

# Former workings in Jurassic ironstone near Grantham

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**Abstract:** The Lower Jurassic Marlstone Rock Formation was formerly worked for ironstone near Denton (SE Lincolnshire), and the Middle Jurassic Northampton Sand Formation near Hungerton and Colsterworth (SE Lincolnshire) and Saltby (NE Leicestershire), southwest and south of Grantham. Two ammonites from the Northampton Sand Formation at Hungerton are illustrated.

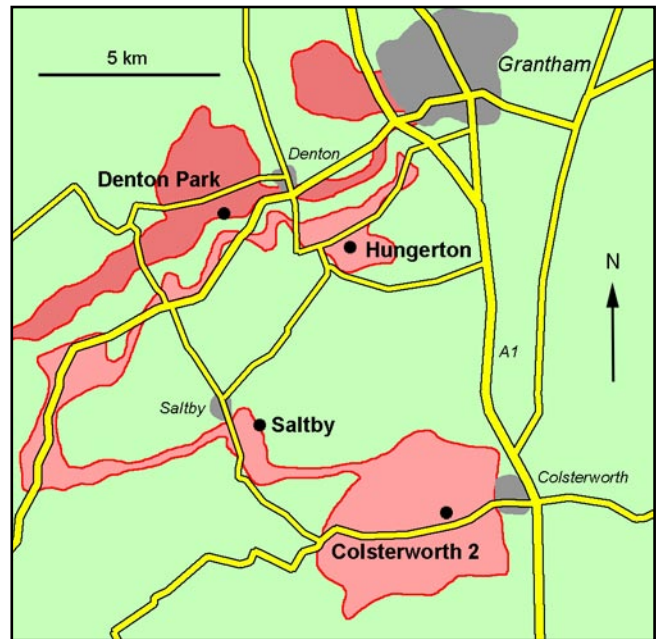
Four ironstone quarries near Grantham (Fig. 1) were visited during an excursion from the British Association meeting in Nottingham in 1966. One, at Denton Park in SE Lincolnshire, was worked for the Marlstone Rock Formation (Upper Pliensbachian – Toarcian; formerly the Marlstone Rock Bed). The others, at Colsterworth and Hungerton in SE Lincolnshire and Saltby in NE Leicestershire, were worked for the Northampton Sand Formation (Aalenian; formerly the Northampton Sand Ironstone Formation). The lithostratigraphic nomenclature follows Cox *et al.* (1999) and Carney *et al.* (2004), with equivalents used in older literature given in parenthesis at the first mention.

The Denton and Hungerton sites are now infilled, but exposures remained at Colsterworth and Saltby in 2008. Photographs taken in 1966 record a once-important extractive industry in its last years. (All grid references cited below are [SK]).

## Denton Park Pit, in Marlstone Rock

The history of working at Denton Park [857317], the most easterly of the quarries in this formation in the Woolsthorpe area, was documented by Tonks (1992). In 1966 this quarry was worked by Stewarts & Lloyds Minerals Ltd. About 3 m of the Marlstone Rock was exposed in the lowest part of the excavations (Fig. 2),

below the Whitby Mudstone Formation (formerly Upper Lias). The ironstone, a slightly calcareous sideritic ore, was greenish-black when unweathered, and whitish or grey-brown when weathered. Cross-bedding indicated an easterly transport direction, similar to that recorded



**Figure 1.** Locations of the four ironstone quarries and the outcrops of the two ironstone beds (generalised, and including sub-economic material); the darker red is the Marlstone Rock Formation and the paler red is the Northampton Sand Formation.



**Figure 2.** Two views of Denton Park Pit in 1966, with the Marlstone Rock Formation overlain by the Whitby Mudstone Formation

in the formation near Holwell, c.14 km SW of Denton Park (Carney *et al.*, 2004, fig.21). The only fossils seen in profusion in the Marlstone Rock were belemnites (*Passaloteuthis*). Brachiopods, including *Lobothyris punctata* (J. Sowerby) and *Tetrarhynchia tetrahedra* (J. Sowerby), and bivalves were seen but were more randomly scattered in the formation. Hallam (1955) gave an account of the stratigraphy and palaeontology of the Marlstone Rock in Leicestershire and later he interpreted clusters of *L. punctata* and *T. tetrahedra* present in that unit in quarries at Branston, c.5 km WSW of Denton Park, as biocoenoses (Hallam, 1962); an example was illustrated by Carney *et al.* (2004, pl.11). The Whitby Mudstone at Denton Park contained brachiopods, bivalves, ammonites, including *Dactyloceras* and *Harpoceras*, and belemnites.

Whitehead *et al.* (1952) noted that the Marlstone Rock worked on the western side of Denton Park and south of Denton between 1916 and 1930 comprised c.3 m of brown decalcified ironstone with some bluish-green bands, and, when dry, contained 37% iron, 12.3% silica and 2.3% lime. Later workings, in Denton Park Quarry, comprised an east-west face some 275 m long in which c.0.6 m of ironstone rubble rested on 1.5 to 2.1 m of “rather soft brown limy ironstone with much green stone and occasional shelly bands, notably towards the base” (Whitehead *et al.*, 1952, 121). Analyses made in 1940 by the Stanton Ironworks Company showed the ironstone here to be a relatively high-grade ore with an iron content, when dry, of 36.62 to 38.4%, and with 13.65 to 14.2% silica and 2.0 to 3.6% lime. Trials in a large unworked area revealed an easterly-trending zone of “barren material” up to 185 m wide south of the Denton Park Quarry face. In the area as a whole the ironstone had a workable thickness of c.2.12 m, with an iron content of 26 to 35%; silica averaged 10% and lime 10 to 17%. Carney *et al.* (2004, pl. 9a, b) illustrated the petrography of the Marlstone Rock with photomicrographs of specimens from Brown’s Hill Quarry, near Holwell, and from one near Branston.

Denton Park was one of the Woolsthorpe group of workings where Stewarts & Lloyds Minerals Ltd introduced the practice of laying rail tracks on the ironstone bed (Fig. 2), rather than on the floor of the quarry (Tonks, 1992). After temporary closure in 1962, activity continued until 14 February 1974, when the last loads of ironstone left the quarry and 91 years of quarrying in the Woolsthorpe area, and all working of the Marlstone Rock, came to an end.

5. Upper Chamosite – Kaolinite Group
4. Upper Siderite Mudstone – Limestone Group
3. Lower Chamosite – Kaolinite Group
2. Main Oolitic Ironstone Group
1. Lower Siderite Mudstone – Limestone Group

**Table 1.** Sub-divisions of the Northampton Sand (after Taylor 1949, from Hollingworth).

The Marlstone Rock is no longer visible at Denton but exposures have been documented nearby in Lincolnshire [at 871357] (Berridge, *et al.*, 1999, pl.3), and at several sites in Leicestershire, including Brown’s Hill Quarry SSSI [741234], near Holwell, the Tilton railway cutting SSSI [76160555] and quarries at Pickwell [78411157, 78951130] (Stevenson, 1964; Clements, 1989; Cox *et al.*, 1999; Carney *et al.*, 2002, 2004, 2009; Ambrose, 2006). Whitehead *et al.* (1952, pl.1B) and Carney *et al.* (2003, pl.17) illustrated workings near Eastwell, c.8.5 km SW of Denton Park. Others illustrated were farther SW, at Holwell (Whitehead *et al.*, 1952, pl.1A) and near Wartnaby (Anon., 2000); the latter site was described as in ‘Middle Lias Limestone’.

## The Northampton Sand Formation

The other sites visited in 1966 were in this formation, the petrology of which was documented by Taylor (1949) and other aspects, including its distribution and stratigraphy, by Hollingworth and Taylor (1951). These sites all lie within areas affected by large-scale ‘valley bulging’ (Hollingworth *et al.*, 1944, pl.III). Their history and working were documented by Tonks (1991). Two ammonites collected from the Northampton Sand Formation at Hungerton in 1966 are noted and illustrated because of their rarity in that formation.

## Hungerton Pit

This was one of the Harlaxton group of workings and was known as Harlaxton No. 4 (Hungerton) quarry [883305 to 889309] (Tonks, 1991). In 1966, it was worked by Stewarts & Lloyds Minerals Ltd in a face that extended WSW-ENE for some 800 m. The quarry exposed Northampton Sand (c.6 m) overlain successively by the Grantham Formation (formerly the Lower Estuarine Series, c.5 m) and the Lincolnshire Limestone Formation. The Whitby Mudstone Formation was visible locally beneath the Northampton Sand (Stevenson, 1964).



**Figure 3.** ‘Boxstone’ structure in the Northampton Sand Formation exposed at Hungerton Pit in 1966.

The Northampton Sand was divided into five units (Table 1). Of these, units 3 to 5 had a relatively limited distribution (Taylor, 1949). Only units 1 to 3 were seen at Hungerton where Unit 1, up to 3 m thick, but averaging c.2.25 m, was largely unworkable; Unit 2 was up to 4.6 m thick but averaged c.2.25 m, and Unit 3, up to c.1.5 m thick, comprised unworkable beds that occupied channels. The Lincolnshire Limestone at Hungerton was highly cryoturbated, and the Northampton Sand, an oolitic sideritic ironstone with a kaolinite content of 23 to 28%, showed very distinct 'boxstone' structure (Fig. 3), a product of weathering (Taylor, 1949). In places, a thin sideritic mudstone, resting on a decalcified shell bed, was present at the top of the Northampton Sand but in others only the shell bed was present. This bed contained large pectinids and other bivalves, many of which had been bored, as indicated by ferruginous tubes that remained in relief after dissolution of the shell.

The Hungerton pit subsequently extended WSW-ENE for 1.6 km. Activity there around 1971, and on 14 February 1974 when the last ironstone left the quarry and working in the Northampton Sand north of the Welland valley ended, was illustrated by Tonks (1991). Kent (1975) referred to it as 'Harlaxton Main Face (No. 4 Mine)' and provided descriptions of the Northampton Sand (c.1.07 m seen), Grantham Formation (3.21 m) and basal Lincolnshire Limestone. Earlier observations on the Northampton Sand in this area were given by Hollingworth and Taylor (1951).

### Saltby Pit

In 1966 this quarry [857263 to 860255] comprised a face c.1 km long that was being worked eastwards, down-dip, towards the west side of Saltby airfield. The workings exposed the upper 2.4 m of the Northampton Sand, overlain successively by the Grantham Formation and the Lincolnshire Limestone (Fig. 4), the latter more massive than at Hungerton, some 5 km to the NE. The Northampton Sand appeared as at Hungerton, with a shell bed present at the top. The Grantham Formation comprised grey to silver, silky-textured, silty mudstones and silty sandstones, and darker grey mudstones. In



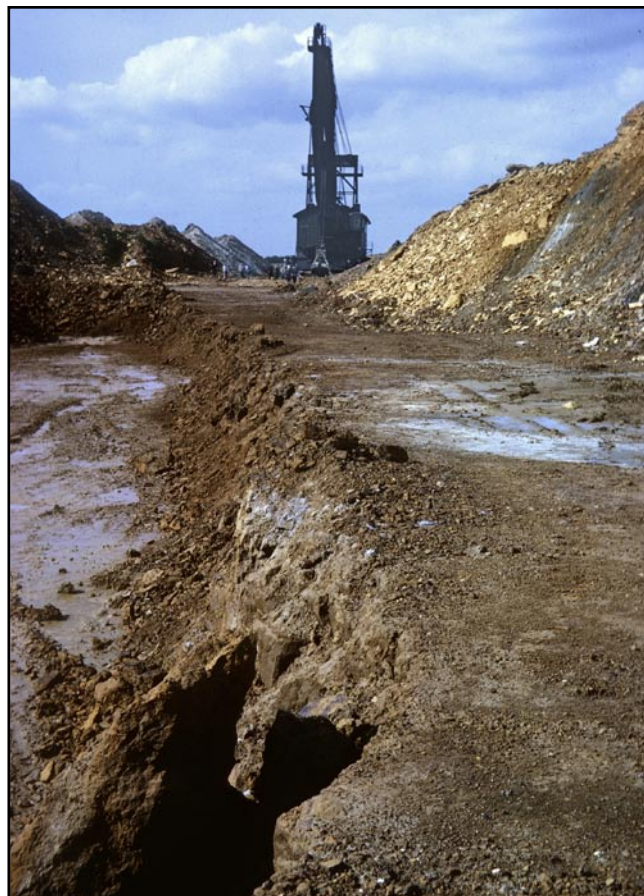
**Figure 4.** Two views of Saltby Pit in 1966, with Northampton Sand Formation overlain successively by the Grantham Formation and the Lincolnshire Limestone.



**Figure 5.** The Saltby Pit site in 2008, looking northeast across the former worked area, with Lincolnshire Limestone exposed in what was the overburden face.

1971 a section at [857262] exposed Northampton Sand (c.2.5 m seen), Grantham Formation (5.05 m) and Lincolnshire Limestone (6.0 m seen) (Kent, 1975). An exposure of the Lincolnshire Limestone remained in 2008 (Fig. 5).

This site is slightly NW of quarries [865254 to 865249] c.1 km NE of Sproxton, Leicestershire, where the Northampton Sand averaged 7.0 m in thickness, of which up to 5.2 m was worked by the Clay Cross Company Ltd (Richardson, 1939). The Park Gate Iron & Steel Co. subsequently worked some 3.35-4.27 m of "brown weathered ironstone" beneath up to c.10.7 m of overburden (Hollingworth & Taylor, 1951) until a glacial channel was encountered along c.270 m of the working face; operations ceased around 1961 but the excavation remained open until 1965 (Stevenson, 1967). Descriptions of the channel, with illustrations of



**Figure 6.** Colsterworth Pit No.2 in 1966, looking east, with Northampton Sand Formation overlain successively by the Grantham Formation and the Lincolnshire Limestone; compare this photograph with Plate 1A in Hollingworth and Taylor, 1951.



the workings in 1959 and 1961, were given by Wyatt *et al.* (1971) and Stevenson (1967) respectively. In 1969 a section at [867248] in ‘South Top Quarry’, Sproxtton, exposed Northampton Sand (c.4.5 m seen), Grantham Formation (3.35 m) and Lincolnshire Limestone (12.8 m seen) (Kent, 1975).

### Colsterworth Pit No.2

Extensive workings at this site [914233] in 1966 (Fig. 6) exposed a section similar to that at Saltby, c.6 km to the WNW, with the Northampton Sand (c.2.5 m seen) succeeded by the Grantham Formation and Lincolnshire Limestone. In this area the thickness of the Northampton Sand varied from 3.7 to 4.6 m, of which c.3.0 to 3.7 m was worked (Richardson, 1939).

In June 1970 a section near the western end of the face exposed Northampton Sand (2.7 m seen), Grantham Formation (3.59 m) and Lincolnshire Limestone (5.8 m seen) (Kent, 1975). In this area the Grantham Formation showed considerable variations in thickness, with 2.4 m present at Stainby Glebe mine [904230], 1 km WSW, but only 1.83 m in Woolsthorpe Face, Colsterworth [920242], c.1.2 km NE (Kent, 1975) and near Woolsthorpe Manor House, the birthplace of Isaac Newton. The Northampton Sand was visible beneath the Grantham Formation in these and three other sections in the area (Kent, 1975; Robinson, 1979). In 2008 exposures of the Lincolnshire Limestone remained near the western end of the Colsterworth Pit No.2 site [910232].

Tonks (1991) illustrated activity in this quarry in 1945. Hollingworth and Taylor (1951) also illustrated this pit when active and described the method of working the Northampton Sand Formation. This involved shot holes being drilled into the beds above the Northampton Sand. After blasting, the overburden debris was transferred back to the area of worked ground by a large excavator, creating a bench on the Northampton Sand (Fig. 6), the top c.2.5 m of which were then removed by a smaller excavator.

### The Hungerton ammonites

In the Northampton Sand Formation, fossils are localised but may be abundant; “... they include numerous bivalves, brachiopods, notably *Lobothyris trilineata* .... and rare ammonites, including several specimens of *Leioceras opalinum* found at Harlaxton near Grantham...” (Kent, 1980, 47). This reference to ammonites concerns two specimens collected from the upper part of the formation in the Hungerton quarry, one by Kent and the second by the writer. Both specimens



**Figure 7.** *Leioceras* sp., showing external ornament; Northampton Sand Formation, Hungerton Pit (BGS #Zm9530; collected by P.E. Kent, 1966). Bar scale is 3 cm long.



**Figure 8.** *Leioceras* sp., showing internal structure and septa; Northampton Sand Formation, Hungerton Pit (BGS # Zm9530a; collected by G. Warrington, 1966). Bar scale is 3 cm long.

are in the British Geological Survey collections at Keyworth, and are registered as Zm9530 and Zm9530a respectively.

Kent (1975) recorded his specimen (Fig. 7) as *Lioceras* cf. *opalinum* [Reinecke] but it was subsequently figured simply as *Leioceras* sp. (Kent, 1980, pl.9, fig.10). Parsons (1980, 15) referred to it as *Lioceras*, and noted that it provided confirmation of an early Aalenian age for the 'Northampton Formation'. The specimen is involute, compressed and possibly keeled, and shows weak falcoid striae. The writer's specimen is less well preserved but, because of the rarity of ammonites in the Northampton Sand, it is illustrated for the first time (Fig. 8). This specimen shows internal features, including septa, and weak ribbing on the remaining external surface. Dr Beris M. Cox examined both specimens but did "not wish to identify either specimen beyond *Leioceras* sp." (pers. comm.).

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