When it is remembered that only one other ordinal type of existing fishes (the Dipnoan) has been discovered during the present century, the importance of the new group may be realized.

2. On the Segmental Sense organs of the lateral line, and on the Morphology of the Vertebrate Auditory organ.

By John Beard, Zool. Station, Naples.

eingeg. 22. Dec. 1883.

The mode of development of the lateral nerve in fishes is still a disputed question. Since the commencement of my researches two papers have appeared in both of which the question is dealt with. But my own results differ very much from those obtained by Van Wijhe and Hoffmann — a difference not to be accounted for by difference of material, for Hoffmann has worked upon the same genus. In a subsequent section of this paper I shall have occasion to draw certain conclusions from the researches of Van Wijhe and others on the cranial nerves, but on the one point of the mode of growth of the lateral nerve I differ very much from him. My researches lead me to accept the conclusion of Balfour that the lateral nerve arises just as all the other nerves do, and not as a splitting off of a portion of the epiblast.

In the Embryo of *Salmo fario*, the first appearance of the lateral line consists in the splitting off of certain of the cells of the inner epiblastic layer. This separation takes place at the level of the notochord. It commences in the region of the neck just behind the ear capsule and opposite the hyoid arch. At its point of origin it is broad, and is at first short, but soon grows back longitudinally along the whole length of the body. This cord of cells gives origin to the sense organs of the lateral line.

When the cord is completely established along the whole body it presents the following characters. In the region of the neck it is broad, thinning out a little further back about opposite the hinder end of the anterior fin. In each segment of the body from this point backwards it presents a thickening, the cord between these consecutive thickenings being thin and composed of one layer of cells. The thickenings in the body are much smaller in breadth and extent than the anterior thickening in the region of the neck.

A transverse section in the region of one of these thickenings shows a somewhat oval plate of two layers of large oval cells. In the intermediate region the rod in section consists of only one narrow layer of cells. In the subsequent growth of the embryo the intermediate

portion of the lateral line thins out and ultimately it is quite impossible to find it in sections. But probably it never really disappears but persists throughout life as a connexion between the individual sense organs. In Adult Teleostei according to Bodenstein and Solger such a connexion exists, and Solger says that »In der That eine nervöse Verbindung der Einzelorgane zu einer Organkette vorliegt.« Such »Verbindung« is I believe brought about by the persistence of the cord of cells which as shown above connects the sense organs of the lateral line in their development.

The development of a sense bulb from one of the segmental thickenings takes place in the following manner. Certain of those cells of the thickening which are next the outer surface, lengthen until they reach the surface of the body, and acquire terminal hairs. The remaining cells arrange themselves around the base of these cells as a centre.

Shortly after the lateral line has commenced to form from the epiblast, the lateral nerve arises as a branch of the vagus, taking its origin from the ganglion of the vagus. I have not observed the very first origin of this nerve, in the earliest stage I possess it is already a well marked nerve and is found in several transverse sections. It grows backwards along the whole length of the body following the course of the lateral line. At its origin it is situated far from the epiblast, but as it grows backwards it approaches the skin and comes to lie between the two muscle plates just under the epiblast. But it is everywhere separated from the epiblast and the lateral line by the cuticular basement membrane of the epidermis. In the neighbourhood of the ganglion of the vagus the lateral nerve is a nerve of fairly considerable thickness, but as it approaches the epiblast it becomes much thinner and difficult to follow. Its growing point is somewhat abrupt, and at this place as elsewhere it is not fused with the lateral line. Indeed here as everywhere else it is separated from the lateral line by the cuticular basement membrane of the epidermis. In fine, at no period of its development does the lateral nerve of *S. fario* lie within the epidermis.

With regard to the later history of the organs and nerve there remains but little to add. At the time of hatching the sense organs consist of a number of bulbs lying on the free surface of the epidermis. The connexion between neighbouring organs which in the early stages is so well marked a feature is no longer obvious. But I believe it still persists. As long as the young *S. fario* possesses yolk the sense bulbs still lie free on the surface. But about the time at which the yolk is entirely used up, viz. when the young are three months hatched, the

organs become shut off from the surface by the development of the protecting canals. With regard to the development of these canals I have nothing to add to that which is already known.

The backward growth of the lateral nerve along the whole length of the body is one of the most curious circumstances in Vertebrate Embryology. How comes it that a nerve which is a branch of a cranial nerve complex, innervates a region comprising the greater number of the segments of the body?

In that portion of the head in front of the vagus the lateral line is innervated not by branches of one, but of four cranial nerves. That is, in the four or five segments in front of the region of the vagus nerve, there is primitively a »lateral nerve« for every segment. Whereas in the body posterior to the origin of the vagus there is only one »lateral nerve« which supplies the lateral sense organs of a very considerable number of segments. Is this a primitive state of things?

For the elucidation of these problems it must be noticed that developmentally the sense organs of the lateral line are segmental, — in every segment of the body one pair of these sense organs is developed. No segment of the body, from the first segment of Van Wijhe backwards, is an exception to this rule. Later more than one pair may be developed in some or all segments [1], some may disappear, the arrangement also, may become complicated, but in all cases in the embryo the organs are segmental. Hence we may call these organs the segmental sense organs.

Eisig in his valuable paper on the »Seitenorgane der Capitelliden« has drawn attention to the above point, originally discovered by Stannius, Malbranc and Solger, and to the further fact that in all essential points the side organs of the Capitellidae agree with those of Vertebrates. The one difference which obtains between the two sets of organs concerns the nerve supply. Eisig has shown that in the Capitellidae there are a pair of nerves in each segment to the corresponding segmental sense organs. This simple state of things does not exist in Vertebrates. But traces of such an arrangement are to be found. And indeed I hope to show that such a condition must be taken to have been the primitive one in Vertebrates.

The segmentation of the vertebrate head, marked out by the course of the segmental nerves, is now universally accepted. In order to demonstrate the truth of the theory mentioned above it is necessary to know how many segmental nerves exist in the Vertebrate cranium.

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[1] Since writing the above I have found that the number of sense organs is increased in the embryo by division of the primitive segmental ones. I think Malbranc has already recorded this in adult Amphibia.

The matter is still somewhat in dispute, but since the publication of Marshall's researches on the subject, and the confirmation (in the main) of them by Van Wijhe it may be taken as established that in front of the vagus group of nerves four segmental nerves exist. These may be taken to be represented by: no. 1. The Motoroculi; no. 2. Trigeminus; no. 3. Facialis; no. 4. Glossopharyngeus: The Olfactory nerve has been omitted from this list, because its segmental nature is still disputed. But even if the latter nerve be considered a segmental nerve, I think the very special function it fulfils sufficiently accounts, in accordance with Dohrn's principle of change of function, for the absence of any innervation by it of segmental sense organs.

It would have been impossible before the researches of Van Wijhe to classify the Motoroculi among those segmental nerves which supply segmental sense organs. But, according to Van Wijhe, a »Zweig des Ganglion Ciliare« goes to an epidermis thickening which becomes a segmental sense organ.

The nerves of the second and third segments, viz. the 5th and 7th cranial nerves, give in common, according to the same author, a branch to the supply of segmental sense organs. He says: »Beide Nerven (Ram. buccalis und Portio facialis) entstehen gegen das Ende des Stadiums J. oder den Anfang des K., gemeinsam als ein kurzes Rudiment (Ram. Oph. Sup.), welches, vom Facialis nahe an seinem Austritt aus dem Gehirn entspringend, in eine kleine hinter dem Auge befindliche verdeckte Stelle der Epidermis endet« etc.

Like the three preceding the fourth segmental nerve or Glossopharyngeus gives off a dorsal branch to supply its segmental sense organs.

(Schluß folgt.)

III. Mittheilungen aus Museen, Instituten etc.

1. Zoological Society of London.

5th February, 1884. — Mr. F. Day, F.Z.S., exhibited and made remarks on a specimen of a Dog-fish, of which the entire interior had been eaten out by Isopod Crustaceans of the genus *Conilera*. — Mr. G.F. Butt, F.Z.S., exhibited two specimens of a singular variety of the Red Grouse, shot in Westmoreland. — A communication was read from Mr. W. Leche, of the University of Stockholm, in which he gave an account of a collection of Bats from Australia. Two new species were described and named respectively *Nyctinomus Petersi* and *N. albidus*. — Mr. Sclater read some notes on the Lesser Koodoo (*Strepsiceros imberbis* of Blyth), with a view of confirming the distinctness of this Antelope from its larger relative *Strepsiceros kudu*. — A communication was read from Mr. R. Bowdler Sharpe,