

A NEW FISH BED IN THE CARBONIFEROUS LIMESTONE
OF DERBYSHIRE

by

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Summary

A new discovery of a bed crowded with the dermal denticles of Petrodus patelliformis M'Coy is described. It occurs in the uppermost Viséan limestones and is thought to be M'Coy's type locality. Comparisons are made with other fish beds in the Carboniferous Limestone of Derbyshire and the palaeoecology is discussed.

Introduction

Whilst fossil fish remains are to be found sporadically distributed through the limestones of Derbyshire, they have only been found in abundance at two localities previously. These are at Ticknall (Wilson 1880) and in the Barmoor Clough Quarry near Chapel-en-le-Frith (Jackson 1908). The first of these is now overgrown and partly filled in and the other is completely filled in. Thus it was a considerable surprise to find a new fish-bearing bed near Wirksworth and this note records the details.

Locality and Stratigraphical Relationships

The new fish bed is in Steeplehouse Quarry, approximately mid-way between Wirksworth and Cromford, immediately west of the railway siding at the crest of Bole Hill (National Grid Reference SK/288554). Here some 3 feet of limestone with intervening shale bands in a crinoidal off-reef facies have been found to contain large numbers of dermal denticles of Petrodus patelliformis M'Coy. (Dermal denticles are broadly equivalent to scales embedded in the skin of early shark-like fishes, but have the internal structure of teeth). The beds in the quarry were mapped by Shirley (1958) as part of the Cawdor Limestones at the top of the Lower Carboniferous succession in Derbyshire, and the beds were referred to the P₁ sub-zone by comparison with the Cawdor Quarry some 2½ miles to the north. Shirley made a reference to fish remains being present.

The quarry, temporarily not being worked, exposes some 25 feet of limestones, of which the upper 20 feet are fine-grained calcarenites with some chert nodules and scattered Gigantoproductus shells. There is a downward passage into the crinoidal facies, which reaches a little over 6 feet in thickness in the step in the middle of the quarry floor. The lowest bed visible, forming the quarry floor, is characterized by numerous burrows and other trace fossils, rarely seen in Derbyshire. The step is formed of beds of crinoidal limestone 12 to 18 inches thick with shale-partings in places up to an inch thick. Traced laterally some of the partings die out and massive beds 1½ to 2 feet thick result. The fish dermal denticles are present throughout some 3 feet of beds as scattered individuals, but become concentrated at the top of each limestone below the shale-parting, and in the shale itself. The quarrying away of blocks left the shales exposed to weathering and some surfaces were so rich in dermal denticles that hand-fulls could be scooped up. Samples of the shale-partings reaching 20% by weight of dermal denticles have been obtained. Traced laterally, westwards along the north wall of the quarry the grain-size of the crinoidal limestone is rapidly reduced, and dermal denticles are no longer found after some 20 yards from the quarry step. Southwards the shale-partings die out, but a weathered joint face shows dermal denticles following the line of one parting as a layer in a limestone bed, until this disappears into the southern quarry wall, which is largely hidden by debris. The next quarry, 100 yards away to the south, fails to reveal any dermal denticles. The occurrence thus seems to be confined to a small thickness of beds, 3 feet, over an area not more than 50 yards across from north to south. The west wall of the quarry on the same horizon reveals no fish remains, whilst the gentle easterly dip conceals the continuation of the beds. Any renewal of quarrying may remove it altogether.

The Fauna

The fish fauna consists almost entirely of dermal denticles of Petrodus patelliformis, the details of which are discussed below. Other fish remains are a few teeth of Cladodus type all damaged too much for specific identification.

A varied invertebrate fauna is found in both limestones and weathered shale-partings, and it includes:-

The corals Dibunophyllum bipartitum M'Coy; Caninia juddi (Thomson); Zaphrentis spp; Michelinia tenuisepta (Phillips); Emmonsia parasitica (Phillips); and Chaetetes septosus (Fleming)

The brachiopods Echinoconchus punctatus (J. Sowerby); Pustula pustulosus (Phillips); Gigantoproductus giganteus (J. Sowerby); Dictyoclostus semireticulatus (Martin); Athyris sp.; and Spirifer bisulcatus J. de C. Sowerby. Numerous Bryozoa. Crushed crinoid calices and ossicles.

Systematic Palaeontology

Sub phylum Pisces
Class Chondrichthyes
Subclass Elasmobranchii
Order Selachi
Suborder Hybodontoidae
Family Hybodontinae

<u>Petrodus patelliformis</u>	M'Coy	1848	Ann. Mag. Nat. Hist. (2) II pp. 132-3.
-ditto-	M'Coy	1848	Proc. Camb. Phil. Soc. 1 p. 66
-ditto-	M'Coy	1854	Contrib. British Palaeont. p. 27.
-ditto-	M'Coy	1855	British Palaeozoic Fossils in the Sedgwick Museum, Cambridge. p. 637 and Plate III G figs. 6, 7, 8.

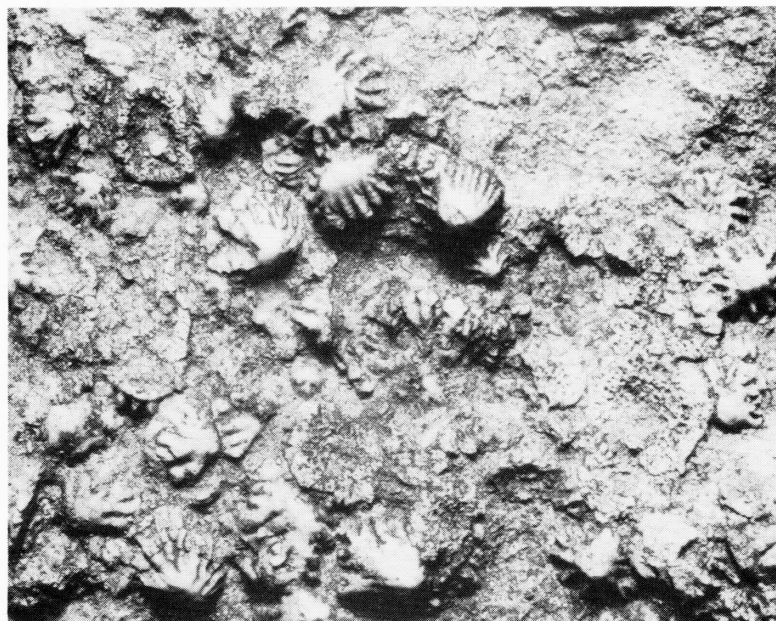


Fig. 1. Part of the Petrodus patelliformis bed at Steeplehouse Quarry, near Wirksworth, showing the abundance and random disposition of the dermal denticles. Magnification X2



Fig. 2. Dermal denticles of Petrodus patelliformis M'Coy to illustrate the variation in original shape and abrasion. Magnification X3.5.

<u>Petrodus patelliformis</u>	Davis	1883	<u>Trans. Roy. Dublin Soc. (2) 1 p. 400</u> <u>Tablet 208 Plate LI figs. 16, 16a, 16b.</u>
-ditto-	Moy-Thomas	1935	<u>Proc. Leeds Phil. Lit. Soc. III pp.</u> <u>68-72, pl. 2 and fig. 1.</u>
<u>Petrodus petalliformis</u>	Morris	1854	<u>Cat. Brit. Fossils p. 337.</u>
-ditto-	Woods	1891	<u>Cat. Type Foss. Woodwardian Museum</u> <u>p. 165.</u>
<u>Ostinaspis barbotana</u>	(Romanovsky) Trautschold	1874	<u>Nouv. Mem. Soc. Imp. Nat. Hist.</u> <u>Mosc. XIII.</u>
<u>Listracanthus hystrix</u>	(Newberry & Worthen) emend.		<u>Demanet (pars). Demanet 1941. Mem.</u> <u>Mus. Roy. Hist. Nat. Belg. No. 97, pp. 159-61.</u> <u>Pl. VIII, figs. 5-9.</u>

M'Coy's original description is here quoted in full:-

"Conical, height one-half to two-thirds the width of the base, which is round or rarely subtriangular; apex rudely pointed, becoming flat by wear; sides radiatingly ridged with about thirteen or fourteen very strong, single or dichotomous ridges, the sides of which are usually cut by numerous deep oblique sulci; the ridges are highest at the base, where they terminate abruptly; osseous base a little wider than the crown. Diameter of base three to four lines.

This tooth presents considerable variation in the proportion of height to width of the base, and also in the number and relative thickness and complexity of the ridges; there is no variety however sufficiently striking to require particular notice or occasion any difficulty in the identification of the species.

It seems abundant in some parts of the Derbyshire limestone."

Remarks: M'Coy's type material was noted as being in the Cambridge University collections, and Specimens E 4509 to 4511 in the present Sedgwick Museum Collections are listed as syntypes, being referable to M'Coy's 1855 illustrations Pl III G figs. 6, 7, 8 respectively, and E 4512 as a paratype. The material was listed as from "Derbyshire - presented by W. Hopkins". Hopkins published a short paper on the stratigraphy of the Derbyshire limestones in 1834 but did not refer to any fossil fish localities, so that the type locality is not known any more accurately than "Derbyshire". Green in the North Derbyshire Memoir (1887) lists only this together with Morris's (1854 p. 337) mis-spelling of the specific name. In view of M'Coy's reference to its abundance and the fact that the species is not listed from either of the other Derbyshire fish beds it seems highly likely that the locality described here was Hopkins' original locality.

Petrodus patelliformis was listed from "the Yoredales of Todmorden, Lancashire" by Sherborn and Woodward (1890) (specimen No. P 5855 in the British Museum (Natural History)), and this vague locality may be the same as that which provided the slab with a pectoral girdle and crushed skull in the Wellburn Collection at Leeds Museum described under the same name by Moy-Thomas (1935). Wellburn's locality was similarly vague, "Local Shales, Dane Valley, Pendlesides", and it cannot now be identified. Naming the pectoral girdle and skull Petrodus patelliformis by Moy-Thomas was perhaps unwise as the association with scattered dermal denticles is based on the evidence from a single slab only. The assignation to the Family Hybodontidae is similarly tenuous and is based on an apparent resemblance to the pectoral fin of the Jurassic Hybodus. Woodward (1903) found similar dermal denticles in association with a spine of Listracanthus wardi Woodward in the Gin Mine marine band of the North Staffordshire coalfield but he referred them only to Petrodus sp., though he likened them to the denticles of Hybodus sp.

The denticles herein described appear to grade into the form described from Indiana as Petrodus sp. by Newberry (1873) and into a form from Illinois described by Newberry and Worthen (1866, p. 72 and Pl. IV, fig. 17) as P. acutus. These species were described also from the Carboniferous Limestone of Mjatschkowa,

Russia, mistakenly referred to the Devonian by Trautschold (1874) and Davis (1883, p. 401). Trautschold placed them in a new genus Ostinaspis, listing Petrodus as a synonym, but Sherborn and Woodward (1890) list Ostinaspis as a synonym of Petrodus. Trautschold's figures of Ostinaspis barbotana Romanowsky (1875 Pl. XXVII, figs. 12a to f), some of which are reproduced by Woodward (1903, figs. 9 and 9a) on the basis of specimens in the British Museum (Natural History) (No. P 5117), differ only by a prolongation of the radial ridges into flanges. Woodward appears to regard these as possibly transitional with the longitudinal ridges on the spine fragments of Listracanthus wardi, though without much evidence quoted.

Demanet (1941) described and figured spines of Listracanthus hystrix Newberry and Worthen in assemblages with Petrodus patelliformis in the Lower Namurian of Belgium. Demanet referred both spines and dermal denticles to the species Listracanthus hystrix on the grounds that, although Petrodus patelliformis had priority, Woodward had referred the denticles to the prior genus Hybodus. This is incorrect as Woodward merely noted a similarity to Hybodus but did not refer the denticles specifically to that genus. Thus M'Coy's name must still stand.

The association of these denticles with a pectoral girdle and skull and with spine fragments elsewhere may or may not be fortuitous and it is regretted that the remains at this new locality throw no further light on the subject. The considerable variation in the denticles at Steeplehouse Quarry does however suggest that separation into a number of species is unfounded. The association with Cladodus teeth may be similarly fortuitous but on the other hand they too may be part of the same fish, indicating an association of "primitive" Cladodont teeth with more "advanced" Hybodont dermal denticles.

Trautschold also figured (Pl. XXVIII figs. 12 g, h and i) Ostinaspis simplicissima, but the description appears to have been omitted from his paper. No comparable denticles have been seen at Steeplehouse Quarry. Trautschold's paper was published in 1874, although the title page of the volume gives 1860, so that his generic name is invalid; so the last named species may possibly stand as Petrodus simplicissima Trautschold until further material is available.

Comparison with other Fish Beds in the Carboniferous Limestone of Derbyshire

The fish bed in Bolt Edge Quarry, Barmoor Clough, near Chapel-en-le-Frith (SK 088798) yielded a number of palatal teeth to T. Parker which were listed and briefly described by Davis (1886). The list was added to by Jackson (1908), who noted that the worn appearance of the teeth was similar to the worn and damaged brachiopod shells, and he concluded that this was a beach deposit similar to that described at Castleton by Barnes and Holroyd (1896). Davis had suggested that the brachiopod shells were damaged owing to having been crushed by the fish but Jackson found no evidence to support such a conclusion. The bed is now buried under a rubbish tip.

Scattered fish teeth have been found in similar beds in the "Beach Beds" in a small disused quarry (now a private garden) at the foot of Treak Cliff (SK 139829) (Barnes and Holroyd 1896) and apparently in two other localities between Castleton and Sparrowpit though their wording is ambiguous (1897 p. 182) and they cannot be found today.

The Ticknall locality was noted by Wilson (1880), again without sufficient detail for it to be found today with certainty, but a few finds (not in situ) by the writer suggest that it was in coarse crinoidal limestone in the now very overgrown quarries to the north of the road through Ticknall. Wilson also listed a few teeth from Ashford-in-the-Water and Bakewell, again without detailed localities.

Bemrose's (1907) discussion of the species listed in Woodward's catalogue (1889) added nothing new. None of these localities are known to have yielded Petrodus so the only deduction which can be made is that

fish with palatal teeth occupied different ecological niches from those with dermal denticles and that they were probably both restricted in distribution.

Palaeoecology

The dermal denticles are found, as outlined above, in some 5 feet of beds of crinoidal limestone with shale-partings. The coarse clastic nature of the deposit with the larger fossils little if at all worn, indicate rapid deposition of material derived from a nearby source area. Exposures of reef limestones of bank, fore-reef and inter-reef facies within a few hundred yards suggest that the beds in the Steeplehouse Quarry were deposited close to a reef-complex, perhaps as a result of scour through an inter-reef channel with deposition resulting from a reduction in currents in the off-reef area.

Comparison with the other fish beds of Derbyshire suggests that these too were deposited in off-reef areas.

One problem remains - the denticles are dispersed through 3 feet of beds over a small area, but the species is rarely recorded elsewhere. Such an unusual concentration requires an explanation. It is unlikely that many thousands of denticles all came from one fish and that all the 3 feet of beds, both coarse clastic limestone and fine shales, were deposited during the decomposition of one carcass. It is possible, however, that a shoal of Petrodus inhabited the reefs and that the death of a number of these would yield such a deposit by winnowing and short distance transport over a period of a few months or years. The presence of brachiopods showing little sign of wear and of crushed but not dissociated crinoid calices indicate that transport was through a short distance without appreciable abrasion.

Two of Demanet's figures of the Belgian material (1941, Pl. VIII figs. 8 & 9b) suggest a comparable occurrence and thus palaeoecology, but he made no comment on either lithology or palaeoecology.

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