

*Fig. 4.* Section of the upper portion of the tooth of *Polypterus*, from Agassiz, showing the cap of enamel, *a*.

*Fig. 5.* Section of portion of maxilla of *Rhizodopsis*, much enlarged, exhibiting the bony pillars supporting the teeth: *a a*, bony pillars; *b, b*, teeth in an abraded condition, the enamel having all disappeared, and, in some instances, portions of the dentine.

XLVI.—*On the Development of the Position of the Eyes in Pleuronectidæ.* By Prof. J. C. SCHIÖDTE. Communicated by C. A. Gosch, Esq.

[THE question of the asymmetry of Pleuronectidæ has of late attracted so much attention, and we possess so few reliable descriptions of the appearances presented by very young specimens (whereby alone that question can be solved), that the following observations on this subject by Prof. Schiödt will doubtless be found highly interesting, not only to ichthyologists, but to zoologists generally. I wish particularly to draw attention to two of his results, now established by actual examination of successive stages of development of the same species, viz. :—first, that the eye of the blind side glides across the head in front of the dorsal fin without ever disappearing from view, and, when arrived on the other side of the dorsal fin and clear of it, recedes backward alongside the fin, which does not, as supposed by some, prolong itself after the passage of the eye; and, secondly, that this shifting of place is a very slow process, for which, in all probability, preparation is made in the foetus.]

Prof. Schiödt's article is destined shortly to appear in the fifth volume of the 'Naturhistorisk Tidsskrift;' but having been favoured by the author with a separate impression, I am enabled already to present it to the readers of the 'Annals.' The author begins by describing the specimens which form the principal material of his treatise in the following manner.]

On examining a young specimen of *Rhombus barbatus* which lies before me, and which measures 18 millims. in length from the apex of the closed lower jaw to the extreme end of the caudal fin, I observe that the ramifications of the muciparous canal on the head are not traceable; but the outline of the parts of the mouth, of the præoperculum, and the opercula are clearly perceptible through the skin, as well as the layers of the muscles, particularly of the great masseter on the right side. The left eye stands very nearly opposite to the middle of the upper jawbone. The right eye is placed at the top of the head, in front of the dorsal fin, but so much inclined to the left, that only one-third of its surface is visible when the fish

is viewed from its right side. The right eye is rather more round in outline—that is, a little shorter and broader than the left. This difference is caused by its being under pressure, wedged in as it is between the anterior frontal bones and the dorsal fin; and the pressure causes the interspinous part of the dorsal fin to form a small slightly upward-curved projection above the eye.

The smallest of three young of *Pleuronectes platessa*, which I have also before me, has a length of only 10 millims., the measure being taken as above. The ramifications of the muciparous canal cannot be discovered on the left (blind) side of the head, whilst on the right side they are just traceable as indistinct lines; but no ducts are to be distinguished. The whole head has a clumsy, toad-like shape, the parts of the mouth presenting soft swelling outlines. The right eye stands over the beginning of the lower third of the maxillary bone. The left eye stands at the top of the head, so much inclined to the right, that from the left side only a trifle more than one-third of the pupil can be seen; it stands in front of the dorsal fin, so that the front ray of the latter is just behind the end of the left and beginning of the middle thirds of the eye.

On comparing with this the head of another young *P. platessa*, which measures 14 millims. in length, one observes at once that the head has a somewhat less clumsy appearance, and the ramifications of the muciparous canal are more clearly observable. The position of the left eye is so far changed that when the head is viewed straight from the left side the pupil is invisible, only a part of the iris can be seen; and its position with regard to the dorsal fin is at the same time altered so that the latter touches the left margin of the eye, which cannot now be described as entirely situated in front of the dorsal fin; for the foremost ray of the fin stands at the side of the eye, a little in advance of the extreme posterior margin of the eye. When, therefore, the fish is examined from the blind side, the outline of the eye cannot be followed in its whole extent, the posterior extremity being hidden from view behind the first ray of the dorsal fin.

In a third young *P. platessa*, measuring 40 millims. in length, the head presents almost the same pointed shape as in the adult fish. The ramifications of the muciparous canal are much more distinct, and the ducts are easily distinguished on the præopercular branch on both sides, as well as on the infra-orbital branch on the blind side. The right eye stands over the lower extremity of the upper jawbone; but, in spite of this more depressed position of the right eye, the distance between the eyes is nevertheless only a little greater than in the speci-



men last described, on account of the change which is observed in the position of the left eye, which is now placed not only above the right eye, but at the same time a little behind it. The left eye is entirely transferred to the right side, though it stands so high on this side that its pigment, dimly shining through the skin, can still be seen from the left side as a small dark border. A striking evidence of its having receded further back is afforded by the fact that the first ray of the dorsal fin in this specimen stands so far forward, in comparison with the eye, that it is on a level with the middle of its left margin, whilst the third ray occupies the place relatively to the eye which in the former specimen is occupied by the first ray.

The specimens of young *Hippoglossus pinguis* which I have before me present a similar progressive development. The smaller is 57 millims. long. The outlines of all the superficial parts of the skull are distinctly seen through the skin, as well as the branches of the muciparous canal and their numerous ducts. The left eye is placed at the top of the head, so much inclined to the left (blind) side, that from the right side the iris is only partly visible, and the pupil altogether invisible; it is placed straight in front of and close to the dorsal fin, which points alongside the right margin of the pupil. On the head of a second specimen, which is nearly twice as large (100 millims.) the ducts of the muciparous canals are evidently more numerous, and the infraorbital branch on the left (blind) side, which on the smaller specimen appears curved, is here almost straight. It has got space to grow straighter; for on this specimen the left eye has moved across the head so much that it now inclines as much to the right side as formerly to the left; and whilst in the smaller specimen it stood nearly straight before the dorsal fin, the latter would, if prolonged in the larger specimen, cross the eye just inside its left margin. That the eye is under pressure, wedged in between the interspinous part of the dorsal fin and the anterior frontal bones, is evident from an indenture in its outline on the posterior margin; and this pressure evidently cannot cease till the eye, gliding still further to the right, has got clear of the dorsal fin.

In order to explain how the upper eye of the *Pleuronectidæ* comes into that position relatively to the dorsal fin which it occupies in the adults, naturalists have had recourse to the hypothesis that the dorsal fin prolongs itself in a forward direction when the upper eye, by the torsion of the head, has come into its final place. This hypothesis was first proposed by Van Beneden (Ann. Sc. Nat. sér. 3. t. xx., "Note sur la Symétrie des Poissons *Pleuronectes* dans leur jeune âge," p. 342), and has been adopted also by Dr. Traquair, in his exhaustive and

instructive treatise "On the Asymmetry of the Pleuronectidæ" (Trans. Linn. Soc. 1866, vol. xxv. p. 263)\*. The fact, however, that the young fish, at least those examined by me, possess the same number of rays in the dorsal fin as the adults, would in any case render this theory very doubtful, even if it had not now been proved by the observations above detailed that *the eye of the blind side does not only glide over from its own to the eye-side of the fish, but, when arrived here, it recedes a little along the dorsal fin.* It is consequently the eye which moves round the anterior end of the fin, not the fin that prolongs itself past the eye. A comparison between different specimens of the same species shows that the change of place is rather a slow process. On the head of the young *Rh. barbatus* above referred to, which is 18 millims. long, the eye is still quite in front of the fin; on another specimen of the same species which I have before me, and which is 45 millims. long, the centre of the eye is on a level with the second and third ray of the fin; on a third specimen, 90 millims. long, the eye is on a level with the third and fourth rays, and on a fourth specimen, 115 millims. long, it has receded as far as the fourth and fifth rays.

The total length of the first-described young *P. platessa* was, as stated, 10 millims. including the caudal fin. If, then, we take into consideration the proportionally great size of the eggs of this species, which measure 2 millims. in diameter, as well as the fact that the fish-embryo is, as it were, rolled up inside the ovum, it becomes clear that the specimen in question must have been caught not many days after having left the egg. Even allowing a margin for more rapid growth during the first days after hatching, it must be conceded, on comparing the three specimens above described, respectively 10 millims.,

\* Dr. Traquair ascribes to Fr. Rosenthal the opinion that the upper eye of the flounders attains to its anomalous final position by passing under the dorsal fin right through the head; but, although Rosenthal's expressions (Ichthyotomische Tafeln, ii. 3, Berlin, 1821, 4. p. 5) are vague enough, and may be so interpreted, I think that he may equally well be supposed to have intended only, by a sort of figure of speech, to illustrate the peculiarity of the flounder-skull. The idea that a highly complicated organ, after having attained its full development, should loosen itself from the ground out of which it has grown, wander about amongst other utterly different organs of the body—nay, even go right through the body of the animal, in order to turn up again on the other side and take root there—this idea is one which scientific zoology now-a-days can only put aside as a curiosity. I therefore think it due to the memory of so able an anatomist as Rosenthal that such a crude opinion should not be ascribed to him except on more cogent grounds, although the plate in the explanation of which the expressions in question occur was published as early as 1821—that is, only a few years after the foundation of comparative anatomy by Bichat.



14 millims., and 40 millims. long, that the development of the position of the eyes after hatching is upon the whole a very slow process, and that consequently the position of the eye on the future blind side can scarcely have been quite symmetrical even in the new-born fish. In the young fish of 10 millims. length the anomalous eye has already, in every essential particular, the same position with regard to the bones of the skull as in the adult, being placed in its orbit; and I therefore consider it in the highest degree probable that the arrangement of the frontal and anterior frontal bones round the eye of the future blind side takes place in all essential points already in the embryonal state; nor could the matter very well be imagined otherwise according to all we know about the formation of the embryo. But then the whole case falls under a very well-known biological law, and becomes plain enough. The young *Pleuronectidæ* are born with a position of their eyes calculated for life nearer the surface of the water, and grow slowly and gradually more asymmetrical in proportion as the adult fishes seek more the bottom of the sea, or, at any rate, are more calculated upon movement along a firmer surface\*. Hence the well-known long series of forms exhibiting a gradual transition, from *Hippoglossus pinguis*, which does not in any considerable degree alter the shape in which it leaves the ovum, to the soles, which are entirely thrown on one side. It appears, however, that *Hippoglossus pinguis* is not the least asymmetrical form of the family. I have before me two perhaps not quite adult specimens of an apparently undescribed oceanic flounder, taken in the Atlantic, which I propose to call *Bascanius tædifer*, n. s., and which, in the series above alluded to, would take place before the *Hippoglossus*. It is, as is the case with other oceanic animals, clear as water, very high and narrow, about 25 millims. long, foliaceous, almost symmetrical; only the left side is a little more developed, and the eye on that side is placed a little lower on the head. The greatest height of the body is at the commencement of the anal fin, where it almost reaches one-half of the total length. The muciparous canal makes a very slight bend over the pectoral fin. The dorsal fin reaches the nostrils in front, and approaches behind (as also does the anal fin) close to the caudal fin, which is slightly rounded at the end; the open space between the ventral fin and the anal fin is longer than the ventral fin itself. The rays of the fins exhibit only few and long joints; their number I find to be in my two spe-

\* Monstrosities, caused by the eye of the blind side being arrested in its process of transfer in front of the dorsal fin, have long been known. Comp. Dr. Traquair's treatise, p. 265.

cimens, in the dorsal fin 110–112 rays, in the anal fin 78–80, in the caudal fin 16–18. The entire body of the fish is rather closely strewn with small protuberances, which, on the head, stand without perceptible order, but on the greater part of the body, on the interspinous part of the dorsal and anal fins and on the base of the caudal fin are arranged in longitudinal rows. These protuberances are almost round, about 0.1 millim. in diameter, almost flat at the top, and armed with a few very small and short spines; only along the extreme edge of the interspinous part of the dorsal and anal fins and on the base of the caudal fin these protuberances are more projecting, almost semiglobular, equipped with more numerous and longer spines. The mouth is small, delicately formed, both jaws well armed with pointed, needle-shaped teeth. The eyes are round, very projecting, with a broad white ring of sclerotica visible around the iris. Between the right eye and the dorsal fin there is a semilunar depression, where the body is so thin that it easily breaks to pieces or separates itself from the dorsal fin when incautiously manipulated. In that case, of course, a part of the opposite eye is seen through the hole, and, to a superficial examination, the extraordinary appearance is presented of a flounder having two eyes and a half.

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#### BIBLIOGRAPHICAL NOTICE.

*The Birds of South Africa. A Descriptive Catalogue of all the known Species occurring south of the 28th Parallel of South Latitude.*  
By EDGAR LEOPOLD LAYARD, F.Z.S. &c. Cape Town: 1867.  
(London: Longmans.) 8vo, pp. 382.

“CONTRIBUTORS cannot be criticised:” this is the principle on which a good many publications are conducted; and in politics or in general literature it may answer well enough. Naturalists, however, are exempt from any such consideration. They may, nay they are bound to say what they think of the labours of their fellows. Hence, in speaking of Mr. Layard’s recent work, we dismiss from our thoughts the fact that he has been, and we hope will again be, one of the contributors to this Journal. The Ceylon ornithologist whose graphic pen enlivened our pages fifteen years ago, and more, must stand at our bar and listen to our summing-up without being able to call the court as a witness to his character. Indeed he has entirely changed his mode of life since then—of necessity, it need scarcely be said (for no man in his senses would do so willingly): he has abandoned the jungle and the forest for the museum and the library. In this new sphere he is certainly not yet so successful; but *non cuivis contingit*. A drouthy ‘Descriptive Catalogue’ affords but little scope for that kind of talent which distinguished his former writings. It must be judged by other rules.