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# Tillywhandland Quarry

[NO 528 537]

## Highlights

One of the best Early Devonian fish sites in Scotland, Tillywhandland in Forfarshire presents a rich assemblage of primitive cephalaspids and acanthodians, including type material collected from the 1860s onwards, particularly by Mitchell and Powrie.

## Introduction

During the past 200 years or so the quarries on Turin Hill, near Forfar, were worked for the sandstones of the Arbutnott Group. Tillywhandland Quarry displays a section through a fish-bearing clastic–carbonate–organic laminite, and it yields a rich fauna of acanthodians and cephalaspids. Fish specimens, probably from this site, have been reported by Powrie (1861, 1864, 1869, 1870) and subsequent authors (e.g. Watson, 1937).

Powrie collected a great number of fossil fishes from Turin Hill and other sites, and many of his specimens were the basis of type descriptions, but the exact localities and horizons of material from 'Turin Hill' are not known. Nor is it certain if there is one or several fossil fish beds at Turin Hill. From examination of collections in Montrose Museum (Mitchell Collection), RSM and NHM, Trewin and Davidson (1996) consider that material in a laminite matrix and labelled Turin Hill is possibly all from Tillywhandland. Richardson *et al.* (1984) studied the palynology of these beds and others in the Strathmore region and Richardson and MacGregor (1986) ascribed the Tillywhandland fish bed to the basal Lockovian *micronatus–newportensis* Zone.

## Description

The fish bed occurs in a quarry opened originally for the underlying sandstone, a usable building stone in the Dundee Formation (Arbutnott Group). Powrie (1864, p. 414; 1870, p. 285) described the Forfarshire Fish Bed as a single unit (rather than several discrete beds), of distinct lithology, about 0.9–2.4 m thick, readily recognized wherever it crops out. Trewin and Davidson (1996) recorded a complete section of the fish bed and adjacent strata (Figure 5.7)A and logged the position and relative abundance of the fossils within it (Figure 5.7)B.

The sandstone beneath the fish bed contains scattered pebbles and displays cross-bedding and deformation structures. Sand injections form veins within the fish bed laminites, which are themselves affected by soft-sediment deformation. A 60 mm thick pale green to buff sticky clay is a conspicuous marker within the fish bed, and the laminites grade up into the overlying green siltstones. The fish and plant remains are distributed throughout the bed, as are abundant coprolites containing acanthodian debris, showing that fish were present throughout the period of laminite deposition. There is minor bioturbation at some levels within the laminites.

## Fauna

AGNATHA

Osteostraci: Cephalaspidiformes:

Cephalaspidae

*Cephalaspis pagei*

*C. powriei*

C. sp.

## GNATHOSTOMATA

Acanthodii: Climaetidiformes: Climaetidae

?*Brachyacanthus scutiger* Egerton, 1860

*Climatius reticulatus* Agassiz, 1845

*Euthacanthus macnicoli* Powrie, 1864

*Euthacanthus* sp.

Acanthodii: Ischnacanthidiformes: Ischnacanthidae

*Ischnacanthus gracilis* (Egerton, 1861)

?*Uraniacanthus* sp.

Acanthodii: Acanthodiformes: Acanthodidae

*Mesacanthus mitchelli* (Egerton, 1861) *M.* sp.

Trewin and Davidson (1996) found that *Mesacanthus mitchelli* and *Ischnacanthus gracilis* are the most abundant fish, the other acanthodians being much less so, while the cephalaspids are limited to very few specimens (Figure 5.8). Many fish are relatively complete, or lack only the anterior part. The cephalaspids are mostly headshields with rare complete fish. Invertebrates include *Pterygotus* sp. and millipedes *Archidesmus macnicoli*. Trace fossils include small burrows at several levels in the laminites, and arthropod trackways in siltstones overlying the fish bed.

For an account of the flora which belongs to Banks' (1980) *Zosterophyllum* Zone, (Lochkovian) see Cleal and Thomas (1995) who describe the importance of the site for fossil plants.

## Interpretation

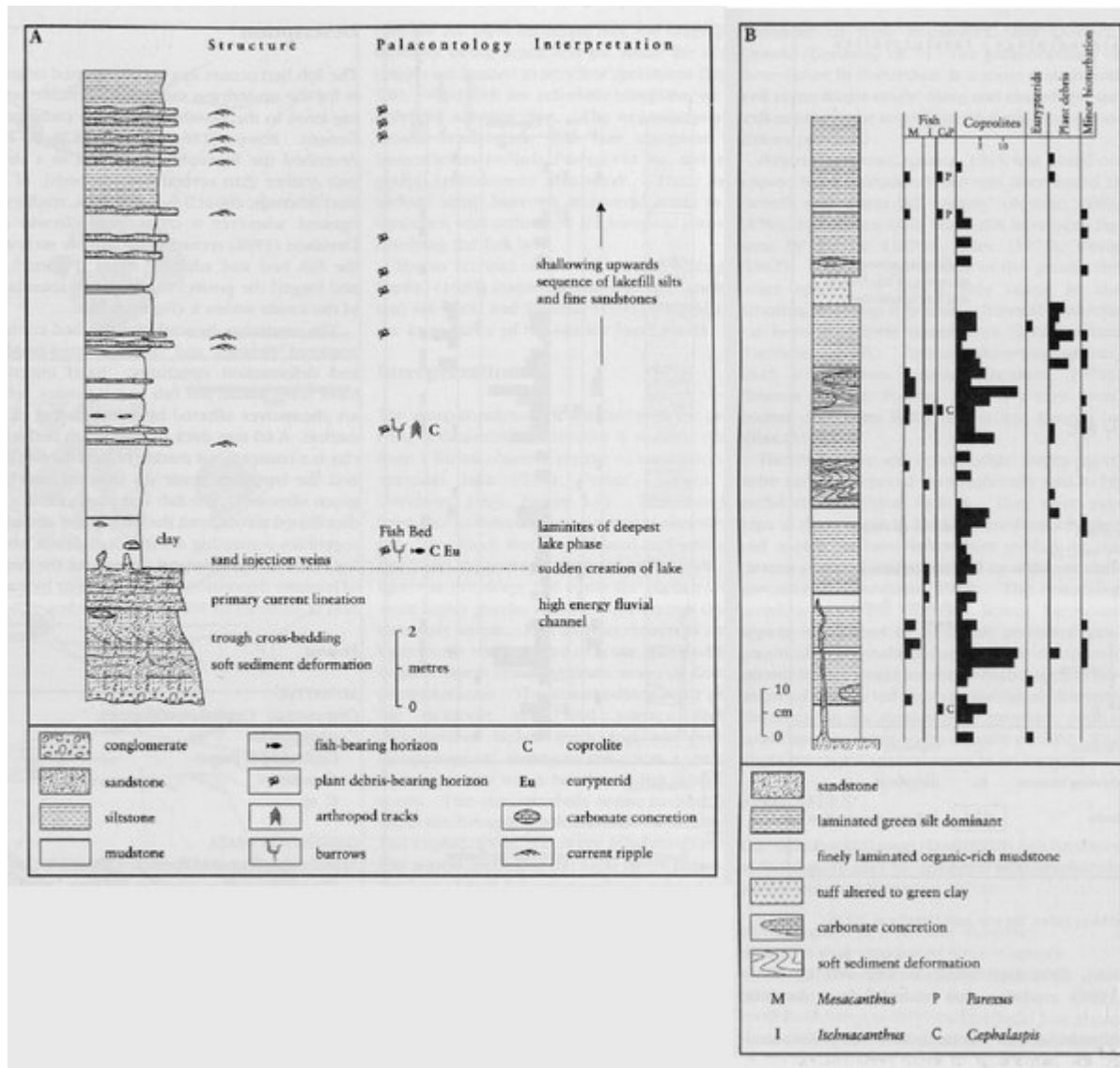
The sharp contact of the fish bed with the underlying red sandstone denotes a sudden change from a fluvial channel regime to deposition in a seasonal lake ('Lake Forfar'; Trewin and Davidson, 1996; (Figure 5.9)). This may have been due to volcanic damming or to tectonic tilting. The water margin and land was well vegetated and supported a range of arthropods. The lake was not deep, but while the surface waters were highly productive, the bottom was discontinuously anoxic. The laminae represent annual increments to the order of some 2000, with the organic layers resulting from seasonal decay of phytoplankton. The acanthodians were probably nektonic mid and surface feeders. *Mesacanthus* lacked teeth and was probably microphagous; *Ischnacanthus* was a predator and *Climatius* was a benthonic fish with sharp teeth. The mesacanthids seem to have been shoal fish living in the shallow or surface waters. The cephalaspids, too, were inhabitants of shallow waters, probably the local rivers rather than the lake. Small fish were perhaps subject to predation from the large pterygotid eurypterids.

The pale green to buff clay appears to be the weathering product of a volcanic ash-fall and the termination of the lake's existence was the result of increased sediment input. The origin of the fish fauna and possible connections with other water bodies remain obscure. Recent studies, as yet unpublished have not been able to confirm that the Tillywhandland fish bed is the same stratum as is exposed elsewhere (R. Davidson, pers. comm.).

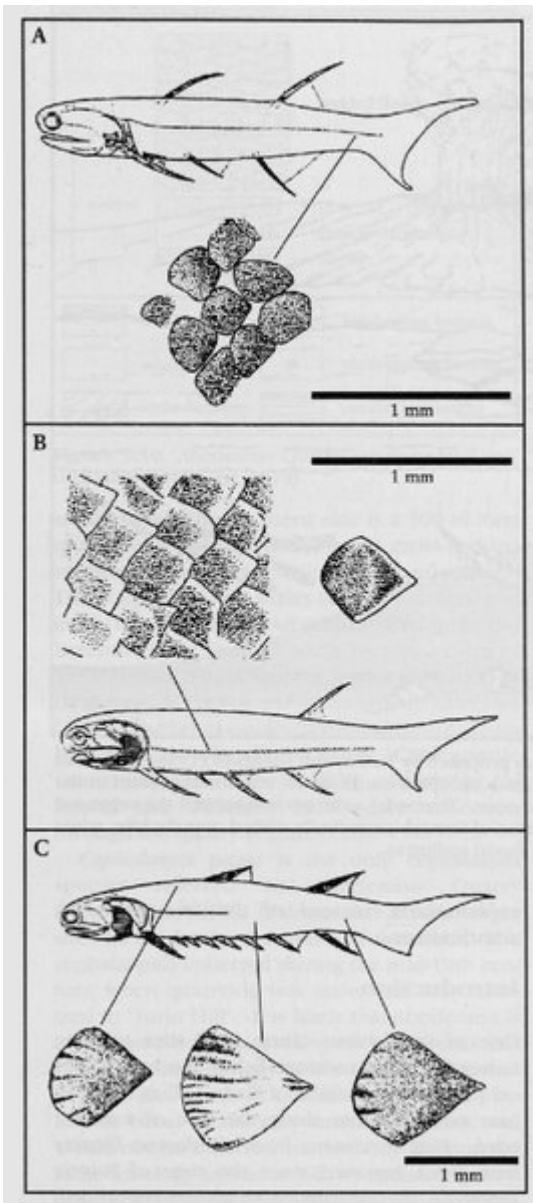
## Conclusion

As one of the best Lower Devonian fish localities in Scotland, its conservation value is enhanced by it being the site richest in acanthodian fishes. It is one of the numerous quarries that formerly existed in the Turin Hill area, and it is one of the few that shows good sections, and in which fossil fish have been found recently. There is a continuing potential for investigation here.

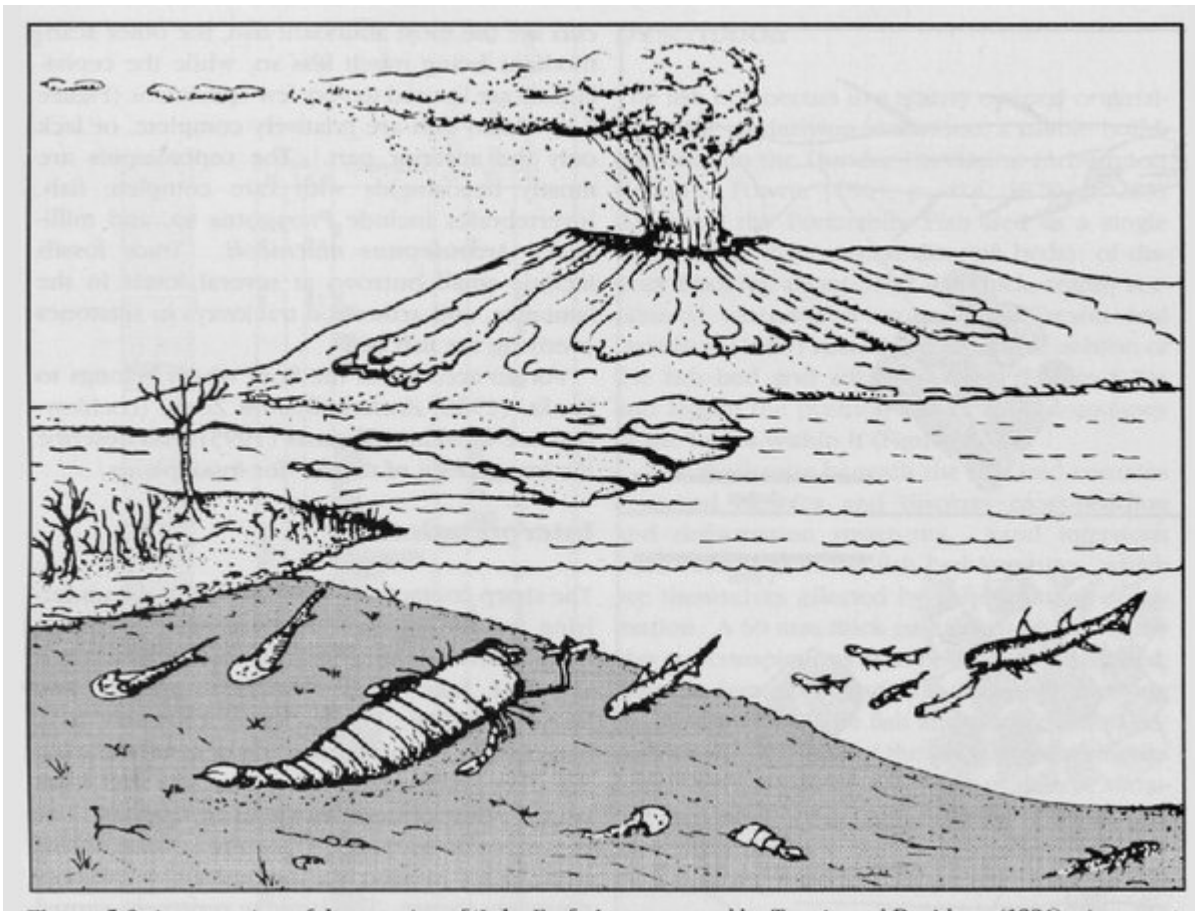
## References



(Figure 5.7) A Tillywhandland Quarry: the succession (after Trewin and Davidson, 1996). B Tillywhandland Quarry: the recorded positions of the fauna and flora within the fish bed (after Trewin and Davidson, 1996).



(Figure 5.8) Characteristic acanthodian scales from Tillywhandland Quarry. (A) *Ischnacanthus gracilis* (Egerton), NHM P 62266, scales rhombic, sub-rhombic or polygonal, relatively flat to gently convex and smooth; (B) *Mesacanthus mitchelli* (Egerton), P 140 and 10892, scales smooth with flat crowns, sharp posterior point; (C) *Euthacanthus macnicoli* Powrie, scales with simple ribs, very flat crowns with five to ten well-spaced grooves. (Courtesy V.T. Young.)



*(Figure 5.9) A restoration of the margins of 'Lake Forfar' as proposed by Trewin and Davidson (1996). A vagrant benthos of cephalaspids, eurypterids and other invertebrates occupied the shallows; acanthodians lived in the open waters. Bottom conditions were probably oxygen-poor. Terrestrial arthropods inhabited the vegetated land adjacent to the lake. From nearby volcanoes quantities of fine ash periodically drifted over the lake, while there was throughout a seasonally variable input of fine fluvial sediment.*