

value—that is to say, the magnetization of the nickel and cobalt was diminished by pull. But this effect came to a maximum, and began to diminish markedly as if towards zero, when the magnetizing force was diminished. Hitherto the critical value, if there is one, has not been reached; but the experiments are being continued to find it, if it is to be found, with attainable degrees of magnetizing force.

(Addition, May 23, 1878.)

It had been reached, for nickel, in Glasgow, about the day on which this abstract was written; advantage having been taken of a kind loan, by Professor Tait, of a much smaller bar of nickel than those which had been specially made for the investigation, and which alone had been previously available. Mr. Thomas Gray, by whom the experiments were made, in the Physical Laboratory of the University of Glasgow, in the author's absence, found the critical value of the magnetizing force for Professor Tait's thin nickel bar to be about 600 times the Glasgow vertical force.

[The author is indebted to the celebrated metallurgical chemist, Mr. Joseph Wharton, of Philadelphia, for a splendid and unique set of bars, globes, and disks, of pure nickel and cobalt, which he kindly made, at his request, for this and other proposed investigations of electro-dynamic qualities of those metals.]

- X. "On the Existence of a Rudimentary Head-Kidney in the Embryo Chick." By F. M. BALFOUR, M.A., Fellow of Trinity College, Cambridge, and ADAM SEDGWICK, B.A., Scholar of Trinity College, Cambridge. Communicated by Dr. M. FOSTER, F.R.S., Prælector of Physiology in Trinity College, Cambridge. Received May 20, 1878.

We have been for some time engaged in an investigation on the mode of growth of the developing Müllerian duct in the chick, and its possible derivation from the Wolffian duct; and, while carrying on our investigations on this point, were struck by some remarkable features of the abdominal opening of the Müllerian duct in its very early condition. We did not for some time pay much attention to these features, but finally devoted ourselves to their interpretation, and have been led to the conclusion that they form the rudiment of a head-kidney, "Vorniere" or "Kopfnier," identical with that present in Amphibia, Marsipobranchii, and Teleostei. We purpose first to give a short account of our observations, and then to proceed to state the grounds on which we have been led to compare the structures we have found with the head-kidney of the Ichthyopsida

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The first trace* of the Müllerian duct we have met with is a very shallow groove in the germinal epithelium some little way behind the front end of the Wolffian body, and nearly overlying, though slightly external to, the Wolffian duct. This stage corresponds with the earliest stage described by Dr. Gasser.† In the next stage, which follows very closely upon the first one, remarkable changes have taken place in the groove, which can best be explained by describing the appearance of a series of successive sections from before backwards through the groove and its continuation.

Anteriorly there appears in section a simple groove, which, after a short distance, is suddenly replaced by an apparently solid thickening of the germinal epithelium. An open groove again appears in this, which in its turn is succeeded by a thickening, which is next converted into a definite ridge, projecting inwards towards the Wolffian duct, in which, we believe, we have observed a rudimentary lumen. After one or two sections, a slit-like opening appears, placing the lumen in the ridge in communication with the body cavity, and, in fact, a groove somewhat deeper but otherwise exactly similar to that visible in the anterior sections has reappeared. This groove after being continued for two or three sections again becomes closed, and its walls are prolonged as a nearly solid rod which cannot be traced beyond one or two sections. In general terms, the change which has taken place is, that the opening of the primitive simple groove has been divided into three, and the three separate grooves are connected by a rod-like structure developed from part of the wall of the original groove, in which a lumen either exists from the first, or very soon appears.

In the next stage, the anterior part of the Müllerian duct is formed of a tube communicating by, at the least, three separate apertures with the body cavity, and the tube connecting these is perhaps slightly convoluted. The hindmost opening of the duct is continuous with a rod-like body which may be traced backwards for some little distance. It is hollow in front, and terminates by a solid point, in a manner which we propose describing in detail in a fuller paper, with illustrations.

This peculiar condition of the abdominal opening of the Müllerian duct does not last for long, and before the Müllerian duct has nearly grown back to the cloaca, it opens in front by a single elongated groove. At this period, its hind end, or growing point, instead of being conical, is rounded, and the lumen of the duct is continued into the rounded extremity.

So far as we know, none of the very divergent accounts which have

* We do not give the number of hours of incubation, as we find these are too inconstant to be of any scientific value.

† "Entwicklungsgeschichte d. Allantois d. Müller'schen Gänge u. d. Afters." Frankfurt, 1874.

been given of the development of the Müllerian duct in the least resemble what we have described, though the well known and often repeated figure of Waldeyer* (copied in the "Elements of Embryology," fig. 51) very possibly represents a section of the anterior extremity of the duct in an interval between two openings.

In the above description we have given the more important results of our investigation, and it only remains for us to prove that the peculiarly modified anterior extremity of the Müllerian duct is in reality a rudimentary head-kidney. For this purpose it is necessary for us to show, first, that it is in the situation where we might expect to find a head-kidney; and secondly, that it resembles a head-kidney in structure.

It will be convenient to reverse the logical order, and to attempt to prove, in the first instance, the second of these points. We will use as our type the head-kidney in the Amphibia.

The head-kidney of Amphibian larvæ was discovered by Johannes Müller,† and is often spoken of as the Müllerian body. Its development has, in recent times, been worked out in a satisfactory manner by W. Müller,‡ Götte,§ Spengel, || and Fürbringer.¶ It develops from the anterior extremity of what becomes afterwards its duct. This duct is called by Fürbringer the duct of the head-kidney, and by one of us** the *segmental duct*.

This duct, for which we shall retain the name segmental duct, develops as a groove-like invagination of the epithelium of the body cavity, which soon becomes constricted into a duct, blind behind, but ending in front by a groove in free communication with the body cavity. *The open groove at first deepens, still remaining in communication with the body cavity. It next elongates, and by process of unequal constriction becomes converted into a horizontal canal, retaining its communication with the body cavity by a number of openings, varying according to the species from two to four.*

The part of the duct following on the horizontal canal next assumes an S-shaped curvature, continuous, however, with the segmental duct behind, which somewhat later acquires an opening into the cloaca. We need not follow the further development and final atrophy of the head-

* "Eierstock u. Ei." Leipzig, 1870.

† "Ueber die Wolff'schen Körper bei d. Embryonen d. Frösche u. Kröten." "Meckels Archiv," 1829.

‡ "Ueber d. Urogenital System der Amphioxus u. d. Cyclostomen." "Jenaische Zeitschrift," Bd. ix.

§ "Entwicklungsgeschichte d. Unke."

|| "Urogenitalsystem d. Amphibien. Arbeiten a. d. Zool-zoot. Institut zu Würzburg," Bd. iv.

¶ "Zur. Entwicklung der Amphibienniere." Heidelberg, 1877. "Zur verg. Anat. u. Entwick. d. Excretionsorgane d. Vertebraten." "Morphologische Jahrbuch," Bd. vi.

** Balfour, "Origin and History of Urinogenital Organs of Vertebrates." "Journal of Anat. and Phys.," vol. x, and "Monograph on Elasmobranch Fishes."

kidney in Amphibia, and consider it only necessary to call attention to the similarity, amounting almost to identity, between our account of the metamorphosis of the anterior part of the Müllerian duct in the bird and the italicised part of our description (taken from Fürbringer) of the changes in the open extremity of the segmental duct in the Amphibia, which results in the formation of the head-kidney.

In this connexion, there is only one point we desire to call attention to, and that is the presence in Amphibia of a peculiar body, usually spoken of as the glomerulus of the head-kidney, which is developed at about the same time as the head-kidney. We believe, though we have not fully satisfied ourselves on the point, that we have found an homologous body in the chick.

In reference to the identity in the position between our head-kidney in the bird and that in Amphibia, we have only to say that one of us* has already, on other grounds, attempted to show that the abdominal opening of the Müllerian duct in the bird is the homologue of the abdominal opening of the segmental duct in Amphibia, Elasmobranchii, &c., and that we believe that this homology will be admitted by most anatomists. Should the interpretation we have given of the peculiarities of the abdominal opening of the Müllerian duct in birds be accepted, a further proof of this homology will be afforded.

We may say, in conclusion, that we trust soon to be in a position to publish a fuller account of our observations, with illustrations.

XI. "Observations on Arctic Sea-water and Ice." By Surgeon-Major E. L. MOSS, M.D. Communicated by Captain Sir GEORGE NARES, R.N., K.C.B., F.R.S. Received May 3, 1878.

[Publication deferred.]

"Note to Mr. Sedley Taylor's 'Experiments on the Colours shown by thin liquid Films under the Action of Sonorous Vibrations.'" ("Proceedings," vol. xxvii, 1878, pp. 71, seq.) Communicated by J. W. L. GLAISHER, F.R.S. Received May 20, 1878.

The failure to obtain steady resultant-forms for two component sounds, mentioned at p. 74, proved, on further inquiry, to be due to the imperfect mode of experimenting there described. I stated this fact in a note, written upon the final revise of my paper; but, by some inadvertence for which I am not responsible, the paper appeared without it.

The Society adjourned over Ascension Day and the Whitsuntide Recess to Thursday, June 20.

* Balfour, *loc. cit.*