Newnham (Wilmcote) Quarry, Warwickshire

[SP 151 594]

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Introduction

The Newnham Quarry GCR overlooks the village of Astow Cantlow to the west and is less than 1 km south of the village of Newnham. The village of Wilmcote lies less than 1.5 km to the south-east and gives the site its alternative name, 'Wilmcote Quarry'. The site comprises a long-disused quarry excavated into the Blue Lias Formation (basal Lias Group), less than 500 m east of a prominent scarp formed by the underlying Penarth Group (Figure 5.3).

The quarry is one of the few remaining inland exposures of the Blue Lias Formation. It is the type locality for the lowest member of the Blue Lias Formation in this area, the Wilmcote Limestone Member, and exposes part of the overlying Saltford Shale Member. It also contains the best remaining section through the 'Insect Beds' of the basal Lias Group, once widely exposed in small quarries across Gloucestershire, Worcestershire and Warwickshire. The Wilmcote Limestone Member is well known for its insect fauna, as well as yielding plant material and important marine vertebrates. Consequently, this part of the succession often was referred to informally in 19th century publications as the 'Insect Beds', 'Insect Limestone' or 'Insect and Saurian Beds'. Material was obtained from many quarries and pits in Warwickshire, but Newnham Quarry is the only site remaining at which the succession can still be seen. The site has proven of outstanding importance for our understanding of terrestrial biotas in earliest Jurassic times.

The stratigraphical succession exposed at this site (Figure 5.4) was described by Wright (1857–1880, 1860a, 1878–1886), Brodie (1860b, 1868, 1887, 1897) and Woodward (1893). Similar successions were formerly exposed in several other quarries within a few kilometres radius, described in various publications (Brodie, 1845, 1868; Wright, 1860a; Williams and Whittaker, 1974). These are significant for the interpretation of the succession at Newnham Quarry, which can be considered representative of the basal part of the Lower Jurassic sequence in this area. Old *et al.* (1991) formally established the Wilmcote Limestone Member for the interbedded limestones and shales at the base of the Lias, and the lithostratigraphy of the site was discussed by Ambrose (2001). A faunal list for this part of the Lias, based on material in Warwick Museum, was included in Old *et al.* (1991, appendix 5) but they did not specify the horizon or, in many cases, the location of most of the species cited. Brodie (1868, 1897) also mentioned various elements of the fauna and flora while more specific accounts dealing with particular taxa were published by Jones (1862), Woods (1925–1931), Woodward (1866, 1888b) and Tomes (1878).

Description

The most extensive section at the Newnham Quarry site was recorded by Kirshaw and Tomes (in Wright, 1860a) (Figure 5.4). They described a section 16.32 m thick comprising 7.27 m (23 ft 8 in.) of Lower Lias above 9.05 m (29 ft 5 in.) of Penarth Group. The Penarth Group and lowest two beds of the Lias Group, beds 28 and 29 of Wright (1860a), were recorded in an excavation made specifically for the purpose of exposing this part of the succession. The same section was reproduced by Brodie (1868), though with minor differences in thickness quoted for some of the units. Brodie's (1857, 1860b) description noted that the section was broken by numerous faults and implied that it occupied a syncline, with 'several bands of limestone and shale in a basin formed by the outcrop of the Firestones, which dip at a considerable angle on the higher ground'. Many of the limestone bands within the succession were given names by the quarrymen.

The base of the Lias Group in this area is taken at the 'Guinea Bed', a thin (0.02–0.03 m thick) shelly limestone containing limestone intradasts and a fairly diverse benthic fauna. From the Guinea Bed at Binton [SP 142 536], 7 km to the south, Wright (1860a, 1878–1886) recorded a range of encrusting, byssate and shallow-burrowing bivalves together with diademopsid echinoids and isastreid corals. Above the Guinea Bed, 0.3 m of rather indurated shale is succeeded by a limestone 0.42 m thick, comprising four distinct beds with mudstone partings. The lower three of these (beds 25–27 of Wright) which together were known as the 'Firestones', comprise fine-grained, recrystallized limestones with fine shell debris, micrite pellets and quartzose silt, and contain a fauna of encrusting, byssate and shallow-burrowing bivalves. These four limestone beds, the underlying shale unit and the basal Guinea Bed, were named the 'Stock Green Limestone' by Old *et al.* (1991).

The lowest 1.54 m (5 ft) of the Lias succession, from the Guinea Bed (Bed 29) up to Bed 21 of Wright (1860a) and Brodie (1868), yielded many remains of large marine reptiles, notable among them a 4.4 m-long skeleton of *Rhomaleosaurus megacephalus* from Bed 21, now in Warwickshire Museum (cited by Cruikshank, 1994). A megalosaurian limb bone described and figured from 'Wilmcote' by Woodward (1908) originated from the sinking of a well near Wilmcote Railway Station [SP 168 583], in shelly limestones of the Angulata Zone, not from the quarry. The lower part of the succession also contains most of the benthic invertebrates recorded at the site. Conspicuous among them is the encrusting bivalve *Liostrea bisingeri,* which led Wright (1860a) to term his beds 21 to 30 the '*Ostrea liassica* and Saurian Beds'. Brodie (1861) cited the occurrence of '*Isastraea*', presumably from this part of the succession.

Overlying the '*Ostrea liassica* and Saurian Beds' is the Grizzle Bed, a 0.08 in-thick bioclastic limestone containing vertebrate debris, a range of encrusting, byssate and shallow-burrowing bivalves, and abundant echinoid spines. This is overlain by a 1.28 m-thick dark laminated mudstone, the thickest unit of the entire section and currently the lowest unit exposed in the quarry. Above this Wright (1860a) and Brodie (1868) recognized nine limestone bands, from 0.05 m to 0.22 m thick, alternating with somewhat thicker (0.18–0.5 m) laminated mudstone units. The limestones are generally fine grained, argillaceous and, in the upper part of the succession, mostly laminated with thin dark organic partings. The mudstones also are well laminated with little evidence of bioturbation.

Ammonites are virtually the only fossils cited by Wright (1860a) from Newnham Quarry. However, Brodie (1868) also recorded marine reptiles, fish and crustacea, together with plant and insect remains, the latter apparently confined to the limestone bands. Brodie (1897) noted that the plants and insects were very fragmentary while the vertebrates and crustacea were more-or-less intact. Buckman (1850) described several fossil plants from what he termed the 'Insect Limestone' or 'Best Paving Slab' of sites in Warwickshire, Worcestershire and Gloucestershire, though not specifically from Newnham Quarry. Tillyard (1925, 1933) described several insect taxa from adjacent sites, notably Binton. Wright (1860a, 1878–1886) noted that certain beds at Binton appeared to be barren, but others yielded vertebrate and insect remains. One limestone bed at Binton was said by Wright (1860a, 1878–1886) to contain 'more insects than in all the other beds collectively', but it appears to be either unrepresented at Wilmcote or can be correlated with part of the laminated mudstone (Bed 19) immediately above the Grizzle Bed.

Greaves (1832) mentioned the discovery of an ichthyosaur at the quarry and figured a large intact specimen of the fish *Dapedium.* The same specimen was figured and described by Agassiz (1832) as *Tetragonolepis angulifer.* Benthic fossils appear to be very rare. They include several species of crustacea, among them forms described and figured by Woodward (1866, 1888b) as *Eryon wilmcotensis,* from the 'Bottom Blocks' (Bed 4), and *Aeger brodei.* Woods (1925–1931) also figured and described these types, together with examples of *Coleia barroviensis* for which he considered *Coleia* (= *Eryon*)*wilmcotensis* probably to be a synonym. There has been little recent work on the fossils for which this site is famous, and Whalley (1985) acknowledged the need for re-examination of the Midland fauna, which includes Newnham Quarry Much of Brodie's fossil insect collection is held in the Natural History Museum in London, with further material in Warwickshire Museum. Cruickshank (1994) undertook a description and interpretation of the skull of *Rhomaleosaurus megacephalus* but other vertebrates have remained largely neglected.

Today a little over 7 m of the section can be seen on the western side of the quarry (Figure 5.4) and (Figure 5.5). However, this includes about 2.3 m of mudstones above the highest strata recorded by Wright (1860a) while nothing can be seen below the upper part of his Bed 19. Of the nine limestone bands recorded by Wright (1860a), only four could be identified by Old *et al.* (1991) and Ambrose (2001). Old *et al.* (1991) recorded *Psiloceras plicatulum, Psiloceras* sp., *Caloceras johnstoni, Caloceras ? intermedium, Caloceras* sp. and *?Psilophyllites,* indicating the presence of both subzones of the Planorbis Zone, and placed the boundary between the Planorbis and Johnstoni subzones immediately above Bed 8 of Wright (1860a). Woodward (1893) claimed that a specimen of *Coroniceras rotiformis* (now *C. rotiforme*) was found at the site, although clearly this is erroneous.

The Blue Lias Formation at Newnham Quarry has been divided into two members, and the site has been designated the type locality for the lower of these, the Wilmcote Limestone Member (Old *et al.,* 1991; Ambrose, 2001). This unit encompasses strata from the Guinea Bed at the base of the Lias, including the Stock Green Limestone, to the highest limestone band, the 'Top Blocks' (Bed 2). Above this the succession is overwhelmingly dominated by the mudstone facies of the overlying member, the Safford Shale Member (Ambrose, 2001) which persists through until the Angulata Zone (Figure 5.4).

Interpretation

Ammonites are the most common fossils in the upper two-thirds of the Wilmcote Limestone Member and have enabled biostratigraphical subdivision of the succession. The base of the Lower Jurassic succession and the Planorbis Zone was placed by Old *et al.* (1991) at the Grizzle Bed, which contains *Psiloceras,* with the top of the Planorbis Subzone 3.18 m higher, above Bed 8 of Wright (1860a), where species of *Caloceras* first appear. However, Wright (1860a, 1878–1886) and Brodie (1868) noted the occurrence of a single *Psiloceras planorbis* from the Firestones at Binton, 7 km to the south. Old *et al.* (1991) were unable to confirm this and suggested that the record had been assigned to the wrong bed.

According to Wright, (1860a) the lower Wilmcote Limestone Member of the Blue Lias Formation can be divided into two distinct facies assemblages. The lower of these he termed the '*Ostrea liassica* and Saurian Beds', corresponding to the Pre-Planorbis Beds, and contains a rich and diverse benthic fauna that demonstrates that benthic oxygen levels were high during deposition of both mudstones and limestones. The predominance of fine shell debris and micritic pellets in several of the limestones indicates that they are primary features of the succession. The presence of several distinct trophic groups of bivalves, including encrusters, epibyssate forms and shallow burrowers, is evidence for a significant diversity of habitat, while the presence of isastreid corals indicates clear warm water well within the photic zone. The base of this facies assemblage is sharply defined by the Guinea Bed, which shows clear evidence of a minor non-sequence originating from erosion between the Penarth Group and the succeeding Lias Group. Brodie (1887) noted that the Guinea Bed and Firestones were developed only where the 'White Lias' (= Langport Member) was absent. Arkell (1933) attributed the presence of limestone intradasts in the Guinea Bed to early Hettangian erosion of the Langport Member although Old *et al.* (1991) regarded them as shoreline debris transported from farther east. The abundance of fossil material in this bed also suggests greatly reduced rates of sedimentation at this time. The top of the '*Ostrea liassica* and Saurian Beds' is marked by a bed rather similar to the basal Guinea Bed, the Grizzle Bed, which again indicates, by its abundance of shell debris, echinoid spines and vertebrate debris, that sedimentation rates were very low and perhaps accompanied by minor erosion.

Above the Grizzle Bed there is an abrupt change to laminated mudstones and limestones in which a benthic fauna is virtually absent. The almost complete lack of bioturbation, and the fine preservation of some of the vertebrates and insect remains, indicates prolonged benthic anoxia during the deposition of most of this part of the Wilmcote Limestone Member. However, Brodie's (1897) statement that most of the vertebrates are preserved more-or-less entire almost certainly reflects some degree of collecting bias, since disarticulated or fragmentary remains were often ignored by early collectors when more intact material was available. The presence, in these apparently anoxic sediments, of several species of crustacean is somewhat anomalous, though not atypical of laminated limestones in the Blue Lias Formation, suggesting either that they were not strictly benthic taxa, that they were tolerant of very low benthic oxygen levels, or that they were able to establish populations during transient benthic oxygenation events. The diversity of the insect and plant remains suggests that a landmass, perhaps the western margin of the London Platform, lay no great distance away, though Brodie (1897) noted that those from Newnham Quarry generally were more fragmentary than those from correlative strata at Strensham, farther west in the Severn Basin.

The laminated limestones lack the fine shell debris found in those near the base of the member, below the Grizzle Bed, and appear to be largely diagenetic in origin. The crushed nature of the ammonite shells indicates fairly late diagenetic cementation. Consequently Brodie's (1868, 1897) assertion that insect remains are confined to the limestones can be seen as merely a consequence of selective collecting; almost certainly insects must occur in the laminated shales but they have not been searched for there.

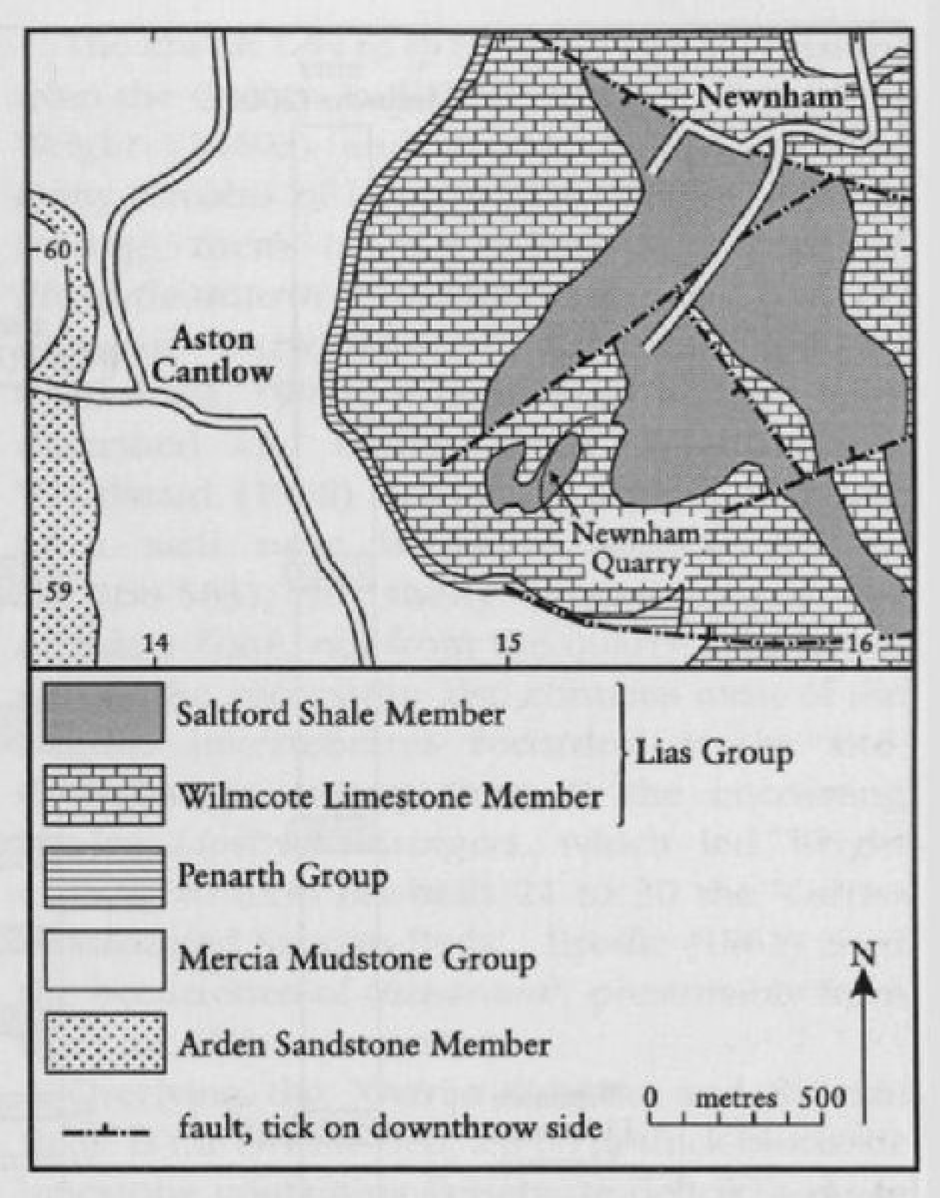
Lithostratigraphical correlation of individual limestones between the various described quarries in this area was attempted by Old *et al.* (1991), with moderate success. They noted that although quarry names were assigned to most of the limestones, these were not consistent between quarries. The only exceptions were the Guinea Bed, the Firestones, the Grizzle Bed and the Top Block. in addition, it appears that some limestones bands were not continuous and could not be correlated between quarries. In particular the insect-rich limestone at Binton appears to be represented by a thick mudstone with laminated horizons at Newnham. Brodie (1868, p. 16) noted that 'in one of the most westerly sections at Wilmcote … the Insect Beds thin out and scarcely amount to three layers … a thick mass of shale succeeds undivided as elsewhere by limestones'. The laminated nature of many of the limestones suggests that they developed through diagenetic modification of laminated mudstones. Their apparent absence or discontinuous nature may therefore reflect local variation in diagenetic factors.

In terms of larger-scale facies interpretations there are significant similarities between the succession at Newnham Quarry and that seen at other sites, notably the Lavernock to St Mary's Well Bay GCR site in south Wales. At the base of the succession comparison may be drawn between the limestone-dominated Bull Cliff Member at Lavemock and the similarly limestone-dominated Stock Green Limestone of the Wilmcote area, with both corresponding to the lower part of the Pre-Planorbis Beds of the Lias Group. At Lavernock this is succeeded by the limestone-rich St Mary's Well Bay Member, which gives way early in the Liasicus Zone to the mudstone-dominated Lavernock Shale Member. A similar transition occurs between the Wilmcote Limestone Member and the Saltford Shale Member (Ambrose, 2001), although it appears to occur rather earlier here, with mudstones becoming dominant towards the middle of the Johnstoni Subzone, and is presumed to relate to a eustatic rise in sea level. The laminated limestones that are such a significant element of the succession at Newnham Quarry are by no means unique and occur quite commonly in the Planorbis Zone elsewhere, such as at Lavernock in south Wales, Pinhay Bay in east Devon, and in temporary exposures near Gloucester (Simms, 2003a).

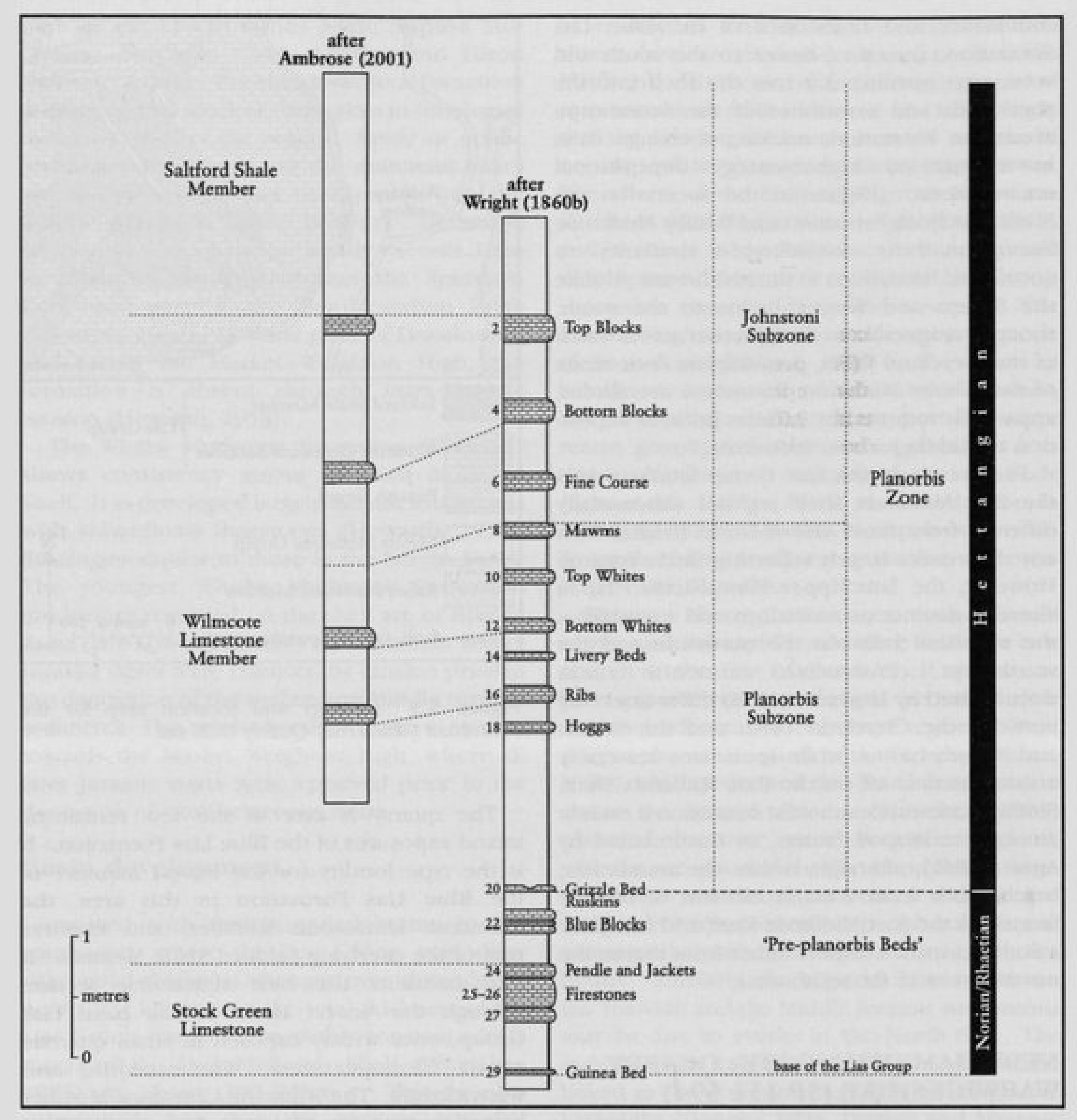
Conclusions

Newnham Quarry is the type locality for the Wilmcote Limestone Member at the base of the (Hettangian) Blue Lias Formation, which includes the so-called 'Insect Beds', laminated limestones that are a particularly characteristic feature of this part of the Lias Group across the Midlands. The site is the best extant inland exposure of the Blue Lias Formation and can be considered representative of this facies development both on the East Midlands Shelf and in the Severn Basin ((Figure 4.1), Chapter 4). The sequence shows a sharp transition from the well-oxygenated '*Ostrea liassica* and Saurian Beds', with an abundant and diverse benthic fauna, to the predominantly anoxic 'Insect Beds', in which benthos is virtually absent and the fauna is dominated by vagile nekton and drifted terrestrial debris. In the 19th and early 20th centuries the site was an important source of fossil fish, marine reptiles, plants and especially insects, fine examples of which are now in the Natural History Museum in London and the Warwickshire Museum.

References

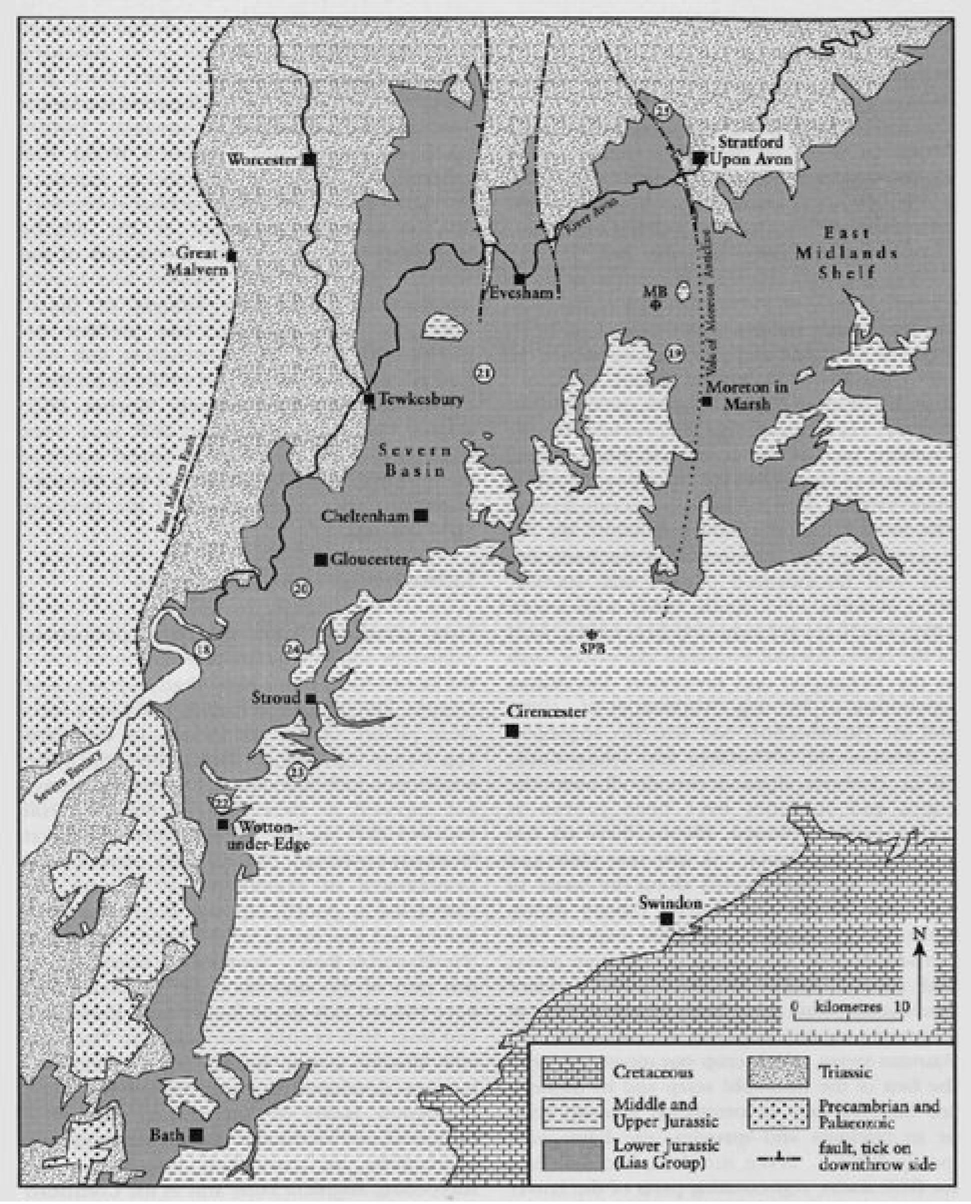


(Figure 5.3) Geology and location map for the Newnham (Wilmcote) Quarry GCR site.



(Figure 5.4) The section at Newnham (Wilmcote) Quarry as seen at the present day (Ambrose, 2001); and in the mid-19th century (Wright, 1860b).

(Figure 5.5) The basal Lias Group exposed at Newnham (Wilmcote) Quarry (Photo: British Geological Survey, No. A10835, reproduced by permission of the British Geological Survey. © NERC. All rights reserved. IPR/51–14C.)



(Figure 4.1) Generalized geology of the Severn Basin and western edge of the East Midlands Shelf. Only the main basin-bounding faults are indicated. Numbers correspond to the locations of the GCR sites: 18 — Hock Cliff; 19 — Blockley Station Quarry; 20 — Robin's Wood Hill Quarry; 21 — Alderton Hill Quarry; 22 — Wotton Hill; 23 — Coaley Wood; 24 — Haresfield Hill; 25 — Newnham (Wilmcote) Quarry (Chapter 5); MB — Mickleton Borehole; SPB — Stowell Park Borehole.