Stonesfield Slate Mines, Oxfordshire

[SP 387 171]

Introduction

The Stonesfield Slate Mines have been a rich source of reptile and mammal vertebrate fossils since the mid-1700s (Clemens *et al.*, 1979; Benton and Spencer, 1995). To date, three mammalian taxa have been described from this site.

The predominantly sandy limestones mined in the Stonesfield Slate Mines area (Figure 2.9) have produced one of the most diverse terrestrial middle Bathonian (Middle Jurassic) vertebrate faunas known. The site has produced many hundreds of fossils that cover a range of taxa, including dinosaurs, pterosaurs, mammal-like reptiles, turtles, crocodiles, ichthyosaurs, plesiosaurs and mammals (Benton and Spencer, 1995). The extant mines and accessible shafts have been designated an SSSI for stratigraphical and palaeontological reasons.

Stonesfield Slate has been mined at least since Roman times. Excavation of the slates from mines and small quarries continued until 1911 (Evans and Milner, 1994; Benton and Spencer, 1995). The sediments consist of a sequence of fine-grained calcarenites with shelly partings interbedded with thinly laminated, impersistent oolitic limestones (Boneham and Wyatt, 1993; Evans and Milner, 1994).

The first mammal fossil was discovered from Stonesfield Slate Mines in approximately 1764, although the significance of the material was not fully appreciated until subsequent study by Buckland some 50 years later (Buckland, 1824; Broderip, 1827; Simpson, 1928; Clemens *et al.,* 1979). Buckland's student, J.W. Broderip, had found two small mammal jaws at Stonesfield Slate Mines around 1812. He sold one to Buckland and mislaid the other, and the former eventually was described in 1828. This was the first published record of a Mesozoic mammal, and it created a sensation (see Chapter 1).

Description

Lithological and stratigraphical sections through the Stonesfield Slate have been recorded by a number of workers, for example Fitton (1836), Phillips (1871), H.B. Woodward (1894), Walford (1895, 1896, 1897), Richardson *et al.* (1946), McKerrow and Baker (1988) and Boneham and Wyatt (1993). The following description is based on Richardson *et al.* (1946, p. 30).

The Stonesfield Slate is a grey or pale-brown coloured calcareous sediment. It is generally well-laminated and fissile, with shelly partings. It contains silt- and sand-grade quartz grains. Impersistent laminae of oolitic limestone are common and are locally interbedded with fine-grained, fissile oolites (Boneham and Wyatt, 1993). A thin horizon of conglomerate sourced from the underlying Chipping Norton Limestone Formation occurs in the middle part of the section (Sellwood and McKerrow, 1974). The Stonesfied Slate has a limited distribution (within 1.5 km of Stonesfield village) and reaches a maximum thickness of 1.8 m (Aston, 1974).

Fauna

The fauna of the Stonesfield Slate is dominated by marine taxa, for example fishes, bivalves, gastropods and rare ammonites, belemnites and corals. Terrestrial taxa are represented by reptiles, mammals, insects and plant remains, including conifers and ferns (Boneham and Wyatt, 1993; Benton and Spencer, 1995; Cleal and Rees, 2003).

(Table 2.1) The stratigraphy of the Stonesfield Slate

	Thickness (m)
White Limestone Formation	
Rubbly Limestone	

Hampen Marly Formation	
Clay with Terebratulites	
Limestone	
Blue Clay	
Oolite	
Blue Clay	In total 9.75
Taynton Limestone Fomation	*c.* 7.6
'Rag', consisting of shelly oolite, with casts of bivalves and univalves	
Stonesfield Slate Beds	
'Soft stuff, yellowish sandy clay, with thin courses of fibrous transparent gypsum	0.15
'Upper Head', sand enveloping a course of spheroidal laminated calcareous gritstones which produce the slate. These are called Totlids' from their figure, and receive with the other slaty bed the name of 'Pendle' as characteristic of workable stone. The stone is partially oolitic and shelly, sometimes full of small fragmentary masses	0.45
'Manure' or 'Race', slaty friable rock	0.3
'Lower Head', sand and grit, including a course of spheroidal concretions of slate	0.45–0.6
'Bottom stuff, sandy and calcareous grit, with admixture of oolite grains	0.3
Chipping Norton Limestone Formation	

REPTILIA

'Therapsida'

Tritylodontidae

Stereognathus ooliticus Charlesworth, 1855

MAMMALIA

Amphilestidae

Ampbilestes broderipii (Owen, 1845)

Phascolotherium bucklandi (Broderip, 1827)

Cladotheria

Amphitheriidae

Amphitherium prevostii (Meyer, 1832)

Amphitherium rixoni Butler and Clemens, 2001

The tritylodont *Stereognathus ooliticus* is represented by two partial maxillae with teeth in place ((Figure 2.10)a,b). It initially was interpreted as a mammal (Charlesworth, 1855; Owen, 1871; Simpson, 1928), but is now regarded as a mammal-like reptile. In fact, it is one of the latest surviving tritylodontids, a group well-known from the Early Jurassic Windsor Hill Quarry site (see GCR site report).

All of the mammals recorded from the Stonesfield Slate were discovered before the publication of Simpson's (1928) review paper, and nothing has been reported since, probably because active mining of the Stonesfield Slate ceased at the beginning of the 20th century.

The amphilestids *Amphilestes* and *Phascolotherium* are known from small lower jaws ((Figure 2.10)c), the first two specimens found by Broderip around 1812 and later named by Owen. The 7–10 cheek teeth are similar in size along the length of the jaw and bear three sharp cusps. They differ from triconodonts, in which order they were once included, in having the central cusp larger than the other two. Since 1828, five additional small jaws have been collected (Simpson, 1928; Evans and Milner, 1994).

The records of *Amphitherium* from this locality, based on four lower jaw specimens (Simpson, 1928), are important as it is one of the earliest known occurrences of a cladotherian (i.e. stem therian but more derived than a symmetrodont). All specimens unequivocally identified as *Amphitherium* are from this site ((Figure 2.10)d, e). Originally named as a single species, *A. prevostii,* restudy of the four jaws has indicated that one (BMNH 36822) belongs to a distinct species called *A. rixoni* (Butler and Clemens, 2001). Unlike the more fragmentary specimens recovered by screenwashing techniques, these near-complete dentitions from Stonesfield Slate Mines are unique for the Bathonian Stage. *Amphitherium* was about the size of a modern shrew. The teeth indicate a diet of small invertebrates (Kraus, 1979).

Interpretation

The limited lateral extent of the Stonesfield Slate facies can be explained by the deposition of clastic sediments during transgression across a discontinuous hardground surface (Sellwood and McKerrow, 1974).

The fossils recovered from the Stonesfield Slate are indicative of shallow marine or coastal conditions. The presence of terrestrial taxa (insects, mammals and plant debris) is explained by the close proximity of the Anglo-Brabant landmass. These remains were probably washed into the sea during storm events, where they were quickly buried in sand bodies (Benton and Spencer, 1995). The diverse flora, comprising 25 morphospecies, is dominated by remains of araucariacean and cheirolepidiacean conifers, bennettitaleans, and leaves of the possible gymnosperm *Pelourdea* (Cleal and Rees, 2003). These mainly represent coastal vegetation, including mangrove-like stands of *Ptilophyllum,* and conifers probably growing in lowland coastal habitats that were subjected to periodic water-stress.

The stratigraphical position of the Stonesfield Slate has been a source of controversy for many decades. The historical aspects of this debate have been reviewed by Benton and Spencer (1995). The most recent stratigraphical analysis of the position of the Stonesfield Slate, by Boneham and Wyatt (1993), reports that the slate facies was worked from three levels within the Taynton Limestone Formation: at the top, within, and at the base. This three-fold recurrent nature of the slate facies means that it cannot be regarded as a formal lithostratigraphical unit and therefore should be considered as an informal name for the laminated calcarenite beds that occur within the Taynton Limestone Formation. The Stonesfield Slate is no longer thought to form part of the Sharp's Hill Formation, although tilestone (slate) facies may occur.

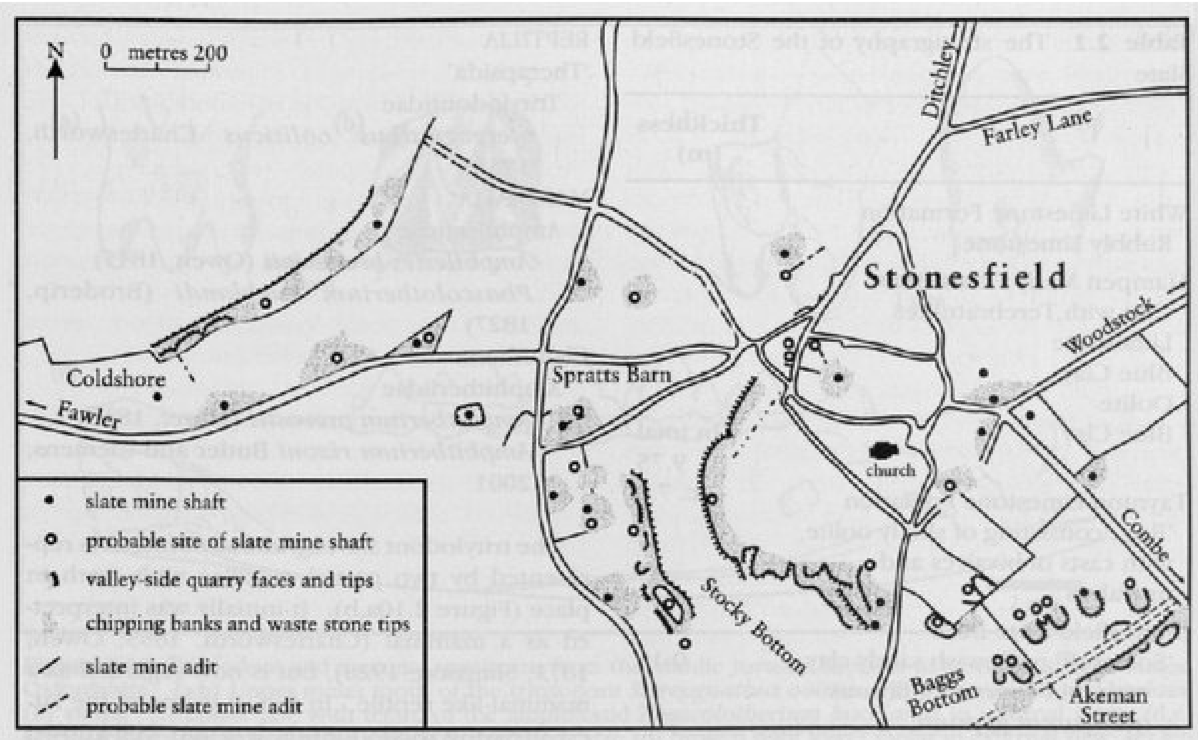
Comparison with other localities

A similar, but wider, array of tritylodont and early mammal taxa has been reported from Kirtlington Old Cement Works, but the Stonesfield Slate is older, being mid-Bathonian in age. Comparable, more isolated, remains also are known from Loch Scavaig, Skye and Watton Cliff, Dorset (see GCR site reports). The Stonesfield Slate Mines, and the other Middle Jurassic localities from Great Britain, cannot be compared directly with localities elsewhere, because generally there is a gap in the preservation of fossil vertebrates during the Mid Jurassic Epoch. One exception is a Bathonian site in the Mahajanga Basin, Madagascar, which has yielded a single lower jaw of the genus *Ambondro* (Flynn *et al.,* 1999; Luo *et al.,* 2001). The only other comparable localities occur in Middle Jurassic sediments in China, but hitherto most of these have yielded only dinosaurs. Exceptions are the reports of the tritylodont *Bienotheroides* from the upper Xiashaximiao Formation (Bathonian–Callovian stage; Benton, 1993) and the haramiyidan *Eleutherodon* from the Toutunhe Formation of Liuhuanggou (?Bathonian; Maisch *et al.,* 2005) of China.

Conclusions

The Stonesfield Slate Mines site is significant as a historical site, the location of the first reported Mesozoic mammal remains and the first site to yield tritylodont fossils. It also is important for continuing finds of mammal fossils at least into the 20th century and for its potential in the future on re-excavation. The Stonesfield Slate Mines site also is important for yielding a classic Middle Jurassic fauna of both reptiles and mammals that has strongly influenced our understanding of these groups since the earliest studies of vertebrate palaeontology. The Stonesfield Slate Mines helps fill an important worldwide gap in the fossil record of early mammals.

[References](#)



(Figure 2.9) The Stonesfield Slate Mines. (Based on Aston, 1974; after Benton and Spencer, 1995.)

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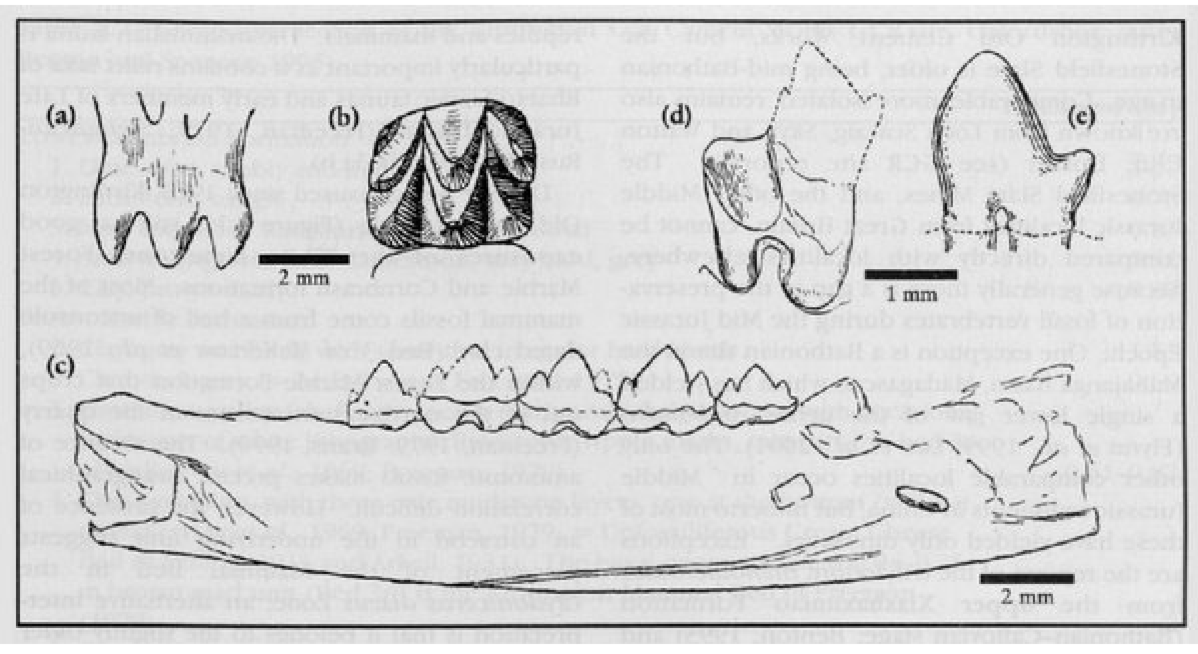

(Figure 2.10) Tritylodont and mammal specimens from the Middle Jurassic deposits of Stonesfield Slate Mines, Oxfordshire. (a,b) Upper molar tooth of the tritylodont Stereognathus ooliticus in posterior (a) and occlusal (b) views. (c)

Lower jaw, with teeth, of the amphilestid Phascolotherium bucklandi in internal view. (d,e) Cheek teeth of the amphitheriid Amphitherium prevostii; (d) broken right lower molar in external view; (e) left lower premolar 4 in external view. (Based on Owen, 1871; and Simpson, 1928.)