Neithrop Fields Cutting, Oxfordshire

[SP 439 419]

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Introduction

The Neithrop Fields Cutting GCR site is a former mineral railway cutting (Figure 5.13), which is now a tarmacked path through a residential housing estate. It is the only site on the western edge of the East Midlands Shelf at which parts of the Upper Pliensbachian and Toarcian Middle and Upper Lias are exposed. It provides an outstanding section through the two, allowing the transition between them to be examined.

Although the Marlstone Rock Formation formerly was worked extensively in the Banbury district, either for low-grade ironstone or for building stone, the workings rarely penetrated the base of the formation and the succeeding Whitby Mudstone Formation often was absent through recent erosion. The cutting at Neithrop Fields exposes the full thickness of the Marlstone Rock Formation, almost 10 m of the underlying Dyrham Formation and the lowest 2 m of the overlying Whitby Mudstone Formation (Figure 5.14).

This GCR site is one of a series of inland sites between the coastal exposures of Yorkshire and Dorset that include the Napton Hill Quarry, Tilton Railway Cutting, Robin's Wood Hill Quarry and Maes Down GCR sites. These sites reveal the lateral facies changes in the Upper Pliensbachian and Toarcian succession and their relationship to underlying structures. Neithrop Fields Cutting is a key palaeogeographical and stratigraphical locality.

The most detailed account of the section was given by Edmonds *et al.* (1965), who provided a sketch of the strata exposed on the southern face of the cutting (Figure 5.14). It was also referred to, though in less detail, by Lamplugh *et al.*(1920), Arkell (1947) and Whitehead *et al.* (1952).

Description

The Lower Jurassic strata exposed in the Neithrop Fields Cutting dip gently westwards and are disturbed by flexuring and minor faulting. The succession, modified after Edmonds *et al.* (1965), is as follows.

	Thickness (m)
Whitby Mudstone Formation	
28: Shale, grey.	0.30
27: Oolite, thinly bedded, ferruginous.	0.20
26: **Upper Cephalopod Bed**: Oolite, greyish-blue, often ferruginous, *ammonites; Harpoceras* cf. *falciferum* and *Zugodactylites* cf *braunianus* recorded by Arkell (1947).	0.30
25: Clay, calcareous, shaly, with ammonites near top.	0.60
24: **Lower Cephalopod Bed**: Limestone, fine grained, with ammonites and calcite veining; *Harpoceras falciferum, Dactylioceras athleticum, D. gracile, Hildoceras* sp. and *Trachylytoceras* sp.	0.20
23: Clay.	0.23
22: Clay, oxidized, ferruginous.	0.02
21: Limestone, pale, discontinuous, sideritic.	to 0.08
20: Conglomerate, discontinuous, with large flattened and rounded limestone clasts.	to 0.05
Marlstone Rock Formation	

19: Oolite, calcitic and sideritic or chamositic, in discontinuous beds, alternating with weathered limonitic horizons. Abundant bioclastic debris. *Lobothyris punctata, L. edwardsi, Tetrarhynchia tetrahedra, Rudirhynchia* cf. *huntcliffensis, Gibbirhynchia* sp., *Zeilleria* sp., *?Spiriferina, Camptonectes cf. mundus, Chlamys cf. Julianus, Oxytoma inequivalvis, Pleuromya costata, Pseudopecten sp., Liostrea sp., Balanocrinus donovani and belemnites.*	4.3
18: Conglomerate, ferruginous, with oysters above.	0.22
Dyrham Formation	
17: Mudstone, silty, micaceous.	0.15
16: Limestone, thinly bedded, shelly, ferruginous, with ironstone nodules.	0.15
15: Shell band, ferruginous, earthy.	0.10
14: Mudstone, limonitic, silty	0.25
13: Mudstone, rather ferruginous, silty, micaceous.	0.13
12: Mudstone, silty, micaceous, with ferruginous layers and nodules.	0.93
11: Clay, grey, silty.	0.15
10: Limestone, bluish-grey, coarsely bioclastic.	0.15
9: Mudstone, sandy and silty, calcareous, micaceous.	0.72
8: Mudstone, micaceous, silty.	0.08
7: Shelly ferruginous band with ironstone nodules.	0.20
6: Limestone, bluish-grey, locally ferruginous.	0.15
5: Mudstone, ferruginous, shelly, micaceous, with ironstone nodules at top.	0.20
4: Limestone, shelly, ferruginous. *Amaltheus* sp..	0.08
3: Clay, discontinous, micaceous, silty.	0.01
2: Limestone, fine, massive, with calcite veins.	0.82
1: Shale and mudstone, micaceous, with ferruginous bands and limestone and ironstone nodules.	5.5

The Dyrham Formation comprises about 10 m of micaceous, silty, and sometimes sandy, mudstone. Limestone and ferruginous bands, often rich in shell debris, occur at several horizons, particularly in the upper part of the section. Most are no more than 0.15 m thick but a finer, more massive limestone (Bed 2) reaches 0.8 m in thickness and is a useful marker horizon. Elsewhere, limestone and ironstone nodules occur scattered through the section or are concentrated at particular levels. Eastwards from the main cutting, discontinuous exposures of brownish, silty, micaceous shale were reported by Edmonds *et al.* (1965) to pass into grey micaceous Lower Lias clays. Lamplugh *et al.* (1920) stated that only 40 feet (12.3 m) of Middle Lias was present below the Marlstone Rock Formation.

The Marlstone Rock Formation here is 4.75 m thick and is dominated by calcareous chamositic and sideritic oolite, in places deeply weathered to limonite. The ooliths may be scattered or concentrated in patches or clusters. Other elements of the Marlstone Rock Formation include shell fragments, crystals of chamosite and siderite, and ferruginous mud pellets similar in size to the ooliths. In unweathered samples the whole may be set in a matrix of sideritic ferruginous mud or calcite cement. Weathering leaches out the carbonate component of the Marlstone Rock Formation, concentrating the iron as the hydrated oxide limonite. Although Edmonds *et al.* (1965) divided the Marlstone Rock Formation into 13 distinct units, these show great lateral variation and few can be traced any distance. Cross-bedding is common throughout the formation and impersistent lenses of shelly calcareous limestone commonly replace the dominant ferruginous oolite facies. The basal unit here comprises a 0.22 m-thick ferruginous conglomerate that can be traced over much of the Banbury area. Clasts within the conglomerate are well-rounded fragments of ironstone and phosphatic mudstone together with eroded belemnites and other fossil debris. The casts are embedded in an ironstone matrix rich in quartz grains. Encrusting bivalves are recorded from immediately above the conglomerate (Edmonds *et al.,* 1965).

Only about 2 m of the succeeding Whitby Mudstone Formation was recorded by Edmonds *et al.* (1965). The lowest unit is a discontinuous conglomerate, up to 0.05 m thick, of large flattened and rounded limestone clasts, which is overlain by up to 0.08 m of pale sideritic oolite. Within the overlying grey mudstones are two further limestone units. The lower is a fine-grained limestone 0.2 m thick while 0.6 m higher is a 0.5 m-thick ferruginous oolite, more thinly bedded in the upper part.

Fossils, other than shell debris, are uncommon in the silty mudstones of the Dyrham Formation but Edmonds *et al.* (1965) listed a number of fossil taxa, mainly brachiopods and bivalves, from the Marlstone Rock Formation. Ammonites, bivalves and crinoid debris are fairly common in the overlying Whitby Mudstone Formation, although not in the conglomerate and oolite at the base. Edmonds *et al.* (1965) were rather imprecise about the exact horizons from which fossil material was obtained but their account suggests that most of the Toarcian material was from the Upper Cephalopod and Lower Cephalopod beds.

Interpretation

Only one ammonite, *Amaltheus* sp., was recorded from the Dyrham Formation (Bed 4) by Edmonds *et al.* (1965). Although not sufficient to confirm a Margaritatus Zone age for the formation, this age is supported by lithostratigraphical correlation with other sites in the general area, such as the Napton Hill Quarry GCR site 20 km to the north.

Amaltheid ammonites are extremely rare in the Marlstone Rock Formation of the Midlands (Howarth, 1958), and none have been found at the Neithrop Fields Cutting. Other fossils listed by Edmonds *et al.* (1965), particularly some of the brachiopods, indicate a Spinatum Zone age for most, if not all, of this formation (Ager, 19561967). Edmonds *et al.* (1965) noted the apparent absence of the so-called 'Transition Bed' (Watford, 1878) from this site despite its widespread occurrence at the top of the Marlstone Rock Formation throughout the Banbury region and farther afield in Oxfordshire, Northamptonshire and Leicestershire. Howarth (1980) subsequently demonstrated that the 'Transition Bed' had no stratigraphical significance and was the weathered top of the Marlstone Rock Formation. He also showed that at least the uppermost few centimetres of the Marlstone Rock Formation in the Banbury district lie within the Tenuicostatum Zone of the Toarcian Stage. Since no ammonites have been recorded either from the main body of the Marlstone Rock Formation or from the conglomerate (Bed 20) and limestone (Bed 21) that immediately succeed it, the placing of the Pliensbachian–Toarcian boundary at the base of the conglomerate (Bed 20) is, essentially, arbitrary.

Edmonds *et al.* (1965) recorded stratigraphically diagnostic ammonites from the Lower and Upper cephalopod beds in the Whitby Mudstone Formation, two prominent limestone marker bands recorded elsewhere in Northamptonshire. The Lower Cephalopod Bed is of Falciferum Subzone age, as are the clays beneath (beds 22 and 23) (Howarth, 1978). The Upper Cephalopod Bed, and the beds above (beds 27 and 28) and immediately below (Bed 25), can be assigned to the Commune Subzone at the base of the Bifrons Zone. The entire Tenuicostatum Zone and the succeeding Exaratum Subzone of the Serpentinum Zone, if present, must lie within the upper part of the Marlstone Rock Formation and the discontinuous conglomerate and limestone units immediately above.

The Dyrham Formation can be compared with the similar sections at the Napton Hill Quarry and Robin's Wood Hill Quarry GCR sites. The 0.8 m-thick limestone (Bed 2) below the Marlstone Rock Formation at Neithrop may correlate with an impersistent 0.88 m-thick limestone 5.54 m below the Marlstone Rock Formation at Napton Hill Quarry but this is far from certain. The correlative beds at Robin's Wood Hill Quarry, which lies towards the centre of the Severn Basin, are siltstone-dominated in contrast to the slightly sandier sequences seen at Neithrop Fields Cutting and Napton Hill Quarry. The slightly coarser sediments in the Banbury district have been attributed to greater uplift of the London Platform in the Banbury district (Hallam, 1968a).

The Neithrop Fields Cutting GCR site is of importance in exposing a complete section through the Marlstone Rock Formation in fairly typical 'Banbury Ironstone' facies of chamositic oolite with minimal detrital clastics. Hallam (1967a) attributed the accumulation of the oolitic ironstones in this area to deposition in fairly shallow-water on a submarine 'high' separated from terrigenous input by a deeper 'clastic trap'. However, it is equally important as one of a series of inland sites which together demonstrate lateral facies changes along the outcrop in this part of the Lower Jurassic sequence. The Marlstone Rock Formation shows considerable variation in facies and thickness both to the south-west and north-east of the Banbury region. In the Cotswold Hills to the south-west it is typically a relatively thin oolitic, often ferruginous, bioclastic limestone. In its thicker development towards the centre of the Severn Basin it may contain a significant sandstone component as on Bredon Hill (Whittaker and Ivimey-Cook, 1972). To the north of the Banbury region the ironstone facies thins and becomes less chamositic while the lower part of the Marlstone Rock Formation is developed as a sandstone. Both units are well exposed at the Napton Hill Quarry GCR site. The Marlstone Rock Formation thickens again into an oolitic ironstone as it passes onto the East Midlands Shelf in north-east Leicestershire and southern Lincolnshire, but thins once more to the north and disappears entirely near Lincoln as the Market Weighton Block is approached.

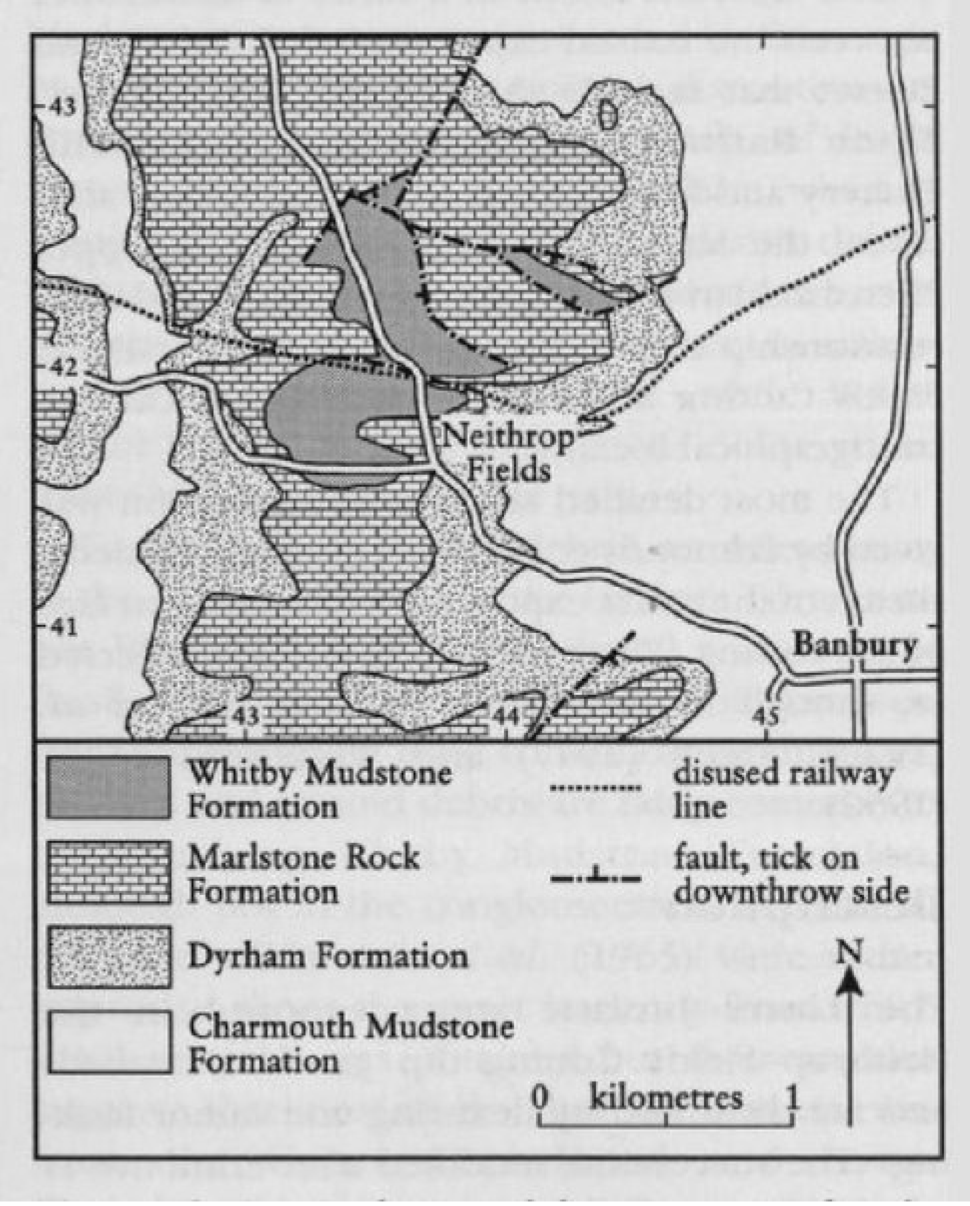
The development of the thick ironstone facies in both the Neithrop Fields Cutting and Tilton Railway Cutting areas may reflect the presence of local structurally controlled highs during this interval, leading to clastic starvation and the accumulation of ironstones. The main difference between the Marlstone Rock Formation exposed at Neithrop Fields Cutting and that at Tilton Railway Cutting, in the Leicestershire Ironstone Field, is that the Tilton Sandrock Member underlies the main oolitic ironstone facies, the Banbury Ironstone Member, at the latter locality (Howarth, 1980). However, there is no firm basis for assuming a direct correlation between the Tilton Sandrock Member and the lower part of the Banbury Ironstone Member and correlation instead with the sandy, upper part of the Dyrham Formation beneath the Marlstone Rock Formation at Neithrop Fields Cutting may be more appropriate.

The Whitby Mudstone Formation exposed at Neithrop Fields Cutting provides an important comparative section to that at Tilton Railway Cutting, more than 60 km to the north-east. At the latter site, Exaratum Subzone strata are at least 1.5 m thick and the preceding Tenuicostatum Zone is represented in at least the upper 0.9 m of the Marlstone Rock Formation. These two zones are unproven at Neithrop Fields Cutting, but Howarth (1978) showed that a few kilometres north-east of Neithrop the Exaratum Subzone is represented by 1 m of sediment and the Tenuicostatum Zone occupies almost the top 1 m of the Marlstone Rock Formation. As with the sandy facies of the Dyrham Formation near the base of the section, the localized condensation of the basal part of the Whitby Mudstone Formation at Neithrop Fields Cutting may also reflect slightly greater uplift in this area of the London Platform.

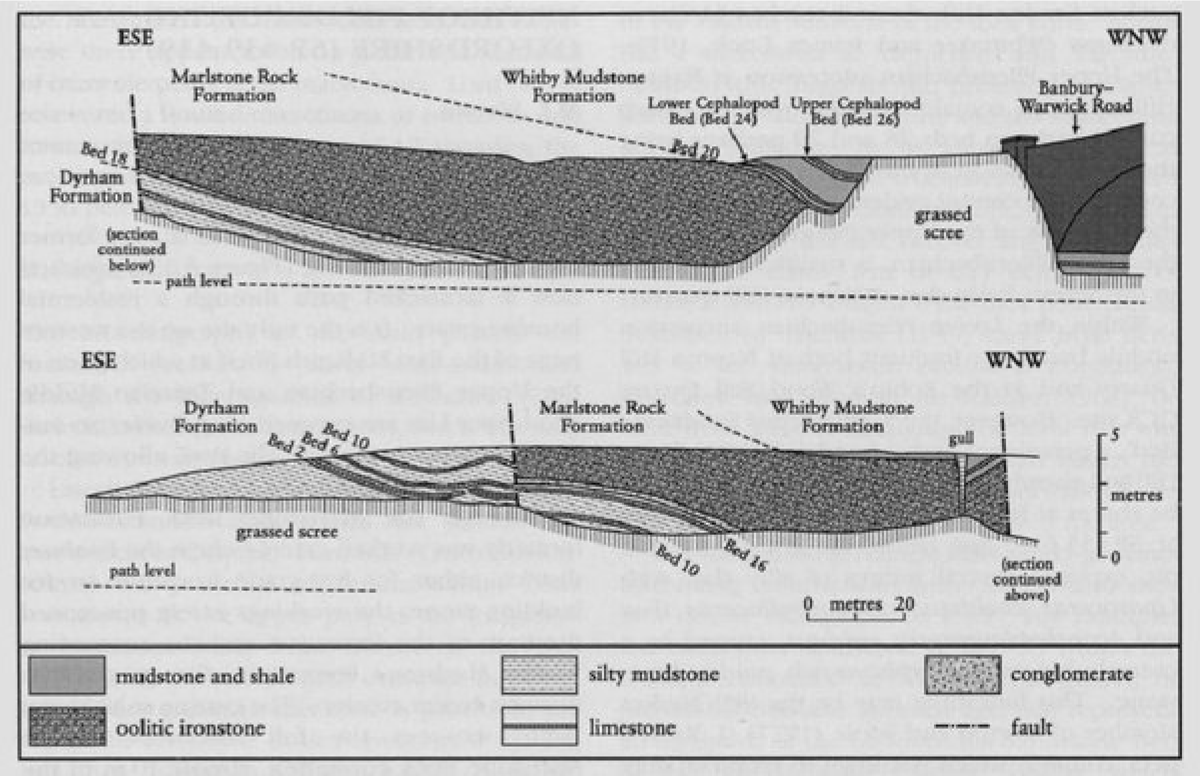
Conclusions

The importance of the Neithrop Fields Cutting lies primarily in exposing a complete section through the thick, oolitic ironstone facies of the Marlstone Rock Formation. This is developed over a considerable area around Banbury on the north-western margin of the London Platform but, although widely exploited as an ore of iron, the quarries rarely exposed the base and none are now working. It is one of a series of inland sites that together demonstrate the substantial facies changes shown by the Upper Pliensbachian succession in passing along the Jurassic outcrop between the Dorset and Yorkshire coasts. As such, it is of critical importance for any interpretation of early Jurassic palaeogeography and basin development. The Whitby Mudstone Formation above the Marlstone Rock Formation provides one of the only exposures of this part of the Lias succession in this area.

References



(Figure 5.13) Geology and location map for the Neithrop Fields Cutting GCR site.



(Figure 5.14) The section at Neithrop Fields Cutting. After Edmonds et al.(1965).