Zoology. — "*On an eel, having its left eye in the lower jaw*". By Mrs. C. E. DROOGLEEVER FORTUYN—VAN LEYDEN. (Communicated by Prof. J. BOEKE).

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Through the kindness of Dr. H: C. REDEKE I obtained an eel in which the left eye was lacking in the ordinary place, while on the lower side of the head, somewhat to the left of the medial line, an eye was visible which externally was quite normally shaped.

In order to find out whether this submaxillary eye was the left one and if so, how it had come to occupy such a curious position, and further whether it was also internally of normal structure, two series of transverse sections were made, one of the lower jaw and one of the remainder of the head.

It appeared that the left eye had indeed been shifted downward, that the structure was quite normal and that a well developed optic nerve and strong muscles, attached to the sclerotic in the usual way, rendered it possible and even very likely that the eye had functionated. These nerve and muscles originated from the upper part of the head; the nerve came forth from the brain in the usual manner, perfectly symmetrically with the nerve of the right eye; the muscles proceeded caudally quite symmetrically with the muscles of the right side. Nerve and muscles however followed the normal way over a short distance only, they soon bent downward and descended through the head to the lower jaw, right through the buccal cavity along a stalk connecting the upper and lower jaws and situated just before the tongue. The nerve was surrounded by the four straight eye-muscles; the two oblique ones were situated orally of the first-mentioned complex of muscles and nerve.

From this stalk the whole complex proceeded downward right through the lower jaw to the place where the eye was found. Besides nerve and muscles also a blood-vessel descended, which entered the eye together with the nerve.

Of the bony roof of the mouth, which this complex of muscles and nerve had passed, the entopterygoid, lying between the parasphenoid and the palatine, was laterally and posteriorally shifted, so that it no longer bordered on the parasphenoid. A muscle, the arco-palatine adductor muscle, was much lengthened and behind the muscle-nerve complex bent from the entopterygoid to the parasphenoid.

For the rest little change had occurred in the upper part of the head. The place where the eye should have been, was filled up with

connective tissue, except a small pit. The tongue was shortened and the copula of the hyoid arch strongly compressed, probably on account of the stalk which proceeded exactly in front of the tongue. In the lower jaw the genio-hyoid muscle was also strongly compressed on the left side; otherwise here also little change was noticed.

What may have been the cause of the abnormal growth and how can this condition have developed? On the former point we must remain entirely in the dark. As to the second we may start from two suppositions: 1. the eye has descended in a full-grown condition; 2. the eye-vesicle already deviated from the ordinary course when evagination from the brain took place and has developed to an eye in an abnormal place. In my opinion the first supposition is impossible. For the changes brought about in the head point out that it is *the eye* which chose its course and that the shifted bones and muscles adapted themselves to the abnormal condition which they found when being formed. If it were the eye that had deviated after the bones had developed, not the entopterygoid would have been displaced, but the muscle-nerve complex would have grown along the bone. Moreover it is not likely that the tongue would have been compressed *after* developing, but that it developed after the eye-stalk had formed and so was impeded in its growth. Finally it is difficult to understand how with a full-grown eye the cornea would have participated in the descent.

Assuming the second supposition, namely that the eye-vesicle already deviated from its normal course when it evaginated from the brain, we must, in order clearly to understand the process, consider how the condition of the head was when the eye first originated. For Muraena Prof. BOEKE gives us important data on this point. (Die Entwicklung der Muraenoiden, PETRUS CAMPER, Vol. II, 1903). At the time of the evagination of the eye-vesicles also the infundibulum is evaginated ventrally. Before it lies the so-called anterior mesodermic mass, a coalescence of mesoderm and entoderm, according to BOEKE. It consists of a thickened cell-mass, proceeding in two wings on both sides of the brain, and of a one-layered tongue bordering on the periblast. At a later stage the thickened mesodermic mass coalesces with the ectoderm, while the lower tongue curves round and coalesces with the intestinal epithelium.

The ectoderm invaginates and grows towards the entoderm of the intestine; afterwards the buccal cavity is formed in it.

The two lateral mesoderm streaks of the head originally form a solid mass ventrally of the evaginating eye-vesicles. Later in these

streaks cavities arise and according to BOEKE they are transformed into true somites. After the stalks of the eye-vesicles have been formed, cells grow from the wall of these somites against the capsule of the eye-vesicles in order to form the eye-muscles. BOEKE observed that the musculus obliquus superior and the musculus rectus externus originate from the wall of these somites. The same has been observed by MISS PLATT in Selachians for all eye-muscles.

How shall we imagine now that all this took place in our abnormal eel, related to the Muraena? When the eye-vesicle evaginated it probably did not grow laterally, but forward and downward. It reached the anterior mesodermic mass, which it pierced in growing in a forward and downward direction. It passed the place where entoderm and ectoderm grow towards each other and finally came to lie against the ectoderm, more particularly the ectoderm from which later the skin of the lower jaw is formed. This latter reacted on it by forming a lens and a cornea, which is in itself very remarkable but not impossible, since the experiments of SPEMANN, LEWIS and others have shown that at any rate in Amphibians lenses may be formed from the ectoderm in very unusual places.

It still remains to be explained how the eye-muscles found their way towards the eye in the lower jaw. This will also have happened at a very early stage in the development of the eye, immediately after the formation of the stalk of the eye-vesicle. This latter had then been little shifted aside yet. The cells derived from the wall of the somites of the head then laid themselves, as in ordinary cases, against the capsule of the eye-vesicle and were carried along its unusual course through the anterior and inferior part of the head, while as in a normal case they developed to muscles.

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