

IV. Le tube digestif est quelquefois littéralement tapissé de jeunes grégaires, encore retenues par leur épimérite. Elles sont très-voisines de l'*Anchorina* de la *Capitella capitata*.

Habitat. Manche: 1°. Wimereux (Pas-de-Calais)<sup>3</sup>, dans la boue qui recouvre les rochers argileux de la Tour Croy, en compagnie de *Fabricia sabella* Ehr., *Pygospio elegans* Clpde., *Polydora ciliata* Johnst.; — 2°. anse St Martin, près du cap de la Hague, dans l'épaisseur des *Lithothamnion polymorphum* qui tapissent les mares des rochers granitiques du rivage.

Affinités. Eisisig distingue 6 genres de Capitelliens. Parmi eux, *Capitella* Blv. et *Capitomastus* Eisisig (pour *Capitella minima* Lnghs; Madère) constituent un groupe à part, surtout caractérisé par l'absence de branchies et l'existence d'un appareil copulateur, au moins chez les mâles. *Capitellides* appartient à ce groupe et sert de trait d'union entre les deux genres anciennement connus. Mais il est surtout voisin de *Capitella*, dont il ne diffère essentiellement que par l'existence d'appareil copulateur aussi bien chez les femelles que chez les mâles. Par là, au contraire, il se rapproche de *Capitomastus*; mais il s'en distingue par l'absence de dimorphisme sexuel.

## 2. On the 'Notochord' of *Cephalodiscus*.

By A. T. Masterman, B.A. B.Sc.

eingeg. 19. October 1897.

I have read with interest Mr. Harmer's kindly criticism of the conclusions arrived at in my recent work upon *Actinotrocha* and *Cephalodiscus*. (On the Diplochorda. Quart. Journ. Micr. Sc. Aug. 1897.)

Mr. Harmer sums up his contentions under three heads, each of which we may deal with in turn.

1) 'The median notochord of *Cephalodiscus* is really the homologue of the 'Eicheldarm' of *Balanoglossus*.'

My objections to this homology are three, based respectively upon a) its structure, b) its relationship to other organs and upon c) the fact that other organs, as I hold, have a greater claim to this homology.

a) A transverse section of the organ in question shews that it consists of a single layer of glandular cells enclosing a fine but perfectly definite lumen. The inner surface of these cells is covered with minute cilia and down the centre of the lumen is often (but not always)

<sup>3</sup> La présence de cette espèce y avait été remarquée par M. le Professeur Giard, à qui je me plais à la dédier. —

found a rod of hardened mucoid material. The organ has a uniform structure throughout its length.

It seems to me that these facts point to an actively secretory function, and there is no indication that the organ is in any degree vestigial. As already emphasised, it does not show any present or former modification into vacuolated tissue. In the higher Chordata, the formation of hypoblastic chordoid tissue is usually regarded as a process of histological degeneration, and in accordance with this, the loss of passive supporting function is accompanied by extinction of the organ (Vertebrata). There is, as far as I know, no instance of a chordoid structure once having been acquired, becoming secondarily redifferentiated into an actively secretory tissue.

Apart from this, there can be little doubt that both in form and function this organ differs from the 'Eicheldarm' of *Balanoglossus* and the notochord of Eu-chorda. Mr. Harmer would account for this by assuming a degeneration owing to the small size of the organism, and although reduction in size is an undoubted element in the simplification of structure, it would seem that we have to deal with an entirely different kind of organ. We may also note that structures of a chordoid nature are present both in *Actinotrocha* and in young *Phoronis*, organisms of smaller bulk than *Cephalodiscus*.

b) Its relationship to other organs.

Here Mr. Harmer differs with me with regard to the facts and, before proceeding further, an explanation is, I think, due. My paper, 'On the Diplochorda' was sent in for the Granville Prize of London University<sup>1</sup> and in consequence it had to be finished by a certain date (May 1st). Hence my revision of the plates was not as careful as I would have desired. In my original drawing of Pl. XXIV Fig. 14 the anterior body-cavity is completely continuous with the space that Mr. Harmer would homologise with the 'heart'. It might perhaps have been more clearly indicated in the figure alluded to, but as Mr. Harmer has re-examined this part for himself he will not be relying upon this evidence.

Immediately after the first examination of my sections of *Cephalodiscus* I supposed that the organs brought to view had exactly the structure and homologies since suggested by Mr. Harmer, but a closer inspection proved them to be untenable.

My sub-neural blood-sinus is perfectly continuous with the dorsal blood-vessel and is, in fact, merely the swollen termination of the latter.

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<sup>1</sup> I ought in fairness to state that it was unsuccessful, as the examiners, Prof. Lankester and M. Beddard, did not consider it of sufficient merit'.

It is limited dorsally only by the nerve-ganglion (ectoderm). I have traced the one into the other in both the transverse sections which I figured and in longitudinal sections. I should not have felt justified in tinting both organs red and thus running the risk of perpetuating a possible error, unless I had convinced myself beyond a doubt of their continuity as two parts of the blood-system.

In the buds, with only one pair of tentacles, the relationship of these parts is much more clearly seen. The sub-neural sinus is spherical and of large dimensions. A section of the region shews almost diagrammatically that it is formed as a haemocoel-space between the ectoderm and mesoderm. At this stage there is no sign of the cavity which Mr. Harmer would homologise with the 'heart' of *Balanoglossus*. In the adult, the communication between this space and the anterior body-cavity is easy of demonstration in longitudinal sections. It gives no indication of having been artificially produced. From a comparison of the blood-vessels in the living *Actinotrocha* and their appearance in sections, I am convinced that the true extent and size of the vessels of *Cephalodiscus* are not shewn in sections, and that the sub-neural gland of *Cephalodiscus*, like that of *Actinotrocha*, is surrounded by a blood-sinus on all sides, contained between the walls of the coelomic cavities.

Since Mr. Harmer's opinions have been expressed I have naturally been carefully over the sections of half-dozen specimens, but considering that, as already mentioned, I at first held these views myself, I had already tested them and had formed them incompatible with the facts of the case.

It is with great diffidence that I thus find myself in disagreement with one to whom I am indebted for my first knowledge of this species, and for whose opinions I have a profound respect.

Mr. Harmer's diagrams and my own agree in shewing that his 'notochord' lies essentially between the anterior body-cavity and the collar-cavities and further forward than the collar-cavities (fig. 1); it lies dorsal to the anterior body-cavity.

In *Balanoglossus*, on the other hand, the mutual relationships of the parts in the proboscis are clearly seen in a series of transverse sections through a young specimen, as figured by Morgan (Journal of Morphology Vol. V. Plate XXVIII, figs. 59, 60, 63, 61, 62). Here it is evident (Fig. 2) that the 'Eicheldarm' of *Balanoglossus* lies essentially in a space between the anterior body-cavity and the ventral wall of the proboscis. If, as in many species figured by Prof. Spengel, the 'Eicheldarm' moves dorsalwards in later life, its line of displacement is clearly indicated by the formation of a mesentery, or 'ventrales Eichelseptum' (cf. fig. 4).

Thus the subneural gland of *Cephalodiscus* and the 'Eicheldarm' of *Balanoglossus* occupy entirely different relationships to the surrounding organs in each case. If either or both of these organs had lost their connexion with their parent-tissue, the gut-wall, a phyletic migration might be assumed (cf. notochord and dorsal bloodvessel of Chordata), but this is not the case, and it appears to me that the homology of two organs in such different relative positions is hard to prove.

To proceed to Mr. Harmer's second contention:

2) 'The comparison of the median 'notochord' of *Cephalodiscus* with the proboscis-vesicle or heart vesicle of *Balanoglossus* is untenable.'

My expressed idea was that just as in the hypophysis of the Vertebrata (its suggested homologue) the distal part is segmented off as the pituitary body, so in *Balanoglossus* the distal part of the subneural gland is represented by the proboscis-vesicle.

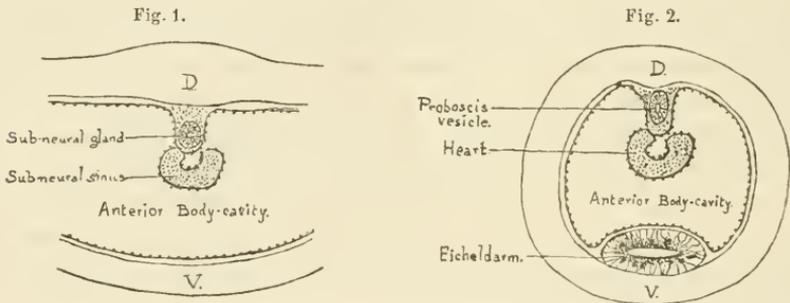


Fig. 1. Transverse section of epistome of *Cephalodiscus*, through distal end of subneural gland.

Fig. 2. Transverse section through proboscis of young *Balanoglossus*. (After Morgan.)

The main arguments for this homology are these:

The proboscis-vesicle has exactly similar relations to the anterior- and collar-cavities and to their intervening blood-sinus as has the distal part of the sub-neural gland in *Cephalodiscus* (cf. figs. 1 and 2). It lies dorsally and anteriorly to the anterior body-cavity and, together with the 'heart', fills up the space between this and the collar-cavities. In these figures may also be noticed the great similarity of the subneural sinus (fig. 1) to the heart (fig. 2) as figured by Morgan.

In each case, a portion of the anterior body-cavity is surrounded by the blood-sinus and nearly cut off from the rest.

Should the homology be true, one might expect either in ontogeny or in the anatomy of some of the group (Enteropneusta) to find a trace of the proximal end of the sub-neural gland.

Plate XII fig. 2 of Professor Spengel's monograph, a median section of *Schizocardium brasiliense*, shows a shallow invagination of the ectoderm of the proboscis, just inside the mouth. It is in the median ventral wall of the proboscis and is exactly opposite the space behind the posterior wall of the anterior body-cavity.

Again, in *Balanoglossus canadensis* (Pl. XVII figs. 5, 6, 7, 8) is a mid-ventral invagination in the mouth-region, which squeezes in between the notochord and the wall of the anterior coelome (fig. 8) and lies ventral to the former (fig. 5). This 'sinnes-organ' (Spengel) has precisely the position and origin of the proximal part of the sub-neural gland of *Cephalodiscus*, and appears, as far as can be judged, to be closely similar in structure. *Glandiceps Talaboti* (Pl. XIX fig. 1) appears to possess an organ of a like nature, but rather less developed, and one cannot help surmising that the investigation of *Glandiceps abyssicola* might be interesting in this connexion.

The fact remains that in certain species of Enteropneusta a small organ occurs very similar, in structure and in relative position to the mouth, body-cavities and vascular system, to the lower part of the sub-neural gland of *Cephalodiscus* whilst the proboscis vesicle presents a similar likeness to the distal part of the same organ. The latter homology has been emphasised in figures 1 and 2 and the former is illustrated by the oblique sections shewn in figs. 3 and 4. The only important difference between the two sections is that in fig. 3 the pre-orally extended notochord is shewn. (cf. Pl. XVII fig. 8. Spengel.)

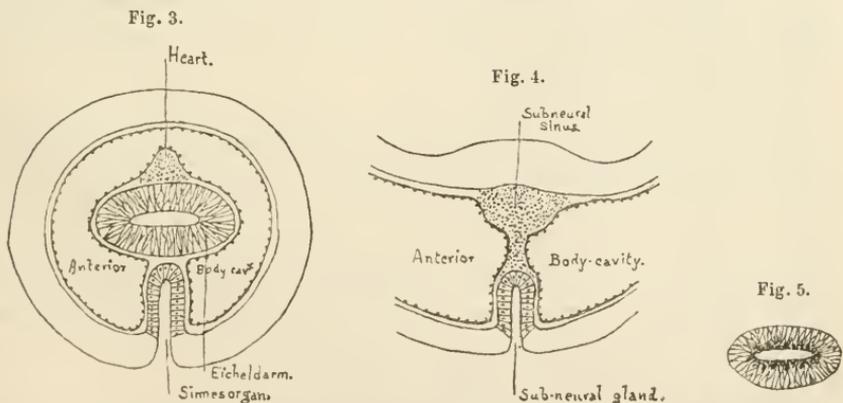


Fig. 3. Oblique section through proboscis of *Balanoglossus canadensis*, cutting the aperture of 'sinnesorgan'. (partly after Spengel.)

Fig. 4. Oblique section through epistome of *Cephalodiscus*, cutting the aperture of sub-neural gland.

Fig. 5. Transverse section of pleurochord of *Actinotrocha*.

These facts alone will, I hope, be sufficient to shew that the term 'untenable' is not applicable to the homology suggested. I have left

out of consideration the collateral evidence to be derived from the structure of *Actinotrocha*, but it will be evident to all who have read my work on this form that its resemblances on the one hand, to *Balanoglossus*, and on the other to *Cephalodiscus*, greatly strengthen the homologies put forward above.

There can be no doubt whatever that the sub-neural gland of *Actinotrocha* is epiblastic (see p. 300). 'In the immediate neighbourhood of the mouth' does not accurately describe its origin (p. 300, woodcut 1). It first appears well outside the mouth, in the epiblast of the hood. If, as I understand Mr. Harmer, this organ is to be compared with the 'Eicheldarm' of *Balanoglossus*, the homology of the latter with the notochord of the Chordata is untenable.

On the other hand, the sub-neural gland of *Actinotrocha* is exactly comparable in form, function and relationships to other organs, with the sub-neural gland of *Cephalodiscus* (Mr. Harmer's notochord) and the structures I have compared with it in *Balanoglossus*. Pl. XXI fig. 42 and Pl. XXIII fig. 2 are worthy of comparison, as regards the sub-neural sinus and proboscis pores.

We now come to Mr. Harmer's third formula:

3) 'The proof of the homology of the so-called 'paired notochords' of *Cephalodiscus* and *Actinotrocha* with the notochord of higher Chordata is not convincing.'

I cannot here reproduce the arguments which were given in favour of this homology, but am not surprised that at present Mr. Harmer is not convinced. The objections he puts forward shew that, possibly because I did not make my views sufficiently clear, he has entirely misunderstood my standpoint.

This is seen most clearly in his reiterated assertion of the essential connexion of *Balanoglossus* in the establishment of the homology. I do not regard *Balanoglossus* as forming 'a transition to the Chordata' and the existence of this group has not the slightest direct bearing upon the homology of the 'paired notochords'. The claims of these organs in *Cephalodiscus* and *Phoronis* to notochordal value stand entirely upon their identity in structure and origin with the chordate organ and these would be of as strong a nature even if such a group as Enteropneusta were unknown to science.

If Mr. Harmer will refer to p. 334 of my work, as well as to the accompanying tree, he will see that my idea was a suggested derivation of the Euchordata directly from an Actinotrochan-like ancestor of the Archichorda and not through the Hemichorda. The paired pleurochords of this type have persisted in *Cephalodiscus* and in young *Phoronis* but have fused together and extended pre-orally in the case

of *Balanoglossus*, and have fused dorsally but without pre-oral extension in the Eu-chorda. Although I naturally attempted to shew that the condition in *Balanoglossus* could be derived from that in *Cephalodiscus* by fusion and pre-oral extension, this question is absolutely apart from the derivation from the latter of the euchordate condition<sup>2</sup>.

The homology of the paired 'lateral notochords' in *Actinotrocha* and those of *Cephalodiscus* appears to me to be indisputable, for they are identical parts of the same organ, with an identical structure, in two closely allied species.

Mr. Harmer appears to be in some difficulty about this, through he suggests that the lateral notochords of *Actinotrocha* may be homologous with 'the dorsal branchial part of the pharynx of *Cephalodiscus*' almost the whole of which is formed by the lateral notochords of this species.

In Pl. XXVI fig. 21 I figured the lateral notochords of *Actinotrocha* and compared them directly with 'the dorsal branchial part of the pharynx of *Cephalodiscus*' (Pl. XXVI fig. 22). Such being the case it can only be supposed that Mr. Harmer thinks, that on the whole, their homology may be accepted.

As regards the absence of pigment in the notochords of *Actinotrocha*, Mr. Harmer considers the evidence insufficient. In Pl. XXI fig. 30 is represented the appearance, as seen in surface view, of the vesicles. Thereafter, no less than ten sections (figs. 30a—37) of these vesicles are figured, with not a trace of pigment in any of them. It seems to me that further evidence than this does not come within the usual scope of morphological literature. The most casual inspection of the living larva would convince Mr. Harmer, or any other worker familiar with the microscope, of the truth of these statements. Meanwhile I must rely upon other zoologists not to assume that I have drawn the figures alluded to, and deliberately left out all pigment that might have been present.

In conclusion, it appears to me that those who in the meantime will allow of no Chordate affinities in the Archi-chorda (*Enteropneusta*, *Cephalodiscus* and *Phoronis*) and assume that the gill-slits, mesoblastic skeleton, notochords, and dorsal nervous system in these species are all convergent imitations of the similarly-named structures in the Eu-chorda, will deem Mr. Harmer and myself equally wrong in our attempted homologies.

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<sup>2</sup> In this connexion, not only is the notochord in the young *Balanoglossus* paired at its base, as figured by Morgan (loc. cit. Pl. XXVIII fig. 58), but this author figures a chordoid condition of the gill-slits in fig. 65. Compare also Figs 4 and 5.

Those who hold that the Archichorda are genetically connected with the E-chorda must seek for a notochord in *Cephalodiscus*. Mr. Harmer offers them a glandular diverticulum of the gut, with no trace of chordoid structure, with no substantiated claim to being hypoblastic, (but bearing an undoubted homology with a similar organ in *Actinotrocha* which is epiblastic), and with a preoral position and no evidence that it was ever differently situated. Its claims appear to consist in the fact that it is unpaired and is a diverticulum of the alimentary canal. I offer, on the other hand, paired dorso-lateral grooves of the pharynx which are indubitably hypoblastic and fulfil a function, with a histological structure, identical with that of the E-chordate notochord, and each closely similar to a stage passed through in the ontogeny of the latter.

Those morphologists who, recognising the fact that the difference between 'paired' and 'median unpaired' in bilaterally symmetrical animals is not of fundamental importance, adopt my view, will also accept the term *Diplochor da*, as rightly emphasising the condition of this fundamental chordate organ, and to them the alternative inclusion of *Phoronis*, *Cephalodiscus* and *Rhabdopleura* in the Hemichorda will appear a contradiction in terms.

United College, St. Andrews, Scotland. October 16 1897.

### 3. Beiträge zur Turbellarienfauna der Umgegend von Moskau.

Von W. Zykoff, (Privatdocent an der Universität Moskau).

eingeg. 2. November 1897.

Als Ergänzung zum Verzeichnis der Turbellaria Rhabdocoela, welches ich in dem Zool. Anz. Jahrgang 1892, No. 407 veröffentlicht habe, kann ich jetzt noch folgende Arten, die ich im Sommer dieses Jahres im Gouvernement Moskau gefunden habe, anführen:

1) *Stenostomum lemnae* Graff. (*Catenula lemnae* Dugès) fand sich in großer Anzahl im Monat Juni in einem kleinen Teiche unweit des im Bogorodsker Kreise liegenden Dorfes Aniskino vor; im August ließen sich weniger Exemplare finden. Am häufigsten kamen Einzelwesen vor, zuweilen aber auch Ketten von 2 Individuen.

2) *Microstomum giganteum* Hall. Im Juni fand ich ein Exemplar in der Bucht des Flusses Osernaja, in der Nähe des im Rusaschen Kreise liegenden Dorfes Uglyn. Seine Länge ca. 3 mm, der wurstförmige Körper war dick, der Hinterteil desselben stumpf, ohne Haftpapillen; Augen waren nicht vorhanden.

3) *Gyrator coecus* Graff. Im Juni fand ich ein Exemplar im Flusse Osernaja in der Nähe des im Rusaschen Kreise liegenden

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