

LVIII.—On the Affinities of the Cretaceous Fish *Protosphyræna*.

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IN 1889\* it was incidentally pointed out that a remarkable resemblance could be observed between the jaws and dentition of the Cretaceous fish *Protosphyræna* and those of the Upper Jurassic genus *Hypsocormus*. Since that date further important information has been published in reference to the osteology of the first-named genus †, while beautiful examples of *Hypsocormus* have been acquired by the British Museum from the Lithographic Stone of Bavaria and the Oxford Clay of Peterborough. The opportunity is therefore afforded for extending comparisons further, and I undertake this task with all the more interest since it is now proved beyond doubt that *Protosphyræna* differs from all known "Teleostei" (i.) in the structure of the pectoral fins, (ii.) in the development of the splenials in the mandible, (iii.) in the structure of the large teeth, and (iv.) in the presence of a large gular plate, followed by a numerous series of comparatively short and broad branchiostegal rays.

All the new evidence combines to show that the original suggestion of five years ago was one of some importance, and it now appears that *Protosphyræna* and *Hypsocormus* resemble each other in at least the following seven prominent characters.

(1) *Rostrum and Upper Jaw*.—The ethmoidal region is consolidated into a pointed rostrum, usually more produced in *Protosphyræna* than in *Hypsocormus*, but similarly fused at the base with the small vomers, which bear a pair of very large teeth ‡. As shown by an example of *H. tenuirostris* in the Leeds collection from the Oxford Clay of Peterborough (Brit. Mus. no. P. 6917), the premaxilla is triangular in that fish, and both this bone and the maxilla agree closely with the corresponding elements of *P. nitida*, as described and figured by Felix (*loc. cit.* pl. xiii. fig. 1). As in *Proto-*

\* Smith Woodward, "Preliminary Notes on some new and little-known British Jurassic Fishes," *Geol. Mag.* [3] vol. vi. p. 451 (1889).

† J. Felix, "Beiträge zur Kenntniss der Gattung *Protosphyræna*, Leidy," *Zeitschr. deutsch. geol. Gesell.* vol. xlii. pp. 278–302, pls. xii.–xiv. (1890); A. R. Crook, "Ueber einige fossile Knochenfische aus der mittleren Kreide von Kansas," *Palæontogr.* vol. xxxix. pp. 109, 110 (1892).

‡ From the Cambridge Greensand the writer is acquainted with undescribed evidence of a species of *Protosphyræna* with a snout as short as in *Hypsocormus tenuirostris*.



*sphyraena*, so in *Hypsocormus* the premaxilla bears a few very large teeth, the maxilla having smaller and more numerous teeth.

(2) *Cheek-plates*.—Besides the large postorbital cheek-plates in *Protosphyraena* Felix also notes (*loc. cit.* p. 282) some comparatively small secondary postorbitals forming the actual hinder border of the orbit. Exactly the same arrangement is observed in *Hypsocormus* (Brit. Mus. nos. P. 6011, P. 6917), as also in the allied genus *Pachycormus*\*.

(3) *Mandible*.—The mandibular symphysis is similarly constituted in the two genera under comparison, the stout (anterior) splenials entering the symphysis, rapidly tapering behind, and each bearing one or two very large teeth in addition to the smaller teeth. In both genera also the anterior end of the tooth-bearing margin of the dentary bone curves downwards and is provided with about three large teeth pointing forwards. The present writer has never observed any evidence of a distinct presymphysial bone in either genus.

(4) *Structure of the large Teeth*.—Felix observes (*loc. cit.* p. 289, pl. xiv. fig. 4) that, when viewed in transverse section, the large teeth of *Protosphyraena* exhibit a remarkably complex structure. They are, in fact, compound, showing a number of distinct small pulp-cavities, each surrounded by its own separate zone of vasodentine. Precisely the same structure can be seen in a transverse section of a large tooth of *Hypsocormus Leedsi* in the British Museum (no. P. 6914).

(5) *Branchiostegal Apparatus*.—The large gular plate and numerous broad branchiostegal rays shown by Felix in his figure of *Protosphyraena* (*loc. cit.* pl. xii. fig. 3) are exactly similar to the corresponding plates in *Hypsocormus* and *Pachycormus*, and only approached among "Teleostei" in *Elops* and its allies.

(6) *Pectoral Fins*.—It is now proved† that the pectoral fins of *Protosphyraena* are the well-known fossils described by Cope under the name of *Pelecopterus*‡; and on comparing these with the corresponding fins of *Hypsocormus* as shown in the British Museum (nos. P. 6011, 6917), it will be observed that there is a very close general resemblance. The fin-rays are unjointed except quite at the extremity, and they are all

\* H. E. Sauvage, "Note sur le Genre *Pachycormus*," Bull. Soc. Linn. Normandie, [3] vol. vii. p. 144, pl. iv. (1883).

† A. R. Crook, Palæontogr. vol. xxxix. p. 110.

‡ E. D. Cope, 'Vertebrata of the Cretaceous Formations of the West,' p. 244a (1875).



very closely pressed together; in both cases the anterior edge of the fin is oblique, some of the anterior rays terminating successively at the border (considerably more in *Protosphyræna* than in *Hypsocormus*); and in both cases the anterior edge is roughened by a deposit of a hard enamel-like substance. Unfortunately there is as yet no precise information concerning the basal bones of the pectoral fin in *Hypsocormus*.

(7) *Axial Skeleton of Trunk*.—Negative evidence can only be regarded as of slight value, but it is nevertheless noteworthy that traces of vertebræ are wanting in all the known specimens of *Protosphyræna*. It seems likely indeed that this fish will eventually prove to have possessed a persistent notochord as devoid of peripheral ossifications as that of *Hypsocormus* and *Pachycormus*; and in this connexion it is of interest to record that two fragmentary examples of the trunk of a small *Hypsocormus*-like fish have been discovered in the Upper Cretaceous of Sahel-el-Alma, Mount Lebanon. One of these specimens is in the British Museum (no. 49531) and the other in the Syrian Protestant College, Beyrout; and although no remains of a *Protosphyræna*-like skull have hitherto been met with in the same deposit, the present writer has little hesitation in predicting that such will eventually be found. The axial skeleton of the trunk in these fossils exactly resembles that of *Hypsocormus* in the form and disposition of the close series of neural and hæmal arches; the squamation cannot be distinctly seen, but must have been very delicate; and the remains of the dorsal fin are well in advance of those of the anal fin.

In conclusion, it may therefore be stated that *Protosphyræna* is not a "Teleostean" in the ordinary acceptance of the term, and that none of its characters hitherto discovered warrant its separation from the family to which the Jurassic genera *Hypsocormus* and *Pachycormus* are referred. It differs from both in the lateral compression of the teeth, and future discoveries may reveal still more distinctive features; while it is not easy as yet to estimate the true value of some of the points of resemblance noted above. It must suffice at present merely to suggest a profitable form of comparison to be made when still more satisfactory specimens of *Protosphyræna* are available for study.



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