Copper Hill, Lincolnshire

[SK 978 427]

M.G. Sumbler

Introduction

The quarry at Copper Hill, 1 km south of Ancaster, Lincolnshire, exposes an impressive section through much of the Lincolnshire Limestone Formation. Alluded to by Woodward (1894), a section here was recorded by Richardson (1939b; Newton and Scott's Quarry) and, in more detail, by Ashton (1977, 1980) and Sumbler *et al.* (1991). In particular, the quarry at Copper Hill illustrates the erosional, channelling base of the Upper Lincolnshire Limestone.

Description

The quarry at Copper Hill exposes *c.* 20 m of strata as shown in (Figure 4.39). The section has been greatly extended since it was recorded by Ashton (1980), and exposes nearly the full local succession of the Lincolnshire Limestone Formation. A borehole sited in the quarry (Berridge *et al.,* 1999) shows that the base of the formation (resting, probably conformably, on the Grantham Formation) lies only 3–4 m below the floor of the quarry.

The lower part of the succession (beds 1–23 of (Figure 4.39)) belongs to the Lower Lincolnshire Limestone (including the Middle Lincolnshire Limestone of Ashton, 1980). It comprises a succession of peloidal or ooidal packstones to grainstones that are succeeded by lime mudstones (i.e. micrites) and wackestones. The basal beds belong to Ashton's (1980) Sproxton Member, which was proved by a borehole to be present just beneath the floor of the quarry. The member is 3.14 m thick, and comprises somewhat sandy limestones with a bed of sandy mudstone at the top. The lowest beds currently exposed belong to Ashton's (1980) Greetwell Member (see Greetwell Quarry GCR site report, this volume), which is, in total, some 7.8 m thick at this locality It is dominated by peloidal and ooidal packstones with some better-sorted grainstones. Bed 7, a distinctively uniform, sandy-textured and massive, very fine-grained, slightly quartz-sandy ooidal grainstone, probably equates with the so-called 'Wragby Bed' of Ashton (1980). Bed 12 is an ooidal grainstone with some larger yellow peloids. The Greetwell Member is succeeded by white, thinly and flat-bedded, carbonate mudstones (micritic limestones) and wackestones with some thin bands of laminated and burrowed marl and clay (beds 13–22). These beds, included in the Kirton Cementstones by Richardson (1939b), constitute Ashton's (1980) Leadenham Member. The topmost clay (Bed 22) is succeeded sharply by Bed 23, a distinctive pale pinkish-brown, indurated packstone to grainstone up to *c.* 0.5 m thick and with a well-developed, oyster-encrusted hardground at the top. This bed, taken as the basal unit of the Lincoln Member, is very thin in the western part of the quarry because of downcutting of the Upper Lincolnshire Limestone.

The Upper Lincolnshire Limestone is dominated by shell-detrital, ooidal grainstones, often exhibiting spectacular cross-bedding and channelling. It is clearly divisible into two units. The lower part (Bed 24) is particularly coarse-grained and generally flat-bedded, and is capped by a recrystallized hardground. It comprises the Sleaford Member of Ashton (1980), which (at Copper Hill, at least) corresponds with the Ancaster Freestone of Richardson (1939b). The succeeding Bed 25, belonging to Ashton's (1980) Clipsham Member (Richardson's (1939b) Ancaster Rag), is somewhat finer-grained and is conspicuously cross-bedded throughout, with predominantly NE-directed foresets. Its base is somewhat erosional in character (as noted by Richardson, 1939b), cutting down locally into the underlying Sleaford Member, which, in places, has a hardground at its top (Figure 4.40).

Interpretation

The Lower Lincolnshire Limestone (beds 1–23) is dominated by low-energy, micritic limestones (mainly packstones and wackestones) laid down in a lagoonal setting, separated from the open sea by a barrier-bar complex to the east (Ashton,

1980). This part of the succession has been divided into a number of members by Ashton (1980), which, although not mappable entities (Sumbler *et al.*, 1991; Berridge *et al.,* 1999), are of some correlative value on a local, if not regional, basis.

As developed at Copper Hill, Bed 12, within the Greetwell Member, strongly resembles the basal bed of the Lincoln Member elsewhere (e.g. at Greetwell Quarry, see GCR site report, this volume) and was interpreted as such by Ashton (1980, Bed 1) at a time when it was the lowest bed exposed in the quarry. However, the extended succession now visible indicates that this is incorrect and that, in fact, it is the topmost bed of the Greetwell Member. This emphasizes the cyclic nature of the Lower Lincolnshire Limestone succession, which includes a number of essentially similar 'rhythms' in which peloidal or ooidal packstones to grainstones pass upwards into lime mudstones. Each 'rhythm' represents a temporary incursion of the 'bar' environment into the lagoon.

Bed 23, at the top of the Lower Lincolnshire Limestone, is probably cut out entirely in some places as it does not appear to have been seen by Ashton (1980). Comparison with other quarry sections in the neighbourhood, in which the Lincoln Member is up to *c.* 5 m thick (Ashton 1980, fig. 60), demonstrates the markedly erosional base of the Upper Lincolnshire Limestone. In places, the eroded top of Bed 23 is heavily encrusted by oysters, indicating a hiatus before deposition of the succeeding strata.

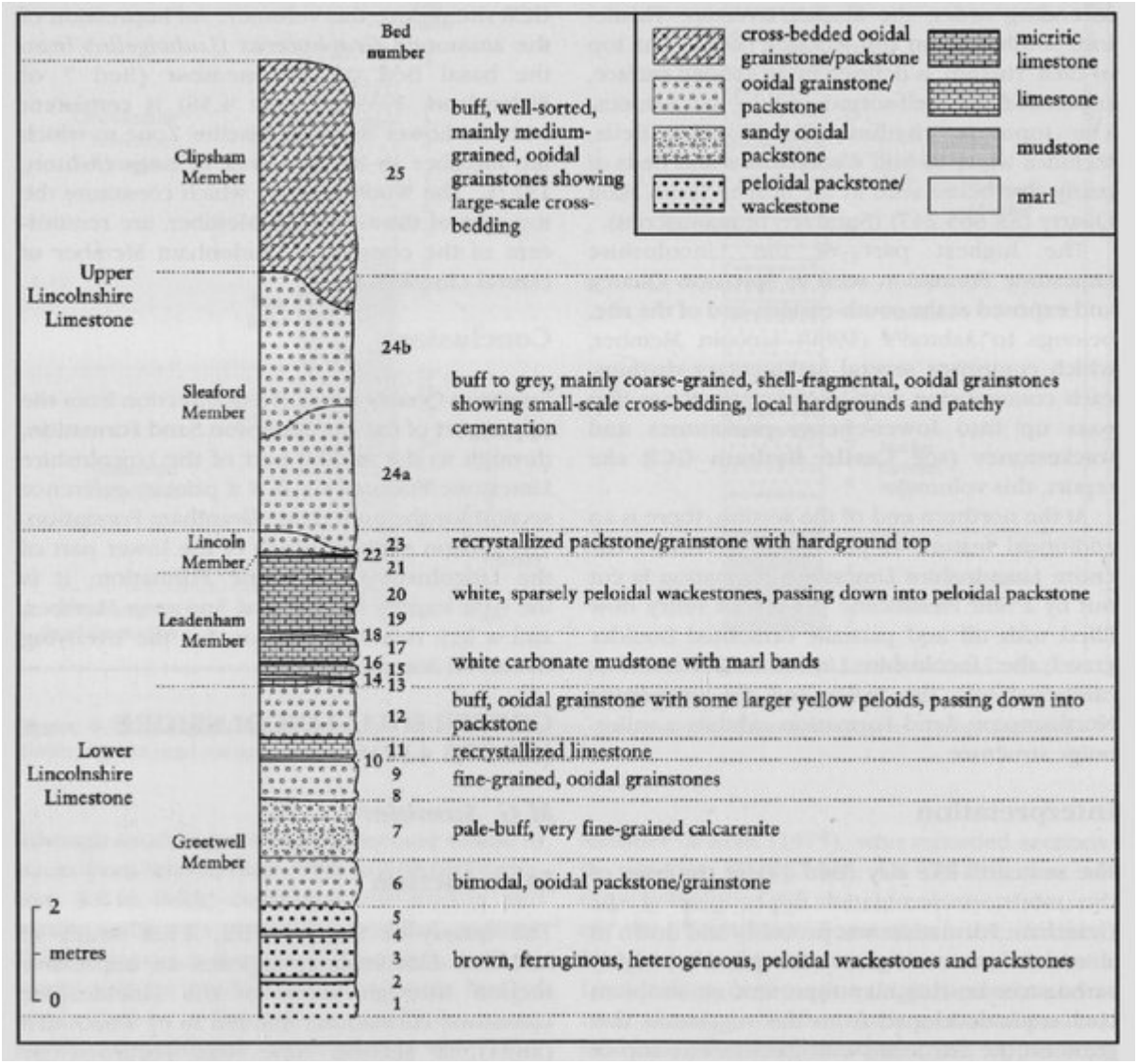
The upper *c.* 10 m of the section (beds 24 and 25) are assigned to the Upper Lincolnshire Limestone, which is dominated by high-energy ooidal grainstones (oobiosparites) representing the barrier-bar complex itself, which gradually prograded westwards over the earlier lagoonal sediments (Ashton, 1977; Tucker, 1985). As with the Lower Lincolnshire Limestone, the Upper Lincolnshire Limestone has been subdivided into members by Ashton (1980), although the succession is highly variable from place to place. The beds were formerly worked on a large scale as a source of high-quality freestones (e.g. Ancaster and Clipsham stones), but at Copper Hill most of the stone was crushed for aggregate. Parts of the succession show herring-bone-type cross-stratification, suggesting fluctuating, bidirectional tidal currents. A number of hardgrounds have been noted in the succession (e.g. within and at the top of Bed 24), but all seem to be laterally impersistent and of little or no correlative value.

The quarry at Copper Hill is designated as the type locality of the Sleaford Member (Ashton, 1980), although the name is inappropriate, as the town of Sleaford, 10 km to the north-east, is situated on the outcrop of the Great Oolite and Ancholme groups that succeed the Lincolnshire Limestone Formation.

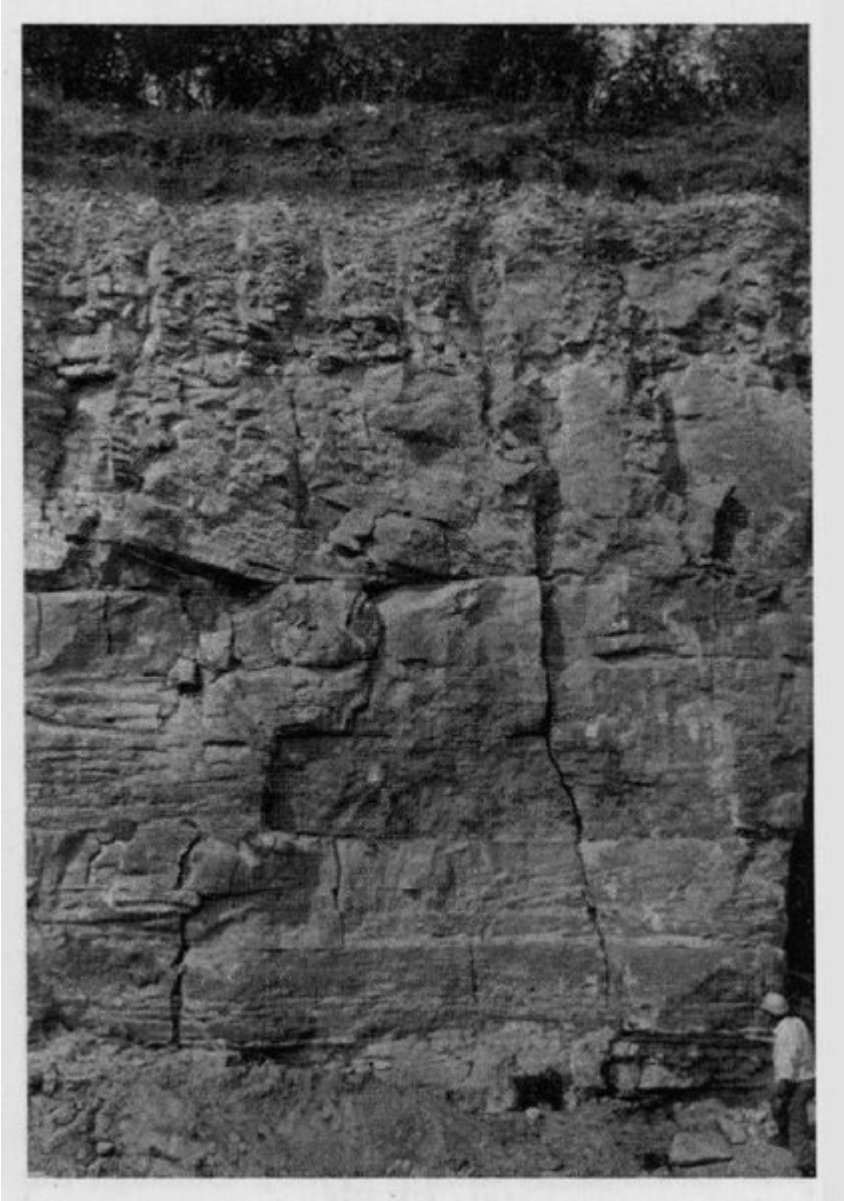
Conclusions

Copper Hill exhibits an impressive section showing almost the whole of the Lincolnshire Limestone Formation. The contrasting facies of the Lower (low-energy micritic packstones and wackestones) and Upper (high-energy ooidal grainstones) Lincolnshire Limestone are particularly well displayed, as is the undulating erosion surface between the two divisions. The site is thus an important one for palaeoenvironmental and palaeogeographical reconstructions showing the relationship between a mobile barrier-bar complex (Upper Lincolnshire Limestone) and the older lagoonal sediments (Lower Lincolnshire Limestone) over which it gradually prograded.

References



(Figure 4.39) Graphic section of the Lincolnshire Limestone Formation in the quarry at Copper Hill. (After Sumbler et al., 1991, fig. 6.))



(Figure 4.40) Part of the NNW face in the quarry at Copper Hill showing the Clipsham Member (with large-scale cross-bedding dipping 20–30° northwards) and the Sleaford Member of the Upper Lincolnshire Limestone resting (near the base and marked by a hammer) on Lower Lincolnshire Limestone. (Photo: British Geological Survey, No. A15099; reproduced with the permission of the Director, British Geological Survey, © NERC, 1991.))