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ORIGINAL ARTICLES:

I. GEMS FROM PRIVATE COLLECTIONS, No. 2.

ON THE GENUS *ÆCHMODUS* FROM THE LIAS OF LYME REGIS,
DORSETSHIRE.

By Prof. MORRIS, F.G.S., etc., etc.

(PLATE X.)

AMONG the many fossil remains of fishes obtained from the rich Liassic deposits near Lyme Regis, species of the genera *Dapedius*, *Æchmodus*, *Semionotus*, and *Pholidophorus* are most frequently found in a good state of preservation. These Lepidoid genera are chiefly Liassic, two of the more long-bodied forms, *Pholidophorus* and *Semionotus*, having species which occur in the Purbeck (*Phol. ornatus*) and the Chalk strata (*Sem. Bergeri*). *Lepidotus*, another Lepidoid, ranges from the Lias through the intermediate Oolite and Wealden strata into the Chalk, and according to Sir P. Egerton, "the genus *Lepidotus* has the most extensive geographical range of any genus of fossil fish." With the exception of *Lepidotus*, Prof. Owen¹ classes the above genera under the Dapedoid family of the order *Lepidoganoidei*, the genus *Dapedius* (*D. politus*) first noticed by the late Sir H. de la Beche² forming the type of the family. All the genera were arranged by Sir P. Egerton under the Lepidoid family of the order *Ganoidei*, and Mons. Pictet³ placed them in his second family of Rhombiferous Ganoids—the *Lepidosteidae*, and under the second tribe of that family—the homocerocal *Lepidosteidae* (*Lepidoides Homocerques*, Ag.), which he further subdivided into sections, some of which included the above-mentioned genera—viz.,

Species having an elongated body, a short dorsal fin, fulcræ in a single row, dorsal chord persistent and protected by half-vertebræ ("halb-wirbel," Heckel.)—*Semionotus*, *Pholidophorus*.

Species having the body elevated and compressed, a single dorsal fin, one row of fulcræ, a persistent dorsal chord protected by partially ossified vertebræ—*Tetragonolepis*, *Dapedius*, *Amblyurus*.

¹ Palæontology, 1861, 2nd Edit., p. 166.

² Geol. Trans., 2nd Series, Vol. i. pl. 6, fig. 1-4.

³ Traité de Paléontologie, 2nd Edit., 1854, Vol. ii., p. 157.

Species with a short dorsal fin, *two rows* of fulcra on all the fins, [vertebral column completely ossified and terminated as in all the homocercal Ganoids¹].—*Lepidotus*.

According to Prof. Huxley, in a note to his valuable Memoir, On the Classification of the Devonian Fishes,² the above genera belong to the second sub-order, *Lepidosteidae* of the Ganoid fishes, and to the family *Lepidotini*, which he distinguishes from the first sub-order *Lepidosteini*, in having—the maxilla in one piece, branchiostegous rays many and enamelled, the anterior ones taking the form of broad plates, and he classes together as one of the sub-families, *Æchmodus*, *Tetragonolepis*, *Dapedius*, *Lepidotus*, etc.

The genus *Tetragonolepis*, Bronn., formerly arranged with *Dapedius* and *Amblyurus* (and which also included a large number of species now classed under *Æchmodus*), has been shown by Sir P. Egerton to be a "Pycnodont" closely related by its dentition to the genus *Microdon*, and having the scales differently arranged and articulated; instead of the interlocking pegs and notches by which the scales of *Amblypterus* and allied genera are joined, "each scale bears upon its inner anterior margin a thick solid bony rib, extending upwards beyond the margin of the scale, and sliced off obliquely above and below, on opposite sides, for forming splices with the corresponding processes of the adjoining scales."³

The genus *Æchmodus* was instituted in 1854⁴ to include several species formerly arranged under *Tetragonolepis* by Agassiz, but which were found by Sir Philip Egerton to present certain distinct characters. These are *Æchmodus* (*Tetragonolepis*, Ag.) *angulifer*, *confluens*, *dorsalis*, *heteroderma*, *Leachii*, *leiosomus*, *ovalis*, *pholidotus*, *pustulatus*, *radiatus*, *speciosus*, *mastodonteus*. Thus dismembered, *Tetragonolepis* contains but one British species, *T. discus*. Eg., for the *T. monilifer* and *striolatus* are now referred to *Dapedius* and *T. mastodonteus*, (Ag. 2, p. 216 to 23e., f. 3-5), is probably a *Lepidotus*.

The main difference which exists between *Æchmodus* and *Dapedius* consists in the character of the teeth, the former being unicuspid, the latter bicuspid, as shewn in Figs. 2 and 3, Plate X.

The specimen figured (Plate X.) presents the following characters:

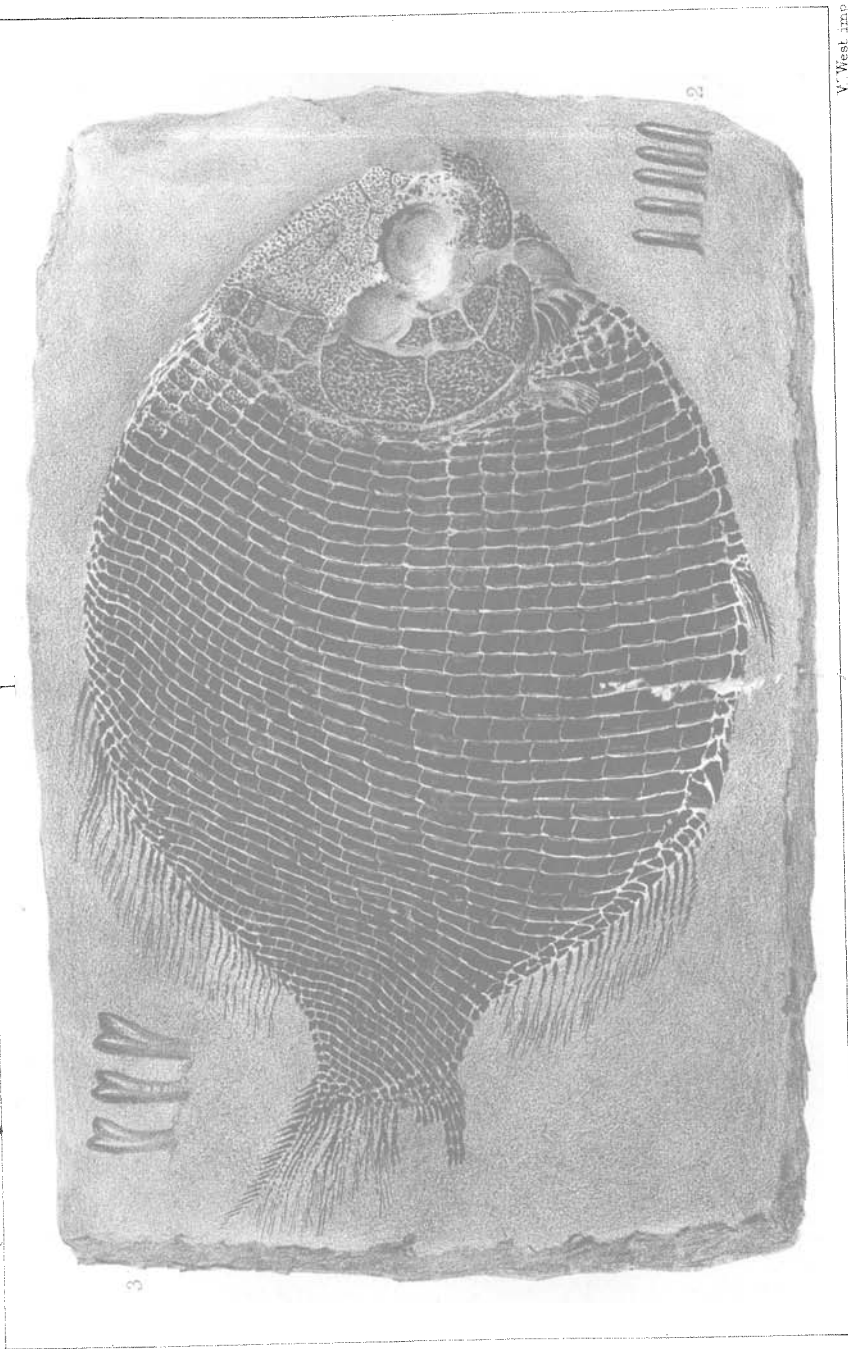
Body short, orbicular, compressed; length from the opercular plate

¹ Among the many examples of Fossil Fishes belonging to this genus which are preserved in the National Museum, Mr. W. Davies (to whom I am exceedingly indebted for much valuable assistance in drawing up this paper, and whose knowledge of Fossil Ichthyology is very extensive) assures me that no trace of a decided bony column exists in any well authenticated species of *Lepidotus* with the exception of *Lepidotus serrulatus* from the Lias of Barrow, and *L. fimbriatus* from Lyme Regis, both of which species, from other peculiarities, may eventually be found to form a sub-genus. I am therefore led to conclude that the complete ossification of the notochord is not a characteristic point in *Lepidotus*, as stated by M. Pictet. Prof. Pictet says, *op. cit.* p. 161, *Le Lepidotus fimbriatus*, Ag. est une espèce dont la position générique est encore douteuse. Les écailles ont une fine dentelure sur leur bord. *Le L. serrulatus*, Ag. a des rapports avec le *L. gigas*, mais en diffère, ainsi que de presque tous ses congénères, par ses écailles qui sont plus étroites vers le bord ventral.

² Mem. Geol. Survey, 1861. Decade x. p. 28.

³ Quart. Journ. Geol. Soc., Vol. ix. p. 276.

⁴ Egerton, Quart. Journ. Geol. Soc., 1854, Vol. x. p. 367.



1. *Achmodus orbicularis*, Morris. Lr. Lias, Lyme Regis.

to the commencement of the caudal fin exactly equal to the breadth of the flank from the ventral to the commencement of the dorsal fin. Scales twice as broad as long, and rectangular as far as the middle of the large opercular plate, gradually becoming smaller towards and near the dorsal line; scales smooth and more or less crenated posteriorly. (The line of lateral scales perforated by the mucous canal, although not distinctly marked in the specimen figured in the plate, is more clearly seen in some of the specimens in the British Museum.) The nuchal scales are marked by elongated tubercles which decrease in size and number, and finally disappear before reaching the dorsal fin. The pedicle scales are longer than broad and rhomboidal; dorsal fin nearly half the length of the body, commencing nearly opposite the ventral fins, and ending near the pedicle of the tail, the rays, about thirty in number, diminishing in size posteriorly; pectoral fins very small (about twelve rays), ventral (six or seven rays) small, placed midway between the pectoral and commencement of the anal fin, which is nearly one-third the length of body, and has about twenty rays, and is continued nearly to the caudal fin. Caudal fin moderately large, squarish, rays about twenty-four in number, which bifurcate at a short distance from their origin, and are further subdivided, the upper and lower rays with fulcra, in a single series.

General form of head sub-oval; the orbital, opercular and sub-opercular, and other plates are coarsely tuberculated. The tubercles being somewhat adpressed and more or less elongated. The branchiostegous rays five? on each side.

The length from the snout to the extremity of tail is about 8 inches, the height $4\frac{3}{4}$ inches; length of body from opercular plate to the commencement of tail 5 inches; length of head from the snout to posterior part of opercular bone $1\frac{3}{4}$ inches; depth of head $2\frac{1}{2}$ inches.

The bones of the head are somewhat displaced and broken, the maxillary crushed and distorted, but the opercular, sub-opercular, and dentary bones, as also the branchiostegous rays are well shewn.

There are in the National Collection no fewer than six specimens of this Liassic fish agreeing closely both in size and proportions, and quite as well preserved as the specimen figured in our Plate.

It is interesting, too, to notice that whereas the other species of *Echmodus* and *Dapedius* are exceedingly variable in proportions—indicating several distinct species—the fish before us is well-marked and quite specifically distinct from any figured by Agassiz, or described by Sir P. Egerton.

The figure in the Poissons Fossiles, which most closely approaches it, is the *Echmodus pholidotus* of Agassiz, from the well-known Lias locality of Boll, in Wurtemberg (see Poiss. Foss., pl. 23e, fig. ii.); but from this species it is distinguished by its more orbicular outline (resembling that of *Dapedius orbis*, Ag. Poiss. Foss. Tab. 25d) and by the length of the pedicle, the form of the tail and character of the scales, which are longer than in the specimen figured by Agassiz.

The *Echmodi* are rather short sub-orbicular, compressed-bodied

fishes, with rhomboidal scales, a single well-developed dorsal fin, partly opposed to the anal, the pectoral and ventrals being small, and the fin-fulcrum in a single series. They closely resemble *Tetragonolepis* and *Dapedius* in general form and character, but differ from the latter genus, as above noticed, in having the anterior teeth conical and single pointed, instead of being notched or bifurcate; from the former they are distinguished by the dentition and mode of articulation of the scales.

On the discrimination, however, of a genus of fishes by the form of the teeth, Sir P. Egerton remarks:—

“But, alas for the constancy of fishes’ teeth! a specimen came into my hands not long ago having a combination of the two forms of tooth, the principal sets in each jaw being conical and single-pointed, and all the subsidiary teeth bifurcate. Having had my attention thus directed to this point, I have since found a specimen of *Dapedius punctatus* in Lord Enniskillen’s collection, which has both forms of tooth in the principal series in both jaws. The conclusion, therefore, is irresistible, that the form of tooth is a character too capricious to be relied upon in this instance as a generic definition.”¹

The species of *Æchmodus* are chiefly from the Liassic deposits of Europe, and one has been recognized from the Oolitic beds of the Deccan, the *Dapedius Egertoni*, Sykes (*Æchmodus*, Egerton).²

It has been considered useful to figure this species of *Æchmodus*, not only as illustrating the genus which has not heretofore been figured in any English work, with the exception of a restored outline of the genus in “Lyell’s Elements of Geology,” p. 418, but also as shewing a type of ganoid fish of the Mesozoic period having the tail nearly symmetrical (homocercal)—a character by which the majority of the Secondary ganoids are distinguished from the so-termed heterocercal³ ganoid fishes of the Palæozoic period.

¹ Quart. Journ. Geol. Soc., Vol. ix. p. 275.

² Ibid. p. 352.

³ With regard to these terms, see the remarks by Prof. Huxley, Quart. Journ. Mic. Science, Oct. 1858, and Mem. Geol. Survey, Decade x. to p. 3, where he states “that the so-called ‘homocercal’ *Teleostei* of the present epoch are in reality excessively heterocercal; but the word ‘homocercal’ is now so generally understood to signify a tail like that of most existing *Teleostei*, that I prefer to employ Prof. McCoy’s term ‘diphycercal’ for truly homocercal tails.”

In alluding to these structures, Prof. Owen writes:—“The shape of the caudal fin varies much in fishes, according to the kind and degree of motion required: in the imprisoned embryo, in the long and slender undulating eel, in the sluggish *Lepidosiren*, the vertebræ continue to the end of the body in a straight line, distinct and decreasing to a point; and the tail is bordered above and below by a vertical fold of skin; terminating either in a point or obtusely. Such fold or fin is symmetrical, but not ‘homocercal.’ The vertical folds deepen; at first equally, forming a terminal lobe; then excessively, in the lower or hæmal fold, with the development therein of rays, and with an upward or neural inclination of the supporting vertebræ. Shorter rays are developed in the shallower neural fold, which terminates at the pointed end of the vertebral series. The anterior rays of the hæmal fold, which are the longest, form a second point. The tail is thus bifurcate, but unsymmetrical; and this stage of the development is termed the ‘heterocercal’ one. It was the fashion of tail which prevailed in fishes throughout the palæozoic and triassic periods. In some oolitic fishes, first is observed such a lengthening of the dermoneurals of the tail, with such a shortening and run-

I beg to propose for this fish the trivial name of *orbicularis*.

I am indebted for this specimen to the kindness of W. H. Huddleston, Esq., F.G.S., who obtained it during a late geological excursion to Lyme Regis.

EXPLANATION OF PLATE X.

Fig. 1. *Echmodus orbicularis*, Morris, from the Lower Lias, Lyme Regis, Dorset.

Original specimen in the collection of the author (two-thirds nat. size).

Fig. 2. Teeth of *Echmodus* (magnified three times nat. size).

Fig. 3. Teeth of *Dapedius* (magnified three times nat. size).

Figs. 2 and 3. Drawn from specimens in the British Museum.

II.—ON FAULTS IN STRATA.

By HENRY B. MEDLICOTT, B.A., Geological Survey of India.

A LITTLE time back there appeared in the Magazine, some short papers on the subject of faults,¹ and on the nature of the conditions and the forces through which these important structural features may have been produced. The points I would now bring to notice are more elementary; they refer to the evidence for faults; hence involving the principal data upon which the higher discussion of the phenomena must be based, and the same data very largely affect our attempted restoration and history of bygone phases of the earth's surface. Faults and flexures in stratified rocks are the leading features through which we interpret the disturbances that have affected the earth's crust; and any looseness in determining their existence, form and amount, must vitiate many of our inferences. No one but an experimental field geologist can appreciate the difficulty of such determinations, and understand how faults are particularly liable to elude observation. This circumstance accounts for, but does not justify, the arbitrary use of faults in interpreting sections. To call in question the evidence upon such a familiar subject implies, of course, dissatisfaction at the manner in which it is handled in practice. This I at once admit, and will proceed to explain. The criticism I have to make is no more than might occur to one who had never left his study; but I would state that with me it has had a most practical origin: in the progress of the work of the Geological Survey of India, several great boundary faults have been proposed in connection with our main rock-series, and in some cases published descriptions have been already given; but both on the score of the insufficiency of the evidence brought forward, and after personal examination in the field, I am unable to admit that some of the features in question can, without very implicit qualifications, be brought within the received definitions of a fault. I believe that it

ning together of the terminal vertebræ, and such a proportion of the dermohæmals, as leads to an equal-lobed caudal fin, which has been termed 'homocercal'; but as it is only symmetrical in contour, and remains more or less unsymmetrical in its framework, I term it 'homocercoid.' The ganoid fishes of the mesozoic periods manifest several interesting gradations of this transitional state from the hetero- to the true, homo-cercal form, each step being a permanent character of the extinct species presenting it.—Comparative Anatomy and Physiology of Vertebrates, 1866, Vol. I., p. 253.

¹ See GEOL. MAG. 1868, Vol. V., pp. 205, 339, 341, etc.