

III. Further development of the testes and ovaries.

§. 30.

The first precursors of the testes and ovaries, which appear on the inner side of the Wolffian bodies and on their anterior surface, are completely indistinguishable; in all embryos they are elongated and flat, and extremely small in comparison to the big mass of the Wolffian bodies. Soon, however, an important change becomes obvious as these white little bodies develop into either testes or ovaries. Rathke presented this difference admirably. Rathke says:

"On the seventh day, the gamete-producing structures show the same form and the same gelatinous structure in all individuals. On the ninth day, however, they have become bean-shaped or cylinder-shaped (millet seed-like) in some individuals, while in others they have retained the flat shape. The former are the testes, but the ovaries, are still paired at this time. However, soon after the appearance of the kidneys, the left ovary begins to increase in size much more than the right ovary, so that on the ninth day it is sometimes found to be twice as long and as wide. The right ovary, on the other hand, does not grow any further, retains its size until birth and is finally absorbed after birth."

§. 31.

I quote this fact, which Rathke first proved, in his own words, because my own investigations have almost always provided me with only confirmation of his

observations. However because I examined not only chicken eggs, but also fertilized eggs from many other small and large birds, which were brought to me from the country, from forests and fields, I found that the time at which the right ovary becomes smaller and atrophied, was not so consistent with respect to the simultaneous development of the other organs and of the whole fetus. In several birds it appears that this reduction of one of the ovaries occurs very late, much later than on the ninth day of development; I even noticed

only a very small difference between the two ovaries in the almost formed embryos of large birds of prey. I cannot give more exact information here regarding bird genera and species, as I, unfortunately, did not know for sure some of the eggs. Incidentally, I saw on this occasion how useful and often indispensable the most minute knowledge is to the natural scientist. How much would I have appreciated if every time I would have been able to recognize the bird by its egg.

§. 32.

It is certain, however, that in most birds at about half of the incubation period the right ovary and, as we shall see, the right oviduct is atrophied, whereas in almost completely hatched birds of prey the right ovary is still not much smaller than the left and also the right oviduct is not much smaller. This is in accordance with the observations by Emmert, Meyer, Wolf, that birds of prey have two ovaries, of which the right one is only smaller. This last observation was already mentioned by J. Fr. Meckel *), but the assumption expressed here that in other birds both ovaries merge is incorrect.

§. 33.

In males there is only something similar in the fact that in adult birds the right testis is usually a little smaller, especially shorter, than the left, which Tannenberg repeatedly found confirmed in his investigations. S. Tannenberg, *On the Male Reproductive Parts of Birds*, translated by Schoenberg and Spangenberg. Götting. 1810. 4. p. 13. §. 8.

*) Contributions to Comparative Anatomy. 3. B. 2. H. p. 17G.

§. 34.

The excretory ducts of the Wolffian bodies are present in both sexes throughout the entire life of the embryo, but remain only in the male sex, by becoming the seminal ducts, after the Wolffian body gradually becomes smaller next to the testis. At hatching there is still a remnant of the Wolffian body present, but it disappears gradually in young birds. In the case of female individuals, on the other hand, the excretory ducts of the Wolffian bodies are still present at hatching, but apart from them and independently of the Wolffian bodies, an oviduct has formed. The Wolffian bodies themselves wither away more and more with the completed formation of the fetus and finally disappear altogether. This is what we will prove in the following chapters as the result of all our investigations.

IV. Further development of the male genitalia.

§. 35.

Rathke, of whose account I differ here, commented only vaguely about the relationship between the excretory ducts of the Wolffian bodies and the vas deferens. On page 56. a. a. O. [an abbreviation when a source is cited multiple times] he says that the filament or excretory duct of the Wolffian body is resorbed very early in the male individuals; on the ninth day of incubation the same was hard to find, but completely disappeared on the 10th. However, he adds that for him nothing was more difficult in his investigations

of the chicken than to be convinced of the existence and the early disappearance of that excretory duct in the male sex. Rathke describes the development of the excretory genitalia as being particularly distinct from the excretory ducts of the Wolffian bodies. Both are indeed different in females, which is very easy to be convinced of. The very obvious oviduct is present next to the excretory duct of the Wolffian body. Rathke has at no point an observation that he has really seen the vas deferens and excretory duct of Wolffian body side by side. Rathke rather tends to, on page 68. a. a. O. assume that in male individuals the excretory duct of the Wolffian body and the vas deferens become one, and are in fact the same, because the vas deferens later

seems to be just as connected with the end of the Wolffian body as formerly the excretory duct of the Wolffian body. This last statement by Rathke is, according to my investigations, perfectly correct, but it is incompatible with his earlier statement that the excretory duct of the Wolffian body disappears already towards the ninth day, which certainly must be incorrect.

Also von Baer, who agrees with Rathke's account in regard to the Wolffian body on the sixth to the seventh day*, claims that the excretory duct of the Wolffian body becomes unrecognizable towards the end of the tenth day, and disappears. However, there are no excretory ducts of the male genitalia other than the excretory ducts of the Wolffian body at any time.

§. 36.

During the whole of spring and summer of 1829, I occupied myself by almost daily examining bird eggs that had been incubated, to clarify this most important point after having recognized the former, namely to distinguish whether there is a separate excretory duct next to the Wolffian body's excretory duct, similar to the oviduct being different to the Wolffian duct in females, or whether in males the excretory duct of the Wolffian body itself becomes the vas deferens, after the Wolffian body next to the testis has become smaller and smaller and finally disappears. If I would have concluded about a questionable point in birds according to my observations in another class, namely in mammals, then I, like Rathke, would have had strong reasons to assume that birds

have a peculiar vas deferens; because in mammals the ducts, which in males become the vas deferens, and in the females uterine tubes [Müller calls them trumpets], are very similar, or rather there is a similar duct on each side in both sexes, which is not the excretory duct of the Wolffian body, but will give rise to the uterine tubes in females, and becomes the tail of the epididymis in males.

*) a. a 0. p 97.

**) Ibid. p. 113.

My intention was, with respect to such a difficult and important matter, to provide a complete and independent series of observations for every animal class; and if these observations, performed with the greatest accuracy and endurance from step to step and on a large number of bird embryos, showed a somewhat different relationship than in mammals, then this must rather increase the confidence in the correctness of my observations. In fact, the peculiar mode of formation of a new organ, such as the epididymis, explains that deviation in mammals.

§. 37.

My very numerous and long-time daily observations provide a complete series in which the only duct I found in males was the excretory duct of the Wolffian body, until the time of hatching and until the first week after hatching, which descended from the Wolffian body and indirectly from the testis itself. The smaller this body becomes, the more narrow are the ducts and testes connected by the vasa efferentia of the testis, while the blind-ending tubules of the Wolffian body gradually atrophied more and more, and in young birds the rest of the Wolffian body disappears with only the connection of the testis with the former excretory duct of the Wolffian body remaining, a connection formed by new and peculiar vessels, which have the very faint appearance of an epididymis in the adult bird.

I have never examined a male embryo in which I did not recognize the identity of the vas deferens with the former excretory duct of the Wolffian body. As before, I saw

the same relationship between the blind-ending tubules of the Wolffian body and the excretory duct, even in male embryos, which were close to hatching; I also saw this duct arising at the anterior end of the body; I saw the blind-ending tubules laterally connecting to this duct along the entire length of the body, I even could move under the microscope a white-yellow secretion from single blind-ending tubules into the excretory duct in male and female embryos.

§. 38.

In this respect, I certainly disagree with my esteemed friend Rathke, who asserts that the front part of the excretory duct of the Wolffian body, which used to run along its entire length, is gradually absorbed, and finally disappears, so that it only originates from the posterior end of the Wolffian body from the 12th to the 14th day. This duct, however, still runs along the whole length of the Wolffian body until hatching, and the relation is as it was before.

Tab. II Fig. 5. explains this relationship between the testis, the Wolffian body and its excretory duct, and the kidneys.

- a. Kidneys.
- b. Ureter.
- c. Wolffian body.
- d. Excretory ducts of the same, later vas deferens.
- e. Testes.
- f. Adrenal glands.

Here, the Wolffian bodies are still much larger than the testes, which are bigger for the entire fetal life; the Wolffian bodies are even still bigger than the testes themselves in hawks, which have just hatched, See **Tab. IV. Fig. 1.**

§. 39.

I have made a great deal of effort to determine the actual connection between the testis and the Wolffian body. Frequently repeated microscopical observation has taught me the following. From the upper end of the testis and from the side with which it rests on the Wolffian body, several greyish white tubules or vasa efferentia emanate from the testis to the Wolffian body. I have clearly seen five such connecting tubules, they are extremely delicate, yet stretchable, and the most anterior is the strongest. They do not seem to be hollow at the beginning, just as the testes do not contain any seminiferous tubules at this time. These connecting tubules probably are distinct from the blind-ending tubules of the Wolffian body, the latter being thicker, white and very clear, the former quite grayish and

do not turn into those blind-ending tubules, but into the spaces between them and into the interior of the Wolffian body. Later, when the Wolffian body has become extremely small, for example in the newborn hawk, you can clearly see the relationship of the excretory duct, which runs past and upwards from the testis, and the testis because of transverse running ducts. However, it is not possible to see the actual transition of the described vasa efferentia into the excretory duct earlier, because these ducts penetrate into the interior of the still considerable large Wolffian body. **Tab. II, Fig. 6.** shows a magnification of what is visible through the microscope.

Actually, these vasa efferentia connecting the testis and the Wolffian body are already clear and visible at a time when the testis is still a millet-seed-like, granular, gelatinous substance. For as early as the blind-ending tubules of the Wolffian body are visible and clear, so late are the infinitely finer seminal tubules in the testis. Only towards the end of the embryonic life can one recognize a trace of the latter. This seems very important to us. Never do the blind-ending tubules of the Wolffian body penetrate the testes, as Rathke is inclined to believe; the testes do not develop as a continuation and metamorphosis of those blind-ending tubules, neither in birds nor in mammals. Instead, only interacts with the Wolffian body through the described novel connecting tubes.

Tab. II. Fig. 6.

A. Wolffian body.

B. Testes.

C. Adrenal gland.

a) Excretory duct of the Wolffian body, originating at the upper end, and connecting with the blind-ending tubules, b) lower, free part thereof, which later becomes the seminal duct, c) vasa efferentia of the testis, which, in between the blind-ending tubules, run into to the upper part of Wolffian body.