Preliminary Note on the Development of the Pronephros in Petromyzon.

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I have recently studied the history of development of the pronephros in *Petromyzon*, and the results arrived at throw, I believe, some light on this subject. I will enumerate the chief points obtained in the following pages.

1). In *Petromyzon*, the pronephros becomes apparent at a comparatively early stage, that is, the stage approximately corresponding to the early section of stage II in the list given by me*. When the metameric segmentation of the mesoblast in the anterier region of the body has been finished, we can distinguish, in each of a few somites in this part, a piece of mesoblast which lies between the proximal somatic and the distal unsegmented portion (the lateral plate). The component cells of this piece first assume the regular arrangement of a columnar epithelium, and the parietal row of them is a little elevated aganist the epiblast. It is this piece which develops, as the subsequent history teaches, into the pronephric tubules and the nephrostomes; I will, therefore, hereafter call it the *anlage of the pronephros*. All the *anlagen* of the pronephros are cut off, with the lateral plates, from the segmented portion of the mesoblast, and are still more thickened by the repeated multiplication of cells. These thickened parts, however, is never a solid knob: for they acquire a lumen as soon as the *anlagen* come into view. The lumina of the pronephric *anlagen* communicate, of course, with the body cavity, which is a mere fissure in the stage in question. The cells forming the the *anlagen* are high and columnar in shape, while the cells

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of both the somatic and splanchnic layers of the lateral mesoblast are of irregularly quadratic forms.

2). The first appearance of the *anlage* of the pronephros is observed in the region under the fourth somite; this is the first pair of pronephric tubules. The following pairs become pronounced one after the other. The distal end of these tubules become confluent by the multiplication of their cells and thus a direct connection is established among them. These connecting pieces together from the collecting duct (Sammelrohr of RÜCKERT or the anterior continuation of the segmental duct) of the pronephros.

3). When all the tubules have become developed, there are 6 pairs, the first of which contains no lumen, while all the remaining pairs soon acquire a tubular structure. The independent canalization of each tubule proceeds backwards and into the collecting ducts, and finally all the tubules and the duct on each side are set in free communication. Then the ducts shift toward the median line of the body; consequently each tubule takes a latero-ventral course, and the funnels themselves become open just ventrally.

4). The first pair of tubules does not develop further, and the second pair degenerates after a short existence, while the 6th. pair loses its connection with the duct. The disconnected tubules remain unchanged for some time, but finally they disappear.

5). The total number of persistent tubules is, threfore, six, i. e. three pairs, of which the second and third pairs are developed most vigorously. This fact would explain why certain investigators believe 3 pairs to be present, while we are told by some others that there exist 4 or 5 pairs. In later stages, the foremost pair of the three persistent tubules is in close contact with the posterior wall of the gill-chamber.

6). The tubules are prolonged and grow downwards, pushing their way into the body-cavity, until the funnels almost meet with the cardiac tube. The proximal portion of the tubules also grows enormously and becomes coiled many times, so that the chest-cavity is at last filled up with the convolutions of the tubules and the cardiac tube.

7). In the anterior region, the segmental duct has every appearance of having been formed in the same manner by the thickening of the proximal margin of the lateral plates, as in the pronephros proper; the only difference is that the *anlagen* do not develop into tubules, but unite with each other to form the duct. Owing to a large quantity of yolkmass in the posterior region the process is here much delayed and somewhat modified: it is brought about by the multiplication of a few cells proliferated from the proximal margin of the somatic layer of the lateral plates. I have observed neither any trace of an epiblastic origin of the duct nor any free growth of its posterior end*. In a much later stage, the posterior extremities of the ducts open into the cloacal section of the enteric canal.

8). From early stages, there is a complete blood supply in the pronephros: the arterial blood comes from the dorsal aorta; the blood corpuscles are found scattered between the tubules, and are afterwards transformed into two pairs of glomi, the anterior of which soon atrophies. The venous blood is taken away by the cardinal veins which drain the pronephros from early stages.

From the facts mentioned above the following conclusions are justified: Both the pronephric tubules and the segmental ducts are purely organs of the lateral unsegemented portion of the mesoblast †; the somatic mesoblast as well as the other germinal layers have no share in their formation. The *anlagen* of the tubules follow, from their first appearance, the same segmental arrangement as the mesoblastic somites. The maximum number of the pronephric tubules formed is 6 pairs, of which the first, second, and sixth degenerate one after the other. The persistent tubules are, therefore, the third, fourth, and fifth, of which the third pair is not so well developed as the next

* I have observed a case in which mitotic cell divisions are taking place in that point of the epiblast, where the segmental duct lies in close contact with it; this subject will be explained in the full paper.

† For convenience's sake I divide the mesoblast into two portions the somatic and the lateral plates, and no more.

two. It is an interesting fact that the first and second pairs originate in the region where afterwards the gill-slits are formed, and they disappear when the latter come into view. In later stages, the third or foremost pair of persistent tubules is in close contact with the hind wall of the gill-chamber.

These facts bear a close resemblance with those in *Bdellostoma* as described quite recently by G. C. PRICE*. Hence we have a strong reason to believe that the pronephros of cyclostomata is homologous with the "*Nierencanälchen*" of Amphioxus as described by TH. BOVERI†, and that at the same time, the persistent tubules of *Petromyzon* are homologous with those of Selachia, Teleostei, Amphibia, &c.; the mesonephros does not seem to be a part of the pronephros, but it probably belongs to another series of excretory organs.

The full paper will appear in the next number of the Journal of the College of Science, Imp. Univ., Tokyo.

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* PRICE.—Development of the Excretory Organs of a Myxinoid, Bdellostoma Stouti, Lockington. Zool. Jahrb., Bd. X.

† BOVERI, TH.—Die Nierencanälchen des Amphioxus. Zool. Jahrb., Bd. V.

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