

Second section.

Observations on the development of the genitalia in the embryos of birds.

Tab. II.

I. Development of the Wolffian Bodies (mesonephros).

§. 16.

In birds, as Rathke first described in more detail, the Wolffian bodies reach on the fourth day of incubation, within the Carina, as a narrow, thin layer of a delicate substance consisting of transversal plates, through the greater part of the trunk. I saw them from the heart to the posterior end, or better, to the vesicle-like allantois or chorion. Rathke says, like Wolff, that this substance will soon split into two side parts; but I have never seen it not split; because when they first appear, the main blood vessel descends between them. Also, von Baer denies decisively that it originates as one unity *). I must also note here that this substance seemed to me to consist of an aggregate of transverse cylinders or stalked vesicles right from the very beginning, however the stalks were hardly thinner than the round ends; moreover, these elementary particles were within a still tender material. See fig.1. Tab. II. showing the lower trunk of a chicken embryo on the 4th day.

*) C. von Baer on the Development of Animals. I. B. p. 63.

§. 17.

Very soon were these bodies lined up more densely, and the Wolffian body on each side becomes more pointy at the top, in the middle and below broader, almost spindle-shaped, as I have shown in a magnification in fig. 2. Tab. II. in a chicken embryo. According to Rathke, the Wolffian bodies already have that spindle-shaped appearance on the fifth day; however our picture shows an older embryo.

§. 18.

If one very closely examines the Wolffian bodies microscopically at this time, one sees attached to the posterior surface of the Wolffian body a thread-like excretory duct, which starts at the tip of the body, picking up very regularly the stalked vesicles or little bulbs, and runs towards the posterior end. Rathke saw this excretory duct already on the 5th day to lead to the end of the intestinal canal. Mr. von Baer *) suggested that the Wolffian bodies appeared to form from a blood vessel, in as much as the parts of the Wolffian body not only appeared to be bloody at the beginning, but also a vessel which runs through the middle of the Wolffian body contained blood. Although I know from personal experience how accurate Mr. von Baer's observations on the development of the chicken are, I think I must certainly dispute that statement. At the beginning, I only saw the interstices of the stalked bodies or little cylinders were bloody; Never did I see the excretory duct on the outer posterior side of each Wolffian body as bloody; this duct is indeed excretory, as I shall later prove; it leads secretion in consequence. However, Mr. von Baer has no doubts about the existence of this passage, but about his first appearance, as I have recently learned through the correspondence of my highly respected friend. And I gladly admit that we are still in the dark about not only the first appearance of this duct, but also the way of the first development of the Wolffian body itself.

*) a. a. O. p. 63. vergl. 71. 81. 98.

§. 19.

In order to represent the relationship of the vesicle-shaped, stalked bodies to their common duct and to the delicate tissue in which they lie, I designed fig. 3. panel II. which illustrates the microscopic picture of a Wolffian body from an almost 1-inch long embryo. The stalked vesicles will later become more numerous and elongated, especially in the lower part of the Wolffian body, and, as their bulbous ends become thinner, they become blind-ending tubules or ducts that are equally thick along their whole length and have a blunt end. At that time, they are parallel to each other and transverse, still almost straight; and as the duct is descending along the posterior surface, but almost on the outer edge of the Wolffian body, the blind-ending tubules are located at the anterior surface usually diagonally from the outside to the inside, and their blind ends extend for the most part to the inner side.

§. 20.

While the blind-ending tubules are initially diagonal and straight and almost parallel, they will soon become a little bit coiled due to their elongation, they will twist around each other without connecting or budding off branches. None of these tubules is neither now nor later branched, all have the same thickness everywhere up to their blinded end. Therefore at this stage, the Wolffian body resembles the kidneys of the Batrachians, which likewise consist of transverse-lying, coiled and blind-ending tubules with even thickness along their whole length. In Panel II. shows a microscopic view of the beautiful structure of the organ.

The diameter of these blind-ending tubules from two embryos was, according to micrometric measurements, 0.00377 in one case and 0.00300 of a Paris inch (1 "Pariser Zoll" = ~2.707 cm) in the other case.

§. 21.

It was very easy to confuse these organs with the kidneys at a stage before the kidneys have formed. This happened already to Wolff with respect to chickens as well as several other observers with respect to mammals. However, Rathke was the first to establish that they are different organs, and after the sixth day of incubation these organs certainly cannot be mistaken for each other anymore.

§. 22.

Rathke claims that the kidneys emerge from the Wolffian body on the 6th day. According to my observations, the kidneys appear first as a seemingly worm-like, jelly-like grey substance, that consists of many very small, intercalating lobules, which originates and spreads from behind and on the outer side of the Wolffian bodies. From the very first appearance, the tissue from which the kidneys originate is quite different from the tissue that forms the Wolffian body; because it is a greyish-gelatinous accumulation of substance, which has on its surface only worm-like coils of small lobules, and not of blind-ending tubules. In contrast, the Wolffian bodies consist of exceedingly clear, loosely connected, whitish or white-yellowish blind-ending tubules. However, Rathke did not prove that the kidneys or the tissue from which the kidneys originate developed and grew out from the Wolffian bodies. The reasons, which he considered sufficient for this assumption, namely, that when he dissected the Wolffian body from the carina on the 6th or 7th day, the kidneys remained connected to those Wolffian bodies, and not the latter (carina), and were difficult to separate from the Wolffian body with the scalpel, are by no means sufficient. Both are connected with each other, but both organs retain their individual formation up to the point of their loose attachment, and there is certainly no continuum between the blind-ending tubules of the Wolffian body and the tissue of the kidney, which gradually organises completely differently into the renal tubules of the kidney. As similar the kidneys of the Batrachians and the Wolffian bodies of the birds are, as dissimilar are the renal tubules of the birds and those of the Batrachians, which I have shown in my anatomical work on the internal structure of the glands.

What finally decides is that in the frogs, toads and salamanders, the kidney and Wolffian bodies are always far apart and have no contact at all, that the Wolffian bodies in mammals have absolutely no connection with the kidneys, and that the enormous adrenal glands are located between the kidneys and Wolffian bodies at the earliest stages of development in human embryos.

§. 23.

It must also be noted here that the Wolffian bodies have no relation to the adrenal glands, which are located and develop over the kidneys, and are soon present at the same time as the Wolffian bodies.

§. 24.

The germ cell-producing genitalia, testes or ovaries, appear at the time of the most completed development of the Wolffian bodies on their inner, anterior surface, as narrow, white tissue bands, without clear organization, and shorter than the Wolffian bodies. They are still mere primordia (blastema), which developed here and only much later becomes organised inside according to the forces that inhabit it. However, this primodium is intimately attached to the Wolffian bodies and, like Rathke did, it could be assumed that the primordia of the testes and ovaries would be deposited by the Wolffian bodies themselves, especially if also in mammals it is believed that the origin of testes and ovaries is on the inner side of Wolffian body. Only in Batrachians there is no such relationship. As we have seen, testes and ovaries develop much deeper in these and are completely separate from them from the very beginning, but rather develop on the inner side of the kidneys. Rathke believed that also in birds he had seen that the vessels or blind-ending tubules of the Wolffian body penetrate into the germ cell-producing organs which are located at their inner side. However, I could not confirm this, neither in birds nor in mammals; those exceedingly beautiful and distinct white tubules are, as usual, blind ending, and the relation of the testes and ovaries to the Wolffian bodies is at first a mere juxtaposition; only a delicate tissue that connects them is common to both. It may be possible that the substance of those organs in birds and mammals developed from the Wolffian bodies; at least, this can not be strictly proven; in contrast, it has become certain to us that the constituents of the Wolffian body, namely those blind-ending tubules, do not undergo any changes in the area where testes and ovaries develop from.

II. Internal construction of Wolff's body.

§. 25.

I have already sufficiently explained the external formation of the blind-ending tubules or white coiled little cylinders of which the Wolffian bodies consist. I shall now emphasize a very important recent observation, which sheds light onto the inner structure of these little cylinders. I will prove that they are hollow, that their cavity is connected with the cavity of their excretory duct, and that they indeed are secretory.

Namely, I have observed in many embryos of the male and female sex a white-yellow pulpy secretion in the blind-ending tubules and in the excretory duct of the Wolffian body at later stages. I could easily move this substance, which is easily distinguishable from the matt walls of the tubules due to its bright yellow or white-yellowish color, adding pressure to the tubules under the microscope. I saw very often that this substance moved in this way from the blind-ending tubules into the excretory duct, and often that this strange substance filled up the whole excretory duct from top to bottom at the cloaca. Under the microscope, with the help of a needle, I could move this substance, back and forth within the cavity of the blind-ending tubules and the excretory

duct. In this way, I have convinced myself that all these blind-ending tubules are hollow, and that they lead into the excretory duct. I have already mentioned this fact, which I first to observe, in the zoological section of the Assembly of Naturalists in Berlin; but since then, in the spring and summer of 1829, I often had daily the opportunity to repeat this observation.

I also convinced myself that this is still the case when the sex is clearly recognizable, it is the same in both sexes, and I would not be able to be so confident without the premature disappearance of the right ovary which is a reliable means for the determination of the sex of every embryo. This tissue is most clearly manifested in the later period, when one can no longer be in doubt about the difference of sex. I have not found this tissue in the blind-ending tubules of the Wolffian body in fresh mammalian embryos; but the lumen of the hollow tubules in these embryos can be seen very clearly already in a section through the whole organ using a microscope or a magnifying glass.

§. 26.

A second, very strange analogy of the false kidneys, or the Wolffian body, with the true kidneys, exists in the behavior of the finest arteries. The finest arteries in the kidneys of frogs, turtles, birds, mammals, and man, form small spheroidal glomeruli, consisting of several loops, and represent in their injected state round, small bodies, the corpora malpighiana. Mr von Baer already noted that there are many blood droplets in the Wolffian bodies; These blood droplets or red spots are not located within in the blind-ending tubules of the Wolffian bodies themselves, but, as I have always convinced myself, only between the completely white, blind tubes, in their interstices. The Wolffian bodies often look bloody to the naked eye because of this abundance of blood; but if one examines these organs using a microscope or a magnifying glass, one immediately sees that only the interstices are bloody. Rathke was the first to uncover the true behavior of these bloody areas recently, and explained it in his letter issued to me on the 18th of February, 1829, as follows

"The strange ball of blood vessels, which I suspected are presented in the false kidneys of the birds, snakes, lizards, and mammals, which I mentioned to you in Berlin, I now have identified with certainty as a beautifully shaped cluster of arterial ends in pigs

and sheep. "

§. 27.

Here I can add that the round, bloody areas between the blind-ending tubules of the Wolffian bodies look exactly like the balls of blood vessels or Corpora Malpighian in the kidneys of those animals in which I had seen them, namely frogs, turtles, birds, mammals, and in man, balls of blood vessels, injected from the arteries, also lie between the blind-ending tubules, without connecting with them.

§. 28.

I cannot confidently state, where the secretion of the Wolffian body, which I have seen in the most perfect state of formation, both in the blind-ending tubules and in the excretory ducts, ends up. It probably gets first into the cloaca; but, as the allantois or chorion bladder originates from it, it may perhaps mix with the fluid of this bladder.

§. 29.

At later stage the secretion of the kidneys also ends up in this bladder. Jacobson has found uric acid in the allantois, even of the young, few days old bird embryos. Consequently, the uric acid content of the allantois at the early stages may have originated from the Wolffian bodies, but not from the kidneys, which develop later. The white matter within the blind-ending tubules, however, bears resemblance in appearance to the white matter, which later accumulates in the allantois, and to the white-yellowish urine of birds, which is first noticeable towards the end of embryonic period in the superficial, small, urinary canals of the true kidney. But it would require a chemical examination to determine the identity and difference, and it would be sufficient to prove that the Wolffian bodies are very early, secretory organs.