion becomes elongated without any distinction of parts, and the first joint of the creature is formed. Taking the sea-thread, *Laomedea geniculata,* as an example best calculated to show the analogies between the formation of the polype cells and ovarian vesicles, the central pulp of the seed becomes the central granular pulp of the adult. After the *ovule* has become superiorly elongated to a distance equal to the usual length of the cell and its footstalk, it enlarges and becomes bulbous. All is now one undefined mass; but in the course of a few hours the stalk becomes shrivelled, and the bulbous termination acquires a deeper tint towards the centre and lighter towards the circumference. At first this central shade is slight and indistinct, but it soon becomes darker and more defined. As this condensation or organization advances, the pulp becomes more transparent at its circumference, and darker towards the centre. At this stage the transparent circumference appears to be drawn into transverse folds, as if from a force acting towards the centre, and leaves behind a transparent horny covering which eventually forms the walls of the future cell. In this way the whole of the pulp becomes separated from the investing sheath. This being effected, the upper edge of the bulbous portion of the pulp acquires a serrated edge, which in a short time becomes more and more distinct and enlarged, and finally is produced into finger-like prolongations forming the tentacula of the polype. It is by an extension of development that the horny cell is opened, and not by any mechanical pressure as has been supposed, since the only source of pressure is from the polype, and that is not in contact with it at the time. In this the polypes are formed from the central granular pulp in all the Sertularian species, having but very slight modifications in the different genera. The prolongation of the stem is formed in precisely the same manner, but

without a bulbous termination. The granular matter or pulp, which is at first diffused, becomes condensed or organized towards the centre, leaving the investing sheath in its annular form, and no further development goes on. It is this cessation of growth for the purposes of organization that regulates the length of the internodes both of the trunk and branches. Hence also arise many of the irregularities so frequently observed. If growing in a variable situation, some of the internodes are short, while others are nearly double the usual length, depending on the vigour with which each portion is developed. These variations are more observable in *Sert. pumila* than in the Sea-thread (*Laomedea*).

The formation of the ovarian vesicle, in this genus at least, occurs in a very similar manner to what has been described in the polype cell and trunk. The ovarian vesicles are cells formed during the summer and autumn in situations varying with the different species; and these having performed their function of reproduction are periodically shed, to be replaced by others at some future time. Their first appearance are small protuberances or elongations of the part on which they rest. At first a darker appearance of the pulp and sheath is observed on the part in which the vesicle is about to be produced. This is prolonged precisely in the manner noticed in the formation of the polype cell and trunk, and the separation of the pulp from the sheath occurs also in the same manner. It increases in length to the usual length of the vesicle, and with the exception that its axis is larger, resembles a branch in everything. But instead of being produced into a polype as in the polype cell, the surface becomes marked with circular lines, which, as development goes on, assumes the form of small grains or globules, more or less embossed according to the stage of advancement. They rapidly become more and more defined and separated from each other, but remain attached to the central pulp by an umbilical cord. This also becomes more attenuated and finally gives way, and the gemmule remains free in the horny case. These gemmules have a central granular pulp surrounded by a semitranslucent zone or case, and have their surfaces covered from a very early stage of their formation with numerous vibratory cilia. In this free state they remain in the case a short time, for the upper portion of the vesicle opens and the remarkably active gemmules revolve rapidly from spot to spot, as has been previously described. From this it will be perceived that the function of these periodic vesicles is reproduction, and therefore, when Prof. Forbes says that their nature is unknown, he can mean only the *ideal* form, from which he supposes them changed during their development.

From the foregoing observations it will appear, that in the earliest stages of growth, the stem, the polype cells and the ovarian vesicles of the *Sea-threads, Laomedea,* are precisely alike, and that at a particular point of their development each assumes its individual character. The stem advances to one point and is there arrested in its organization; the polype cell advances to the same point, but instead of being arrested, the pulp becomes developed into a polype and the sheath into a cell. This however seems to be only the case when the termination is bulbous; for in many instances I have seen that where the pulp was not bulbous, but of the same diameter throughout, and about the size of the stem, that no polype has been developed, but merely a distorted branch. Where specimens grow in unfavourable situations, such distortions are not unfrequently to be found; and most of them I believe are attributable to this cause. This malformation is most frequently to be seen in *Sert. polyzonias, rosacea,* and a few other kindred species.

The ovarian vesicle also advances as the branch and cell, but instead of being of equal diameter throughout, as the former, or bulbous at its extremity, as the latter, it is enlarged or bulbous throughout its extent, and is united to the branch or trunk by a narrow and short peduncle. Instead of the vesicle being arrested in its growth at the same point as the stalk, or organized into a polype as in the cell, it becomes developed into numerous minute globes covered with vibratory cilia as previously mentioned. Here then we see a great similarity between the different organs of these creatures,—a similarity so great as to warrant the supposition of their primary identity and subsequent individualization, even if there were no others. In *Sertularia polyzonias* I have several times seen a polype cell terminate in a distorted branch; and on the other side I have seen a branch terminate in a polype cell, showing a convertibility into each other.

In all my examinations I have never seen the ovarian vesicle occupied by a polype. Ellis, however, has figured something like this with the polype protruding, but he says nothing of the kind in his text, and I am unacquainted with any one who has witnessed anything of the sort, though observers have become numerous since Dr. Johnston's work has been published. I have however seen a cell, apparently designed for a vesicle, small in its growth and occupied by a polype. This form of vesicle has been selected for my illustration, because, if I understand Prof. Forbes, it is the one about which he had doubts. At some future time, when I have a little more leisure, I should like to offer a few observations on others and diversified forms of these transitory cells.

EXPLANATION OF PLATE XIII. A.

Fig. 1. Earliest state of branch.
Fig. 2. Earliest state of polype cell.
Fig. 3. Earliest state of ovarian vesicle.
Fig. 4. A second state of fig. 1.
Fig. 5. A second state of fig. 2.
Fig. 6. A second state of fig. 3.
Fig. 7. Perfect state of branch fig. 1.
Fig. 8. Perfect form of fig. 2.
Fig. 9. Perfect form of fig. 3.
Fig. 10. Showing a cell of *Sert. polyzonias* converted into an imperfect branch.
Fig. 11. An abortive branch of *Sert. polyzonias* converted into a polype cell.

Chapel Street, Penzance, Dec. 3, 1844.

XXIII.—*Ornithological Notes.* By John Blackwall, F.L.S.

The Osprey, *Pandion Haliaëtus.*

On the 2nd of November 1844, Lord Edward Thynne obligingly sent to me a specimen of the osprey, which had been shot by Mr. Griffith Jones of Glyn, on the same day, near the banks of the Lleder, a small river in Caernarvonshire, which flows past the village of Dolwyddelan. It was a male bird, and measured five feet and an inch from tip to tip of the extended wings; twenty-two inches from the point of the bill to the extremity of the tail; and weighed three pounds and a quarter, after the remains of a bull-trout, which, when newly captured, must have weighed about two pounds, had been taken from its craw.

Several days previously to the 2nd of November this bird had been seen flying about the river Conway in the vicinity of Bettws y Coed, and it is a remarkable fact, that three years since another individual of the same species was killed within a hundred yards of the spot where this was shot.

The Tawny Owl, *Syrnium Aluco.*

A hole in a decayed tree is usually selected by the tawny owl for the reception of its eggs; but in the neighbourhood of Llanrwst, where this species is numerous and decayed trees are comparatively scarce, it frequently deposits its eggs in an old nest of the carrion crow.

In May 1844 one of a brood of young owls bred in a crow's nest accidentally fell to the ground before it was fledged, and was as carefully attended to by the parent birds under this change of circumstances as those were which remained in the nest, being abundantly supplied with mice and small birds. When any person approached the spot where the young owl stood, one of the parent birds, probably the female, invariably made its appearance, and with looks and gestures expressive of the utmost solicitude reiterated a loud sharp cry, and snapped its mandibles together by way of menacing the unwelcome intruder.