Grinshill Quarries, Shropshire

[SJ 520 237]

Highlights

Grinshill Quarries have had a long history of producing skeletons and footprints of fossil reptiles. The quarries have yielded many skeletons of the small plant-eater *Rhynchosaurus,* and they are the richest site for such material in the British Isles.

Introduction

Grinshill Hill, and the adjoining Clive Hill, 300–500 m north of Grinshill village, are marked by numerous quarries, of which four large ones lie along the crest of the hill ([SJ 5205 2392], [SJ 5238 2387], [SJ 5249 2384], [SJ 5264 2380]). The last of these is still operational (Figure 4.3). The quarries, exposing sections in the Tarporley Siltstone Formation and the Helsby Sandstone Formation, have yielded specimens of the reptile *Rhynchosaurus* and associated rhynchosauroid footprints. All the old quarries on Grinshill Hill are still accessible and the currently operating quarry provides good exposure. Although excavation is slow, fresh finds of bones and footprints occur from time to time.

The buff-coloured sandstone of Grinshill was quarried in the 18th and 19th centuries and provided much of Shrewsbury and northern Shropshire with building stone. Murchison (1839, pp. 37–41) described a section taken in one of the Grinshill quarries and the Reverend Dr T. Ogier Ward of the Shrewsbury Natural History Society described (1840) vertebrate footprints, rain mark impressions and ripple marks taken from the Waterstones of Grinshill (Ward, 1840; noted in Murchison, 1839, appendix, p. 734). More footprints were reported from Grinshill by Beasley (1896, 1898, 1902, 1904, 1905, 1906), who identified most of them as of 'rhynchosauroid' type. Thompson (1985) and Benton *et al.* (1994) note also the occurrence of some cheirotherioid tracks at Grinshill.

The first bones from Grinshill, discovered during the 1840s, were noted by Ward (1840). The specimens had been found some years earlier by John Carlin, quarrymaster at Grinshill, and were given to the museum of the Shropshire and North Wales Natural History Society. Between August 1840 and November 1841, Ward obtained several more bones belonging to *Rhynchosaurus* from various quarrymen, although he later claimed that these specimens were 'first discovered by myself in 1837–1838' (Ward, 1874). These he sent to Richard Owen at the Royal College of Surgeons in several packages (Owen correspondence, Coll. Sherborn, BMNH letters 110, 103, 118, 105, 109, 107, 114, 116; D.B. Thompson, pers. comm., 1988).

In a paper to the Geological Society of London on 24th February 1841, Owen referred most of the Grinshill material to a species of *Labyrinthodon* (i.e. *Mastodonsaurus*), an amphibian which Jaeger (1828) had described from the Late Triassic of Germany. Owen (1842b, 1842c) later recognized the reptilian affinities of the material and named it *Rhynchosaurus articeps.* Further specimens of *Rhynchosaurus* provided more detail for the description of the skull (Owen, 1859a, 1863a). *Rhynchosaurus* was later redescribed from Owen's specimens and from newer material by Huxley (1887), Woodward (1907a), Watson (1910a), Huene (1929a, 1938, 1939), Hughes (1968) and Benton (1990c). More details of the history may be found in Benton (1990c) and Benton *et al.* (1994).

Some *Rhynchosaurus* remains have been recovered recently from Grinshill, as well as 11 slabs bearing good vertebrate trackways, collected by Dr J. Stanley and Dr D.B. Thompson (Keele University) between 1968 and 1982. All of this material came from the single operational quarry.

Description

Grinshill Hill consists of Triassic sediments dipping north and north-west. It is bounded to the east and west by NE–SW trending faults and these are linked by two WNW–ESE trending faults.

Murchison (1839, pp. 37–41) gave a section in 'Grinshill Stone Quarries', a locality no longer identifiable exactly — it may have been generalized from several quarries (Pocock and Wray, 1925, p. 39). Hull (1869, p. 64), in his revision of the Triassic rocks of the Midlands, showed the presence of Upper Mottled Sandstone, Lower Keuper Sandstone and Waterstones at Grinshill (although he could not identify the boundary between the last two), and reproduced Murchison's section in simplified form:

	Thickness Ft in
Lower Keuper Sandstone	
1. Fee and jay (rubbly thin bedded rock)	13 0
2. Flag rock, yellowish or light brown in colour	19 0
3. Sand bed called Esk	0 9
4. Hard burr	2 6
5. Coarse freestone, mottled, of yellowish and reddish colours, best building stone	9 6
6. Grey freestone	7 6
7. Good light yellow freestone underlain by a seam of clay	11 0
8. Good white freestone	2 0
9. Strong white freestone	8 0
Upper Mottled Sandstone (Bunter)	
10. Sandy and bad freestone	2 0
11. Bad stone, sometimes used for walls, &c	9 0
12. Soft yellow sandstone, the grains of sand cemented by decomposed feldspar	4 6
13. Sandstone of deep red colour sunk through for water	222 0
TOTAL	311 7

Pocock and Wray (1925, pp. 15–16) established the 'Ruyton and Grinshill Sandstones' to include 'a group of red and yellow freestone, forming a passage-bed between the Bunter and Keuper and including at its base a small thickness of the Upper Mottled Sandstone and limited upward by the base of the Waterstones'. For the 'main Grinshill quarries, 550 yards N20 degrees E of the Elephant and Castle Hotel', Pocock and Wray (1925, pp. 39–40) offer the section:

	Thickness Ft in
Keuper Marl: Red marl	seen to 2 0
Waterstones:	
Flag rock: grey and light-yellow sandstone, evenly bedded, with thin reddish seams; ripple marks	20 0
Esk bed: incoherent grey sandstone and sand, with harder patches; full of specks of manganese dioxide	0 9
Grinshill Sandstone:	
Hard burr: hard yellowish-white sandstone (coarse-grained sandstone)	2 6
Hard yellowish freestone	2 6
Soft yellow sand	0 2
White and pale-yellow freestone, with iron-stained patches towards the base	33 0
White freestone with iron-stained and speckled patches seen to	5 6

Pocock and Wray (1925, p. 40) gave another section taken in the only quarry then working (650 yards N45 degrees E of the hotel) which shows a similar succession. The Upper Mottled Sandstone of these authors (f3) has been renamed the Wilmslow Sandstone Formation, the Ruyton and Grinshill Sandstones (or the Building Stones; f4) the Helsby Sandstone Formation, and the Waterstones the Tarporley Siltstone Formation (Warrington *et al.,* 1980).

The Tarporley Siltstone Formation, typically ranging from 20 m to 250 m in thickness (Warrington *et al.,* 1980, table 4), is only about 6–10 m thick at Grinshill. The sediments are well-bedded, white, pale-green or reddish fine-grained sandstones and marls. Two facies, A and B, have been identified by Thompson (1985, pp. 119–21). Facies A, fluvial and tidal, is characterized by trough-shaped erosion channels filled with beds of ripple cross-laminated, fine- to medium-grained sandstone, which bear on their bedding surfaces ripple marks, rhynchosauroid footprints (see below), trace fossils formed by invertebrates(?), and supposed raindrop impressions, which were reported for the first time from Grinshill by Ward (1840) and Buckland (1844). Facies B, largely intertidal and rarely hypersaline, consists of interbedded fine sandstones, siltstones and mudstones. The mud and silt horizons are generally 10–20 mm thick; the sand beds are thicker at about 100 mm. Many of these horizons show current and wave ripple marks, load casting, flute marks and prod marks. A few show adhesion ripple marks, indicating half wet, half dry conditions. Mudcracks and halite pseudomorphs have been observed occasionally, as well as rhynchosauroid footprints and poorly preserved invertebrate trace fossils.

The underlying exposure of Helsby Sandstone consists of about 30 m of buff and yellow, medium-grained, well-sorted sandstones. These are well cemented, and contain numerous small spots of manganese hydroxide. Large-scale cross-beds are sometimes visible in vertical quarry faces, bearing lamination structures which imply aeolian conditions of deposition (Thompson, 1985), relating to large transverse barchanoid dune ridges. At Grinshill, the Helsby Sandstone Formation appears to grade up into the Tarporley Siltstone Formation through a bed of loose sand, about 0.3 m thick, termed the Esk Bed (Pocock and Wray, 1925, pp. 39–40; Thompson, 1985, p. 119), of indeterminate environmental origin (Figure 4.4).

Most of the reptile specimens appear to have come from the debris associated with quarrying, but were probably derived from horizons within a thickness of about 2 m. The *R. articeps* specimens occur in two main lithologies, as noted by Owen (1842b, p. 146); a fine-grained grey sandstone and a coarser pinkish-grey sandstone (his coarse 'burrstone').

The remains of *R. articeps* and the tetrapod trackways appear to have come from a number of quarries on Grinshill (D.B. Thompson, pers. comm., 1984). The footprints described by Ward (1840) were found on ripple-marked surfaces in a finely laminated buff-coloured sandstone beneath the rubbly red-coloured sandstone called 'Fee', presumably equivalent to part of Thompson's (1985) largely intertidal Facies B. Walker (1969, p. 470) observed that the specimens of *R. articeps* came from the siltstones and fme sandstones of the Tarporley Siltstone Formation, and possibly from the immediately underlying beds at the top of the Grinshill Sandstones (the coarser sandstone) (Walker, 1969). This was implied also in Pocock and Wray's (1925, pp. 39–40) section, in which the top of the Grinshill Sandstone is described as 'Hard Burr: Hard yellowish-white sandstone, 2ft 6in'. However, Thompson (1985, p. 118) was doubtful whether any bones had been found in the aeolian Grinshill Sandstone Formation, noting (D.B. Thompson, pers. comm.) specimens only from his largely fluvial Facies A of the Tarporley Siltstone Formation, in the operating quarry [SJ 526 238].

Mr John O'Hare, the former quarry owner, is certain that the Keele University (1984) *Rhynchosaurus* specimen came from the lowest 0.2 m of the Tarporley Siltstone Formation. The 1986 and 1991 finds are in large blocks of coarse sandstone, which are most likely to have come from the hard burr stones at the top of the aeolian Grinshill Sandstone (D.B. Thompson, pers. comm., 1993).

The Grinshill specimens of *Rhynchosaurus* are largely complete (Figure 4.5) and undisturbed, but the bone material is soft and friable. The skeletons tend to lie flat in the dorso-ventral plane with the limbs stretched out to the sides: this suggests relatively rapid burial with little scavenging or transport.

The commonest tctrapod tracks at Grinshill are of the 'rhynchosauroid' type termed rhynchosauroid D1 by Beasley (1902); rarer finds include *Cheirotherium* prints, all from the Tarporley Siltstone Formation. The remainder are small prints, possibly of a different vertebrate type. These include small arcs of claw marks ('type C') and more or less complete 'hand'-shaped marks which could be of the same foot type ('type B'). The rhynchosauroid prints are generally small (15–20 mm across) and, when well preserved, they show clawed digits with an opposing associated impression. Single slabs may preserve a variety of impressions belonging to a number of overlapping trackways.

The tracks are most frequently preserved in sandstone as negative moulds on the undersurface of current and wave ripple-marked horizons. The ripples are asymmetrical and, because they are on an undersurface, their crests are well preserved. The preservation of these trackways is excellent. One slab preserves 11 distinct sets of claw prints, and in some specimens there is clear indication that the claws were twisted sideways (revealing their arcuate shape) as the foot was impressed into the sediment. Another specimen (JSW GH 3) exhibits a more or less circular area of sediment disturbance, which appears to suggest that the animal had been engaged in some activity such as eating from the ground. Other specimens exhibit regular series of impressions which appear to be teeth or jaw marks. More details of the taphonomy of the skeletons and footprints are given in Benton *et al.* (1994).

Fauna

Diapsida: Archosauromorpha: Rhynchosauridae

Rhynchosaurus articeps Owen, 1842 About 17 individuals: SHRBM, SHRCM, BMNH, MANCH, BATGM, Keele Univ; some specimens have been missing since the 19th century and the total could be greater

Footprints

Rhynchosauroides sp. 23 slabs: SHRBM, MANCH, WARMS, BGS(GSM), BUGD, others in private hands

Cheirotherium sp. Two slabs: SHRBM, SHRCM.

Interpretation

On the basis of palynological evidence Warrington (1970b) dated the basal Helsby Sandstone Formation as Scythian, a view followed by Pattison *et al.* (1973), and by Warrington *et al.* (1980, p. 33, table 4) who placed the overlying Tarporley Siltstone Formation in the Anisian. However, a more recent assessment of the palynological data (Warrington, *in* Benton *et al.,* 1994) confirms an Anisian age for both formations (Figure 4.2).

The ages have also been debated on the basis of the reptiles. Walker (1969, 1970a) argued that all relevant horizons were of Mid Triassic age because of the resemblance between *Rhynchosaurus* and *Stenaulorhynchus,* and because of the purported intermediate evolutionary position of *Rhynchosaurus* between Early and Late Triassic rhynchosaurs. Its closest relative seems to be *Stenaulorhynchus* from the Manda Beds (?Anisian), of Tanzania, although it seems slightly more advanced in some respects according to Walker (1969). *Stenaulorhynchus* and *Rhynchosaurus* were grouped in the subfamily 'Rhynchosaurinaei (Chatterjee, 1974, 1980; Benton, 1983d), but this view has not been supported in more recent analyses (Benton, 1990c).

Rhynchosaurus articeps was a relatively small reptile, about 0.5 m long, and probably like a large lizard in appearance (Figure 4.5). The triangular skull (60–80 mm long) is low and broad at the back, and it shows all the typical rhynchosaur features of beak-like premaxillae, a single median naris and fused parietal. The dentition was specialized, as in other rhynchosaurs, consisting of a grooved maxillary tooth plate with several rows of teeth and a lower jaw (that slots into the groove) with teeth on the upper edge and down the inside surface. The pattern of wear, and the nature of the jaw joint, suggest that *Rhynchosaurus* had a precision shear bite, as in other rhynchosaurs, with no back and forwards motion. The diet was probably tough vegetation, which was dug up by scratch digging, raked together with the fore feet or the premaxillary beak, and manipulated in the mouth by a large, fleshy tongue (Benton, 1990c).

The skeleton of *R. articeps* is relatively more slender than that of most other Mid and Late Triassic rhynchosaurs. This is probably an allometric effect resulting from its relatively smaller size. The slim body and the semi-erect limb posture deduced from the skeletons may have assisted in fast terrestrial locomotion and the strong limbs and girdles support the notion of an active lifestyle.

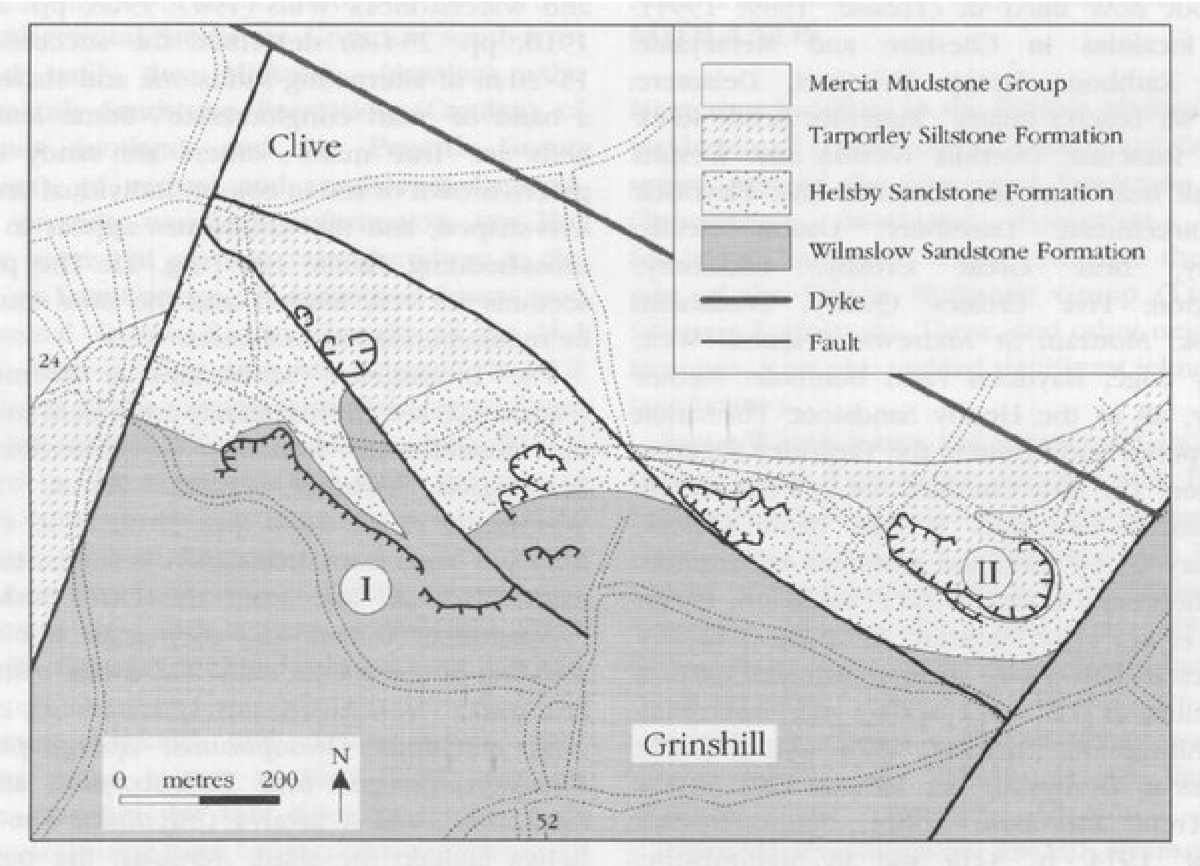
Comparison with other localities

Grinshill is a unique site. Its sole reptile species, *Rhynchosaurus articeps*, is most comparable with *R. brodiei* from Coten End (q.v.) and Bromsgrove, and with *R. spenceri* from Devon.

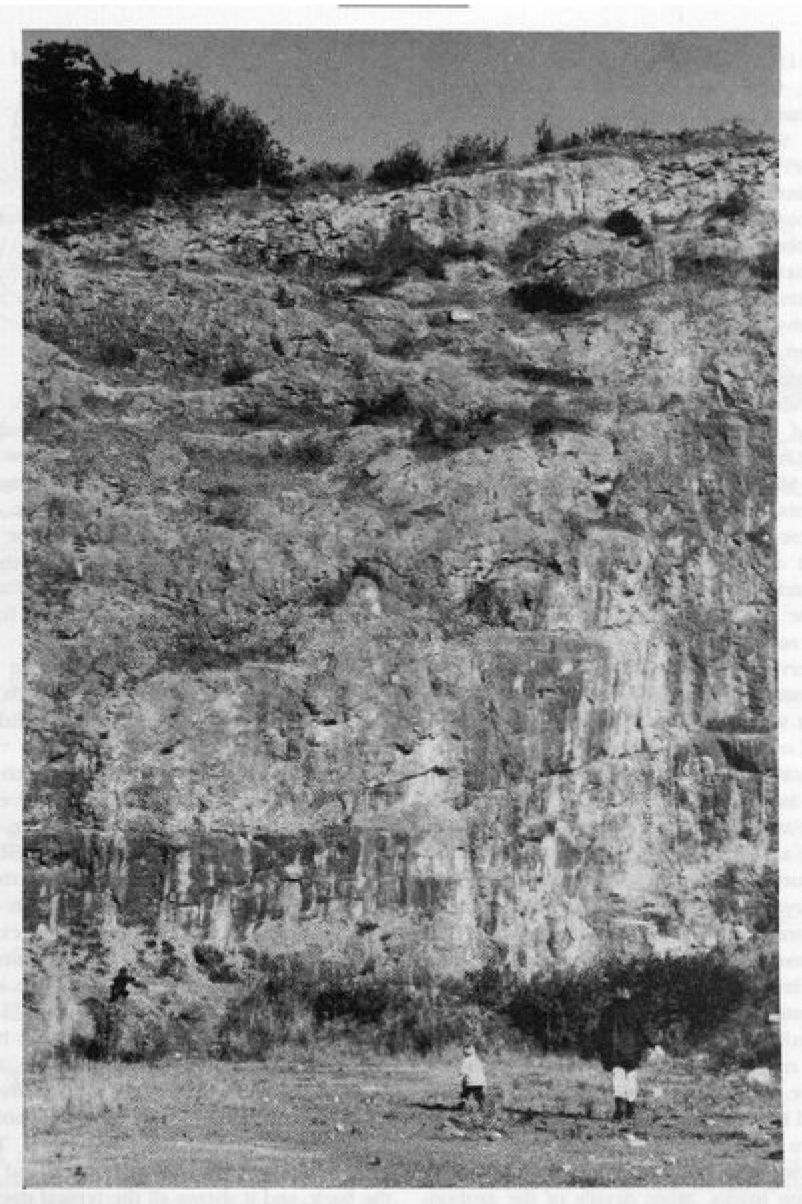
Conclusions

Grinshill is important as the site of the type species of *Rhynchosaurus,* a genus represented from other localities in England (Coten End, Bromsgrove, Sidmouth, Budleigh Salterton) and hence of some value biostratigraphically. Specimens are still coming to light at Grinshill, as are slabs with footprints. There is much potential here for new finds and for studies of the palaeobiology of rhynchosaurs. The association of excellent skeletons and footprints is unusual and gives the site considerable conservation value.

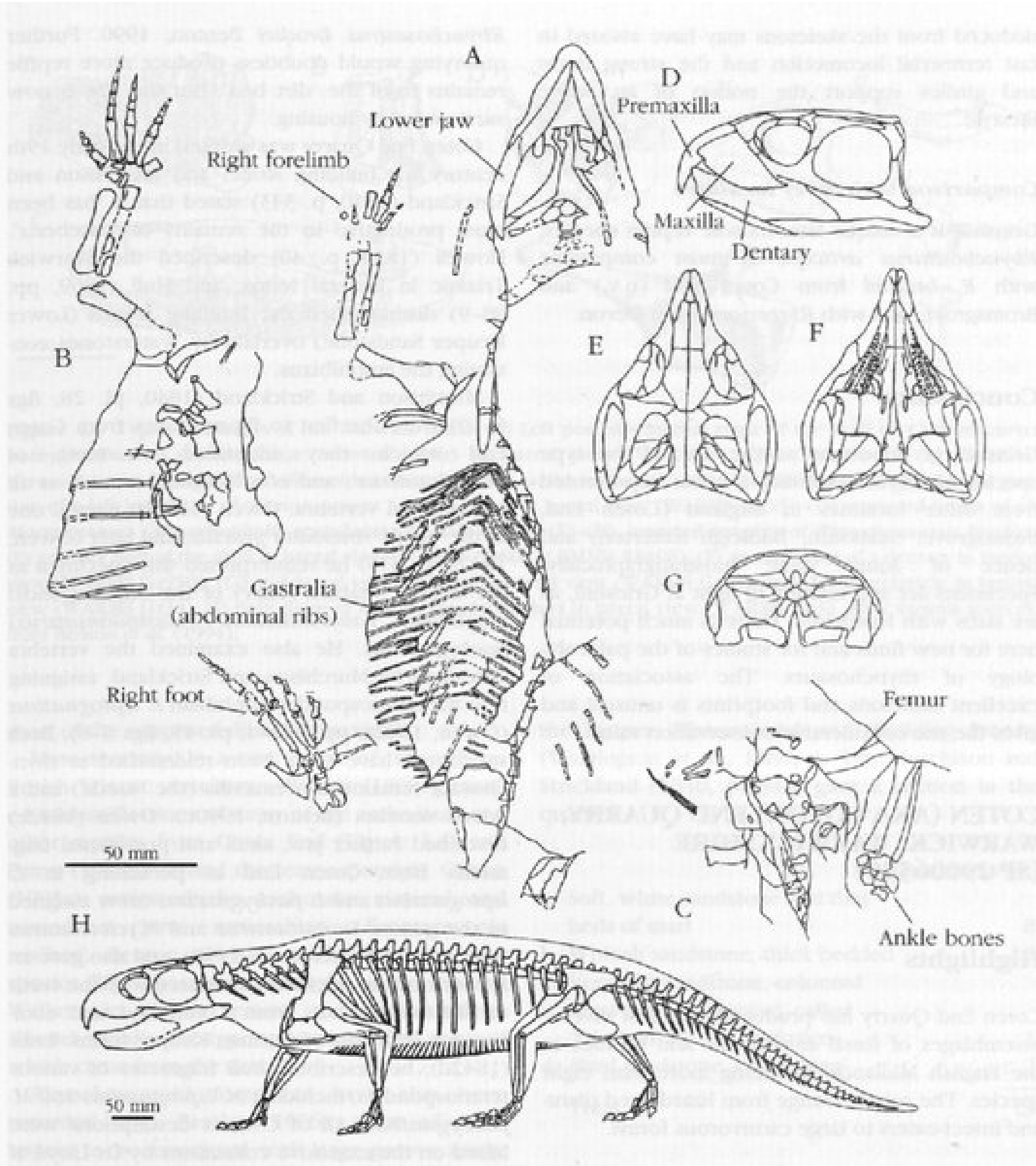
[References](#)



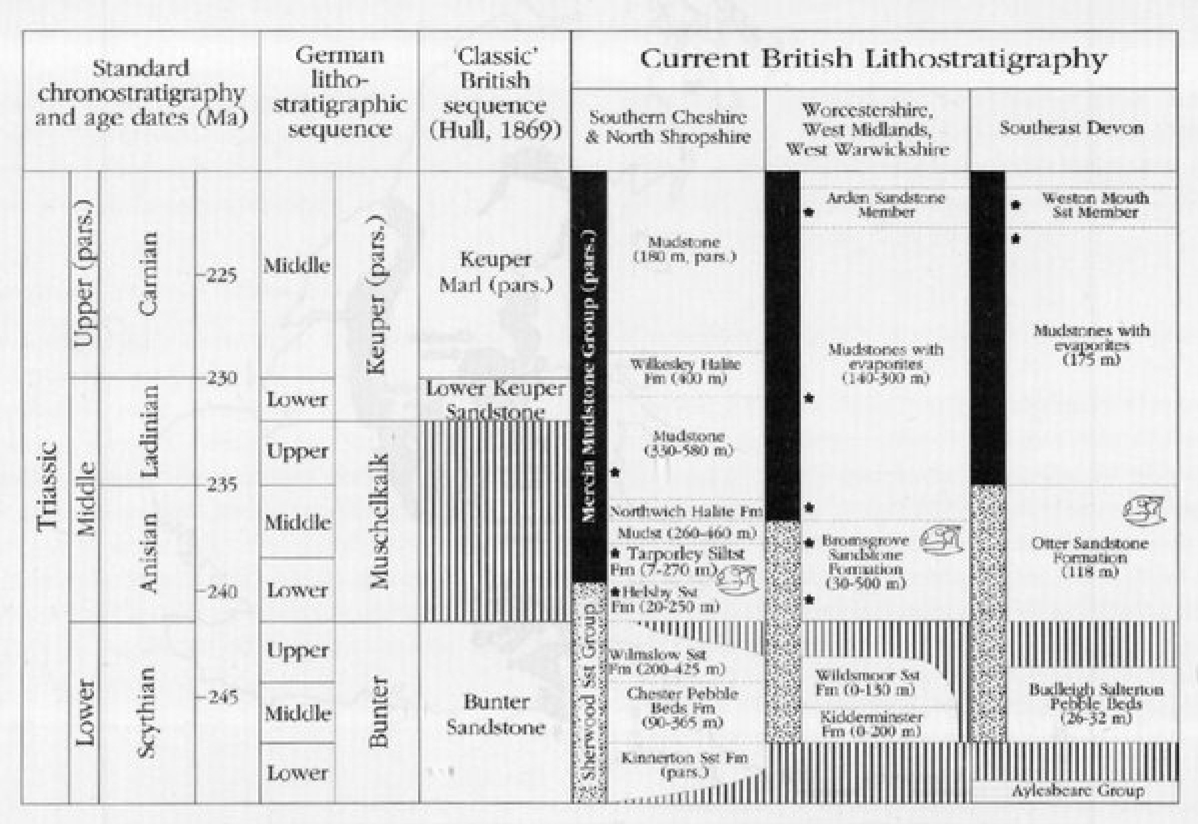
(Figure 4.3) The Grinshill localities. The map is based on published maps of the British Geological Survey (BGS 1:63, 360 scale Geological Sheet 138, Wem) and on field observations by M.J.B. I. Bridge Quarries; II. working quarry (ECC Quarries Ltd).



(Figure 4.4) The operational quarry on Grinshill: view of the north face, showing the massive cross-bedded Helsby Sandstone Formation at the bottom, and the softer, more thin-bedded Tarporley Siltstone Formation above. (Photo: M.J. Benton.)



(Figure 4.5) Rhynchosaurus articeps, the only member of the Grinshill skeletal fauna: typical fossil remains (A–C) and restorations (D–H). (A) Partial skeleton lacking the tail and the limbs of the left side, in ventral view (BMNH R1237, R1238); (B) dorsal vertebrae, ribs, and right forelimb in posteroventral view (SHRBM 6); (C) pelvic region, right leg with ankle bones, presacral vertebrae 22–25, sacral vertebrae 1 and 2, and caudal vertebrae 1–8 (BATGM M20a/b); (D)–(G) restoration of the skull, based on SHRBM G132/1982 and 3 and BMNH R1236, in lateral (D), dorsal (E), ventral (F), and occipital (G) views; (H) restoration of the skeleton in lateral view in walking pose. All based on Benton (1990a).



(Figure 4.2) The stratigraphy of the British Triassic reptile faunas. Correlations of the standard Triassic divisions and the German Triassic sequence with the British Triassic, as proposed by Hull (1869) for the 'classical' British succession, and by Warrington et al. (1980) for currently recognized lithostratigraphical units. Skull symbols indicate the levels of the main tetrapod faunas, and asterisks denote palynological evidence of relative age. Age dates (Ma ± 5) after Forster and Warrington (1985). From Benton et al. (1994).