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ORIGINAL ARTICLES.

I.—On a New Specimen of the Liassic Pachycormid Fish *Saurostomus esocinus*, Agassiz.

By A. Smith Woodward, LL.D., F.R.S., Pres. Geol. Soc.

(PLATE II.)

ALTHOUGH the Pachycormid fish *Saurostomus esocinus* was known only by part of a lower jaw from the Upper Lias of Baden when it was first named by Agassiz, its principal characters have since been revealed by many incomplete specimens from the Upper Lias of Würtemberg, France, and Yorkshire, and by a well-preserved fish from Ilminster, Somersetshire, in the Charles Moore Collection, Bath Museum.[1] The internal skeleton of the trunk and the fins, however, have not hitherto been so well seen as in a nearly complete fish from the Upper Lias of Würtemberg, prepared by Mr. Bernhard Hauff and now in the British Museum.

This new specimen, which measures about 1·4 m. in total length, is shown of about one-eighth the natural size in Plate II. The head is deepened by crushing, so that the roof is pushed upwards above and the gular plate downwards below; but it is obviously shorter and wider than that of *Pachycormus*, while the snout is comparatively blunt. The external bones are thin and of fibrous texture, and are thus crushed on the stouter inner elements in a confused mass, but a few features are recognizable. A notch in one bone which seems to be nasal may be regarded as marking the narial opening. The blunt rostral region is shown in front view, with a row of small conical teeth along the oral border as already observed in a Whitby specimen. The large orbit is indicated by an ossified sclerotic in two halves, anterior and posterior. The cheek-plates are obscured by their crushing on the mandibular suspensorium and pterygo-palatine bones; but it is clear that although the hyomandibular is inclined backwards, the quadrate turns as sharply forwards, so that the mandibular articulation is not far behind the orbit. Below the cheek the long and slender maxilla is conspicuous, a little downwardly curved in its hinder portion, where its upper border is overlapped by a single long and narrow supramaxilla. The maxilla bears the usual large conical teeth in a spaced series, flanked outside by a close series of comparatively minute teeth, as in *Hypsocormus*. A cluster of rather large teeth, of the palatine or other inner element, is also seen between the maxilla and displaced premaxilla. In the mandible the

[1] For references to literature see Catal. Foss. Fishes Brit. Mus., pt. iii, p. 388, 1895; also A. S. Woodward, "Fossil Fishes of the Upper Lias of Whitby," Proc. Yorks. Geol. and Polyt. Soc., vol. xiii, p. 158, pl. xx, 1896.

angular bone is relatively small, and the dentary is as originally described by Agassiz. The lower teeth of the spaced series are slightly larger than those of the upper jaw, but are similarly flanked outside by clustered minute teeth. All the teeth are conical, a little incurved at the apex, covered with smooth enamel, and vertically fluted at the base. The preoperculum, operculum, and subopercular are vaguely seen, of the characteristic shape. Behind the large gular plate there are also traces of the branchiostegal rays.

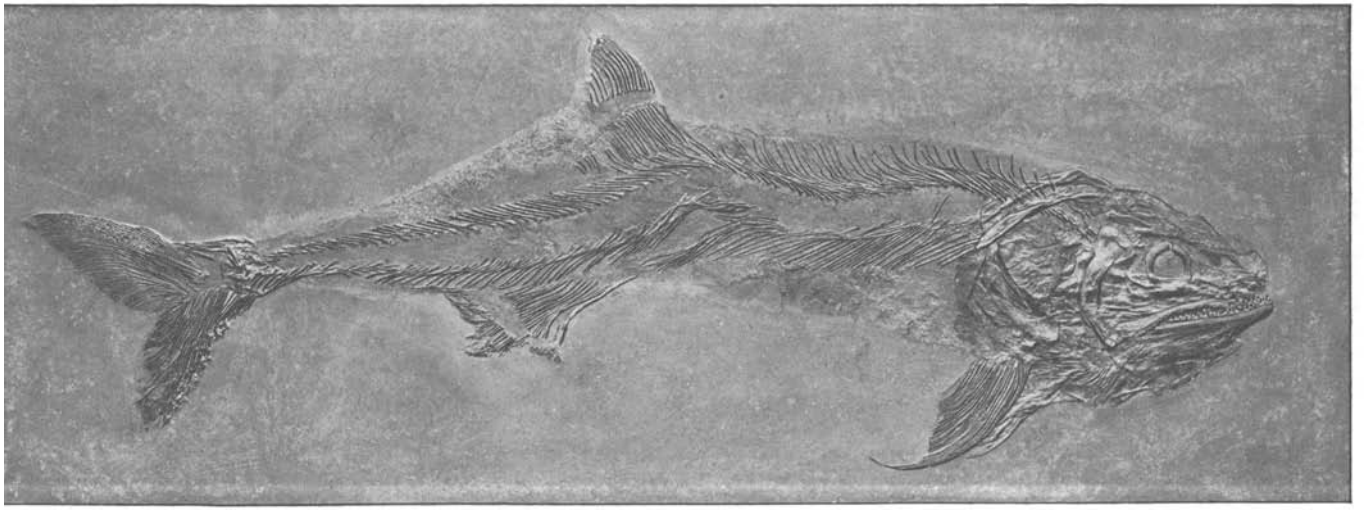
The trunk is distorted as usual, especially just in front of the dorsal and anal fins, which are thus separated a little from their supports. The vacant space for the notochord is widened by this distortion, but most of the arches above and below are well preserved. The total number of vertebral arches is about 110, of which 50 may be assigned to the abdominal region. The ribs are comparatively short and slender, while the neural arches of the abdominal region bear gently curved spines, each forming an irregular node at its fused lower end and tending to slight expansion at its upper or distal end. In the caudal region the simple neural and hæmal arches are nearly symmetrical above and below the notochordal space, and sharply inclined backwards. Within the base of the tail six or seven hæmals become relatively stout, and the last hæmal forms the fan-shaped bone which is so characteristic of the Pachycormidæ.

In the pectoral arch the two supraclavicles are well seen, relatively large, long and narrow, straight, and of conspicuously fibrous texture. The clavicle is obscured, but behind it there are traces of the usual thin and large postclavicular scales. The right pectoral fin is specially well preserved, with at least twenty rays, which do not appear to be transversely articulated but become very finely divided distally. The fourth or fifth and longest ray is gently curved and much longer than the others, which rapidly shorten backwards.[1] There is no trace of pelvic fins. The supports of the dorsal and anal fins, which are well preserved though displaced, are remarkable for their great length. Not less than twenty-five or twenty-six of these supports are shown in each fin, all expanded at the end for articulation with the fin-rays. The dorsal fin must have been almost completely in advance of the anal, and the fragmentary remains show that it was elevated in front, comparatively low behind. The anal fin is altogether less elevated, and the articulations of its rays are shown to have been distant. The rays of the powerful forked caudal fin are also articulated only at distant intervals, but are very finely subdivided distally.

Nearly all the scales have been removed from the fossil, but a scattered patch behind the dorsal fin shows that they are small and thin, with some traces of a very fine tuberculation. There are vague remains of the enlarged scale at the origin of the anal fin. Indications of digested food are also seen in the abdominal region.

The most interesting feature of this new specimen of *Saurostomus* is the remarkable elongation of the anterior pectoral fin-ray, which

[1] The pectoral fin from Whitby figured in Proc. Yorks. Geol. and Polyt. Soc., vol. xiii, pl. xx, fig. 2, 1896, thus seems to belong to *Pachycormus*, not to *Saurostomus*.



SAUROSTOMUS ESOCINUS, *Agassiz.*

Upper Lias. Holzmaden.

Nat. size 72 × 69 cm.

suggests its use as a tactile organ. Although such elongation is not uncommon among modern Teleostean fishes, it does not appear to have been observed hitherto among Mesozoic Ganoids. I may also add that some of the bones, such as the supraclavicle and the neural arches fused with their curved spines, are exact miniatures of some of the bones of the gigantic *Leedsia problematica* from the Oxford Clay. They therefore tend to support the opinion that this largest known Mesozoic Ganoid belongs to the Pachycormidæ.

EXPLANATION OF PLATE II.

Saurostomus esocinus, Agassiz; nearly complete fish, about one-eighth natural size. Upper Lias: Holzmaden, Würtemberg. British Museum No. P. 11126. Prepared by Mr. Bernhard Hauff.

II.—On the Punctation of the Shells of *Terebratula*.

By F. G. Percival, B.Sc., F.G.S., Assistant Lecturer in Geology at the University of Manchester.

(PLATE III.)

In 1844 Carpenter [1] divided the fossils then known as *Terebratula* into two groups—a perforate group, having the test covered with minute pores, and an imperforate group (the Rhynchonellids). These perforations (see Plate III) correspond to tubular processes of the mantle.

Sharpe [2] suggested that these cæcal processes of the mantle had a respiratory function; but the shell is covered with a chitinous periostracum which is imperforate. Carpenter considered this might be cellular, allowing water to pass through. Sollas [3] in 1885 suggested that they were sense organs affected by light, since the periostracum is transparent. Morse [4] offers the suggestion that they are organs of general sensibility.

The tubules are not of uniform diameter throughout. The inner half, near the mantle, according to King [5] is narrow, the outer half wider, with a sudden dilation at the 'mouth'. From the mouth a number of fine lines or tubes radiate. It is interesting to note that from the outer lip of each cæcal process a number of fine cilia radiate. Possibly these cilia fit into the radiating tubes (see Morse [4]). The radiating tubes are rarely seen in fossils. An example is shown in Pl. III, Fig. 3.

In some forms, e.g. *T. punctata*, Sow., the punctæ are elongated and slit-like at the outer surface, but have a round cross-section a little farther in. This is well shown in Fig. 5, where part of the outer layer has flaked off.

In *Terebratulina* (Fig. 1) the cæcal tubules branch as they pass outwards, but I have not observed this in any species of *Terebratula*. It would, however, be difficult to recognize in fossil specimens, even if present.

The examination of the punctæ, or external openings of the tubules, was first undertaken with the hope of using their variations as aids in distinguishing species. The punctæ are arranged in rows roughly parallel with the growth-lines. When the apertures are slit-like the long axis of each slit points to the umbo, and this emphasizes the fact that they are also arranged in rows radiating out from the umbo.