Tytherington Quarry, Avon

[ST 660 890]

Highlights

Tytherington Quarry has produced abundant and varied Late Triassic reptiles from fissures in the background Carboniferous limestones. This varied fauna includes small lizard-like animals as well as abundant bones of the dinosaur *Thecodontosaurus.*

Introduction

The fissure infillings and their enclosed fauna are found in the new quarry, centred on [ST 660 890] (Figure 4.26). The quarry company (Amey Roadstone Corporation Ltd) work the Black Rock Limestone and the Black Dolomite of the Carboniferous Limestone which dips in a southeasterly direction at about 20–30°. The fissures in the limestone have yielded a large fauna dominated by lepidosaurs and the dinosaur *Thecodontosaurus* that are dated as Rhaetian on the basis of a contained palynomorph assemblage. Realistically, the only sites that can be preserved are those of fissures which occur at the top level and at the edge of the current quarrying operations, and a palynomorph-bearing fissure on the second level. These fissures are very near the road leading to Tytherington village and it is therefore improbable that any further quarrying will take place on this face. Tytherington is a working quarry and this allows new fissures to be revealed continually, greatly adding to its potential.

The first fossils, discovered in 1975, were the postcranial bones of the prosauropod dinosaur *Thecodontosaurus.* These remains, found by two amateur geologists, Mike Curtis and Tom Ralph, were preserved in a breccia composed of clasts of limestone and dolomitized limestone of Carboniferous age set in a sandy clay matrix. The bulk of the fossil-bearing material (about 10 tonnes) was transported to the University of Bristol, where Whiteside (1983) studied the fauna, and published a description of the cranial skeleton of the most abundant sphenodontid, *Diphydontosaurus avonis* (Whiteside, 1986).

Description

The fissures exhibit a variable morphology; some are aligned vertically on joints, whereas others appear to be true caves which usually follow joints, but also cut unjointed sections of the massive crinoidal limestone and principally follow the dip. The solution fissures can be divided into two types, those formed above (vadose) or below (phreatic) the water table:

1. vertical, with sub-parallel walls (vadose);
2. those with a circular cross-section (phreatic).

The sub-parallel fissures probably represent palaeodolines (e.g. fissure 1), and are filled with finely laminated calcareous clays and sandstones, some showing cross-bedding and some being ripple-marked, with mud cracks and water droplet impressions. Other doline-like features have an infilling of breccia composed of Carboniferous Limestone clasts in a red sandy matrix and resemble the marginal facies of the local Triassic (the Dolomitic Conglomerate); this can be seen, for example, in fissure 3. Fissure 2 appears to be a phreatic cave formed in times of very high water table, when the sea level was approximately 100 m higher than today. This fissure exhibits long, horizontal solution features and large flute marks formed on the Carboniferous Limestone wallrock. Of the other fissures currently exposed, no. 7 exhibits repeated fining-upward cycles of conglomeratic, sandy Westbury Formation facies with clasts of black shales. This sequence is best exhib ited on the southern side; the middle of the fissure is cut by a hydrothermal vein of baryte, galena and sphalerite. The infilling on the northern side of the hydrothermal vein is of contorted Westbury Beds sands and conglomerates which have been deformed, probably as a result of the fall of Carboniferous Limestone blocks into partly consolidated sediment. The hydrothermal vein has also been broken as a result of this fall. Simms (1990) gave further

information on the karst aspects of the fissures.

Nine fossil-bearing sites have been identified. The *Thecodontosaurus*-bearing breccia formed the middle section of the infill of a large cavernous fissure (no. 6b; Whiteside, 1983), 4 m in diameter, situated at the third level of the quarry [ST 6618 8894]. Disarticulated isolated bones of a crocodilomorph and two sphenodontids were also found in a fissure (no. 8) lying to the northwest.

A glauconitic clay, a mineral usually associated with marine conditions, recorded from the now destroyed fissure 6b is apparently unique in that it was found in a quartz-rich conglomerate which contains a predominantly terrestrial reptile fauna.

Fauna

Lepidosauria: Sphenodontida

Diphydontosaurus avonis Whiteside, 1986 Type specimen: BRSUG 23760 and abundant material in BRSUG

Clevosaurus sp. Varied material (BRSUG)

Planocephalosaurus robinsonae Fraser, 1982 Varied material (BRSUG)

Archosauria: Crocodylomorpha

Terrestrisuchus sp. Varied material (BRSUG)

Archosauria: Dinosauria: Saurischia:

Sauropodomorpha

Thecodontosaurus ?antiquus Riley and Stutchbury, 1840 Varied material (BRSUG).

Interpretation

Marshall and Whiteside (1980) proposed that at least one fissure (no. 2, see below) at Tytherington was infilled in a marginal marine location, on the basis of an assemblage of Rhaetian marine and terrestrial palynomorphs. Whiteside and Robinson (1983) expanded this model, suggesting that the fissure was infilled in a fluctuating freshwater to saline environment, with evidence based upon the occurrence of a glauconitic clay. Whiteside (1983) demonstrated that some fissures were infilled in a freshwater environment, some in brackish conditions, and others in a mixed freshwater and marine regime.

An assemblage of palynomorphs from fissure no. 1 at Tytherington, consisting of 18 elements including the miospore *Rhaetipollis germanicus* and the dinoflagellate cyst *Rhaetogonyaulax rhaetica,* affords unequivocal evidence for a Rhaetian age (Marshall and Whiteside, 1980). The palynomorphs are not reworked, and the enclosing lithology and associated *Euestheria minuta* and *Pholidophorus* indicate equivalence with the Westbury Formation (Rhaetian) (Whiteside, 1983). Fissures 4, 5, 6a and 7 also have Rhaetian palynomorphs indicating equivalence with the Westbury Formation or Cotham Member. All other fissures contain infills interpreted as Rhaetian, except fissure 3, which may be older. The significance of the Tytherington find is that a relatively precise date can be assigned to some of the fissure infillings and the presence of the reptiles *Clevosaurus* and *Diphydontosaurus* in the same matrix is a pointer to the age of the fauna as a whole.

The diversity of sphenodontids from Tytherington is only exceeded by that at Slickstones (Cromhall) Quarry, but at least one species of sphenodontid, here named 'C', is unique to the fissure 1 deposit at Tytherington. The sphenodontids *Clevosaurus* and *Planocephalosaurus* are well represented by isolated material, but *Diphydontosaurus avonis* is the best known form from the site where over 100 individuals have been recovered from fissure 6b. The entire skull (except for the

auditory capsule) of this species has been reconstructed (Whiteside, 1986). This form was the smallest member of the Tytherington fauna and its numbers suggest that locally it formed high-density populations. It was probably insectivorous and had a unique dentition among sphenodontids in which pleurodont teeth and acrodont teeth occur together in the same jaws: the pleurodont teeth in the premaxilla and on the anterior margins of the dentary and maxilla, the acrodont teeth behind the pleurodont series on the maxilla and dentary. These alternate in size, an autapomorphic sphenodontid character. All other known sphenodontids have an entirely acrodont dentition, but some have successional anterior teeth as a neotenous feature. *Diphydontosaurus* thus appears to be a primitive form, and Fraser and Benton (1989, p. 440) confirmed this position when, on the basis of computer-based cladistic analyses, *Diphydontosaurus* came out as the most primitive known sphenodontid.

The prosauropod *Thecodontosaurus* is represented at Tytherington by numerous postcranial elements, some of which may be partly articulated. The bones of *Thecodontosaurus* are normally well preserved as a hard white substance with all internal structure intact, but they may be broken and abraded through transport. Such fine preservation of bone assigned to *Thecodontosaurus* is not found at any other fissure locality. See the Durdham Down account for more details of this dinosaur.

Clevosaurus hudsoni, Planocephalosaurus robinsonae and sphenodontid 'B' also occur at Slickstones Quarry (Fraser and Walkden, 1983; Fraser, 1988b), and *Clevosaurus* also occurs in the Highcroft Quarry fissure near Gurney Slade and at Pant-y-ffynon Quarries (Crush, 1980). Adult *Planocephalosaurus* specimens from the Tytherington fissures appear generally larger than those recovered from Slickstones Quarry, and may represent a more derived later form (Fraser and Walkden, 1983, pp. 359–60, fig. 15). Only one maxillary fragment out of approximately 250 maxillae recovered from Slickstones Quarry is comparable in size to the Tytherington form.

Of the archosaurs, *Thecodontosaurus* has also been recorded from the Durdham Down fissure (Riley and Stutchbury, 1840) and Old Pant-y-ffynon Quarry (Kermack, 1984). The Tytherington material is better preserved than that from Durdham Down, but no cranial elements have so far been identified. The remains of terrestrial crocodilomorphs are better preserved and more numerous at other fissure localities such as Slickstones and Pant-y-ffynon (Crush, 1984).

One important, although rare, member of the Tytherington fauna is a fish whose scales resemble those of *Pholidophorus,* which is found in the Cotham Member (Lilstock Formation, Penarth Group) nearby. The only other non-marine fish found in fissure deposits is *Legnonotus,* a species also recorded from South Wales (M. Howgate, pers. comm.). Tiny reworked teeth and scales of the Rhaetian marine fishes *Gyrolepis, Hybodus* and '*Saurichthys'* have been recorded from a number of fissures at Tytherington, and have also been found at Holwell and Windsor Hill (C. Copp, pers. comm.; Savage and Waldman, 1966; Savage, 1977) and in the covering sediments at Cromhall (Walkden and Fraser, 1994). The importance of these fish remains is that they indicate a Rhaetian (probably Westbury Formation time equivalent) age and independently confirm the probability of a saline intrusion into the fissure at the time of infilling.

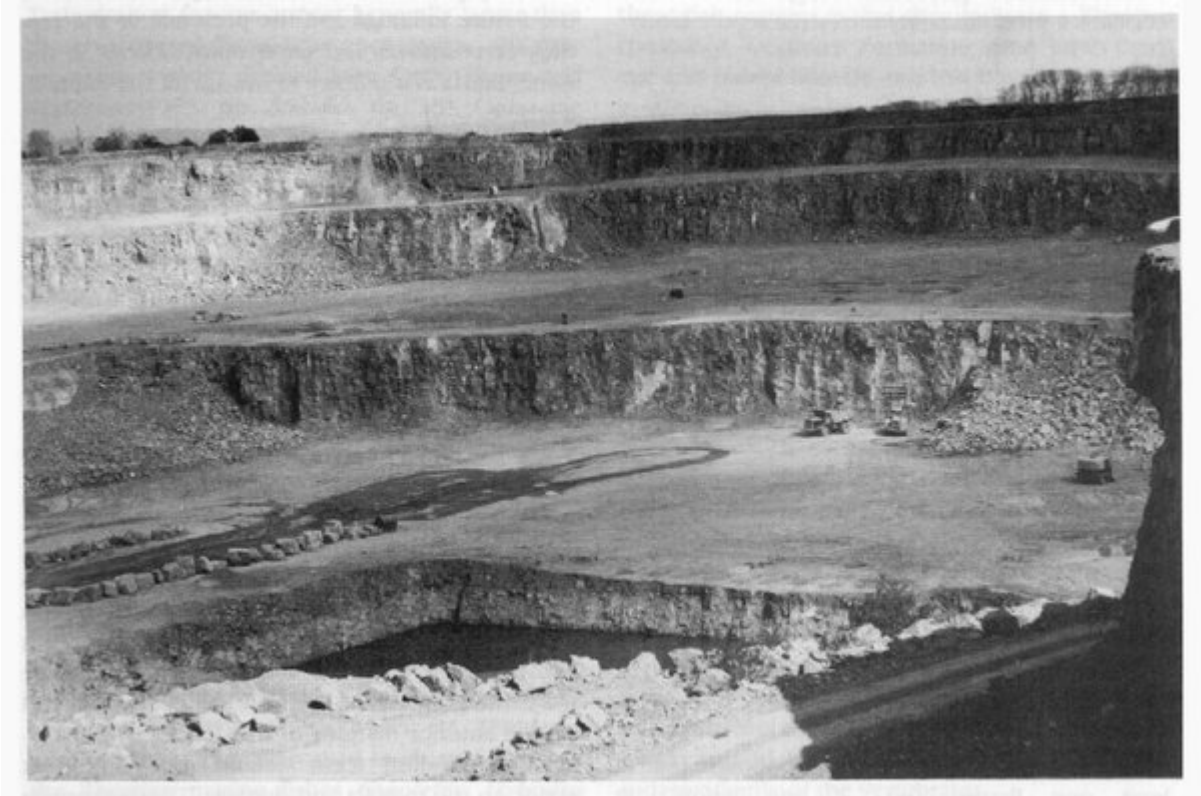
Contemporaneous invertebrates are rare and, apart from the internal moulds of possible Rhaetian gastropods, the only specimens are a few individuals of the branchiopod *Euestheria minuta* var. *brodeiana* known elsewhere from the Cotham Member.

Conclusions

Tytherington provides many unique finds, particularly *Diphydontosaurus* in fissure 1, an admixture of terrestrial reptiles and non-marine fish in fissure 2, and the palynomorph assemblage of fissure 5. The Tytherington fissures as a whole provide the best evidence of infilling of an ancient subterranean cave complex. The solution-marked surface of fissure 2 is an excellent phreatic cave passage. Moreover, Tytherington is the only quarry in which fissure infillings have been dated independently of the vertebrates.

The considerable conservation value of this quarry lies in the combination of the potential for new finds from continued working and the preservation of some fissures that are marginal to the quarrying.

References



(Figure 4.26) Tytherington Quarry: view taken in 1981. Fissures containing Triassic sediment occur in the upper levels. (Photo: R.J.G. Savage.)