Middridge, Durham

[NZ 2455 2535]

Highlights

Middridge Quarry has been the source of several fossil reptile specimens from the Marl Slate. These reptiles are close to the origin of groups that became important later, such as lizards and dinosaurs. Middridge is Britain's best Upper Permian reptile locality.

Introduction

The Upper Permian Marl Slate exposed in a quarry and railway cutting 1 km south-south-west of Middridge, and close to East Thickley and Thickley Wood, has long been known (e.g. Hancock and Howse, 1870a, 1870b) for its rich fossil plant, invertebrate and vertebrate assemblages. There is another quarry, Old Towns Quarry [NZ 257 246], about 1 km to the south-east, and closer to Newton Aycliffe than to Middridge. However, the reptile site is almost certainly the former, sometimes termed Thickley Quarry. Extensive collections were made in the 19th century, and these include important specimens of the reptiles *Protorosaurus, Adelosaurus* and the 'amphibian' *Lepidotosaurus.* The sections of the quarry that lie near the railway line and the side of the railway cutting are now rather overgrown and the Marl Slate is no longer visible. However, a new excavation in the floor of the eastern end of the old quarry exposes a good section right through the Marl Slate and gives clear access to the fossiliferous beds (Mills and Hull, 1976, pp. 137–8; Bell *et al.,* 1979). The Marl Slate here has already produced abundant fossils which include possible reptile bones (Bell *et al.,* 1979, p. 452), and there is a good chance of further discoveries.

Description

Middridge Quarry and railway cutting expose sections in the lowest portion of the Upper Permian which rests unconformably on Carboniferous sediments. Typical sections taken in the new pit at Middridge show the following sequence (Bell *et al.,* 1979, p. 445):

	Thickness (m)
Lower Magnesian Limestone	4+
Marl Slate	2.58–2.76
calcareous laminated siltstones and thin silty limestones	(1.47–1.60)
laminated limestone (upper invertebrate bed)	(0.02–0.03)
calcareous laminated siltstones and thin silty limestones	(1.09–1.13)
Basal Permian Breccia	
Calcareous breccia (lower invertebrate bed) with abundant *Lingula* in the top (0.02–0.03 m)	0.38–0.42
———unconformity———	
Lower Coal Measures Thin-bedded micaceous sandstones and shales	1.20

The new pit exposed the Basal Breccias (?Lower Permian) which may be equivalent to the breccias observed elsewhere in Durham, Yorkshire and North Nottinghamshire lying below the Lower Permian Yellow Sands (Smith *et al.,* 1974; Smith, 1989; Smith and Taylor, 1992). The Yellow Sands are not seen at Middridge.

The Marl Slate is well represented, compared with the thicknesses of 0–3 m elsewhere in south Durham. It comprises a succession of rusty brown-weathering, thinly laminated, calcareous siltstones and thin silty limestones rich in bituminous and other organic material. There is a thin, highly fossiliferous laminated limestone (upper invertebrate bed) just over 1 m above the base of the Marl Slate. Pyrite, galena and sphalerite occur as spherulitic aggregates, small veins and as a

partial replacement of some fossils (Bell *et al.,* 1979).

Numerous fossils have been found in the Marl Slate at Middridge, in addition to the reptiles and amphibians (Pattison *et al.,* 1973; Bell *et al.,* 1979). These include 12 genera of plants (Thallophyta, Pteridophyta, Pteridospermae, Coniferales), as well as a wide selection of invertebrates (foraminifers, bryozoans, brachiopods, bivalves, nautiloids and ostracods) and fish. The fishes are represented by isolated scales and fragments, as well as by a few complete flattened specimens. Typical genera are the shark *Wodnika,* the holocephalian *Janassa,* the palaeoniscoids *Acentrophorus, Acrolepis, Dorypterus, Palaeoniscum, Platysomus* and *Pygopterus,* and the coelacanth *Coelacanthus.* Some fish remains are found in coprolites deposited by other fishes or by tetrapod predators.

The reptile remains were found in the Marl Slate, and the amphibian just above (Hancock and Howse, 1870a, 1870b). Hancock and Howse (1870a, p. 556) state that 'it is, in the middle, or nearly so, of this yard of Marl-Slate that Mr. Duff has found… the remains of two species of reptiles…'. They then note (p. 557) that the amphibian *Lepidotosaurus* was found 'at about seven feet above the Marl-Slate proper'. Hancock and Howse (1870a) were referring to a section taken at Middridge by Sedgwick (1829), and it is clear that by 'Marl-Slate proper', they refer to the lower portion of the 'Marl-Slate' of Bell *et al.* (1979). A height of 7 ft (*c.* 2 m) above this 'Marl-Slate proper' would appear to lie near the base of the Lower Magnesian Limestone, an assignment noted by Pattison *et al.* (1973, p. 232). However, Hancock and Howse (1870a, p. 557) state that the *Lepidotosaurus* specimen was associated with the fossil invertebrates which suggests an assignment to the Marl Slate near the 'upper invertebrate bed' of Bell *et al.* (1979).

Fauna

The amphibian and reptile remains from Middridge are:

?Sarcopterygii/Amphibia

Lepidotosaurus duffii (Hancock and Howse, 1870a)

Holotype specimen: NEWHM G.55.38

Diapsida *incertae sedis*

Adelosaurus huxleyi (Hancock and Howse, 1870b)

Holotype specimen: NEWHM G.26.49

Diapsida: Archosauromorpha: Prolacertiformes: Protorosauridae

Protorosaurus speneri Meyer, 1830 (described in Hancock and Howse, 1870b)

Holotype specimen: NEWHM G.55.46

Interpretation

The Marl Slate is interpreted as a shallow-water marine deposit. It is generally reckoned to be the oldest unit in the British Late Permian, and is treated as a correlatable stratigraphic marker that stretches from north Nottinghamshire, through central and east Yorkshire, south Durham, the Durham coast and into the North Sea (Smith *et al.,* 1974; Smith, 1989; Smith and Taylor, 1992). It is correlated with the Kupferschiefer of northwest Europe (Lower Zechstein).

The specimen of *Lepidotosaurus* shows numerous ribs, large scales and a partial skull. Hancock and Howse (1870a) were convinced that it was a labyrinthodont amphibian, but the ganoid scales, ribs and skull look more like those of a bony fish (?lung fish) than an amphibian. There has been no recent work on this specimen.

Hancock and Howse (1870b) described a specimen of a small (1 m+) reptile from Middridge (Figure 3.2)A which they assigned to *Protorosaurus speneri* (Meyer, 1830), described previously from the Kupferschiefer of Germany. Seeley (1888b) further described *P. speneri,* and made speculations on its relationships. The Durham *P. speneri* is represented by a series of 35 or 36 vertebrae and casts of vertebrae, as well as a few partial ribs and a fragment of ?pelvis. *Protorosaurus* is best characterized by its long neck, perhaps developed in relation to a semi-aquatic mode of life.

The taxonomy of *Protorosaurus speneri* has been seen as problematic in the past, and it has been variously related to the euryapsids and diapsids. Recent cladistic analyses of diapsid relationships (e.g. Benton, 1985; Evans, 1988b) have shown that *Protorosaurus* is a basal prolacertiform, related to Triassic forms such as *Prolacerta, Macrocnemus* and *Tanystropheus.*

In the same paper as they described the Durham *Protorosaurus speneri,* Hancock and Howse (1870b) described a new species, *P. huxleyi,* distinguished from *P. speneri* on the basis of differences in rib structure and limb proportions. Watson (1914) confirmed differences between the skeletons of *P. huxleyi* and *P. speneri,* and erected the new genus *Adelosaurus.* The type specimen of *A. huxleyi* (Figure 3.2)B is a fairly complete skeleton exposed in ventral view. It is about 130 mm long, and shows the trunk, both forelimbs and one hindlimb; a large portion of the tail and the skull are missing. *Adelosaurus* is broadly similar to *Protorosaurus,* but differs in several respects, notably in the proportions of the humerus and cervical vertebrae, in the length of the neural spines, and in size (estimated length of skeleton 250 mm, as opposed to 1 m+ in *Protorosaurus*). *Adelosaurus* was probably a fully terrestrial form (Watson, 1914; Evans, 1988b), and it may represent an immature (?neotenous) individual (Evans, 1988b).

The taxonomic position of *Adelosaurus huxleyi* has been difficult to resolve. Vaughn (1955) was unable to establish any definite relationship between *Adelosaurus* and other early amniotes and left it *incertae sedis,* while Huene (1956) and Kuhn (1969) referred it to the Broomidae, and Romer (1966) to the Younginiformes or Protorosauridae. Haubold and Schaumberg (1985) classified *Adelosaurus* as a junior synonym of *Protorosaurus speneri.* Evans (1988b) reassigned the reptile to *Adelosaurus* and concluded that, in the absence of diagnostic features such as the ankle and skull, the taxonomic position remained equivocal. Derived diapsid features noted by Evans (1988b) include the strong humerus with poorly expanded ends, the strong sigmoidal curvature of the femur, and a triangular ilium in the pelvic girdle.

Comparison with other localities

Fossil reptiles have been found in the Marl Slate of Durham at Eppleton Quarry, or High Downs Quarry [NZ 360 483] near Hetton-le-Hole, which has produced a specimen of *Coelurosauravus (= Gracilosaurus, Weigeltisaurus;* Pettigrew, 1979; Evans, 1982; Evans and Haubold, 1987). A new specimen of *Protorosaurus* has been reported from Quarrington Quarry ([NZ 329 378]; Evans and King, 1993).

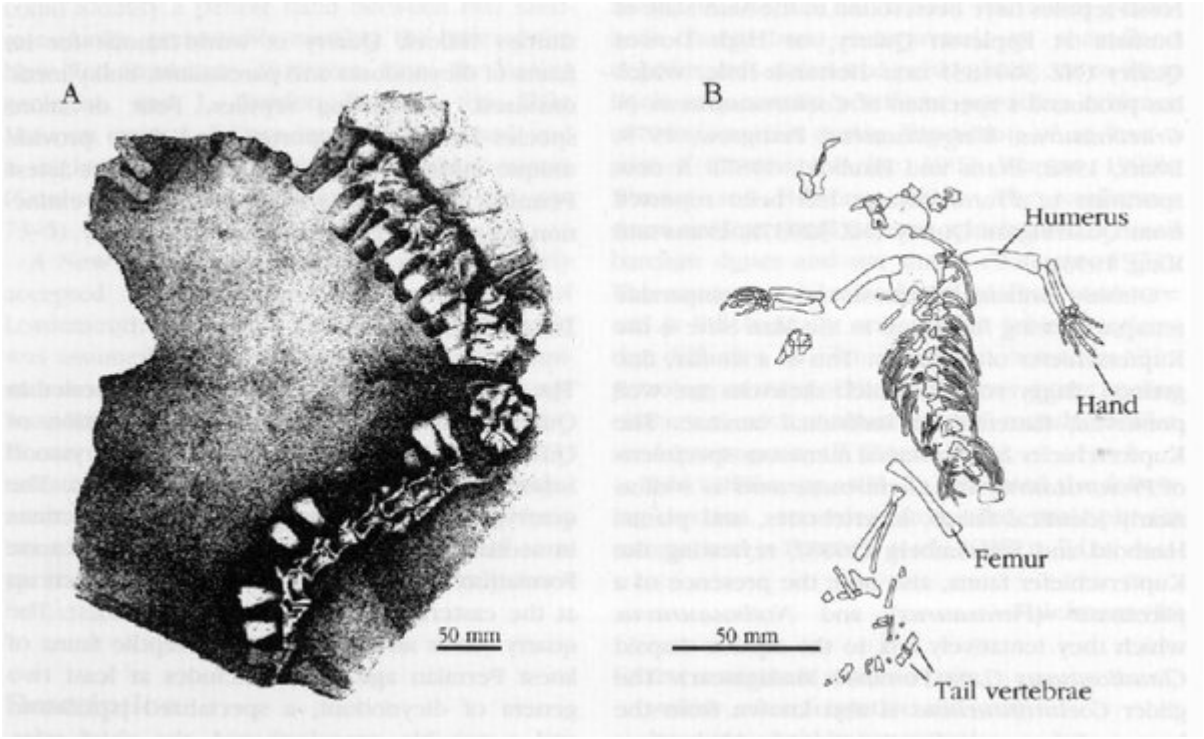
Outside Britain, the most closely comparable tetrapod-bearing formation to the Marl Slate is the Kupferschiefer of Germany. This is a similar, fine grained, flaggy rock in which skeletons are well preserved, flattened on individual laminae. The Kupferschiefer has produced numerous specimens of *Protorosaurus* and *Coelurosauravus* as well as nearly identical fishes, invertebrates, and plants. Haubold and Schaumberg (1985), reviewing the Kupferschiefer fauna, also note the presence of a pareiasaur (*Parasaurus*) and *Nothosauravus* which they tentatively link to the aquatic diapsid *Claudiosaurus* (Late Permian, Madagascar). The glider *Coelurosauravus* is also known from the Lower Sakamena Formation of Madagascar (Carroll, 1978; Evans, 1982; Evans and Haubold, 1987).

Conclusions

Middridge Quarry is the best tetrapod locality in the Marl Slate of the British Upper Permian sequence. The remains found in the last century are well preserved, are very important in themselves, and allow correlation of the Marl Slate with the German Kupferschiefer. The diapsid reptile *Protorosaurus* lies at the base of the archosauromorph branch of reptile evolution, and is a member of a group of Upper Permian diapsids important in establishing the wider ancestry of all Mesozoic and Cenozoic groups. Relatively little is known of contemporary diapsid faunas in northern Pangaea, which adds to the value of the other diapsids, *Adelosaurus* and *Coelurosauravus.*

The palaeontological importance of the fossil reptiles from here and the potential for future discoveries with re-excavation give the site considerable conservation value.

References



(Figure 3.2) Reptile specimens from the Late Permian Marl Slate of Middridge Quarry, County Durham: (A) Protorosaurus speneri Meyer, 1830, part of the backbone (after Hancock and Howse, 1870b); (B) Adelosaurus buxleyi (Hancock and Howse, 1870), partial skeleton (after Evans, 1988b).