

## 5. The Regeneration of the Tail in *Lumbriculus*.

By Harriet Randolph, Philadelphia, Pennsylvania.

eingeg. 30. März 1891.

An examination of the regeneration of *Lumbriculus*, made in the biological laboratory of Bryn Mawr College, Pennsylvania and undertaken with reference to a more special point, has led to results in regard to the general mode of regeneration that differ materially from those at present accepted.

As some time must necessarily elapse before the complete account can appear, I offer this preliminary paper for the sake of the bearing of the results upon some biological questions.

The researches of Bülow are the source of our knowledge in regard to the regeneration of the tail in *Lumbriculus*, and for comparison they may be briefly summarized as follows:

1) The processes of development in the regenerating tail are similar to those in the developing embryo.

2) In the origin of the mesoderm alone is there a modification, since the mesoderm is not as in the embryo given off from the entoderm, but arises in the regenerating tail from the line where ectoderm and entoderm are continuous.

The results of my work confirm Bülow's more general statement, but differ most widely in regard to the origin of the mesoderm. They are briefly:

1) The new ectoderm arises by the proliferation of the ectoderm around the line of fission. From the ectoderm is formed the ventral nerve chain and the lateral nerve line. Between these two foundations are two others on each side in positions corresponding to the subsequent positions of the nephridia and the ventral setae. I am not at present prepared to say to what they give rise. From the ectoderm are formed also the dorsal setae.

2) The new entoderm is similarly formed from the old. When fission occurs, the violent contraction of the longitudinal muscles curves the body-wall inward and the wall of the alimentary canal outward so that the two tend to meet and a union is ultimately established. A faster growth of ectoderm than of entoderm furnishes the extent of material necessary for the proctodaeal invagination.

3) The new mesoderm is formed in great part from specialized cells in the region of the peritoneal epithelium of the ventral longitudinal muscles, on each side of the ventral nerve cord between it and the ventral row of setae. These cells, which I propose to call neo-

blasts, are distinguishable from the cells of the peritoneum by their great size and by the presence of a cell body. They are to be found in every somite with the possible exception of one or more at the anterior extremity, and represent the »chorda cells« described by Semper in the Nais and *Chaetogaster*. Very soon after the fission of the worm the neoblasts in the end somite begin to divide and give rise to the greater part of the embryonic tissue that is afterward differentiated into mesodermic structures. This embryonic tissue arranges itself in a very definite way into a median and two lateral elements — the median element apparently consisting of two parts, one from each side. From the median element are derived the ventral mesentery and the walls of the ventral blood vessel. From the lateral elements arise the lateral mesodermic structures with the exception of the circular muscles.

In very early stages, as soon as the ectoderm and entoderm have extended themselves sufficiently to form a new cavity there are present dorsally, laterally and ventrally small cells that seem to be wholly unconnected with the neoblasts and their products. Of the origin of these cells I can give no positive account. One very clear set of early sections, however, shows with great distinctness cell division taking place in the region of the dorsal peritoneum just at the posterior limit of the old tissue. After careful examination I am unable to find any connection between this mesoderm and the ectoderm or the entoderm. I infer, therefore, that the regeneration of the dorsal mesoderm is similar to that of the ventral, but I believe that the tissue in the two regions arises separately. These smaller mesoderm cells give rise to all the circular muscles<sup>1</sup> and apparently to the dorsal longitudinal muscles and the walls of the dorsal blood vessel.

The neoblasts are to be regarded as specialized embryonic cells set apart for the rapid formation of new mesodermic tissue immediately upon the fission of the worm. They are present in greater number in the Nais where the formation of new tissue is much more

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<sup>1</sup> It appears that the origin of the circular muscles in the regeneration of *Lumbriculus* differs absolutely from that assigned by Bergh (Zeitschr. f. wiss. Zool. September 1890) for the circular muscles in the embryology of *Lumbricus*. The process of regeneration in *Lumbriculus* is closely similar to that in *Lumbricus* and the regeneration of *Lumbricus* is apparently a repetition of its embryological development; hence there are in the regenerating tail of *Lumbriculus* cell rows that are the equivalents of those to which Bergh ascribes the origin of the circular muscles, but long before these cell rows are separated from the ectoderm the circular muscles are already distinctly formed and from elements that have no connection with the ectoderm.

rapid than in *Lumbriculus*, and also in *Tubifex* in which regeneration is a very slow process.

The general interest of the neoblasts consists in their bearing upon the subject of the germ-layers and of agamic reproduction. From the brief nature of this article all attempt to discuss either of these questions must be left for the final paper, with the remark that, on the one hand, the neoblasts seem to point to the independent existence of the mesoderm as a germ layer. In regard to agamic reproduction, on the other hand, the presence of neoblasts in Nais and in *Tubifex* appears to connect the processes of budding and of regeneration on definite structural grounds.

## II. Mittheilungen aus Museen, Instituten etc.

### Anfrage.

In den »Verhandlungen des Vereins für naturwissenschaftliche Unterhaltung zu Hamburg, 4. Bd., für 1877, Hamburg 1879« steht in den Sitzungsberichten (p. XV) zu lesen, daß Herr J. D. E. Schmeltz einen Holothurien-Zwilling von *Cucumaria acicula* besprochen und vorgezeigt habe, an dem beide Thiere mit ihren hinteren Theilen seitlich verwachsen sind. Etwas Genaueres über dieses merkwürdige Geschöpf ist nicht bekannt geworden.

Da ich nun einen zweiten derartigen Fall von der mittelmeerischen *Cucumaria Planci* vor mir habe und mit dessen Untersuchung soeben beschäftigt bin, so wäre es mir sehr erwünscht auch jenen ersten Fall näher kennen zu lernen. Vermuthlich existiert jene *Cucumaria acicula* noch in irgend einer Sammlung. Ich wage deshalb die Bitte mir eine Mittheilung über den Verbleib jenes Thieres machen zu wollen.

Bonn, 24. April 1891,  
Colmantstr. 30.

Prof. Dr. Hubert Ludwig.

Ich werde am 1. Mai auf 6 Monate nach den Galapagosinseln gehen, um diese Gruppe einer gründlichen wissenschaftlichen Untersuchung zu unterwerfen.

G. Baur.

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