XXIX. *On the Anatomical Characters of a remarkable form of* Compound Tunicata. *By* JOHN DENIS MACDONALD, *F.R.S., Assistant-Surgeon of H.M.S. 'Herald,' commanded by Captain* H. M. DENHAM, *R.N., F.R.S. Communicated by* GEORGE BUSK, *Esq., F.R.S., F.L.S.*

Read February 17th, 1859.

ON examining an encrusting form of Compound Tunicata, taken from the ship's copper while refitting in Sydney Harbour, I was surprised to find that each little cluster of viscera was surmounted by two similarly-constructed branchial chambers or thoraces, as though two zooids had been combined together.

Each branchial chamber was supported on a narrow pedicle, and both pedicles arose from one short trunk, which suddenly expanded into the abdomen, while little gemmations were frequently seen clustering near its base.

About four delicate and unbranched tubules, with a dilated and glandular extremity (derived from that part of the mantle which invests the viscera), extended themselves into the connecting substance.

A stout endostyle occupied the dorsal region, and the branchial network exhibited three or four principal transverse bars, intersected at right angles by the more numerous longitudinal nervures. The orifice of entry was guarded by a circlet of six broad and short tentaculiform processes—organs which are so often mistaken, in other cases, for the true tentacula; and there being no proper atrium, the anus opened directly upon the surface near the middle of the ventral aspect. The existence of a superficial common cloacal system was clearly indicated by the low position of the rectum, and the absence of pigment-cells within a circumscribed space on the fore-part of the body. The actual disposition of this system, however, I have not succeeded in determining, on account of the peculiar delicacy of the connecting substance.

A small spur-like appendage or caudex was sometimes distinctly observed, projecting from the dorsal surface of the pedicles, just below the branchial chamber.

The viscera formed a large subglobular mass, in which a voluminous stomach, testis, and ovarium were plainly discernible. In the specimens examined, the diameter of the ova, visible in the ovarium, far exceeded that of the pedicles, through which, according to the present view of the subject, they were destined to pass; moreover, numerous ova, scarcely further advanced than those within the ovarium, were scattered through the connecting substance, in which they were perfectly enclosed. The ova of this genus, like those of the larger solitary Ascidians, were invested with a stout chorion, supporting a beautiful epithelial pavement, and containing a dull amber-coloured or reddish yelk.

The process of yelk-cleavage was easily traceable in a selected series of ova; and where that of differentiation had commenced, the vitelline mass appeared to be encircled almost completely by a long and gradually tapering tail, while three short sucker-tubes diverged from an opposite point. In more advanced examples, the transparent polygonal cells, including the true embryonic structures, formed an oval tadpole-like body, from the delicate

investing membrane of which the tail received a covering. These cells no doubt form the proper test of the embryo, and as such must also be the basis of the connecting substance or common test of the mass.

The part destined to become the future abdomen was divided into several rounded lobes, from the confluence of which the tail emerged posteriorly, and two distinct branchial chambers arose in front.

A nervous ganglion with an otolithic sac, and what may probably be a rudimentary visual organ, were connected with one of the thoraces; while the three sucker-tubes and four glandular stolons, above referred to, originated near the pedicle of the other.

The incipient branchial network was marked by several transverse rows of short slits, which appeared to have thickened or everted edges, on account of the highly-refracting property of the epithelium at this stage of development.

There are many interesting questions connected with this double form of existence, to be answered perhaps by further observation of its structure, evolution, and history.

The unusually large ova, which undergo the ordinary round of changes subsequently to their liberation from the body of the parent, and are perfectly enclosed in the connecting substance, seem to negative the idea of their being discharged in the usual way, and rather suggest their escape by rupture of the abdominal walls, or by pedicellation and ultimate separation from the abdomen. With this consideration before us, the query naturally arises, Does the embryo at any stage become free and locomotive, as in other cases? and if not, which I am much disposed to believe is the fact, what purposes can the transitory suckers, organs of sense, and tail subserve?

There being two respiratory chambers, with their proper openings, two mouths and two vents, with a visceral mass common to both, forming perhaps the most perfect diplozoon in creation,—now that the originally simple nature of Nordmann's celebrated example has been satisfactorily explained,—are we to recognize here two distinct entities? If so, are the sexes and generative function common to both, divided between them, or restricted to either? Some species of *Polyzoa* clearly exhibit the union of two zooids *ab origine* in the formation of the so-called "ovicell" and its contents, which are very probably developed at the close of a definite cycle of gemmations. These ideas may be considered transcendental and visionary; but surely the scope of our philosophy is legitimate so long as our judgment in relation to immaterial and abstract things is circumscribed by that evidence alone which material things afford. Be it as it may, however, each little animal in the present genus, just as in the case of simple Ascidians, propagates its kind both by gemmation and true oviparous development; and the offspring appears to differ in nowise, either in its structure or history, from the parent. No vascular bond of union pervades the mass; and but for the continuity of the cell-structure of the connecting substance, it would be difficult to regard it as any more than a simple aggregation of individuals. Indeed it is common enough to find the members of aggregate species of simple Tunicata blended by the coalescence of their test or outer covering; yet this circumstance alone cannot be considered a valid reason for classifying such with the compound forms.

What then are the most important distinguishing features of the latter? I think it

may be affirmed that, when the zooids of a compound genus are pedunculated on a central axis, vascular continuity is the most striking characteristic; but, where they are immersed in the connecting substance, the importance of vascular communication as a character yields to the existence of a common cloacal system. The curiously modified forms of the latter system, taken as one of the grounds of classification, I shall have to notice in a summary of Australian genera, now in progress.

It is now full time to give a name to the little subject of this paper; an appropriate one would be *Diplosoma*, as at once sufficiently expressing the peculiar nature of the animal. I therefore propose to call the species *Diplosoma Rayneri*, after Mr. F. M. Rayner, Surgeon of H.M.S. 'Herald,' who investigated its anatomy with me, and satisfied himself of the truth of the descriptive particulars above given.

June 1858.

EXPLANATION OF THE PLATE.

Tab. LXV. Div. I.

Fig. 1. A diplozooid, separated from the mass, and highly magnified, exhibiting the more important points of its structure.
- *a, a.* The two distinct thoraces.
- *b.* The pedicles, bearing gemmations near their confluence, and a caudal appendage at the upper part of their dorsal surface.
- *c.* Branchial opening.
- *d.* Anal aperture.
- *e.* Visceral mass.
- *f, f.* Pallio-vascular tubules, with their dilated glandular extremities.
- *g.* Stomach, showing a sort of valvular cardiac orifice.
- *h.* Ovarium, containing one principal ovum, and several others in an earlier stage of development.
- *i.* The large sacculated testis.

Fig. 2. Ovum in which the process of cleavage is going forward.

Fig. 3. Ovum further advanced.

Fig. 4. Primary state of the embryo, showing the central vitelline mass, the three sucker-tubes, and caudal process.

Fig. 5. Embryo in the ovum more fully developed, presenting, besides the frontal suckers and tail-process, nearly all the parts discernible in the adult state.
- *a, a.* The two distinct thoraces.
- *b.* Otolithic sac, occurring only on one of the thoraces.
- *c.* The frontal suckers arising in common with
- *d.* The pallio-vascular processes from the pedicle of the thorax to the left.
- *e.* Vitelline mass, in which the viscera are faintly marked off.
- *f.* The caudex.
- *g.* Polygonal cells of the primordial test.

Fig. 6. Cells and intercellular corpuscles of the connecting substance.

Fig. 7. Marginal coronet of the branchial opening.

Fig. 8. Caudal process of the adult, springing just below the root of the endostyle.

Fig. 9. Cæcal extremity of one of the stolons.

Fig. 10. Nervous ganglion with otolithic sac and eye-speck (?).

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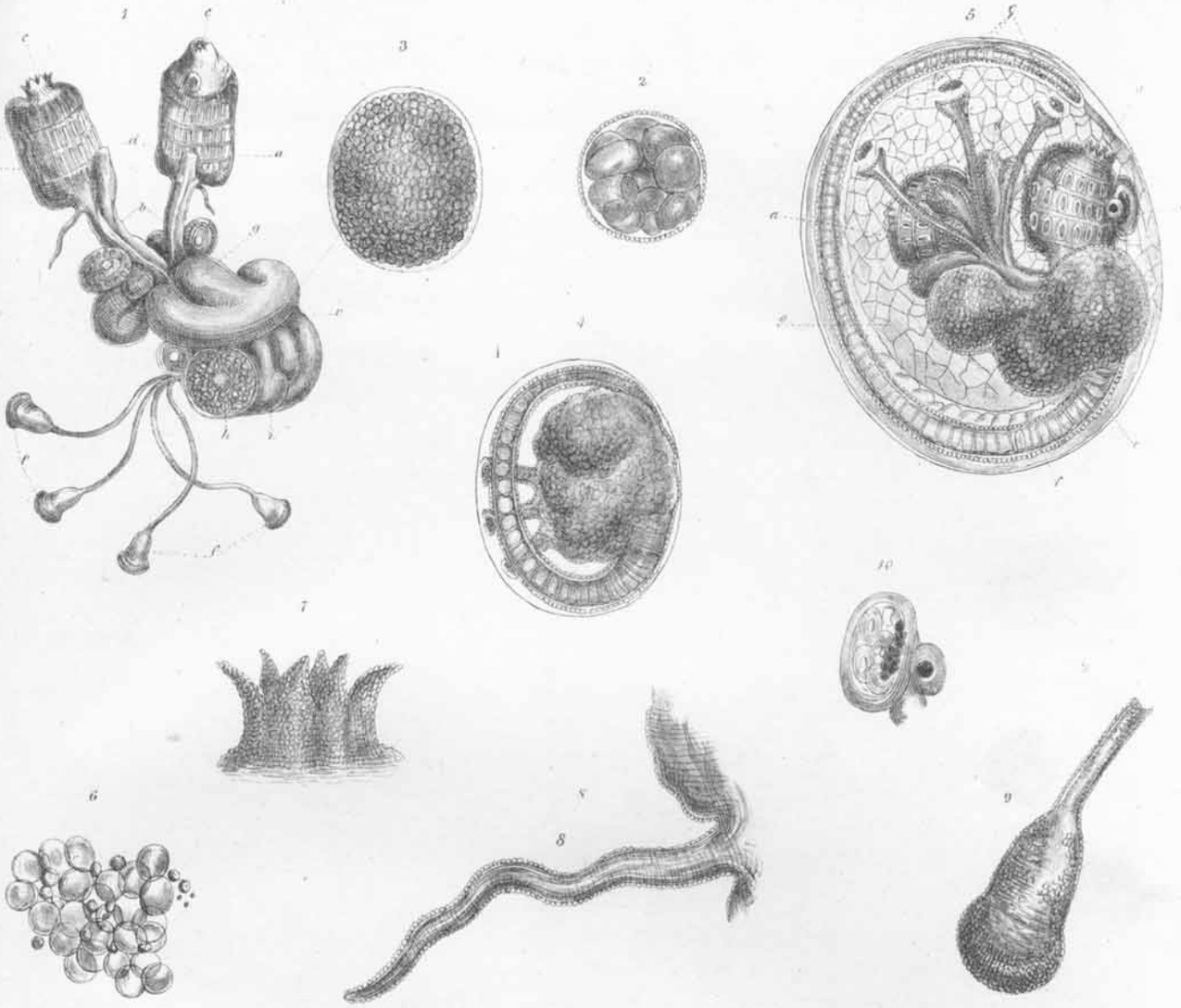

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