

## AN ABNORMALITY IN THE UROGENITAL SYSTEM OF NECTURUS

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During the course of the ordinary laboratory work in the Department of Zoology, University of Illinois, a specimen of *Necturus maculosus* Rafinesque was encountered which exhibited an interesting abnormality in the urogenital system. A description of the specimen, with an attempt to explain the anomaly on the basis of embryology, is offered here.

### DESCRIPTION

The specimen was a sexually mature female, both ovaries being present and filled with eggs of various sizes. On the right side were present the elongated, white, convoluted oviduct opening into the anterior end of the body cavity at the funnel-shaped ostium tubae, and, the minute, straight, unpigmented ureter situated on the lateral border of the mesonephros. These ducts had the usual proportions and appeared essentially normal. An examination of the organs *in situ* failed to reveal the presence of an oviduct on the left side. Further search disclosed the presence of a thin, membranous, vesicle-like structure attached to the dorsal body wall in the anterior end of the body cavity. This occupied the same position as a normal ostium tubae. However, no opening could be made out. The left ureter, which normally is delicate and more or less translucent, was considerably enlarged and somewhat pigmented along its lateral border near the anterior extremity of the mesonephros. Although it was not tortuous it thus resembled in appearance its homologue in the male. The general appearance of the organs *in situ* is shown in figure 1.

Extending cranial from the anterior extremity of the mesonephros along the dorsal wall of the body cavity was a narrow, densely pigmented cord. This spread out fan-like and gradually disappeared in the mesentery attaching the above-mentioned vesicle-like structure to the dorsal body wall. To the naked eye this cord appeared to be an undoubted continuation of the ureter as is illustrated in figure 2. Microscopic sections were made in the

anterior region of the mesonephros in an attempt to determine this point. Unfortunately this procedure met with failure owing to the bad preservation of the tissue.

A similar pigmented cord is normally present in the male *Necturus*. It bears the same relation to the Wolffian duct and presents almost identically the same appearance as in this specimen. According to some authors, notably von Wittich ('53) and Owen ('66), it represents a continuation of the Wolffian duct. Or to express it in other words, it is a remnant of the pronephric duct which persists but has undergone atrophy as a result of the pronephros having lost its importance as an excretory organ. Kingsley ('07), at least, implies this, because he asks the question (page 9) "How far forward does it extend?" and follows up with the statement that "this portion in front of the testis is functionless." Most authors have been somewhat reticent regarding the significance of this cord. The more recent writers, however, are agreed that it represents the rudimentary Müllerian duct and not a continuation of the mesonephric duct or, in other words, the persistent pronephric duct. Balfour ('81), in describing the origin of the Wolffian and Müllerian ducts in Amphibians, claimed that the anterior portion of the Wolffian duct anterior to the mesonephros "undergoes a more or less complete atrophy." According to Chase ('23) the mesonephric duct in both sexes begins at the anterior end of the mesonephros as a continuation of the most anterior collecting tubule and extends posteriorly along its lateral border increasing in diameter slightly throughout its extent. He claims (page 470) that "in the male the Müllerian ducts are rudimentary structures indicated chiefly by a strip of black pigment cells which run longitudinally along the greater part of the lateral edge of the Wolffian duct, following its convolutions. Anterior to the kidney each Müllerian duct runs, covered by the peritoneum, along the dorsal wall of the body cavity just lateral to the posterior cardinal vein, appearing as a slender, cylindrical, densely pigmented cord of cells."

#### EMBRYOLOGICAL CONSIDERATIONS

Obviously we must look to the facts of embryology for an interpretation of the present anomaly. However, when we attempt to view the embryological aspects in order to apply them to this case we immediately run into difficulties, since authors are not in

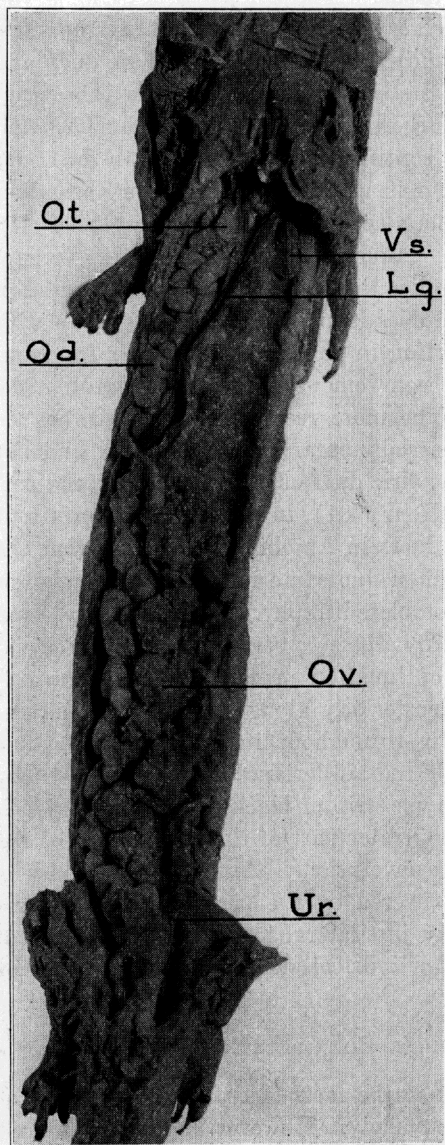


FIG. 1. Photograph of the abnormal specimen of *Necturus*, showing the appearance of the organs of the urogenital system. L. g., left lung; Od., right oviduct; O. t., ostium tubae; Ov., ovaries; Ur., left ureter; Vs., Vesicle-like structure. The left lung was kept intact in order to preserve the pigmented cord shown in fig. 2.

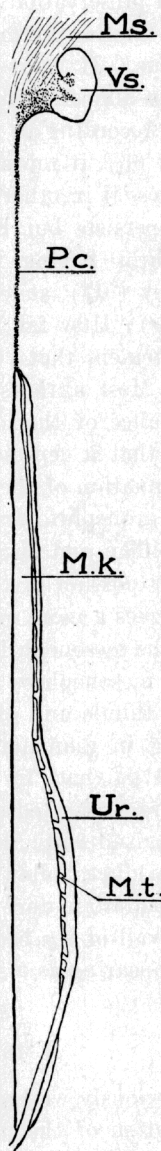


FIG. 2. The Urogenital system on the left side, with the ovaries removed, showing the general appearance of the pigmented cord and its relation to the anterior extremity of the mesonephros and ureter. M. k., mesonephros; Ms., mesentery attaching the vesicle-like structure to the dorsal body wall; M. t., collecting tubule; P. c., pigmented cord; Ur., ureter; Vs., vesicle-like structure.



agreement as to the method of development of these structures in the Amphibia. As far as the writer is aware there is nothing in the literature bearing on the mode of formation of these structures in Necturus and no attempts have thus far been made to ascertain such. Any considerations, therefore, concerning the embryology of the structures in question in an attempt to account for the present abnormality are more or less hypothetical.

Authors have been almost unanimous in their opinions as to the relationship of the pronephros and mesonephros in the Amphibia. It is generally agreed that the pronephric duct arises from a longitudinal groove formed by an outpocketing of the somatopleure in the dorsal wall of the body cavity. This groove becomes converted into a canal by a constriction which commences near its anterior end and thence extends caudad. The anterior end remains in communication with the body cavity at 2, 3, or 4 places, depending upon the species, thus giving rise to the nephrostomes of the pronephros. The posterior end eventually acquires an opening into the cloaca. As soon as the pronephros loses its importance as an excretory organ and its functions are assumed by the mesonephros it undergoes atrophy. The pronephric duct, however, persists and becomes bodily converted into the mesonephric duct. This duct is then replaced by two ducts, the Wolffian (dorso-median) and Müllerian (ventro-lateral) ducts.

The origin of these two ducts has long been the subject of controversy. It is pretty generally conceded, however, that the Wolffian duct represents the original mesonephric duct. Balfour ('81) demonstrated that, whereas, in elasmobranchs the original mesonephric duct is represented by the Müllerian duct, in Amphibians it is represented by the Wolffian duct. The real difficulty therefore lies in determining the origin of the Müllerian duct especially as regards its relation to the Wolffian duct. It is sometimes described as developing in connection with, sometimes independently of the latter. According to one view the Müllerian duct is formed in Amphibians by a longitudinal splitting of the mesonephric duct from before backward as in the elasmobranchs. Fürbringer ('78) described the process in *Salamandra maculosa* as occurring by a progressive separation, from before backward, of a solid cord of cells from the ventral side of the mesonephric duct, the cord gradually acquiring a lumen. He claimed that the remaining portion of the mesonephric duct constitutes the Wolffian duct. Wilson ('94) maintained that in *Siredon pisciformis* the

Müllerian duct is formed by an evagination of the peritoneal epithelium in the region of the pronephros and that it extends backward opposite to and independent of the mesonephric duct. Gemmil ('97) and Hall ('04) both claimed that, whereas, the anterior portion of the Müllerian duct arises by an evagination of the peritoneal epithelium and extends caudad adjacent to the mesonephric duct with which it fuses for some distance and then grows backward free, a small portion of this backward growing duct takes cells from the mesonephric duct.

Another problem of equal significance and still subject of considerable dispute is the mode of formation of the ostium tubae. One view, which is taught in some text books, is that it represents one or the fusion of several pronephric nephrostomes. According to the account which at present receives the most general acceptance, it is formed by one or the coalescence of several evaginations of the peritoneal epithelium in the region of the pronephros but independent of the latter. This evagination is said to fuse secondarily with the cephalic end of the Müllerian duct and after acquiring an opening thus establishes communication with the body cavity.

It is evident that, in spite of the uncertainty in the interpretation of the origin of the Müllerian duct and its ostium tubae in the Amphibia, authors are agreed that the anlagen of the duct originates in the anterior region of the body cavity progressing caudad from this point, and that the ostium tubae develops independently of the Müllerian duct later fusing with it secondarily. Since recent authors have demonstrated that the Müllerian duct persists in both sexes in Amphibians, and, that as the female reaches sexual maturity it becomes dilated and convoluted, but remains thin and inconspicuous in the male, its rudiments being represented by a slender pigmented cord extending craniad from the anterior extremity of the mesonephros, the present anomaly, therefore, may be explained by assuming that it represents a persistent embryonic condition or the failure of the Müllerian duct to attain maturity. As to the significance of the vesicle-like structure in the region normally occupied by the ostium tubae, the suggestion is offered here that it represents a retarded condition of the peritoneal evagination, which, according to other authors, normally fuses with the cephalic end of the Müllerian duct and after establishing an opening furnishes the latter with an ostium tubae.

The abnormally large size of the ureter might possibly be associated with the failure of the Müllerian duct to reach maturity. However, this could not be determined in the light of our present knowledge of the method of development of these two ducts and their relation to each other in *Necturus*. The importance attached to the study of this abnormality lies not merely in the peculiarities presented by this particular specimen but rather in the fact that it brings us face to face with the need of more enlightenment on the origin of the ducts of the Urogenital system in *Necturus*.

## REFERENCES CITED

- BALFOUR, F. M.  
1881. A Treatise on Comparative Anatomy. Vol. II.
- CHASE, S. W.  
1923. The Mesonephros and Urogenital Ducts of *Necturus maculosus* Rafinesque. Jour. of Morph. Vol. 37.
- FURBRINGER, M.  
1878. Zur vergleichenden Anatomie und Entwicklungsgeschichte der Excretionsorgane der Vertebraten. Morph. Jahrb. Vol. 4.
- GEMMIL, J. F.  
1897. Ueber die Entstehung des Muller' schen Ganges in Amphibien. Arch. f. Anat. u. Phy. Anat. Abth.
- HALL, R. W.  
1904. The Development of the Mesonephros and the Mullerian Ducts in Amphibia. Bull. Mus. of Comp. Zool. Vol. 45.
- KINGSLEY, J. S.  
1907. *Necturus*. Henry Holt & Co., N. Y.
- OWEN, R.  
1866. Comparative Anatomy and Physiology of Vertebrates.
- WILSON, G.  
1894. The Development of the Mullerian Ducts in *Axotol*. Anat. Anz. Vol. 9, No. 24, pp. 736-745.
- WITTICH, W. VON  
1853. Beiträge zur Morphologischen und Histologischen Entwicklung der Harm und Geschlechtswerkzeuge der Nachten Amphibien. Zeits. f. wiss. Zool. Vol. 4.