Tilton Railway Cutting, Leicestershire

[SK 763 053]

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Introduction

The Tilton Railway Cutting GCR site is a key geological site of national importance. The section here goes through the Pliensbachian–Toarcian boundary, and the site exposes a section through the full thickness of the Marlstone Rock Formation and parts of the underlying Dyrham Formation and overlying Whitby Mudstone Formation (Figure 5.15) and (Figure 5.16). It encompasses the only remaining exposure of the 'Transition Bed' at the top of the Marlstone Rock Formation, and has been designated as the type locality for the Marlstone Rock Formation (Cox *et al.* 1999), which is represented here by the Tilton Sandrock Member and the Banbury Ironstone Member.

This richly fossiliferous section has been of critical importance for establishing the Toarcian age of the upper part of the Marlstone Rock Formation in the Midlands and for demonstrating the true nature of the 'Transition Bed' as a weathering phenomenon.

The cutting has formed the subject of several important palaeontological and stratigraphical publications. It was described by Wilson and Crick (1889) soon after it had been excavated; their description included two new species from the site. Fox-Strangways (1903) published a photograph of the section taken at about the same time. It was mentioned briefly by Woodward (1893) and Whitehead *et al.* (1952). The section was described in detail by Hallam (1955), who discussed the succession and the palaeoecology of various brachiopod species within it (Hallam, 1962b, 1968a). The site also figured significantly in Hallam's (1967a) analysis of the Pliensbachian–Toarcian boundary beds, while observations of the Whitby Mudstone Formation here were incorporated in Wignall's (1991) model for the environment of deposition of transgressive black shales. The site has yield a rich and diverse invertebrate fauna. A new species of brachiopod, *Gibbirhynchia tiltonensis,* was described from the site by Ager (1954), who also discussed the palaeogeographical significance of the Tilton brachiopod fauna (Ager, 1956a). Lord (1974) investigated the site's microfauna, but recovered only a few poorly preserved ostracods from the Tilton Sandrock Member. The ammonite fauna and its stratigraphical significance has been the focus of the most recent publications, by Howarth (1980, 1992). The site gives its name to the Toarcian ammonite genus *Tiltoniceras,* which occurs abundantly in the top of the Marlstone Rock Formation, although the lectotype itself is from the Yorkshire coast (Howarth, 1992).

Description

The lowest part of the succession is exposed at the northern end of the cutting, with higher beds descending with the gentle southerly dip of the strata and the southward rise of the cutting floor. Beds 1 to 3, assigned to the Dyrham Formation, comprise about 2 m of silty mudstones with a 0.25 m-thick bipartite sandstone and limestone bed. This part of the succession has yielded *Amaltheus subnodosus* and *A. margaritatus.*

There is a clear contact characterized by erosion between the Dyrham Formation and the overlying Marlstone Rock Formation, with reworked pebbles, containing *Amaltheus* sp. (R.G. Clements, pers. comm.) incorporated into the lowest unit (Bed 4) of the latter formation.

A broad two-fold division of the Marlstone Rock Formation can be recognized in the East Midlands, into an upper ironstone unit, here termed the 'Banbury Ironstone Member', and a lower sandstone unit, often referred to as the 'Sandrock' and here termed the 'Tilton Sandrock Member'. Hallam (1955) identified two biofacies within the Banbury Ironstone Member itself each characterized by a distinctive brachiopod fauna. The lower of these, Hallam's 'Band B', is dominated by *Tetrarhynchia tetrahedra* and *Lobothyris punctata.* These taxa become rare in the upper biofacies in the top 0.9 m of the Marlstone Rock Formation, which instead is dominated by *Gibbirhynchia northamptonensis* and *Zeilleria* *subdigona.* Both are also present in smaller numbers in the lower biofacies unit but the upper unit is distinguished by the first appearance of *Gibbirhynchia tiltonensis.*

The 'Transition Bed' at the top of the Marlstone Rock Formation has been described as a pale-brown or cream, finely oolitic limestone, sometimes flaggy and sometimes passing up into sandy marl. It varies from 0.01 m to 0.25 m in thickness and gives the impression of resting non-sequentially on an irregular surface developed on the dark-green oolitic ironstone beneath, with the boundary often marked by an undulating thin sheet of limonite. Specimens of *Tiltoniceras antiquum, Dactylioceras semicelatum* and *Gibbirhynchia tiltonensis* are common in the top 0.2 m, together with many small gastropods and other fossils. A full list of fossils found in the Marlstone Rock Formation was published by Wilson and Crick (1889) and included two new species; the bivalve *Pinna tiltonensis* and the echinoid *Eodiadema granulata.*

Lord's (1974) investigation of the microfauna proved the lowest paper shales of the Whitby Mudstone Formation exposed nearby to be barren, though ostracods were recovered from the Tilton Sandrock Member. Most were heavily encrusted with quartz grains and many were unidentifiable, though examples of *Pachycythere tubulosa tubulosa* and *T. verrucosa* were recovered; they represent one of very few records of ostracods from this stratigraphical level (assumed by Lord to be the Spinatum Zone, but see 'Interpretation' below).

Interpretation

At the top of the succession exposed at Tilton Railway Cutting, the Whitby Mudstone Formation lies entirely within the Serpentinum Zone. Howarth (1980) assigned the lower 2.80 m to the Exaratum Subzone but concluded, from the absence of *Cleviceras exaratum* itself that the lower part of the subzone was represented by a non-sequence between the Whitby Mudstone Formation and the Marlstone Rock Formation beneath.

The site has proved critical to understanding the true nature of the 'Transition Bed'. From the time of Wilson and Crick (1889) this was regarded as a distinct unit 'welded' to the top of the Marlstone Rock Formation. This perception arose partly from the presence of an abundant Toarcian fauna in the 'Transition Bed'. Howarth (1980) showed that the 'Transition Bed' is not a separate unit but Is merely the weathered top of the Marlstone Rock Formation, in which the chamosite and siderite of the oolitic ironstone have been weathered to limonite. Where it has been partly decalcified it assumes a friable granular texture. The Toarcian fauna is not confined to the 'Transition Bed' but extends into the unweathered ironstone beneath. Howarth (1980) even observed vertically embedded ammonites that cross the boundary between the 'Transition Bed' and the ironstone beneath, establishing unequivocally that the supposed non-sequence is no more than a weathering front.

Howarth's (1980) observations at Tilton, and at other locations along the outcrop of the Marlstone Rock Formation, showed that the upper part of the formation was of Toarcian age. At Tilton only the Semicelatum Subzone, the uppermost subzone of the Tenuicostatum Zone, has been proven for the top 0.9 m. No evidence has been found for the lower three subzones. *Pleuroceras* cf. *hawskerense,* indicative of the underlying Hawskerense Zone, has been found 3.0 m below the top of the Marlstone Rock Formation and hence it is possible that part or all of the remainder of the Tenuicostatum Zone is represented in the intervening 2.1 m. However, amaltheid ammonites are rare in the Marlstone Rock Formation of the Midlands (Howarth, 1958) and hence it can only be assumed that the lower part of the formation here may lie entirely within the Spinatum Zone. Howarth (1958) concluded that the Banbury Ironstone Member corresponded broadly with the Hawskerense Subzone and the Tilton Sandrock Member could be assigned to the Apyrenum Subzone.

The presence of *Amaltheus subnodosus* and *A. margaritatus* indicates that the top of the underlying Dyrham Formation can be assigned to the Subnodosus Subzone (R.G. Clements, pers. comm.). The erosion surface and the presence of pebbles and derived specimens of *Amaltheus at* the top of this unit implies the existence of a non-sequence that cuts out at least the overlying Gibbosus Subzone.

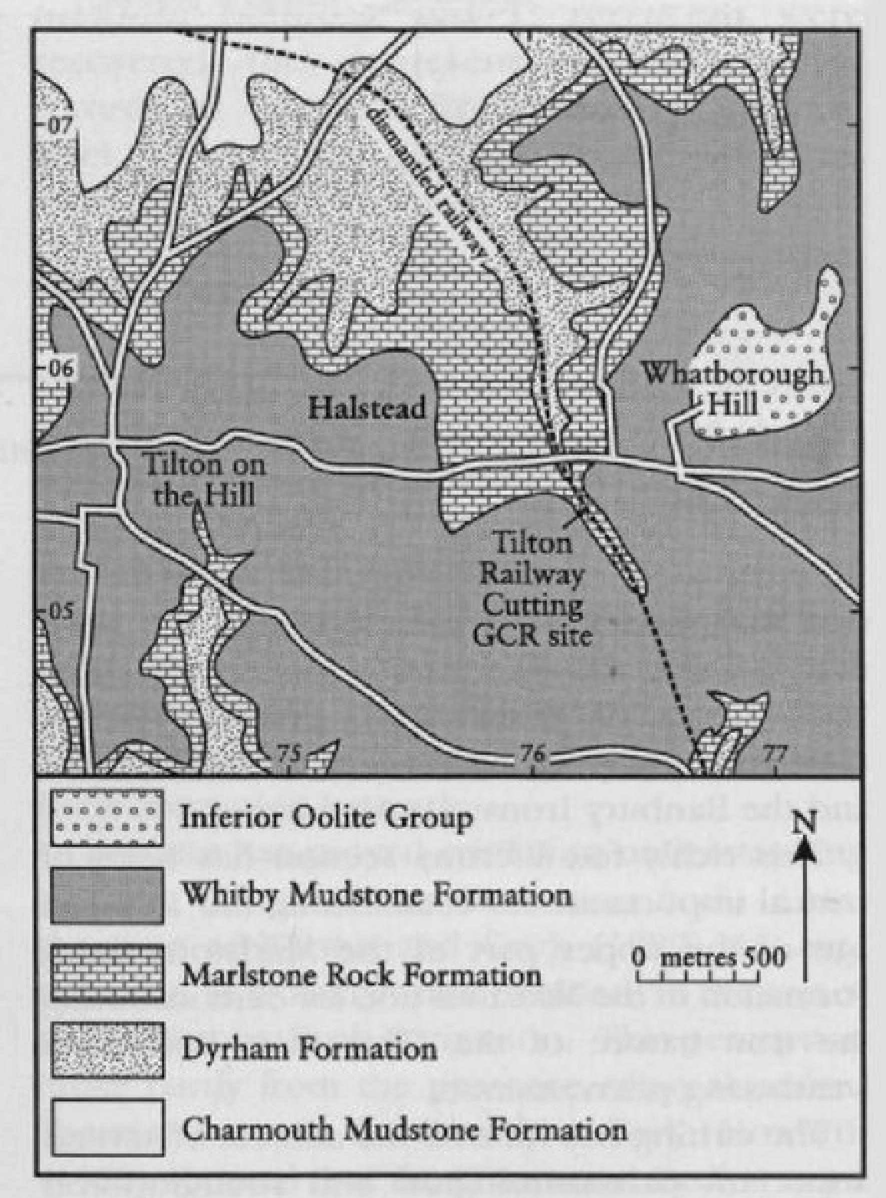
The rich brachiopod and mollusc fauna of the Marlstone Rock Formation at Tilton has been the subject of several palaeoecological and biogeographical publications (Ager, 1956a; Hallam, 1955, 1962b). Hallam (1955) noted that fossil material occurred in two distinct taphonomic settings. In one of these, exemplified by his 'Band A', the brachiopods occur as small densely packed clusters of *Tetrarhynchia tetrahedra* and *Lobothyris punctata* showing little evidence of disarticulation and with many of the shells filled with calcite rather than sediment. They exhibit a wide size-range, suggesting a natural population; Hallam (1962b) considered them to represent life assemblages that grew during periods of reduced current activity. Individual clusters of brachiopods appear to have spread and coalesced, perhaps indicating a longer period of relative quiescence. The other type of shell accumulation, a thanatocoenosis, is exemplified by Hallam's 'Band B' and contains broken and disarticulated shells of bivalves, brachiopods and belemnites. Ager (1956a) recognized a distinctive brachiopod fauna in the Marlstone Rock Formation of the Tilton area and proposed a separate Tilton Subprovince within the wider Midland Province. Like other parts of the Midland Province the fauna is dominated by a super-abundance of *Tetrarhynchia tetrahedra* and *Lobothyris punctata* and an abundance of *Gibbirhynchia northamptonensis* but is distinguished by abundant *Zeilleria subdigona* near the top of the Marlstone Rock Formation. This last species it shares in common with the Spinatum Zone in Yorkshire but it lacks characteristic south-western taxa, such as *Quadratirhynchia* spp. and *Homoeorhynchia acuta,* and hence is distinct from the Banbury Subprovince to the south. Howarth (1958) commented on the remarkable correlation between Ager's brachiopod provinces and the biogeography of the various species of the ammonite *Pleuroceras.* For this group the Midland Province appears to have represented a significant barrier between the faunas of the South-western and Yorkshire provinces, with only a few individuals of *Pleuroceras spinatum* and *P. hawskerense* appearing to have strayed into the region. Ager (1956a) commented on the relatively low diversity of the Tilton brachiopod fauna, despite the abunance of the four species mentioned. This suggests generally adverse conditions for brachiopod colonization and growth, perhaps associated with a mobile and unstable substrate. The life assemblages indicate periods of relatively calm conditions punctuated by episodes of stronger current activity and sediment movement that brought about the death and burial of the brachiopod clusters as well as transporting and breaking up fossil material and creating the prominent cross-bedded units. The same factors that restricted brachiopod diversity in this area may also have prevented the successful establishment of the amaltheid ammonites during ironstone deposition.

As one of only a small number of inland exposures of the Mar(stone Rock Formation and contiguous strata, Tilton Railway Cutting provides an important comparative section for other sites to north and south. The Marlstone Rock Formation at the Neithrop Fields Cutting GCR site, some 65 km to the south-west, differs from that seen here in being developed entirely in ironstone facies. The succession at the Napton Hill Quarry GCR site, 45 km to the south-west, shows greater affinities with that at Tilton since, although the ironstone facies is weakly developed, a 0.5 m-thick sandstone unit occurs in the lower part of the Marlstone Rock Formation. The occurrence of ironstone accumulations at Tilton, as elsewhere in the East Midlands Ironstone Field, indicates the presence of a mechanism for clastic sediment starvation during deposition. The development of ironstone facies may have been associated with local highs on the sea floor, separated from sources of terrigenous sediment by local depocentres. These putative features perhaps reflect the configuration of en-echelon fault-bounded blocks in the underlying basement, with ironstones accumulating on the upthrown crests of these fault blocks and clastics deposited in the downdip troughs. Support for this comes from the general coincidence of the south-western margin of the Midlands Ironstone Field with the Vale of Moreton Anticline, which was known to have been active in Lower Jurassic times (Whittaker, 1972b). Intra-Liassic movement on some of these basement faults may have shifted the location of local depocentres over time and perhaps accounts for the upward transition from sandstone to ironstone facies in parts of the ironstone field.

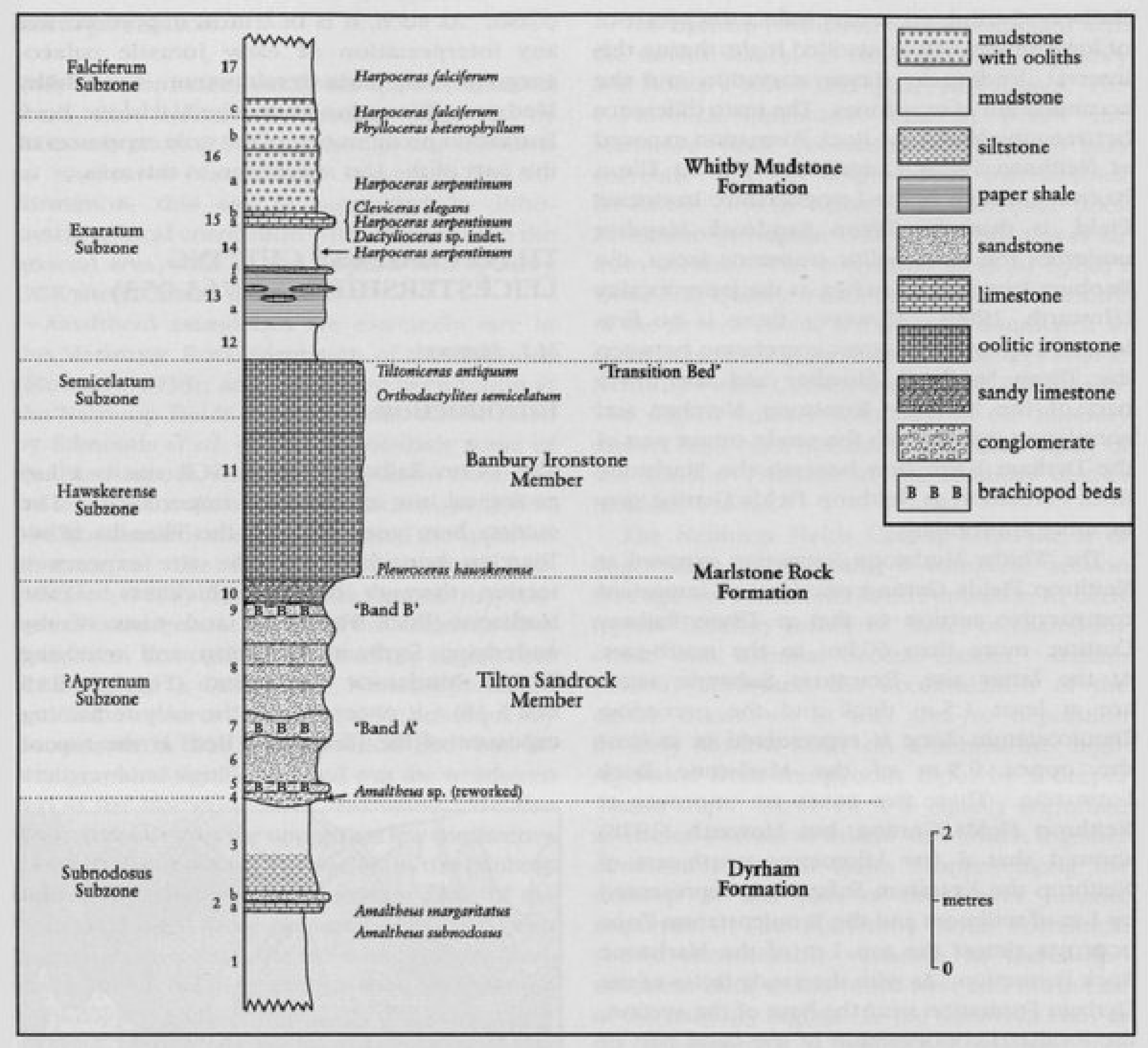
Conclusions

The exposure of the Marlstone Rock Formation and contiguous strata at Tilton Railway Cutting is the finest remaining in the Leicestershire Ironstone Field, exposing both the ironstone and sandstone facies. It is a vital link in a small series of inland sites that establish the distribution and nature of regional variations in Upper Pliensbachian times between the coastal exposures of Dorset and Yorkshire. Observations made here have proved critical to understanding the true nature of the 'Transition Bed' and in establishing the Toarcian age of the upper part of the Marlstone Rock Formation in the Midlands. The rich brachiopod fauna has formed the subject of important palaeoecological and biogeographical investigations. Several invertebrate species were first described from this site, which also lends its name to the basal Toarcian ammonite *Tiltoniceras.*

References



(Figure 5.15) Geology and location map of the Tilton Railway Cutting GCR site.



(Figure 5.16) The section exposed at Tilton Railway Cutting. After Roy Clements, unpublished, reproduced with permission.