

XV. *On the Chorda Dorsalis.* By MARTIN BARRY, M.D., F.R.SS. L. and E.

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FOR the discovery of the remarkable structure in the embryo of some of the Vertebrata denominated the chorda dorsalis, we are indebted to Professor BAER. This naturalist considered it “the axis around which the first parts of the foetus form,” and “the true *virga mensoria* for the whole body and all the chief systems †.” REICHERT supposes it to be that embryonic structure which serves as a “support and stay” for parts developed in two halves ‡.

In the course of my researches on the mammiferous ovum, an object was noticed which seems to correspond in appearance to the incipient chorda now referred to. I am desirous of drawing attention to this similarity in appearance, but more particularly to point out some important differences between my own observations and those of others, as to the mode of origin of the objects in question, and their relation to surrounding parts. For, should it be found that these objects are the same, my belief is that even the most recent views on the incipient growth of the embryo must undergo a change.

Before entering upon the comparison, I must ask the reader to place before him my Second Series of Researches in Embryology §, Plates VI. VII. and VIII.; to certain of the figures in which I will now briefly refer.

The object *bb*, figs. 113 to 116, is the rudimental embryo of the Rabbit in its earliest stage. It is a finely granular, hollow sphere—the nucleus of a cell. Its centre, the nucleolus, is brilliantly pellucid.

The changes which this nucleus undergoes are two-fold. The one consists in the formation of a pointed process, as in fig. 121 D, which is sometimes, and perhaps generally, curved; its concave side being directed towards the centre of the ovum. In this state the rudimental embryo appears to correspond to what has been supposed to be the “*primitive trace*” in the ovum of the Bird. The other change which this nucleus undergoes consists in the origin of fresh substance in its pellucid centre, and the expansion of its peripheral portion into cells. Some of these cells occupy the area pellucida: others, coalescing, form a little sac (fig. 117. *bb*^{2l}), which, expanding and receiving the yolk into its cavity, assumes the form of a network (fig. 132.), and lines the remainder of the ovum (fig. 119. *bb*^{2l}).

† Ueber Entwicklungsgeschichte der Thiere. Beobachtung und Reflexion, 1828. Taf. I. fig. II. III. a. p. 15.

‡ Das Entwicklungsleben, 1840, p. 108.—The chorda dorsalis has received other names; viz. Chorda vertebralis, Rückensaite, Spinalsaite, Wirbelsaite.

§ Philosophical Transactions, 1839, Part II. p. 307.

This two-fold change is but the commencement of a series of metamorphoses, by which the minute object *bb* of fig. 113, is converted into the objects *bb*¹, *bb*², and *bb*^{2'}, collectively, of fig. 122. For it is to be remarked that there is a continual origin of fresh substance in the centre; by which means previously formed parts are pushed further out. These parts consist of cells arranged in layers (fig. 122.), each cell being the seat of a process essentially the same (fig. 149.). As the cells are pushed into a more external situation, they expand and become pale; while in the centre the continued origin of new and unexpanded cells, presents the appearance of a row of globules, nearly black (fig. 122.). The larger end (fore-end) of this row of globules is spherical, and, as we have seen, has a minute pellucid centre. It is this row of globules, in the mammiferous ovum, which I think must correspond to BAER's incipient chorda dorsalis of the Bird, described by him in the following passage.

"The chorda dorsalis," he says, "originally consists of a simple row of dark globules, which towards the fore-end are more closely pressed together, and towards the hinder end more separated.***It becomes thicker and darker, from an increase in the number of its globules. The fore-end is at a very early period developed into a round, much thicker knob; and hence the whole chorda resembles a very fine needle with a minute head †."

Although the object thus described by BAER, as seen in the ovum of the Bird, presents a sufficiently close resemblance to that which I had delineated and have just described in the mammiferous ovum, to warrant the belief that both objects are the same, yet there are some important differences between the two descriptions.—VON BAER speaks of the "fore-end" of his incipient chorda as becoming "at a very early period *developed into* a round, much thicker knob." With me, on the contrary, the linear portion *proceeds from* the round and thicker knob.—Again, he makes no mention of the remarkable pellucid cavity, contained within this round and thicker knob—a part of prime importance, if it be, as my observations show, the main centre for the origin of new substance. Whether these differences between the objects of our respective descriptions really exist (supposing them to be the same objects), or whether, if the embryo of the Bird were examined in a sufficiently early stage, it would not be found to begin in the way I have described as producing the embryo of the Mammal, future observation must determine.

VON BAER farther says that his row of dark globules is "surrounded by a pellucid border:" and that "the border is seen from all sides," being therefore "a sheath for the chorda. Originally the chorda and its sheath are one †." How far these particulars accord with my observations, will be seen on reference to figs. 121 to 123.

VON BAER considered the chorda to arise simultaneously with his "laminæ dorsales;" and this by "a separation of the [supposed] primitive trace into two lateral halves (the laminæ dorsales) and a middle streak (the chorda) ‡." The separation here mentioned, I can regard as no other than the pushing out of the lateral portions of

† *L. c.*, pp. 15, 16.

‡ *L. c.*, p. 15.

the so-called "primitive trace," by the formation of fresh substance in the interior (compare with my fig. 122.). If so, the formation of BAER'S incipient chorda is not simultaneous with, but subsequent to, that of his "laminæ dorsales." (The "laminæ dorsales" of BAER correspond to REICHERT'S "central nervous system.")

VON BAER describes the chorda as "the axis, around which the first parts of the foetus form †." The dark pin-like object we have been considering in the mammiferous ovum, presents merely one of the many layers of incipient cells into which a nucleus becomes resolved.

Notwithstanding these differences, however, facts mentioned by authors regarding the chorda dorsalis at later periods I think afford evidence of the identity of the two objects in question, as will be seen by what follows.

RATHKE states that in osseous fishes the chorda dorsalis is inclosed in a membranous sheath; and that from this sheath there grow in pairs a great number of minute filaments, which are the incipient crura of the arches of the vertebræ. The foundations of the bodies of the vertebræ appear, from the description given by this author, to consist of minute tables or traces, which proceed out of the vertebral arches; and he adds, that "the thickening and ossification of the vertebræ take place at the expense of the inclosed nucleus of the chorda ‡."

REICHERT, in his researches on the development of the Batrachian Reptile and the Bird, found the chorda to decline more and more as the vertebral system advanced in its formation §. "The chorda," says this author, "is reduced in proportion as ossification proceeds, until for the most part only its remains are to be found between the vertebræ ||."

It is known that the chorda dorsalis in a comparatively advanced state is composed of cells. For this discovery we are indebted to Professor J. MÜLLER. SCHWANN has since found the characteristic nucleus in its cells ¶. "If we closely examine," says this observer, "the outer rind of the chorda in *Pelobates fuscus*—covered as this rind is with scattered grains—we find these grains closely to resemble the nuclei of cells; only that they are about half the size. They are besides oval, and furnished with a nucleolus. This rind is not distinctly separated from the proper tissue of the chorda dorsalis: and as the cells of the latter rapidly diminish in size towards the rind, I believe these grains of the rind to be the cytoblasts of flattened down cells, which form the rind ††."

I think there is a great deal in what has now been quoted from these authors, that

† *L. c.*, p. 15.

‡ BURDACH'S *Physiologie als Erfahrungswissenschaft*, 1837, Band II, pp. 279–281.

§ *L. c.*, p. 68.

|| *L. c.*, p. 71.

¶ *Mikroskopische Untersuchungen über die Uebereinstimmungen in der Struktur und dem Wachsthum der Thiere und Pflanzen*, 1838, 1839, Tab. I. fig. 4.

†† *L. c.*, p. 12. It is deserving of notice that SCHWANN conjectures the chorda dorsalis to contain no vessels.

shows a "growing from" the sheath, as it is called, of the chorda,—“at the expense of its inclosed nucleus,”—or as the chorda is “found to decline,” even in these the last stages of this structure. But if we examine it at periods anterior to these, I think we shall find still stronger grounds for believing, that the chorda dorsalis of authors, in an early state, corresponds to the pin-like object in the mammiferous ovum which I have been comparing with it.

REICHERT seems to have been led to form the opinion above-mentioned, that the chorda serves as a “support and stay” for parts developed in two halves, by the following observations; namely, that the chorda becomes visible as a single structure at the same time as the foundations, in two halves, of the central nervous system; and that the central nervous system on the one hand, and his *membrana intermedia* on the other, are so intimately connected by means of the chorda, that it is not possible to separate them. He even states, that the chorda *passes into* the foundation of the embryo.

Farther, REICHERT says, “There are *developed on* the chorda dorsalis the original halves of the central nervous system, with the higher organs of sense, separating as these do from the central nervous system †.” He states that, with a union of the two halves of the central nervous system—such union taking place first at the fore-end—there is observed a decline in the corresponding part of the chorda. On the subject of the *membrana intermedia*, the same author remarks, that it is found between the central nervous system and the mucous membrane; and that it (the *membrana intermedia*) “is the common original foundation of all structures, systems, and organs, which are the means of operation for the two central organs of animal life. Hence from it [the *membrana intermedia*] there are developed the vertebral system, the dermal system, the circulating system, and finally, all the structures which support the mucous membrane, and which,” says he, “I comprehend under the name of system of the intestinal membrane ‡.”

It would thus seem, according to REICHERT, that there is little in the embryo which is not developed out of either the central nervous system, or the *membrana intermedia*. But these are the very parts which the same observer found so intimately connected by means of the chorda, that it was not possible to separate them. And it appears to be these same parts called by REICHERT “the foundation of the embryo,” *into which he says “the chorda passes.”*

Taking then the observations of BAER, RATHKE, and REICHERT, in connection with my own, I venture to believe, that it is not enough to say, with BAER, that the chorda dorsalis is the axis around which the first parts of the foetus form; nor, with REI-

† *L. c.*, pp. 58, 59.

‡ *L. c.*, p. 107. “Da die ferneren Doppel-gebilde,” says REICHERT, “sämmtlich von der *membrana intermedia* ausgehen, so tritt die Wirbelsaite [chorda dorsalis] in die innigste Beziehung zu der Letzteren.”

CHERT, to denominate it a support and stay for surrounding parts: but that it is the continually renewed central portion of the nucleus of a cell, it being out of this nucleus that the embryo arises:—in other words, that growth at the earliest periods consists, not in *external* additions, but in the continual origin of new substance *in the centre*, by which means previously formed substance is pushed farther out. The nucleus of every cell, also, of which the embryo is composed, seems to be the seat of a like process; that is, a subordinate point for the origin of new substance.

The origin of the embryo from the nucleus of a cell, may assist to solve a question on which, I believe, physiologists are not agreed. “The primitive trace,” says VALENTIN, “as well as the***chorda dorsalis, has been made use of by BAER and BURDACH against SERRES, BOURDON, and others, to show that the first rudiments of the parts are not two halves, but a whole, which subsequently splits into two oppositely situated halves. Such positions, however,” VALENTIN adds, “are altogether more adapted for metaphysical acumen, and cannot, and never will, be settled by experience and observation; since by this we do not learn the act of arising itself,—it shows no more than an arisen turn in the formation.***Such problems must remain far from the province of the observing part of anatomy and physiology †.”

I am here compelled to express a different opinion from that of Professor VALENTIN. The subject in question seems to me very properly to belong to the province of observation. But then it is essential that observation should be directed to a period earlier than that with which physiologists have usually begun. By this means it seems possible actually to observe, that if the nucleus of a cell is a single object, the first rudiments of the embryo are not two halves.

Unless the condition just mentioned be fulfilled, namely, an investigation of the earliest periods, it is in vain that we attempt to learn what it is of which the rudiments of the embryo are composed. It appears to have been because of the non-fulfilment of this condition, that physiologists supposed their “*primitive trace*” to arise in the substance of a membrane. And to the same cause seems referable the opinion recently advanced by REICHERT, that the first traces of the new being are derived from cells of the yelk ‡.

† Handbuch der Entwicklungsgeschichte des Menschen mit vergleichender Rücksicht der Entwicklung der Säugethiere und Vögel, 1835, p. 156.

‡ REICHERT very properly denies that the embryo arises in the substance of a membrane; and it is gratifying to me to find an observation previously published by myself confirmed by this talented investigator. Dr. REICHERT, however, does not seem to be aware that he had been anticipated in this discovery, as he will perceive on reference to the “Proceedings” of the Royal Society, April 18, 1839, published at that time, and copied into several periodicals, among which may be mentioned VON FRORIEP’S “Notizen,” No. 228, July 1839, p. 116.