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# Emborough Quarry, Somerset

[ST 623 505]

## Highlights

Emborough Quarry is the source of a varied fauna of Late Triassic small reptiles. It is the locality where the best specimens of the extraordinary gliding reptile *Kuehneosaurus* have been found, as well as *Kuehneotherium*, perhaps one of the oldest mammals in the world.

## Introduction

Emborough is a disused quarry formerly worked for Hotwells Limestone (Carboniferous: Asbian), which dips to the north-east (Savage, 1977). The reptile-bearing cavity filling is exposed in a promontory in the south-east corner of the eastern quarry. The site is important for yielding numerous remains of the unusual gliding reptile *Kuehneosaurus* and the ?trilophosaur *Variodens*. The fissure site occupies a relatively small proportion of the quarry area, and further collecting is possible.

Reptiles were discovered in fissure sediments at Emborough by Kühne in 1946, but the first discussion on the geology of the deposit and the reptiles was that of Robinson (1957a, 1957b). Robinson (1957b) described a tricuspid reptile, *Variodens inopinatus*, from Emborough on the basis of two dentary fragments and referred it to the Tricuspidosauridae. A description of the Emborough gliding diapsid *Kuehneosaurus*, the first known, was made by Robinson (1962). Fraser *et al.* (1985) reported a therian mammal (*Kuehneotherium*) from Emborough, regarded by them as the oldest therian mammal in the world, and used this as evidence to invalidate earlier claims by Robinson (1957a, 1971) for the existence of a clear-cut distinction between sauropsid-bearing Late Triassic fissure fills and therapsid-bearing Early Jurassic ones (see above).

## Description

The sediments may be divided lithostratigraphically into lower and upper units. The lower sediments are unfossiliferous, well-bedded, dark-red clays with green patches. The upper deposit consists of a conglomerate of Carboniferous Limestone clasts, up to boulder-size, set in a matrix of limestone pebbles, pale shale and silts. The silt is finely bedded and free of clasts in some places, usually red, but sometimes pale green. The reptile fossils are found in the higher part of the conglomeratic deposit in the silts. Most of the fossils are dissociated, but some *Kuehneosaurus* material is in articulation.

## Fauna

**Diapsida: Archosauromorpha: *inc. sed.***

*Kuehneosaurus latus* Robinson, 1962 Type material: BMNH R8172

**Diapsida: Archosauromorpha: ?Trilophosauridae**

*Variodens inopinatus* Robinson, 1957 Type material: BMNH

**Diapsida: Archosauria**

Archosaur *incertae sedis*

**Lepidosauria: Sphenodontida**

*Planocephalosaurus* sp.

## Mammalia: 'Symmetrodonga': Kuehneotheriidae

*Kuehneotherium* sp. Tooth AUGD 11133

## Interpretation

Robinson (1957a) interpreted the sediments as the filling of a collapsed cave, the lower beds being deposited by underground streams and the upper deposit formed by a collapse of the cave roof, with fine silt and the reptile remains brought in by land-wash. Robinson (1957a) and Savage (1977) mention solution features such as waterworn faces and boulders; these and the presence of stalactite fragments in the conglomerate confirm the impression that the void was part of a cave system.

It has been possible to date the sediments filling the Emborough fissure as Late Triassic on the basis of direct stratigraphic evidence using the topographical relationship of the cavity to the local, normally bedded stratigraphy (Robinson, 1957a; Fraser *et al.*, 1985). This age assignment is in accord with the date given to *Icarosaurus* (a close relation of the Emborough diapsid *Kuehneosaurus*) from the Late Carnian (Locketong Formation) of the Newark Supergroup in New Jersey.

The reptile fauna from Emborough includes the unusual gliding diapsid *Kuehneosaurus latus* ((Figure 4.24)D; Robinson, 1962, 1967), which is the most abundant animal present (Fraser, 1994), as well as the ?trilophosaur *Variodens inopinatus*, for which Emborough is the type locality. Robinson (1957a) mentions two other reptiles, an archosaur and a sphenodontid, and Fraser *et al.* (1985) reported two teeth of the mammal *Kuehneotherium*.

*Kuehneosaurus* is represented by dissociated as well as good articulated remains, and the skull including the braincase has been figured by Robinson (1962). The only other kuehneosaurs known are *Kuehneosaurus latissimus* from Batscombe Quarry and *Icarosaurus* from the Locketong Formation of the eastern USA (Colbert, 1970). The kuehneosaurs, because of the absence of a lower temporal bar, the presence of a streptostylic quadrate and a pleurodont dentition, were formerly considered to represent primitive squamates, the true lizards and snakes. This view has been strongly doubted by Evans (1980, 1988a), Benton (1985), and others, who regard the kuehneosaurs as primitive archosauromorphs, on the basis of numerous characters that place them close to rhynchosaurs and prolacertiforms in the cladogram. *Kuehneosaurus* is a gliding reptile ((Figure 4.24)D), one of the earliest aerial tetrapods known, which displays a remarkable convergence with the extant gliding lizards of south-east Asia (*Draco*) and also to *Weigeltisaurus*, a gliding form from the Late Permian of Durham (q.v.), Germany and Madagascar. *Kuehneosaurus latus* has also been reported from Slickstones Quarry and the Pant-y-ffynon fissures (Fraser and Walkden, 1983). The numerous Emborough specimens, being mostly dissociated, will allow a complete anatomical study.

The ?trilophosaur *Variodens inopinatus* is known from two dentaries found at Emborough. The trilophosaurs are a diapsid group, currently placed in the Archosauromorpha (Benton, 1985; Evans, 1988a). Trilophosaurs are known from the Triassic of Russia and North America, but *Variodens* is the only probable representative of the group described from Western Europe. Halstead and Nicoll (1971) have figured a possible trilophosaur from a fissure at Slickstones Quarry. Fraser (1986) and others have hinted that *Variodens* may be a procolophonid.

The *Kuehneotherium* tooth from Emborough was claimed to be the oldest therian mammal fossil in the world, coming as it did from probably pre-Rhaetian sediments (Fraser *et al.*, 1985). The determination of the stratigraphic age of the fissure sediments was disputed, and other equally old mammal remains may be known from France. Lucas and Hunt (1990) reported a supposed mammal skull from the Late Carnian Tecovas Formation of West Texas, USA. Nonetheless, the early record of *Kuehneotherium* points to the possibility of more substantial finds in Emborough.

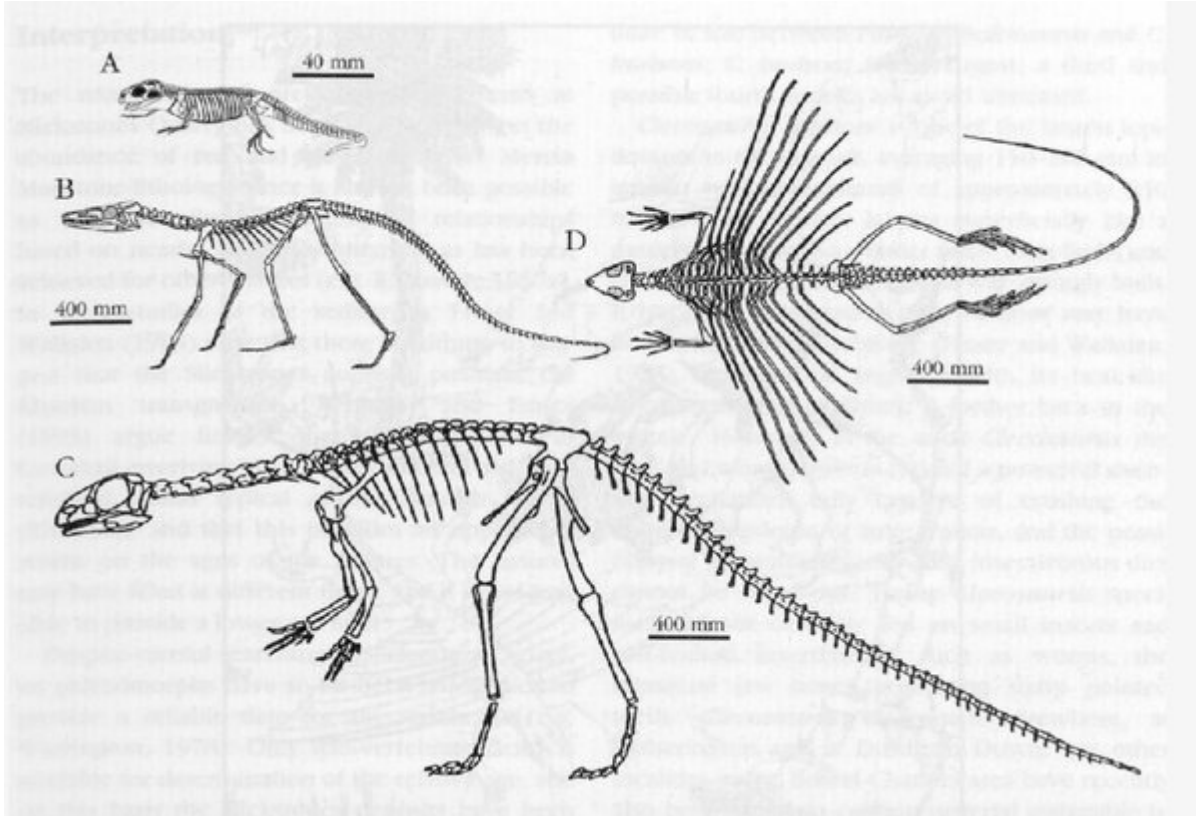
The fauna is most similar to that of Slickstones (see above), but the dominance of *Kuehneosaurus* at Emborough might suggest a different depositional environment, or a different age. However, the different proportions of taxa could equally well be the result of differential sampling of the fauna, either by the nature of the fissure or of collection error.

## Conclusions

Emborough is the type locality of the remarkable gliding reptile *Kuehneosaurus latus*, the only known locality of the trilophosaur/procolophonid *Variodens inopinatus*, and the site for a *Kuehneotherium* tooth, possibly the oldest record of a therian mammal in the world.

This great palaeontological importance, combined with some potential for re-excavation, give the site substantial conservation value.

## References



(Figure 4.24) Typical reptiles from the Late Triassic fissures in South Wales and around Bristol. Skeletal reconstructions of (A) the sphenodontid *Clevosaurus*; (B) the crocodylomorph *Saltoposuchus*; (C) the prosauropod dinosaur *Thecodontosaurus*; and, (D) the gliding diapsid *Kuehneosaurus*. After various sources; in Fraser (1994).