Holwell Quarries, Frome, Somerset

[ST 726 450]

Introduction

The Rhaeto-Liassic fissure fills at Holwell Quarries (Figure 2.5) preserve a variety of vertebrate taxa, including sharks (Dineley and Metca14 1999), crocodiles and other reptiles (Robinson, 1957), the mammal-like reptile *Oligokyphus* (Savage and Waldman, 1966) and the sphenodontid *Clevosaurus* (Benton and Spencer, 1995). This is the type site for a mammalian fauna composed of *Thomasia* and *Eozostrodon.*

The site first came to the attention of scientists in the middle of the 19th century, when Charles Moore discovered the remains of extinct mammals. Moore began work at Holwell Quarries in 1855 or 1856, and he was perhaps the first palaeontologist ever to use a systematic campaign of sieving and washing sediment samples to recover microvertebrate remains (Savage, 1993). Moore presented his initial results to the meeting of the British Association for the Advancement of Science in 1858, noting finds of fishes and reptiles. He also reported rare mammal teeth similar to *Microlestes antiqutts* recorded from the Rhaetic of Germany by Plieninger in 1847. Moore continued his sieving campaign at Holwell Quarries, recovering in total nearly a million individual fossils, including over 45 000 teeth of *Acrodus* and 29 mammalian teeth. The results of all this work were eventually presented in a lengthy paper to the Geological Society of London (Moore, 1867). Owen (1871) and Simpson (1928) provided formal descriptions of the *Microlestes* teeth.

In 1939, Walter Kühne visited Holwell Quarries and collected two tonnes of sediment, which he washed and sieved, extracting 20 mammalian teeth. He worked a different fissure to that studied by Moore, as the earlier fissures had since been quarried away. After this work, Kühne prospected around the Mendips and discovered the new site of Windsor Hill Quarry (see GCR site report). Kane (1946, 1949a) described his finds of mammal teeth from Holwell Quarries, and Parrington (1941, 1946) provided additional information.

Description

Holwell Quarries were actively worked for the Carboniferous Limestone in Moore's day, and high faces were exposed, containing several 'Liassic dykes', as he called them. A drawing by Moore and a photograph of the quarries in the mid-19th century• are given by Savage (1993) (Figure 2.5). However, Moore (1867) clearly understood that the 'Liassic dykes' at Holwell Quarries were fissures filled with sediment. He realized that in early Mesozoic times there were a number of islands in the Bristol Channel region made from Carboniferous limestone and that small reptiles and mammals lived on the islands. The upland regions of the islands were fissured as limestone pavements, and soils, debris and bones were washed into the fissures.

Fauna

Robinson (1957) listed the fauna from Holwell Quarries as consisting of five named species of mammal, as well as unnamed mammalian remains, 'unidentified fragments' of reptiles and 'a few specimens' of placodont teeth and crocodilian teeth; taxonomic revisions have reduced the accepted number of mammals to three.

REPTILIA

'Therapsida'

Tritylodontidae

Oligokyphus sp.

MAMMALIA

Haramiyidae

Thomasia moorei (Owen, 1871)

Thomasia antiqua (Plieninger, 1847)

Morganucodontidae

Eozostrodon parvus Farrington, 1941

Moore (1867) identified most of the mammal teeth from Holwell Quarries as belonging to the genus *Microlestes,* known already from the Ithaetic' deposits of Germany. In his formal description of the 29 mammalian teeth collected by Moore, Owen (1871) accepted this identifica- (Figure 2.6) Upper molar of the haramiyid mammal *Thomasia moorei* from the Early Jurassic fissure filling of Holwell Quarries, Somerset, in crown (a) and internal (b) views. (From Simpson, 1928.)

tion and named the teeth *Microlestes moorei.* Simpson (1928), in his review of British Mesozoic mammals, considered that there were in fact three taxa present, and he named two additional species, *Microcleptes fissurae* and *Thomasia anglica.* The name *Microlestes* derives from the Greek for 'little thief', but it was found to have been given earlier to a beetle, so it was changed to *Microcleptes,* but that too was found to be pre-occupied, so eventually it was changed to *Haramiya,* deriving from Arabic word with the same meaning (Simpson, 1947). More recently, from a study of the occlusal relationships of haramiyid teeth, Butler and Maclntyre (1994) have shown that *Haramiya* represents upper teeth and *Thomasia* lower teeth of the same taxon, the prior name being *Thomasia.* Two different size groups at Holwell Quarries were recognized as different species of *Thomasia.*

The other mammalian group from Holwell Quarries, the family Morganucodontidae, was recognized as a result of the work of Kühne in the late 1930s, and Parrington named two species, *Eozostrodon parvus* and *E. problematicus,* each based on a single tooth (Clemens *et al.,* 1979). *Eozostrodon problematicus* is considered to be a junior synonym of *E. parvus* (Parrington, 1978; Clemens, 1979).

Savage and Waldman (1966) noted isolated remains of the tritylodont *Oligokyphus* from Holwell Quarries, confirming its similarity to the Windsor Hill Quarry site, where that reptile was much more abundant.

Interpretation

The fissures at Holwell Quarries, like the Windsor Hill Quarry fissure (see site report above), are classified as Neptunian dykes. These are fissures that formed in the Carboniferous Limestone subaerially and were then covered by the sea. The fissure then filled up with debris, including biogenic material, by movements of the tides and currents.

The two species *Thomasia moorei* and *T. antiqua* are haramiyids, a cryptic group of early mammals, until recently based solely on teeth from England, France, Switzerland, Belgium and Germany. Such limited fossil evidence of course led to wild speculation about the role of these mammals. Their 'great age implied that they were important in mammalian evolution, and they have often been allied with the multituberculates. New finds in Greenland now show more about the anatomy and affinities of the group (Jenkins *et al.,* 1997). These new finds, from Late Triassic sediments of East Greenland, include maxillae and dentaries (tooth-bearing elements), as well as teeth (the only elements known before), together with isolated post-cranial remains. These specimens confirm the tooth positions and orientations postulated when only isolated teeth were known (Butler and Maclntyre, 1994). Mastication was effected differently from the contemporaneous morganucodontids and lcuehneotheriids, but like the multituberculates the lower jaw moved posteriorly during occlusion. Unlike multituberculates, however, where the main shearing is horizontal, in haramiyids shearing took place as the opposing cusps entered and left their receiving basins, with less intervening horizontal movement (Butler, 2000). The postcranial ele ments suggest that the haramiyids were rather larger and more gracile than their contemporaries, the morganucodontids and kuehneotheriids.

The morganucodontid *Eozostrodon* from the Mendip area is distinct from penecontemporaneous *Morganucodon* from the fissures in southern Wales (Clemens, 1979), which is a primitive nontherian mammal — a small insect-eating form. The

morganucodontids fall very low on recent cladograms of mammalian relationships (e.g. Kemp, 1982; Rowe, 1988, 1993; Wible *et al.,* 1995; Luo *et al.,* 2001, 2002). The material from Holwell Quarries is very incomplete compared with more complete specimens of *Morganucodon* from southern Wales and of its relative *Megazostrodon* from Lesotho.

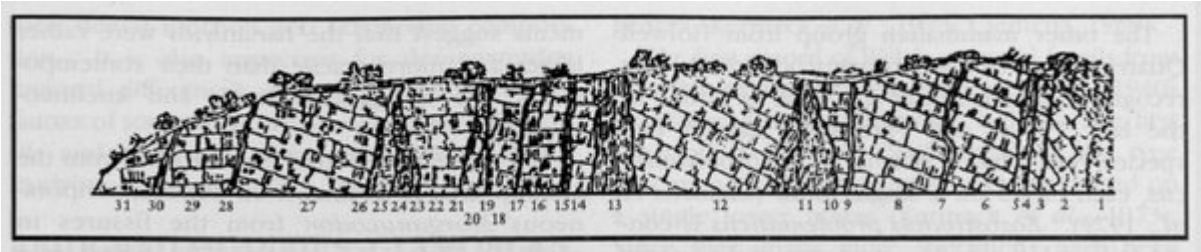
Comparison with other localities

This site is of a similar age to the Windsor Hill Quarry fissure fill from nearby in the Mendip Hills and the Bridgend Quarries fissures in southern Wales. The haramiyids are well represented at Holwell Quarries by dental material, although the new discoveries in Greenland (Jenkins *et al.,* 1997) are of more complete haramiyid remains. However, some dental features of the Greenland taxon appear atypical of haramiyids (Kermack *et al.,* 1998). Thus, the importance of the Holwell Quarries assemblage is undiminished. The isolated Holwell Quarries teeth are most comparable with material from Rhaetic bone beds in south-west Germany and Switzerland (Clemens and Kielan-Jaworowska, 1979; Clemens, 1980). Morganucodontids are better known from the Bridgend Quarries, but the genus there is different. The find of isolated *Oligokyphus* remains (Savage and Waldman, 1966) confirms a certain similarity with the Windsor Hill Quarry site.

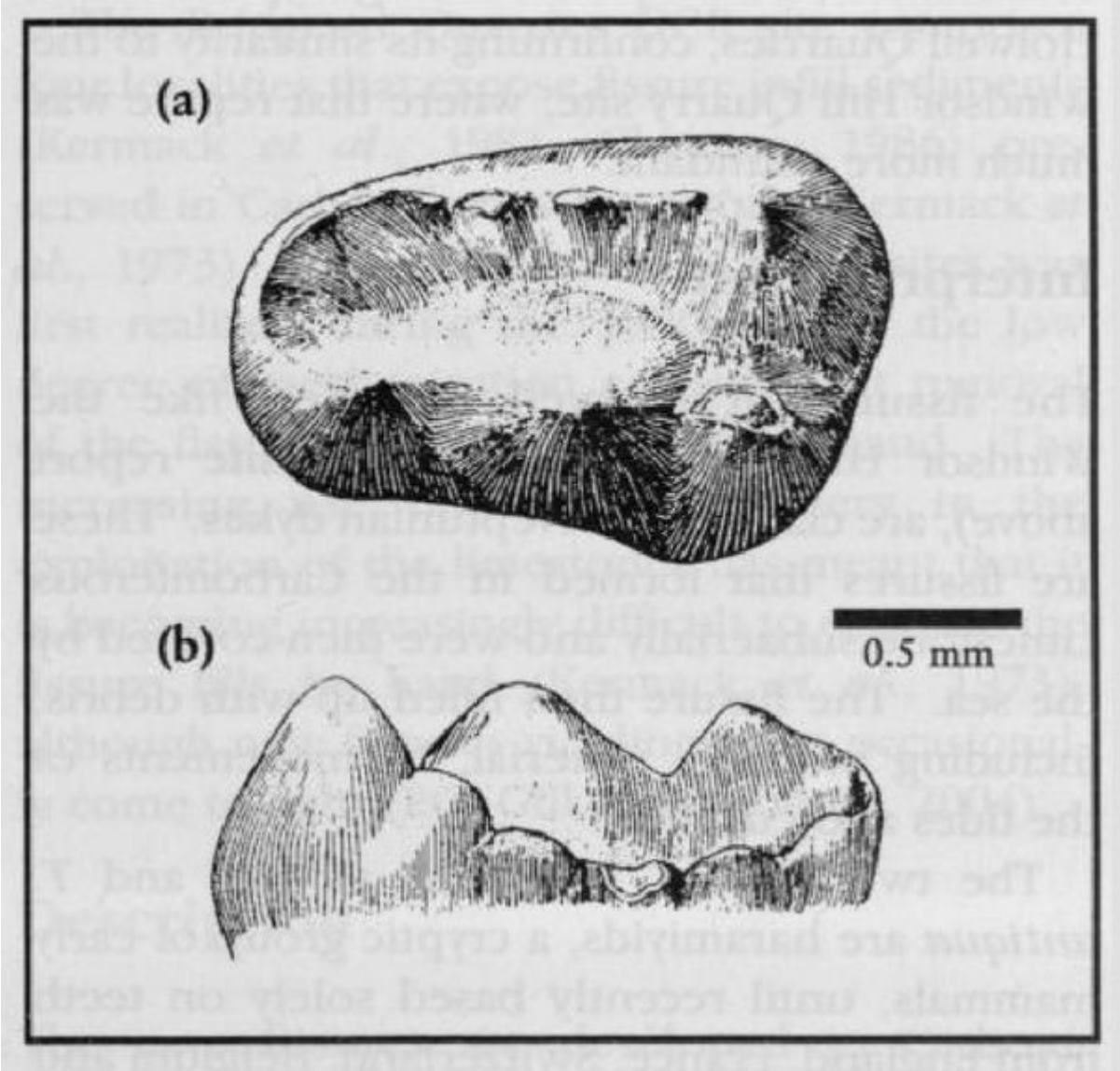
Conclusions

Holwell Quarries preserve one of the most important Mesozoic mammal faunas from Britain. Species present include *Thomasia moorei, T. antiqua* and *Eozostrodon parvus.* The type specimens of *T. moorei* and of *E. parvus* came from Holwell Quarries, as did the species now considered junior synonyms of all three species in the fauna. It is thus a critically important site for haramiyids, forming the basis for the first comprehensive understanding of their dental function and taxonomic composition. It is also important for demonstrating regional differences in Early Jurassic mammal faunas of south-west Britain. The age of the fossils and sediments makes this a key site for studying early mammalian faunas.

References



(Figure 2.5) Sketch of the north end (left-hand side) of Holwell Quarries, Somerset, showing the fissures, as identified and numbered by Charles Moore in his 1867 paper. (After Savage, 1993.)



(Figure 2.6) Upper molar of the haramiyid mammal Thomasia moorei from the Early Jurassic fissure filling of Holwell Quarries, Somerset, in crown (a) and internal (b) views. (From Simpson, 1928.)