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FOSSIL MURRAY COD (*MACCULLOCHELLA MACQUARIENSIS*) FROM DIATOMACEOUS EARTHS IN NEW SOUTH WALES.

By E. S. HILLS.

(Plates xxxi-xxxiii.)

Introduction.

The fossil fishes described in this paper have been gathered together from various sources, and I am indebted to the following persons for the loan of specimens and for other facilities of research: Mr. Heber Longman, Director of the Queensland Museum, who first brought the occurrence of the beautifully preserved fishes from Bugaldi to my notice; Dr. Ida Brown, who subsequently discussed the occurrence with me and arranged for me to borrow the material in the Museum of the Geology Department, University of Sydney; Dr. A. B. Walkom, Director of the Australian Museum, who kindly loaned the specimens in his care, and also enabled me to examine material of the living Murray Cod; Miss E. C. Pope, of the Australian Museum, who supplied measurements and scales of the living species; Mr. J. A. Tubb, M.Sc., of the Fisheries Division, Council for Scientific and Industrial Research, who generously placed at my disposal his unpublished notes on anatomical variation within the genus *Maccullochella*; Mr. G. Mack, formerly of the National Museum, Melbourne, who provided material for comparison; Mr. R. A. Keble, of the National Museum, who loaned a fossil specimen in his care; Mr. H. F. Whitworth, Curator of the Mining Museum, Sydney, who kindly had certain fossil specimens photographed for me and loaned an important specimen for study; Mr. F. S. Colliver and Mrs. Fenton Woodburn, of Melbourne, who loaned specimens from their private collections. The photographs for the plates are the work of Miss M. Johnston, of the Geology Department, University of Melbourne.

The registered material studied by me is as follows:

1. Queensland Museum. No. F.2732. Loc., Baradine, Warrumbungle Mts., N.S.W.
2. Department of Geology, University of Sydney. Nos. 954, 979, 980, 956, 955. Loc., Bugaldi, 14 miles N.W. of Coonabarabran, N.S.W.
3. Australian Museum, Sydney. Nos. F.19324, 5; F.19799, F.30912, F.37085. Loc., Bugaldi. No. F.36921. Loc. Chalk Mt., near Coonabarabran. No. F.18259. Loc. Cooma, N.S.W.
4. Mining Museum, Sydney. No. F.12462. Loc. Bugaldi.—This specimen has been transferred to the Australian Museum Collection, where its registered number is F.42458.

With the exception of the specimen No. F.18259 from Cooma, it appears that all the other material was derived from the well-known deposit of diatomaceous earth at Chalk Mountain, Bugaldi, in the Warrumbungle area, regarding which Kenny (1924) states that "fossil fish and leaves are fairly plentiful". The fishes are beautifully laid out in the diatomite, with the bones but little disturbed and the finest details of the fin-lobes and scales preserved in impression. The bone, if present, is generally extremely friable except in one specimen (No. F.30912), in which both bone and scales are preserved.

All the specimens seen by me clearly belong to the one species, preliminary restorations based on this assumption having been confirmed by the study of material acquired later. No specimen is complete, and most are deficient as to head and tail.

The two most nearly complete examples, No. 954, of the Geology Department, University of Sydney, and No. F.12462 of the Mining Museum, afford most of the essential information and are designated as hypotypes.

Technical Description.

Family MACCULLOCHELLIDAE.

Genus MACCULLOCHELLA Whitley, 1929.

REC. AUSTR. MUS., xvii, 3, June 27, 1929, p. 109, *nom. nov. pro Oligorus* Günther, preoccupied.

MACCULLOCHELLA MACQUARIENSIS (Cuvier and Valenciennes), 1829. *Hist. Nat. Poiss.*, iii, April, 1829, p. 58.

Head and Opercles.—(i) No. 954 (Pl. xxxi, fig. 1). Maxilla exposed, with supplemental bone; both dentaries are exhibited in the specimen, the right being displaced downwards from the symphysis; teeth villiform; head slightly depressed; orbit placed centrally over distal end of maxilla.

(ii) No. 979 (Pl. xxxiii, fig. 1). Opercles thin; operculum with a single weak spine; pre-operculum entire.

(iii) F.36921 (Pl. xxxii, fig. 1). Transverse ridge on frontals posteriorly, connecting the parietal crests; occipital crest feeble, not extending to the frontals.

Vertebrae (Pls. xxxi-xxxiii).—Specimens F.2732, F.19325 and 956 show 20 caudal vertebrae. The number of abdominal vertebrae is difficult to determine, and only one specimen, No. 954, gives a reliable count, showing 15. Five other specimens show at least 13, with the additional anterior vertebrae obscured.

Dorsal Fin (Pls. xxxi-xxxiii).—At least 10, possibly 11 spines (954, F.19325), soft dorsal with 14 (954), 15 (956, 980) or 16? (F.42458) rays.

Anal Fin (Pl. xxxii).—Spines 3, Nos. 1 and 2 crossing (F.36921, F.19799); soft part with at least 11 rays, possibly averaging 12 (956, 979, F.19325, F.30921, F.37085).

Caudal Fin (Pls. xxxi-xxxiii).—Margin rounded, rays about 17 (F.42458, and specimen from Nat. Mus., Melbourne).

Ventral Fin (Pl. xxxii, fig. 1).—One spine, 5 soft rays (979, and specimen from Mrs. Woodburn).

Pectoral Fin (Pl. xxxii, fig. 1).—Rounded, with numerous rays (F.42458, 956, 979).

Scales.—Small, with well-marked ctenoid area. The cyclic ornament is dominant in impressions of overlapping scales, but in F.30912 the actual scales are preserved and the rather weak radii are clearly displayed.

General.—The characteristics of the form, including the lobation of the fins, sculpture of vertebrae and proportions of the body, may be gathered from the illustrations.

Identification.

The general resemblance of the remains to the Murray Cod *Maccullochella macquariensis* (Cuvier and Valenciennes) was obvious after a preliminary restoration had been made. There were, however, many important differences between the fossils and the reported details of the osteology of *Maccullochella* given by McCoy (1884) and Boulenger (1895), which suggested that the fossils were perhaps not even congeneric with *Maccullochella*. The main differences are as follows:

<i>Murray Cod</i> (as described).	<i>Fossils.</i>
<i>Skull.</i> —Strongly depressed anteriorly. Eye placed well forward of distal end of the maxilla.	Not strongly depressed. Eye placed above distal end of the maxilla.
<i>Spinose dorsal.</i> —XI spines, very small compared with depth of body and height of soft dorsal.	X or ?XI spines of moderately large size, about equal to height of soft dorsal.
<i>Vertebrae.</i> —Boulenger gives 16A and 19C.	Fossils show 15A and 20C.

It should be noted that all the fossils from which significant osteological details were obtained were small fishes, averaging 10 to 11 inches in length, whereas the descriptions of Murray Cod in the literature are based on specimens averaging between 2 feet and 3 feet 6 inches in length, and ranging up to 6 feet. Being aware of significant changes in the relative proportions of the various parts of the anatomy of fishes during growth, especially among forms exhibiting giantism, such as *Maccullochella*, I studied the excellent collection of small Murray Cod in the Australian Museum, and also obtained from Mr. J. A. Tubb, of the Fisheries Division of the Council for Scientific and Industrial Research, much valuable unpublished information on the osteological

characteristics of the genus, which he has demonstrated to be remarkably plastic. The examination of the small specimens was quite sufficient to show that the fossils are indistinguishable from such immature examples of *Maccullochella macquariensis*, the differences listed above as to shape of skull, position of eye, and relative size of the spines in the spinose dorsal all disappearing. Mr. Tubb's data show that the number of spines in the spinose dorsal varies between 10 and 12, and, in fact, the number of rays in the several fins in the fossils lies within the range of variation of *Maccullochella macquariensis*. Furthermore, a small specimen of the species dissected by me has 21 caudal and 14 abdominal vertebrae. It will thus be seen that the total number of vertebrae (35) is apparently constant, but that the ratio of abdominal to caudal vertebrae may range from 16:19 according to Boulenger; 15:20 in the fossils; and 14:21 in the above-mentioned specimen. I have, therefore, referred the remains to the living species.

Remarks.

The small size of the fossils calls for some comment. The largest specimen is incomplete, but is estimated to represent a fish nearly 2 feet long; the average length is only 10-11 inches. In spite of their perfect preservation with even the squamation largely intact, there is no trace of stomach contents in any specimen, and it seems very probable that the supply of food was inadequate. No fossils other than these fish, dicotyledonous plant remains, and the diatom tests and *Spongilla* spicules of the diatomaceous earths themselves have been recorded from the deposits. It may therefore be that the fishes died of starvation on attaining a certain relatively small size.

On the other hand, it may be that a single invasion of Murray Cod into the diatomaceous lake was killed by an accession of hot volcanic spring water. David (1896), in discussing the origin of the diatomaceous earths in the area, comments on their close association with Tertiary volcanic rocks, which association, it may be noted, is also found in other parts of eastern Australia, including Queensland and Victoria.

The single specimen from Cooma (F.18259) is a caudal fragment indistinguishable from the remains from Chalk Mountain. This, of course, is not an indication that the deposits at these two widely separated localities are of the same age, but the interesting physiographic implication is that the diatom-bearing lakes at each place were connected with a river system in which Murray Cod existed. It is also worthy of note that no fish remains have so far been discovered in the Cainozoic diatomaceous earths of Queensland or Victoria, although many deposits have been opened up in those States. The indications are, therefore, that the former distribution of the species was similar to the present, that is, mainly in the Murray River system. This being the first record of fossil Murray Cod, the remains are of little value for age-determination, but since the living species is represented, the first presumption would be that the remains are not older than Pliocene, which is the period to which David finally assigned the deposits in the Warrumbungle Mountains (1932). The evidence of age provided by the fishes is, however, not decisive.

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EXPLANATION OF PLATES.

Fossil *Maccullochella macquariensis* (C. & V.), Bugaldi, N.S.W.

Plate xxxi.—1. (F.42459) 954, Department of Geology, University of Sydney. Hypotype.
 2. F.42452, Australian Museum, Sydney. Hypotype.

Plate xxxii.—1. F.36921, Australian Museum, Sydney. Note dorsal view of posterior part of skull. 2. 956, Department of Geology, University of Sydney.

Plate xxxiii.—1. 979, Department of Geology, University of Sydney. Shows ventral fins, pectoral fins, and opercular apparatus. 2. Caudal fin, specimen in National Museum, Melbourne.

Miss M. Johnston, photos.





