V.—NOTE ON THE AFFINITIES OF THE ENGLISH WEALDEN FISH-FAUNA.

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THE question of the affinities of the Wealden Vertebrate Fauna having been re-opened by Professor Marsh in his paper on the Dinosauria, read before the last meeting of the British Association at Ipswich,¹ it may be of interest to place on record a complete list of the species of fishes now known from the English Wealden deposits. This is more extensive than any previous list, being based on the unique collection in the British Museum, which has only lately been examined in detail. Unfortunately, however, none of the specimens, except a few examples of *Lepidotus*, are labelled to indicate the precise horizon from which they were obtained; and scarcely any of the names of localities are very definite. The various species may be enumerated in zoological order as follows:—

Hybodus basanus, Egerton, Quart. Journ. Geol. Soc., vol. i (1845), p. 197, pl. iv; A. S. Woodward, Catal. Foss. Fishes Brit. Mus., pt. i (1889), p. 273, pl. xii, figs. 1-5, and Proc. Yorksh. Geol. and Polyt. Soc., vol. xii (1891), p. 63, pl. i, pl. ii, fig. 1. Coast of Sussex and Isle of Wight.

Hybodus striatulus, Agassiz, Poiss. Foss., vol. iii (1837), p. 44, pl. viii^b, fig. 1. Tilgate Forest.

Hybodus subcarinatus, Agassiz, *ibid.* p. 46, pl. x, figs. 10-12. Sussex.

Hybodus sp.: miscellaneous teeth, some named *Meristodon paradoxus* by Agassiz, *op. cit.*, vol. iii (1843), p. 286, pl. xxxvi, figs. 53-56, others figured in Catal. Foss. Fishes Brit. Mus., pt. i (1889), pl. xi, figs. 14-16. Tilgate Forest.

Acrodus hiruado, Agassiz, *op. cit.*, vol. iii (1839), p. 148, pl. xxii, fig. 27; A. S. Woodward, *op. cit.*, pt. i (1889), p. 296, pl. xiii, fig. 9. Tilgate Forest, and Telham, near Battle.

Acrodus ornatus, A. S. Woodward, *op. cit.*, pt. i (1889), p. 296, pl. xiii, fig. 10. Brixton, Isle of Wight.

Asteracanthus granulatus, Egerton, Ann. Mag. Nat. Hist. [2], vol. xiii (1854), p. 434, and Figs. and Descript. Brit. Organic Remains, dec. viii. (Mem. Geol. Surv., 1855), No. 1, pl. i. Tilgate Forest.

Lepidotus Mantelli, Agassiz, *op. cit.*, vol. ii (1833-37), pt. i, pp. 9, 262, pl. xxx, figs. 10-15, pl. xxxa, figs. 4-6, pl. xxxb, fig. 2, pl. xxxc, figs. 1-7. Including *Lepidotus Fittoni*, Agassiz (*ibid.*, p. 265, pl. xxx, figs. 4-6, pl. xxxa, excl. figs. 4-6, pl. xxxb, excl. fig. 2), and *Tetragonolepis mastodonteus*, Agassiz (*ibid.*, p. 216, pl. xxxiii, figs. 3, 4). Sussex.

Caelodus Mantelli (Agassiz), Heckel, Denkschr. k. Akad. Wiss., math.-naturw. Cl. vol. vi (1856), p. 203; *Pycnodus Mantelli* and *Gyrodus Mantelli*, Agassiz, *op. cit.*, vol. ii, pt. ii, pp. 196, 234, pl. lxix^a, fig. 18, pl. lxii^a, figs. 6-14. Sussex.

Caturus sp., A. S. Woodward, *op. cit.*, pt. iii (1895), p. 350. Hastings.

Neorhombolepis valdensis, A. S. Woodward, *ibid.*, p. 356, pl. viii, fig. 5. Hastings.

Belonostomus sp., A. S. Woodward, *ibid.*, p. 439. Isle of Wight.

Oligopleurus vectensis, A. S. Woodward, Proc. Zool. Soc., 1890, p. 346, pl. xxviii, fig. 1. Isle of Wight.

Nine genera of fishes are thus represented in the English Wealden, and all, except *Caturus*, are known by sufficiently characteristic specimens to be determined with certainty.

Of these fishes, the three Elasmobranchs *Hybodus*, *Acrodus*, and *Asteracanthus* are essentially Jurassic. The beautiful examples of the skeleton of *Hybodus basanus* from the Sussex coast prove

¹ Abstract published in GEOL. MAG. [4], Vol. III, pp. 1-9 (1896).

that this shark had a persistent notochord and other characters like the typical species of the genus in the Lower Lias of Lyme Regis. They show only one difference from the Liassic type, namely in the cephalic spines; the Wealden specimens not being barbed and never observed in more than one pair. In Cretaceous strata, on the other hand, there is no certain evidence of *Hybodus*. Most of the teeth commonly ascribed to this fish probably belong to another shark (*Synechodus*), which has well-developed vertebral centra and smooth dorsal fin-spines; while the ribbed dorsal fin-spines occasionally found in the English Gault, Cambridge Greensand, and Upper Greensand, may be referable either to *Hybodus* or *Acrodus*. Typical teeth of the latter occur rarely in the Gault of Folkestone, but are not known elsewhere. The tuberculated fin-spines of *Asteracanthus* are scarce in the Wealden, and have never been recorded from a higher horizon, unless a fragment described by Pictet from the Lower Neocomian of Switzerland¹ happens to be of a little later date.

Lepidotus Mantelli is most closely related to the species from the Lithographic Stone of Bavaria. Only few and fragmentary remains of the same genus are known from the Neocomian, and all fragments of later date are very doubtfully placed here. *Caturus* is also typically, if not exclusively, Jurassic; and the abraded skull in the British Museum from the Wealden of Hastings (No. P. 6360) cannot be generically distinguished from that of this fish. *Oligopleurus* is also known only from the Jurassic, occurring in the Lithographic Stone (Lower Kimmeridgian) of Ain, France, and in the Purbeck Beds of Dorsetshire.

Belonostomus ranges throughout the Upper Jurassic and to the Upper Cretaceous, with a very wide geographical distribution; but the only known specimens from the Wealden are too imperfect to determine whether they are most closely related to the earlier or to the later species. *Neorhombolepis*, however, although very rare, is an essentially Cretaceous fish, the typical species occurring in the Lower Chalk of Kent; and it is noteworthy that the most closely related genus, *Otomilla*, is found in the Neocomian of Mexico.² The Pycnodont *Cælodus* is also typically Cretaceous, though represented occasionally in the Purbeck Beds and other formations on the horizon dividing the Jurassic and Cretaceous series.

The result is, therefore, that all the known English Wealden fishes are survivors of typically Jurassic genera, except *Neorhombolepis* and *Cælodus*, and these are their little-modified representatives. None but *Belonostomus* appear to range throughout the Cretaceous. In fact, the Wealden estuary seems to have been the last refuge of the Jurassic marine fish-fauna in this part of the world, not invaded even by stragglers from the dominant race

¹ *Asteracanthus granulosus* (Agassiz), Pictet and Campiche, "Foss. Terr. Crétacé St. Croix," p. 98, pl. xii, fig. ii (1859).

² J. Felix, Palæontogr., vol. xxxvii, p. 189, pl. xxix, fig. iii, pl. xxx, figs. 3-5 (1891).

of higher fishes which characterized all the seas of the Cretaceous period. The Wealden river drained a land where a typically Jurassic flora flourished¹; the only two known Mammalian teeth from the Wealden resemble those of a Purbeckian genus²; and now it is clear that the fishes agree both with these and the reptiles in their alliance with the life of the Jurassic era.

VI.—*MEROCRINUS SALOPLE*, N.SP., AND ANOTHER CRINOID, FROM THE MIDDLE ORDOVICIAN OF WEST SHROPSHIRE.

By F. A. BATHER, M.A.

IN June, 1895, Mr. G. H. Morton, F.G.S., of Liverpool, submitted to me three specimens of Crinoidea, registered No. 681 in his collection. One of these specimens was a stem-fragment, impossible to determine; but the other two appeared of such interest that Mr. Morton very kindly allowed me to make a detailed study of them. The results, though not so complete as might be wished, are now submitted to geologists and zoologists, in order that the former may look out for further specimens, and the latter give us the benefit of their opinion.

Locality.—With regard to all three specimens, Mr. Morton writes, under date 24th July, 1895: "I obtained them 25 or 30 years ago at Mincop, the name of a farmhouse, at the north end of a low hill which ends there, being near the east end of a dyke marked red on the 1-inch map, 60, N.E. (Welshpool), on the S.E. of the map. They were collected in a small quarry, or rather large hole, in a field above the house, just inside the gate of the field. I went there seven years ago, but found the hole filled up and corn growing over the spot, so that there is no chance of obtaining any more specimens there. Mr. Watts told me that he had found the same bed on the strike, but I do not think any fossils."

Horizon.—On page 17 of "The Geology . . . of the Country around Shelve," issued at the end of Proc. Liverpool Geol. Soc., session x, 1869, Mr. Morton thus describes the beds: "In ascending order [the Priest-Weston sandstone] is succeeded by the strata of Mincop and Meadow Town, composed of hard light grey sandstones, interstratified with shales possessing an indurated appearance. These sandstones, which run in beds about six inches thick, contain very good examples of *Strophomena compressa*, *Orthis testudinaria*, *Beyrichia complicata*, *Trinucleus concentricus*, *Calymene brevicapitata*, *Diplograpsus pristis*, *Pyritonema fasciculus*, *Glyptocrinus basalis*, and others. The shales associated with the sandstones in many places contain innumerable trilobite impressions, *Asaphus tyrannus*." The name *Glyptocrinus basalis* in the preceding list refers, Mr. Morton tells me, to all three specimens. The stem-fragment presents some

¹ A. C. Seward, "Catalogue of the Mesozoic Plants, Brit. Mus.—The Wealden Flora, part ii," p. 240 (1895).

² A. S. Woodward, "On a Mammalian Tooth from the Wealden Formation of Hastings," Proc. Zool. Soc. 1891 (1892), p. 585; R. Lydekker, "On a Mammalian Incisor from the Wealden of Hastings," Quart. Journ. Geol. Soc., vol. xlix, p. 281 (1893).