

## PROLOGUE.

### §. 1.

Through a wealth of observations and results, the discipline of the developmental biology of animals has become characteristic of today's state of physiology, similarly as Bichat's immortal name and the discipline of general anatomy created by his genius are characteristic of the already passed era. What the latter was able to do for physiology has happened for the most part; what the general anatomy of pathology, already glorious enough in itself, is scarcely known among many of the better physicians among us. For the pharmacology, in which antiquity is more hallowed and venerable than in the rapid progress of related natural sciences, has not yet profited from the vitalizing influence of that great trend which Patt von Walther in that oft-admired presentation of the *Bichat's Systems* proclaimed.

Meanwhile, the developmental history of embryos has, for the second time after that extraordinary observer Caspar Friedrich Wolff, exposed its richness and solved its mystery, which had not been questioned with useless hypotheses. A good eye practiced in microscopic examinations, extensive knowledge, and tireless observations are necessary to uncover the mysterious process of the formation of all organs from the germ cell to the whole organism.

Two objects have particularly attracted me in this large field, in which commendable men found the greatest fame, the development of glands and genitalia. What the evolutionary history of the glands has taught me by way of observation is part of the larger, recently published work on the internal structure of the glands. Here I

describe what I have learned about the initial development and formation of the genitals, especially of the internal genitals.

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## §. 2.

In the course of this historical introduction it will be obvious that I have had only a few predecessors, and indeed with respect to the history of the development of the internal genitals, only one predecessor. Due to the fact that Rathke's observations are very extensive in this respect, and, especially in birds, leave little to be desired, it only remained for me to subject the research of my predecessor to scrutiny, to partially confirming it, to extend it to include several classes, especially to extend it to human beings, and to rectify it in several important points, and to finally happily solve all the remaining doubts and questions. Everything concerned an object, which, in itself, is of the greatest importance, and is almost new in the field of empirical investigations, but will soon attract the general attention of anatomists and physiologists. After all, is it not the initial development of the internal genitalia that must be known before, as it had happened recently, one investigates the causes of differences in the sexual development of embryos? How wrong it is, to begin with, the parents in the latter investigation, when it is clear that in-mass fertilized eggs from Batrachians and fish develop into males and females.

Moreover, the ideas expressed in recent times concerning the initial similarity of the genitals in both sexes, albeit correctly, were based almost exclusively on the knowledge of the external genitalia, but were only very generic ideas with respect to the

internal genitals, which has been proven by the observations of Dr. Rathke, and are confirmed, tested, and extended here.

### **§. 3.**

In fact, what was known about on the initial development of the genitals before Rathke, is limited almost exclusively to the knowledge, which is however complete, about the development of the external genitals, from which Ackermann\*, Autenrieth\*\*, Tiedemann\*\*\*), Meckel<sup>+</sup>) concluded that

the genitals were originally the same in both sexes, and which led Tiedemann to the conclusion that all embryos originally developed as females. Detailed and very precise investigations have been made of the *descensus testicularum* (testicular descent) by Hunter, Scarpa, Brugnone, Lobstein, Seiler, Langenbeck and others. Johann Friedrich Meckel has excellently explained the development of the uterus in the human embryo. Tiedemann conveyed a valuable and complete investigation of the development of the external genitals in his publication: *Anatomy of Headless Abortions* (Landshut, 1815), and while he was at it, also promised a special description of the development of the reproductive organs, which, however, has not appeared.

#### § 4.

One had almost only speculations about the genesis of the internal genitalia. For what was known was restricted to an imperfect observation by C. F. Wolff, to some observations by Oken about the early period of development in mammals, and to some very valuable observations by J. Fr. Meckel in the human embryo. It must be admitted frankly that the most accurate, earliest observations are those by Oken, who described them in a successful publication at a time when this natural scientist had not yet taken the liberty to leave the limits of empirical investigation. Oken and Kieser's contributions to comparative zoology, anatomy, and physiology are among the most outstanding

\*) *Infantis Adrogyni historia*. Jenae 1805. p. 53. As there are so many references to Ackermann in this matter, it is worthwhile, to cite the only thing that Ackermann merely hypothetical and without observations stated. »The early embryo is not granted with a

specific sex from its formation and from its first moment of life, but it is instructed from early training of its genitals and of whichever sex it is to have, and it is formed by natural strengths, which are determined by life and by the development of intrinsic functions. This development depends upon the quantity and direction; thus a male, or, perhaps, a female appears, and the genital organs of whichever sex unfold or whichever genital organs are specific to a male or female are formed.«

\*\* ) Reil's and Autenrieth's Physiology Archive B. 7. Remarks on the diversity of the sexes and their reproductive organs, as a contribution to the theory of anatomy. This essay was written at a time when there were exaggerated expectations of chemistry to support Medicine, and used it an arbitrarily and hypothetically, occupying only a minor place among the extraordinary merits of that honored lucky observer.

\*\*\* ) Anatomy of headless miscarriages. Landshut. 1813. p. 80.

+ ) Contributions to comparative anatomy; and Manual of Human Anatomy. T. IV. P. 584.

work on the anatomy of the embryo. Albert Meckel had founded a hypothesis on the development of the genitals on Wolff's and Oken's observations. This hypothesis of the commendable anatomist is the only detailed conception that had been developed of the formation of the internal genitalia.

Albert Meckel says: "On either side of the spine arise two stripes of a grainy polyp-like mass, which unite into a plate that curves and finally closes into a tube. The canals are initially open at both ends and remain open as tubes in females: but close as ductus deferens in males" \*). This view, without its own examination, is based solely on the misunderstood observations of Wolff and Oken. Firstly, as the author himself admits, it is a mere hypothesis; secondly, it is incorrect. Nothing can be more different than the genesis of the genitals.

#### §. 5.

Heinrich Rathke \*\*) was the first to explain it and to inform us with many real observations about the genesis of the internal genitalia in fish, amphibians, birds, and mammals, with the exclusion of man. Rathke's observations were very accurate, especially for birds. If they were not, he would have left me with a greater yield of new facts and corrections, but also a greater opportunity for error. The following investigations now have the task of examining the results, in particular the ones obtained by Rathke, using new observations, to resolve and to correct doubtful points, to fill in the gaps, especially the many things missing for the classes of amphibians and mammals, and to finally extend these investigations to the human embryo, about which

nobody has made any observations with regard to the first appearance of the internal genitalia.

\*) Albert Meckel in I. Fn. Meckel's contributions to Comparative Anatomy, 11. B. a. II. P. 16.

\*\*\*) On the development of the genitalia (in Rathke's contributions to the history of the animal world. 3rd Abth. Writings of the natural science society to Danzig. IV. Issue. Halle. 1825.)

§. 6.

Inasmuch as I had to follow a close observer step by step and had to make a whole series of new investigations on every point that was found to be doubtful, and then had to explain the large differences which are present in amphibians, birds, mammals and especially in humans, except the general relations of the same development, this work was thankless to some extent, because at first the effort seemed greater than the hope for profit. But the drive for the truth about such an important matter has provided me with the enthusiasm, the patience, and the perseverance, which otherwise become so pleasant and sweet in the pursuit of a new discovery. If I now describe new and more complete observations on all points, then I wish that my investigations will receive accurate criticism from diligent observers as careful as that of my predecessor's in the present work.

§. 7.

I have already developed with a few words the general point of view regarding our task for all classes. \*) Thanks to Caspar Friedrich Wolff we already learned about two very strange embryonic structures in the chicken, which already on the fourth day of incubation are positioned as the main viscera of the trunk within the keel (extension of the sternum in birds) on either side of the aorta, and fill up not only the largest part of the abdomen but also a part of the thorax up to the heart; which later, however, become more restricted to the abdomen. *Theoria generationis auctore Casparo Friderico Wolff. Edit. nov. Ifal. 1774- §. 229. Tab. II. Fig. 15. 16. 17.* These formations consist of transverse, cecum-shaped tubules, from which on the outer rear side an outward



flowing vessel descends. Heinrich Rathke had the pleasure to be the first to examine these important organs in detail. Almost everything we now know about these organs is due to this faithful observer; he called them Wolff's bodies and proved that

\*) Dr. Johannes Müller, on Wolff's body in the embryos of frogs and toads. Meckel's Archive of Anatomy and Physiology. 1829, H. 1 and 2. p. 65.

they are not the kidneys, with which they have often been confused, and could have been so easily confused at the beginning. He showed that the kidneys developed later behind and on the side of these (Wolffian) bodies, and that the Wolffian bodies become smaller and smaller in the course of the embryonic life and, at the time of hatching, all but a few traces have disappeared. Rathke considered these organs to be the common base from which the kidneys and genitalia originate, which did not hold up for the kidneys in his observations, and which, according to my observations, is not the case in amphibians, birds, and mammals. Rathke observed, however, that in the chicken the ovaries and the testes developed from them, which is generally still doubtful, and according to our observations certainly not the case in Batrachians. Rathke also thought he had seen at the time that among the animals which possess an epididymis, they develop into the epididymis, whereas in the female they degenerate. However, it can now be demonstrated that they disappear in males as well as in females and that the epididymis has a completely independent and autonomous origin.

### §. 8.

In mammals, the same organs occur in the fetus. We owe our first knowledge about them in females to Wrisberg \*) and Rosenmüller \*\*); Dzondi \*\*\*) has seen and well described them, but, like Kuhlemann earlier, considered them to be the kidneys; Oken +) described them more accurately at a time of development, when the sexes are yet indistinguishable, Oken showed that they are different from the kidneys and suggested that they have a closer relationship to the development of the genitalia, which Rathke finally confirmed with a series of observations from a later period of development.

Incidentally, our organs, which in mammals also consist of these tubules or blind-ending ducts, may also often have given rise to confusion with the adrenal glands, which in the case of the human fetus are extremely large early on, but are never larger than the mammalian kidneys.

\*) Weiseberg *Commentat medici, physiologici, anatomici et obstetricii argumenti*. Gotting. 1800. 8. p. 285.

\*\*\*) Rosenmüller *from the ovaries to the human embryo and fetus*. Lips. 1802.

\*\*\*\*) Dzondi *Supplement to the Comparative Anatomy and Physiology*. Lips. 1806.

+) a. a. 0. p. 24.

**§. 9.**

Rathke did not find these Wolffian bodies or false kidneys in Batrachians and fish but in the embryos of the lizards, snakes and turtles \*). Because of the similarity between the external and internal formation of the Wolffian bodies and the true kidneys in Batrachians and fish, Rathke considered both to be analogous, namely the Wolffian bodies represent the kidneys of lower animals, and suspected a similar relation between the false kidneys and the true kidneys, similar to the relation between gills and lungs, which can be present in the same animal one after the other. Rathke also suspected a certain relation between the false kidneys and the allantois, as well as the amnion, because the false kidneys appeared to be absent in the animals without amnion and allantois, namely batrachians and fish. This is the condensed summary of the general results of Rathke's observations. Rathke's further communications on the development of the various reproductive organs can be found in an informative synopsis that summarizes all observations relating to this topic by other researchers in the second volume of Burdach's *Physiology as empirical science* \*\*).

**§. 10.**

Since then I have succeeded in discovering the Wolffian bodies also in frogs and toads, where they should be absent according to Rathke, about which I have already given a preliminary note in Meckel's Archive of 1829. I then also found them in the larvae of salamanders. From this single new fact, it follows that there is no necessary relation between Wolffian bodies and Amnion and the Allantois, as Wolffian bodies also develop without these organs, in addition, it also follows that neither the kidneys nor the germ

cell-producing genitalia is necessarily derived from the Wolffian bodies. For Wolffian bodies in frogs, toads and salamanders are remote from the kidneys and genitalia and these organs have no anatomical connection with either the kidneys, testes or ovaries.

Footnotes:

\*) a. a O. p. 135. 136.

\*\*\*) Physiology as empirical science. Volume II, processed by C. Fr. Burdach, with contributions by C. E. von Baer, H. Rathke, and E. Meyer. Leipz, 1828.

§. 11.

In the spring and summer of 1829, I examined the relation of our organs to the fat-bodies of these animals; I also examined them in embryos of lizards and snakes.

For two years I had reproduced Rathke's observations in birds; for this purpose, I used a large number of birds' eggs, which were brought to me from the forest and the field in the spring and summer of 1828 and 1829; I also employed repeated breeding trials to determine the first origin. I finally had to pay attention to Herr von Baer's recent communications on the Wolffian bodies in bird embryos in his productive and most valuable writings on the developmental history of animals, volume I. Koenigsberg, 1828. I discovered through this and satisfied myself that, after learning all about the history of these wonderful organs in every detail, they are secretory that their blind-ending ducts are definitely hollow tubes.

I finally examined the development of Wolffian bodies and genitalia in a large number of embryos of mammals of various ages, especially of sheep, for which there is plenty of opportunity in the autumn in every city. I finally found our organs in the youngest human embryos, and also traced here the development of the external and internal genitalia in a series of observations.

All these investigations will provide a complete history of the development of the genitalia in the amphibians, birds, mammals, and man, a series in which only fish is missing, for which I had no opportunity to study the embryos.