Young Stages of Zeugopterus punctatus.

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On May 4th of the current year a number of small Pleuronectids were captured by the hand in a pool left by the ebb tide at Plymouth Breakwater, and brought to me alive. Two of them were very transparent, and, from their habit of lying on the right side when at rest, evidently sinistral forms. One of them was almost perfectly symmetrical; while in the other the torsion of the facial region and eyes had commenced. The pigmentation had the form of interrupted transverse bands, which were most conspicuous on the dorsal and ventral fins; on the dorsal fin seven bands were indicated. The terminal portion of the original trunk, containing the notochord, was seen at the upper edge of the caudal fin. The neurochord was covered with pigment, forming a very distinct band, situated, however, not in the skin, but in the connective tissue surrounding the neurochord or spinal cord. The mouth was large, and the snout upturned. The pectoral fin was large, the pelvic small. But the most important characteristic was the presence of two straight spines projecting laterally from the auditory region. These have been called otocystic spines by Prof. McIntosh, but I think they would be more appropriately described as periotic spines, as they are evidently projections of the periotic cartilage or bone; to which particular bones of the periotic region they belong has not been determined. Mr. Holt cut sections of the spines *in situ*, and found that they consisted of a knob of periotic cartilage passing into a mass of undifferentiated cells, the whole forming the core of a dermal spine consisting of hyaline ossified tissue. In my specimens I observed a third spine, much smaller, situated in the region of the frontal bone, behind and above the eye; it was visible in both the stages.

The numbers of the fin-rays were D. 90, A. 69, in one specimen, which was kept alive for a few days and preserved when the right

eye had reached the dorsal edge of the head. The younger specimen was 11 mm. in length; the other, after being preserved and mounted, is 10 mm., a diminution which may be due to the process of preservation, or partly perhaps to the advance in metamorphosis, a reduction of size during the transformation having been observed by me in the flounder.

A sinistral Pleuronectid having these periotic spines was described and figured by McIntosh and Prince (Trans. Roy. Soc. Edinb., vol. xxxv, pl. iii, 1890, p. 846) as a stage in the history of the turbot. The specimen was 9·8 mm. long, and another specimen a few mm. longer, having similar spines, is mentioned. The mention of the spines alone seems to indicate that these specimens were either of the same species as the specimens obtained by me, or a closely allied form. The figure given, probably drawn from a spirit specimen, is not perfectly characteristic.

A discussion of the identification of the larva with otocystic spines is given by Prof. McIntosh in the Tenth Report of the Fishery Board for Scotland, p. 279. He refers to Mr. Holt's opinion, that it belongs to the brill, and mentions another specimen, taken on Smith Bank off Caithness, in which the dorsal had 87 and the anal 62 rays.

In the Eleventh Report, published in 1893, Prof. McIntosh makes a further contribution to the question of larval sinistral Pleuronectids. He mentions no new specimens of the form here under consideration, but gives his reasons for concluding that the young specimens shown in pl. xiv, figs. 7, 10, and 11 of the Tenth Report, belong to *Zeugopterus punctatus*: these were 4·5 to 9 mm. in length. He also thinks it possible that the form with periotic spines may be a later stage of the same species, the diminution in the size of the eye being due to changes accompanying growth, or to abnormality. With this opinion I cannot agree. The form without the spines has larger eyes, and has the eye on the edge of the head when only 9·5 mm. long; it is, I think, a distinct species.

It is somewhat difficult to follow the successive discussions in which Prof. McIntosh has described and compared his specimens of young sinistral forms, more particularly as his figures are, as a rule, inadequately characteristic, often having been delineated from dead and imperfectly preserved specimens. Mr. Holt has been able to give a more comprehensive and more completely illustrated description of specimens of similar characters procured in the survey of the west coast of Ireland in 1890 and 1891. His results were published last year in the Scientific Transactions of the Royal Dublin Society, vol. v, ser. 3. The form with periotic spines (if it is a single species and not more than one) is represented in Mr. Holt's collection

(Species XIV in the memoir) by a number of specimens 5·87 to 10·62 mm. in length. The characteristic spines were present even in the smallest specimens, a fact sufficient to disprove Prof. McIntosh's supposition that the spines are developed only at the later stages. Mr. Holt figures two stages, one perfectly symmetrical, 7 mm. in length, having no fin-rays except the first indications of the caudal, but having the characteristic transverse imperfect bands of pigment. The other figure shows a stage 10·62 mm. long, in which the fin-rays of the dorsal and ventral fins are developed. This stage, however, is younger than those I have described, the termination of the original body or opisthure not being so much reduced as in my specimens, and not distinctly marked off from the dorsal and ventral fins. The number of fin-rays in Mr. Holt's specimen was D. 80 ca, A. 66 ca ; it was not possible to count the exact number.

Mr. Holt considers, and I agree with him, that this form cannot belong to *Arnoglossus megastoma*, nor to *A. laterna*, of which he has identified young specimens 19 mm. and 25 mm. in length respectively. The eyes are relatively much larger in *A. megastoma*, and the young *A. laterna* seems to have less pigment. He concludes that the parent form is either *Rhombus lævis*, the brill, or *Zeugopterus norvegicus*, the Norway topknot. Now, in my own opinion the suggestion of the brill is out of the question for several reasons, one of which is that in my specimen the fin-rays are D. 90, A. 69, while the maxima in the brill according to Day are D. 85, A. 63. The symmetrical stage of the brill figured by Raffaele, and nearly 8 mm. long, is of a different shape, and much more opaque and pigmented.

With regard to *Z. norvegicus*, Günther (Proc. Roy. Soc. Edin., No. 127, p. 217) gives the fin-rays as D. 80, A. 66, and I have counted D. 84 in one of my specimens, so that there is no evidence that the number reaches as high as in my young form.

The remaining sinistral forms to be considered are the turbot, *R. maximus*, whose young are known, and not identical with the present form ; and the other two topknots, *Z. punctatus* and *unimaculatus*. The fin-rays of the latter, according to Day, are D. 70 to 80, A. 61 to 68. *Z. punctatus*, on the other hand, according to the same authority, has D. 87 to 101, A. 69 to 80, so that there is strong probability that this is the parent form we are seeking. This conclusion is supported by the shape of the outline of the fins in the larval specimens, the posterior part of the fish approaching a rectangular shape, as in the adult *Z. punctatus*, and by the comparison of the shape of the snout in the latter and the young form. The snout in the adult is very much shortened as compared with the young, but it exhibits, apart from the anterior part of the dorsal fin which is attached to it, a deep depression at the edge between

the cranium and the extremity of the upper jaw; and further, the end of the upper jaw is broad and truncated in a manner which resembles the character of the young form as seen in my specimens. My conclusion as to the identification of the form with periotic spines agrees with that of Prof. McIntosh, but I differ from him in not including the series of smaller forms without the spines.