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# WAYNE HERBERT QUARRY

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## Highlights

The Wayne Herbert site in Herefordshire has yielded a diverse fossil fauna including rare complete cephalaspids, pteraspids and the oldest known complete acanthodians. Its importance rests in the quality of these specimens and in their age.

## Introduction

A small overgrown quarry to the south-west of Wayne Herbert (or Wainherbert) Farm yielded in the 1930s a rich and diverse fauna of complete fossil fishes and eurypterids from a green siltstone lenticle and its overlying sandstone. This original level is now beneath the present floor of the quarry, but disarticulated material has been obtained recently from the associated sediments above the lens. The geology of the site has been referred to by White (1935), Allen and Tarlo (1963), Allen (1964), Miles (1973), Turner (1982a) and White and Toombs (1983). The fossils have been described by Woodward (1891a), Traquair (1899a), Leriche (1903), Kiaer (1924, 1932b), Gross (1933, 1968a), Brotzen (1933), Kiaer and Heintz (1935), Wills (1935), White (1935), Berg (1940), Obruchev (1941), Kermack (1943), Denison (1956, 1964), Tarlo (1961b), Halstead Tarlo (1965), Miles (1973), Dineley and Loeffler (1976), Märss and Einasto (1978), Turner (1982a), White and Toombs (1983) and Blicek (1984).

## Description

The strata in Wayne Herbert Quarry are of Ditton Group (Lochkovian) age and lie about 66 m above the (local) main '*Psammosteus*' Limestone. White (1935, p. 383) described the fish bed as a very fine green siltstone that formed a thin restricted lens 50 mm thick in a bed of normal coarse grey sandstone that passes laterally into a coarser unfossiliferous rock or thins out. It contains a *Turinia pagei* thelodont assemblage and lies within the *Rhinopteraspis crouchi* Zone; it is also placed in the *microratus*–*newportensis* spore Zone of Richardson and MacGregor (1986), i.e. Lochkovian. The first specimen was found in pieces among the debris on the floor of the quarry. White and Toombs (1983) recorded *P. rostrata* var. *waynensis*, *P. rostrata* var. *virgoi* and *P. ?jackana* as from above the siltstone lenticle, and *P. rostrata* var. *toombsi* from within it. In his study of the Pteraspidoformes, Blicek (1984) created the genus *Errivaspis* for *P. rostrata* var. *waynensis*.

The rock overlying the lens also contains fossil material, although it is disarticulated, and mostly isolated dorsal and ventral pteraspid discs. A fragment of the arthropod *Prearcturus gigas* and broken plates of *Weigeltaspis* sp. were recorded from the 'uppermost beds at Wayne Herbert' (White, 1935, p. 385). There are differences between the species of heterostracans found in the siltstone lens and the associated 'sandstones', but all the cephalaspids (as yet undescribed species), together with *Cephalaspis jacki* and the acanthodians, are found complete in the siltstone lens, where articulated pieces of thelodont were also found. A complete specimen of *P. rostrata* var. *toombsi* has been found in the siltstone lens (the first known complete *Pteraspis*) with plates of the other pteraspids occurring in the overlying cornstone.

## Fauna

AGNATHA Heterostraci: Pteraspidoformes: Pteraspidoformidae

*Pteraspis rostrata sensu stricto* Agassiz, 1835

*P. rostrata* var. *toombsi* White, 1935

*P. ?jackana* White, 1935

*Errivaspis waynensis* (White, 1935)

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Heterostraci: Cyathaspidiformes: Cyathaspididae

*Poraspis sericea* Lankester, 1873

Heterostraci: Phialaspidiformes: Weigeltaspididae

*Weigeltaspis* sp.

Osteostraci: Cephalaspidiformes: Cephalaspididae

*Cephalaspis toombsi* White, 1935 *C. waynensis* White, 1935 *C. virgo* White, 1935 *C. jacki* White, 1935

*C. salweyi* Egerton, 1857

Thelodonti: Thelodontida: Nikoliviidae

*Nikolivia milesi* Turner, 1982

GNATHOSTOMATA

Acanthodii: Climatiformes: Climaetiidae

*Ptomacanthus anglicus* Miles, 1973

*Vernicomacanthus waynensis* Miles, 1973

Acanthodii: Ischnacanthiformes: Ischnacanthidae

*Uraniacanthus spinosus* Miles, 1973

The arthropods *Pterygotus anglicus?* and *Prearcturus gigas* are also found at Wayne Herbert.

*Pteraspis rostrata* was first described as *Cephalaspis rostratus* by Agassiz (1835), based on an internal cast from the Ditton Group of Whitbach Quarry (no longer extant), near Ludlow. This specimen is an immature form, and therefore atypical, which meant that when White (1935) described the species of *Pteraspis* known at the time, he gave five new varieties for all the newer material, while stating that eventually one of these could be shown to be the typical form (Figure 4.16). White's five varieties were: *P. rostrata* var. *waynensis*, *P. rostrata* var. *toombsi*, and *P. rostrata* var. *virgoi*, all from Wayne Herbert, *P. rostrata* var. *trimpleyensis* from Trimpley, Worcestershire, and *P. rostrata* var. *monmouthensis* from Monmouth. Blicek (1984) redefined *Pteraspis rostrata*, removing *P. rostrata* var. *virgoi*, and creating a new genus *Errivaspis* for *P. rostrata* var. *waynensis*, thus *Errivaspis waynensis*.

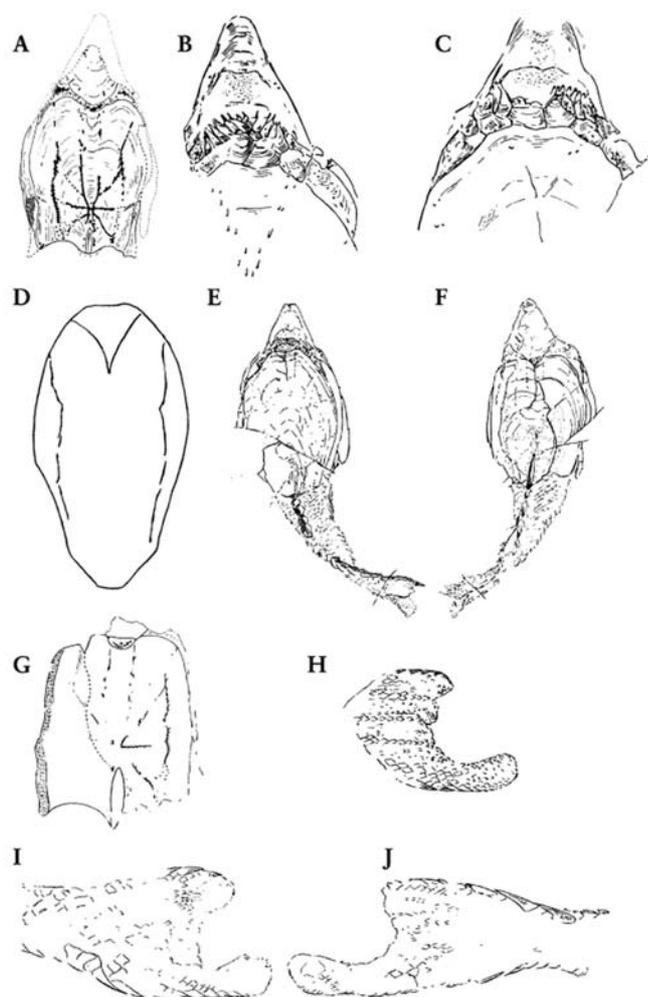


Figure 4.16: *Pteraspids* from Wayne Herbert Quarry, after White (1935). (A) *Pteraspis rostrata* var. *toombsi*, dorsal view of the carapace with parts of the lateral line system shown; (B), (C) ventral views of the rostrum and oral apparatus, NHM P17488  $\times 0.4$  and NHM P17487  $\times 1$ ; (D) *Pteraspis waynensis* (P 16524)  $\times 0.5$ , outline of the ventral disc with lateral line canals indicated; (E) *Pteraspis rostrata* var. *toombsi* (P16789)  $\times 0.33$ , almost complete individual preserved as an external mould, ventral view of carapace trunk and tail; (F) the same specimen preserved in counterpart,  $\times 0.33$ , seen in dorsal view; (G) *Pteraspis jackana* (P17628)  $\times 0.5$  approximately, dorsal disc with traces of lateral line canals in dorsal view; (H)–(J) *Pteraspis rostrata* var. *toombsi*, external lateral impressions of tails with squamation (NHM P 17488, NHM P17521, NHM P 17477), at c.  $\times 0.25$ .

Six more or less complete, flattened specimens of *Pteraspis rostrata* var. *toombsi* were found in the siltstone lenticle at Wayne Herbert, together with some fragments of the caudal and tail region. *Pteraspis rostrata* also occurs in northern France and Belgium.

*Pteraspis jackana* was described by White (1935) from south-west Herefordshire, and north Monmouthshire, with a type specimen from Castle Mattock. An isolated dorsal disc showing growth stages was found above the siltstone lens at Wayne Herbert, and is referred tentatively to this species by White and listed as *P. ?jackana* in White and Toombs (1983).

*Poraspis sericea*, described (Lankester, 1873a, 1873b) from 'Abergavenny', occurs in the Middle Dittonian of the Welsh Borders (Denison 1964) and was recorded at Wayne Herbert by Turner (1982a). It is the type species of the cyathaspidid genus *Poraspis*, and is one of the last species of the Order Cyathaspidiformes to appear in the stratigraphical record. It is also the largest species of the genus, and may be related to *P. magna* from Spitsbergen. Denison (1964) listed 15 species of *Poraspis* from Spitsbergen, the Welsh Borders, Pas de Calais (France), and Podolia (Ukraine). He used length, width, and orbital ratios to distinguish species.

*Weigeltaspis* sp. is recorded from the beds overlying the siltstone lenticle. It has plates ornamented by elongate leaf-shaped tubercles, and when first discovered was thought to be an arthrodire (Brotzen, 1933). Halstead Tarlo (1965) redescribed the genus from new material, suggesting that *Weigeltaspis* is very similar to many of the advanced psammosteids. However, Blieck (pers. comm.) adduces evidence to place it within the Family Traquairaspidae. It occurs in the Upper Lochkovian of Podolia, Latvia, the Welsh Borders and Spitsbergen.

The first discovered specimen of the thelodont *Nikolivia milesi* Turner, 1982 was found at Wayne Herbert. It consisted of a large, 150 mm long fragment from the ventral surface of the cephalothorax. Articulated thelodonts are very rare; most of the 50–60 species described are based entirely on isolated scales. Only two articulated specimens, and several separate scales of this species, are known from the Lower Devonian of Britain (Turner, 1982a). The type species of the genus is *N. oervigi* Karatajute-Talimaa, 1968 from Podolia. Isolated scales in the Early Devonian of Europe and Australia, are associated with turiniid thelodonts, and in the Early Silurian to Early Devonian of north-west Canada (Turner, 1982a). *N. milesi* is a large thelodont, longer than 145 mm, with long cephalothorax and slim triangular pectoral flaps (Figure 4.17). It has thin lanceolate scales with leaf-like crowns, about 1.5 mm long. No isolated scales have yet come from Wayne Herbert (Turner, 1982a).

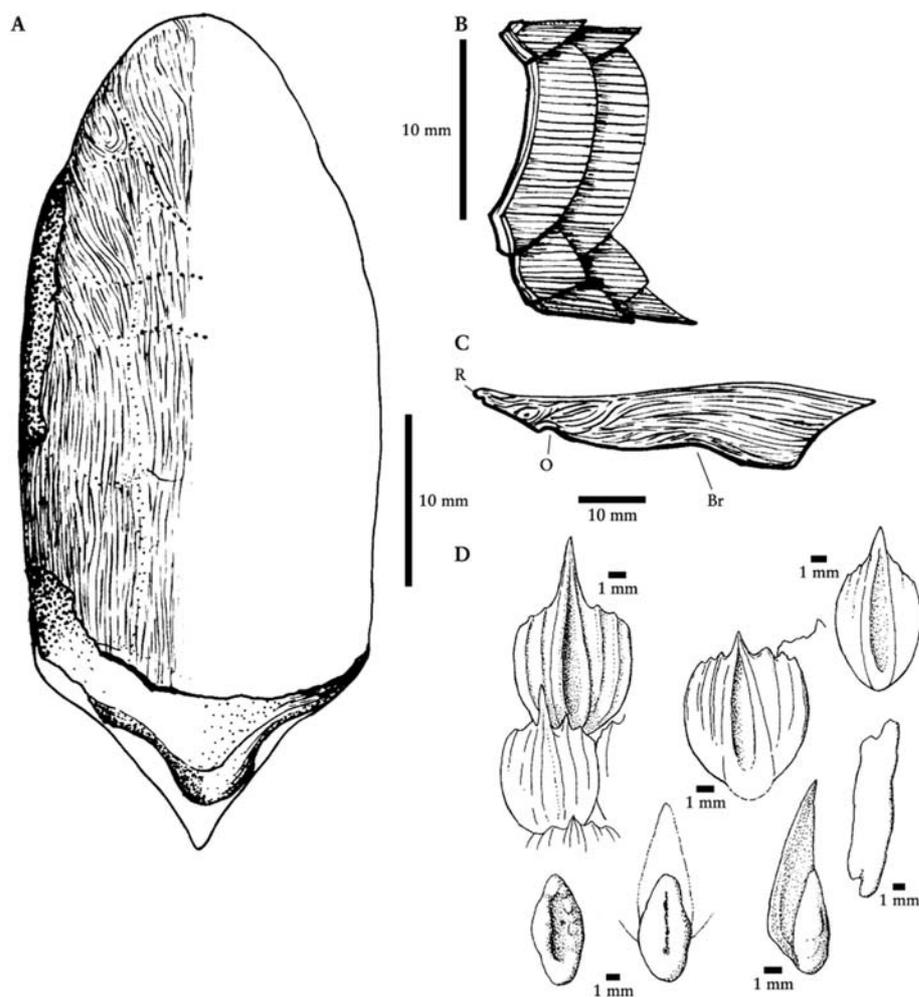


Figure 4.17: (A) *Poraspis sericea* Lankester from Wayne Herbert Quarry: a dorsal aspect of the dorsal disc of the holotype (NHM P.4117); (B) median dorsal, lateral, ventro-lateral and median ventral scales of *Poraspis*; (C) lateral profile of the dorsal disc of *Poraspis*; Br, position of the branchial opening between margins on the disc and the branchial plate; O, position of the orbit; R, rostrum; (D) *Nikolivia milesi*, denticles from the trunk showing overlap (NHM P. 53902). (From Turner, 1982a).

The acanthodians from Wayne Herbert are the oldest known intact British specimens of this group (Miles, 1973). The only other articulated Lower Old Red Sandstone acanthodian material

occurs in the Angus fish beds of Scotland. As isolated scales and spines, with occasional shoulder girdle and jaw material, acanthodians are common throughout the Upper Silurian and Lower Devonian of the Welsh Borders. The Wayne Herbert specimens were found in the siltstone lenticle, which also yielded the complete fossils, *Pteraspis rostrata*, described by White (1935). *Ptomacanthus anglicus* Miles, 1973 is the type species of this primitive genus of climatiid (Figure 4.18). It reaches a length of at least 300 mm, and is closely related to *Nostolepis* and *Climatius*. *Vernicomacanthus waynensis* Miles, 1973 is closely related to the smaller *V. uncinatus* from the the Lower Old Red Sandstone of Turin Hill, Angus, which is the type and only other specimen of this climatiid genus. It has six pairs of intermediate fins, an unusually large number, and a correspondingly elongate body. *Uraniacanthus spinosus* Miles, 1973 is represented by this single species from Wayne Herbert, although it is possible that some of the isolated detached spines found elsewhere in the Dittonian of the Welsh Borders and usually labelled '*Ichnacanthus*' sp. represent this genus.

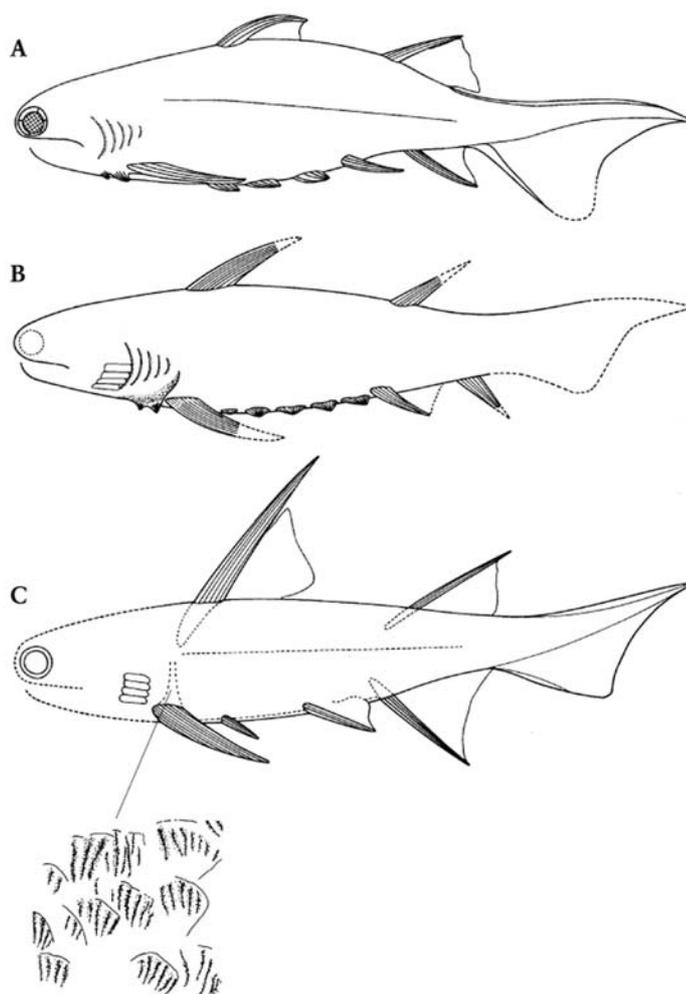


Figure 4.18: Acanthodians from Wayne Herbert Quarry (after Miles, 1973; Young, 1995).  
(A) *Ptomacanthus anglicus* Miles  $\times 0.25$ ; (B) *Vernicomacanthus waynensis* Miles,  $\times 0.45$ ;  
(C) *Uraniacanthus spinosus* Miles,  $\times 0.66$ , with detail ( $\times 2$ ) of scale type in vicinity of the pectoral spine.

## Interpretation

By comparison with the sedimentology of Cwm Mill, the Wayne Herbert siltstone lens records an exceptional preservation event resulting from a flood, which rapidly carried still-living or moribund animals down-river to be buried immediately in pools on the floodplains (Miles, 1973; White and Toombs, 1983). Allen and Tarlo (1963) described it as a cut-off channel that has dried out, but Turner (1982a) pointed out that no sedimentary desiccation structures have been described, and the fishes are not contorted, although they are partly disarticulated. Turner (1982a) described a rare articulated piece of thelodont as being folded as though

pressed down into soft bottom sediment, which may indicate that the fish was trapped in wet mud. She suggested that, by comparison with similar forms from Russia and Canada, this thelodont, *Nikolivia milesi*, lived in quiet waters, such as the ephemeral ponds and lakes of the Early Devonian flood plain of the Anglo-Welsh Basin or in the Caledonian lake.

This Ditton Group assemblage probably represents animals killed during a (local) catastrophe that rapidly buried and preserved the whole sample as mainly intact specimens. Their predator–prey relationships may be illustrated by the holotype of *Ptomacanthus anglicus*, which contains a cephalaspid headshield within its visceral cavity. This headshield was probably part of a fish that was swallowed whole, head first, similar to modern fish, as it is the only small non-articulated specimen of this genus in the lenticle, and the poor preservation of its surface suggests that it has been damaged by digestive acids. The Wayne Herbert specimens of *Pteraspis* were crucial in solving the biomechanical problem of how pteraspids swam. Previously, the shapes of the body and tail were hypothetical, and the tail had been assumed to be heterocercal (Woodward, 1891a; Traquair, 1899b; Leriche, 1903; Gross, 1933). As White (1935) pointed out, this would have thrust the head downward, making it extremely difficult for the fish to raise itself from the bottom sediments. The material discovered at Wayne Herbert showed that heterostracans had a hypocercal tail. This had already been suggested by Kiaer (1932b) for *Anglaspis*, following his important discovery of a hypocercal tail in the Anaspidida (Kiaer, 1924). The reconstruction of *P. rostrata* var. *toombsi* (White, 1935) became the basis of interpretations of the scaled trunk and tail of several heterostracans. This variety, and the six specimens of complete individuals from Wayne Herbert, are therefore extremely important. Kermack (1943) built a scale model of *P. rostrata* var. *toombsi* from White's reconstruction to test the functional significance of the hypocercal tail. He showed that the tail would depress the hinder end of the body, thus inclining the body to act as a lifting plane during forward movement. Since *Pteraspis* is assumed to have no swim bladder or similar flotation aid, it was denser than the

medium in which it lived, so an upthrust would thus be generated by forward motion.

*Poraspis* is the only genus of cyathaspidid that is well enough known to chart its evolutionary changes through time. In the Spitsbergen species, which range throughout the (Podolia–Ludlow) Red Bay Group, the following evolutionary trends are indicated (Kiaer and Heintz, 1935, pp. 125–6): (1) the size increases; (2) the dentine ridge pattern becomes longitudinal; (3) the lateral line canals tend to form a more complete and united network and, most particularly, the posterior ends of the supraorbital canals unite with the medial dorsal canals.

The pores in the elongate scales of the thelodont *Nikolivia milesi* are compared by Turner (1982a) with the pores through certain scales in *Phlebolepis elegans*, which Gross (1967) interpreted as a sensory-line system. The similarities to *P. elegans* from the north Baltic, and *Nikolivia ?heintzi* from Canada, which were both inhabitants of quiet lagoons (Märss and Einasto, 1978; Dineley and Loeffler, 1976) suggested that *N. milesi* also lived in quiet water, such as the ephemeral ponds and lakes of the Early Devonian Welsh Borders flood plain. Turner (1982a) interprets the rarity of nikoliviids and commonness of *Turinia* scales in British samples as either the result of sedimentary sorting processes or the animals' occupation of different environments. The more robustly scaled *Turinia* was adapted to bottom living in faster-flowing rivers and streams, common in the Welsh Borders Old Red Sandstone, whereas *Nikolivia* required the quieter lagoonal conditions that were prevalent in Podolia at the same time.

The acanthodians present were large, robust predators at the top of the local ecological pyramid, the thelodonts and cephalaspids being amongst the prey (Miles, 1973).

### *Comparison with other localities*

Wayne Herbert remains unique in the extent and exceptional preservation of its fauna. There are many localities in the Anglo-Welsh Basin and in northern France–Belgium yielding one or other of the pteraspids, but the material is fragmentary and incomplete.

## Conclusions

The material from Wayne Herbert includes *Pteraspis* with the body and tail region complete, unlike the usual preservation mode where only the heavily ossified head shields are preserved. These specimens are important for showing how these early fishes swam. Also, the site has yielded exceptionally preserved complete acanthodians and thelodont fish. Overall, the conservation value lies in the unusually good preservation of the fossil material. This small, fossiliferous quarry shows only a small exposure of a well-weathered section, but excavation could reopen the fossiliferous horizons.

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