Zoologischer Anzeiger

herausgegeben

von Prof. **J. Victor Carus** in Leipzig.

Zugleich

Organ der Deutschen Zoologischen Gesellschaft.

Verlag von Wilhelm Engelmann in Leipzig.

XXVI. Band. 27. October 1902. No. 685.

Inhalt:

I. Wissenschaftliche Mittheilungen.

1. The Structure and Significance of the Heart of the Enteropneusta.

By Wm. E. Ritter.

(With 3 figs.)

eingeg. 11. September 1902.

In his recent preliminary account of the regeneration of the proboscis in the Enteropneusta, C. Dawydoff[1] has reached conclusions relative to the strncture and significance of the heart in this group of animals that harmonize so well with my own results as to impel me to present at this time a brief communication on the subject. The author's conclusions may be summarized thus:

1) The so-called »Herzblase« (Spengel) or »Pericardialblase« arises as a blind vesicle by abstriction from the coelom in the dorsal portion of the proboscis.

2) The side of the vesicle wall turned towards the chorda invaginates into the cavity of the vesicle to produce ultimately a blood sinus which is the real heart. The outer primary vesicle should be called the pericardium.

3) The relations of the heart and pericardium are, then, similar to those in the tunicate, "especially to those in Appendicularia". This

[1] Über die Regeneration der Eichel bei den Enteropneusten. Zool. Anz., 1902. 25. Bd. No. 677. p. 551.

correspondence is to be interpreted as evidence of homology of the structures in the two groups of animals.

To show that my own independently reached results are in accord with those of Dawydoff, I quote from manuscript of my monograph on the Enteropneusta of the Pacific Coast of North America, now ready for the printer. The quotation has particular reference to a species of *Balanoglossus* (*B. occidentalis*), and was written more than a year ago. The accompanying figures are from transverse sections of the proboscis of the same species.

"It will be observed that in the section just referred to (Fig. 1) the heart, *h*, appears as a wholly closed vesicle lying within the pericardium, *p c*.

Five sections farther back (Fig. 2) in the same series it is found

Fig. 1.

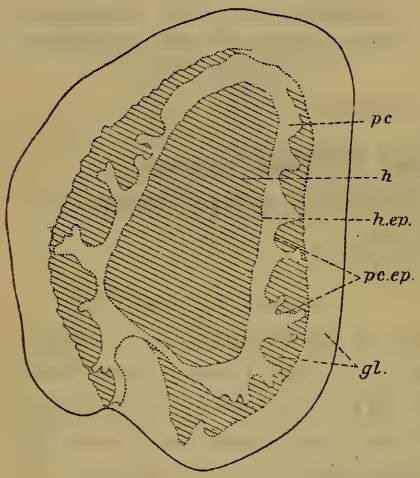
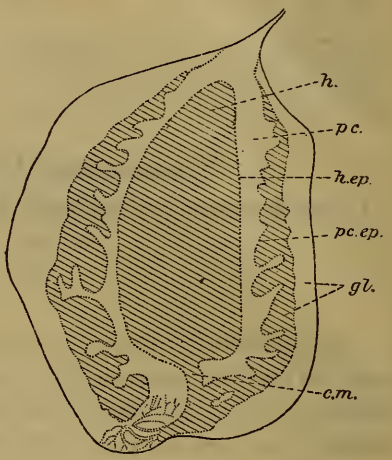


Fig. 2.



that a narrow communication, *c. m.*, exists between the heart and the great blood sinus of the glomerulus, *gl.* In other words the heart is a nearly closed sac formed by the folding into its own cavity of the ventral wall of the pericardium. The very thin wall of the heart, *h. ep.*, is readily traceable around into direct continuity with the wall of the pericardium *pc. ep.*

By following the series of sections still farther back, with the increase in size of the notochord the usual enteropneustic relations of heart, pericardium, and notochord, *n. ch.* come to view (Fig. 3).

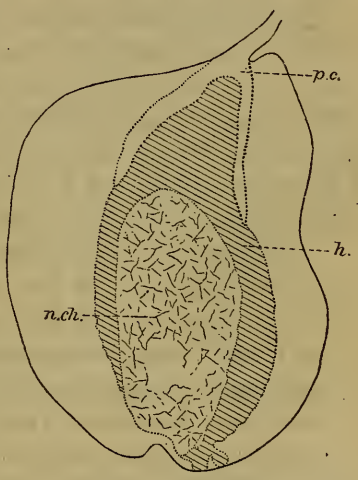
The heart, then, is here the ventral wall of the pericardium pocketed into the pericardial cavity, the mouth of the pocket remaining open backward and laterally, though

narrowly, to form the main vessels. In a word, the heart is constructed on the principle of the tunicate heart. Spengel has described an essentially similar arrangement in *Stereobalanus* (*Balanoglossus*) *canadensis*, Hill, the same thing in *Balanoglossus* (*Ptychodera*) *australiensis*, and Benham the same, engorgement with blood and all, in *Dolichoglossus* (*Balanoglossus*) *otagoensis*."

I then proceed to point out that the seeming uniqueness of the heart in these species is indeed seeming rather than real. That the relations are in reality those of the typical enteropneust heart and pericardium, the seeming difference being probably ascribable to the fact that the heart of these particular individuals happened to be unusually full of blood when death intervened.

From his observations Dawydoff considers that a true homology between the tunicate and enteropneust heart and pericardium should be recognized, and thus that »wir es hier mit neuen Thatsachen zu Gunsten einer Verwandtschaft zwischen den Enteropneusten und den Tunicaten zu thun haben«.

Fig. 3.



In my manuscript of a year ago I have expressly renounced any intention of trying to establish a homology between the two hearts, but on the contrary have pointed out what I then considered as fatal difficulties in the way of such homology. While still recognizing the full force of these difficulties, farther reflection has led me to now seriously doubt whether the facts opposed to homology are after all as weighty as those in favor of it. In the first place the adult structure of the organ in the two animals must be admitted to be fundamentally the same. That the tunicate heart has secondarily acquired a connection at both ends with blood vessels and has taken on the habit of alternating the direction of its contractions; that the mouth of invagination has become more nearly closed in the tunicate than in the enteropneust; and that the epithelial wall of the tunicate heart has produced muscle fibers of a sort not found in the enteropneust can hardly be taken to mean more than that the heart of the tunicate is more specialized than that of the enteropneust.

A few years ago the fact that the enteropneust pericardio-cardiac

vesicle probably originates from the mesoderm, while that of the tunicate undoubtedly in most cases arises from the endoderm, would have been ample ground for rejecting absolutely a suggestion of homology. To-day, however, even from a general point of view and without regard to evidence touching the particular instance, most zoologists would be less sure of the fatality of such a difficulty. But in the light of the information produced by Morgan[2], that the body cavities of Tornaria "may arise as enteric diverticula, as endodermal proliferations, or even arise from mesenchymatous beginnings", and the farther information furnished by Lefèvre[3] that in the bud of *Perophora viridis* the pericardio-cardic vesicle arises from "free amoeboid cells of the blood"; while the same structure certainly arises as an out-pocketing from the wall of the endoderm in the embryos and buds of various other tunicates (Seeliger, van Beneden et Julin, Willey, Hjort, Ritter etc.), the difficulty of origin ceases to be very formidable.

The consideration which at present seems to me to weigh heaviest in favor of the homology of the two hearts is not so much their similarity in structure as the uniqueness of the type. It is a type of heart that is absolutely without counterpart elsewhere in the animal kingdom, and when one reflects on what it really is, functionally, he finds it difficult enough to comprehend how it could have arisen once to say nothing of its having arisen anew twice.

Accepting the now pretty well established hypothesis that the blood vascular system of the metazoa is, in large part, a closed off portion of the blastocoel, we may quite easily understand how that, as the spaces closed in and narrowed down more and more to produce vessels, the walls might become contractile in places, and thus initiate a heart of the annelid or vertebrate type. Such formation would be an easy, and a natural process, and one might suppose it would occur over and over again in different groups of animals, as it undoubtedly has. When, however, we note the steps that must have been taken to produce a heart of the style now under consideration, and then try to imagine what influences could have caused them, we find much difficulty. Observe what we have: 1) A wholly closed vesicle with a capacious cavity. How account for the cavity? 2) This vesicle primarily wholly free in the blastocoel cavity. If it arose from the endoderm why dit it become severed thereform, or of what use could it have been as a heart with no connection with blood vessels? 3) An invagination of one side of this vesicle to produce a second vesicle inside the first. What in-

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[2] The Development of *Balanoglossus*. Journ. of Morph. 1894. Vol. IX.
[3] Budding in *Perophora*. Journ. of Morph. 1898. Vol. XIV.

fluences started this invagination and limited the rythmical contractions to the invaginated part? 4) A secondary connection of the organ with blood channels. What brought this about? One might, perhaps, imagine answers of more or less cogency to these queries but whatever they might be they would only emphasize the complexity of the developmental process involved, and hence the improbability of its having been initiated and gone through twice in entirely unrelated groups of animals.

The type of heart here considered is as unique as that of the arthropoda, which, by the way, it seems to the writer has not usually been estimated at its full importance as evidence of the kinship of the Crustacea and the Tracheata. True it is that the heart and the whole blood vascular system in this great phylum are so extremely variable, even within the limits of small groups, that they can not be assigned much taxonomic importance within the phylum. It is highly significant, however, that wherever the heart appears at all it is fundamentally true to the type, and furthermore that the type occurs in no animals whatever excepting in those belonging to this phylum.

The important question of the relationship of the enteropneust-tunicate type of heart to the true vertebrate type cannot be discussed here, but I may remark in conclusion that I am at present unable to see sufficient ground for supposing the two to be genetically related.

University of California, Berkely, Calif. August, 1902.

2. Chilodon cyprini nov. sp.

Von Dr. Th. Moroff,

Assistent der Königl. Bayer. Biologischen Station für Fischerei in München.

(Mit 3 Figuren.)

eingeg. 16. September 1902.

Körper weich, biegsam, ziemlich oval; das vordere Ende ist bedeutend schmäler als das hintere; letzteres ist in der Mitte mehr oder weniger eingeschnitten und verleiht dem Thiere eine herzförmige Gestalt. Das Thier ist dorsoventral sehr stark comprimiert; die obere Fläche ist schwach gewölbt, nackt, ohne Streifung (Fig. 1); hingegen ist die ventrale Seite flach, mit mäßig langen Cilien bedeckt, die an dem vorderen Ende des Thieres etwas stärker entwickelt sind als sonst. Die Bauchseite besitzt eine feine Streifung, welche parallel den Seitenrändern verläuft, und zwar stehen diese Streifen um so dichter, je mehr sie sich den Seitenrändern nähern (Fig. 2). Die Bauch- und Rückenseite gehen in scharfen Kanten in einander über. Der rechte Rand ist convex, der linke verläuft mehr gerade, nur gegen das