Easthope–Harley Hill

[SO 566 953], [SO 569 964], [SO 575 968], [SO 580 974], [SO 595 983], [SO 592 982]–[SO 605 995], [SO 612 998], [SJ 606 003]–[SJ 612 002]

Introduction

The Easthope–Harley Hill site is a composite one. It comprises various localities that all form part of Wenlock Edge — probably the most symbolic of topographical features globally for strata of Wenlock age. This escarpment runs for some 26 km between Much Wenlock in the north-east and Craven Arms in the south-west, owing its presence to the resistant Much Wenlock Limestone, which dips gently to the south-east at about 10° (Figure 4.27). The limestone ridge is often offset along its length as a result of dip faults. The more easily sculptured mudstones of the Coalbrookdale Formation (Wenlock Series) below the scarp face, and shales and siltstones of the Elton Group (Ludlow Series) above it, give rise to the adjacent, parallel valleys of Ape Dale and Hope Dale, respectively. The term 'Much Wenlock Limestone Formation' (Bassett *et al.,* 1975) is now universally applied to this lithological unit, notwithstanding the suggestion (Lawson, 1977a) that the name Wenlock Limestone' be retained.

Along its strike the Much Wenlock Limestone Formation can be divided in terms of facies into two main areas, an off-reef tract to the southwest and a reef tract to the north-east, the transition between the two taking place around Easthope. Localities constituting the present site all fall into the reef-tract (Figure 4.33); from the south-west to the north-east, they are: small exposures at Easthope; Ippikin's Rock, Hilltop; Lilleshall Quarry, midway between Hilltop and Presthope; the cliff and adjacent portion of the disused railway track, Presthope; Stretton Westward Quarry; Lea and Coates quarries combined; the old quarries, Blakeway Hollow; and the (A458) road section, Harley Hill.

These localities make available in particular the bioherms and associated fauna for which the Much Wenlock Limestone Formation has long been famous. In the type Wenlock area, the Harley Hill section displays better than any other the gradual lithofacies change from the Farley Member, Coalbrookdale Formation, to the Much Wenlock Limestone Formation; it provides, additionally, the designated stratotype base of the Farley Member and also that of the Much Wenlock Limestone Formation (Bassett *et al.,* 1975).

The geology of the Wenlock Edge area has been extremely well documented and specifically that of the Much Wenlock Limestone Formation. Publications include: the formative works of Murchison (1833, 1834, 1835, 1839, 1854) in which the Silurian System was established; descriptions of Shropshire geology (e.g. La Touche, 1884; Davidson and Maw, 1881; Lapworth and Watts, 1894, 1910; Watts, 1925; Whittard, 1952); memoirs and reports of the Geological Survey (e.g. Pocock *et al.,* 1938; Greig *et al.,* 1968); stratigraphical, palaeogeographical and facies work (Das Gupta, 1932, 1933; Shergold and Shirley, 1968; Shergold and Bassett, 1970; Bassett, 1974a, 1989a; Bassett *et al.,* 1975; Hurst *et al.,* 1978; Holland, 1992); debate on diachronism and correlation at the Wenlock–Ludlow boundary (Hurst, 1975b; Bassett, 1976); sedimentological and associated faunal studies (Crosfield and Johnston, 1914; Hill *et al.,* 1936; Scoffin, 1971; Abbott, 1976; Riding, 1981); field guides (Harley, 1988; Siveter *et al.,* 1989); and palaeoecological (e.g. Colter, 1957; Hurst, 1975b), radiometric dating (Ross *et al.,* 1982) and isotope (Corfield *et al.,* 1992) investigations.

Description

The Much Wenlock Limestone Formation of Wenlock Edge has a maximum thickness of 29 m, in the north-east, the reef area; south-west of Easthope, in the Craven Arms area, it thins to about 21 m. The limestone facies of the reef tract comprise bedded, inter-reef carbonates as well as unbedded biohermal mounds.

Shergold and Bassett (1970) and Scoffin (1971) independently identified here more or less the same four lithofacies of the bedded limestones, which the former authors referred to as 'Bluestone', 'Jack's Soap', 'Measures', and 'Gingerbread', after the old quarrymen's terms, whilst the latter author termed them, respectively, Facies A-D. As listed in the order above there is a general stratigraphical younging to these facies, and they also generally coarsen upwards; however they

do not always conform to this simple sequence, sometimes one is missing or they occur in a different vertical combination.

The Bluestone lithofacies contains abundant fossils and consists of blue-grey, muddy, pelmatozoan, 5–25 cm thick limestones interspersed with 5–7 cm thick dark grey shales. It is the commonest of the bedded limestones and is particularly in evidence at the base of the formation, being transitional from the Farley Member below. It is well displayed on Harley Hill and in Presthope Railway Cutting, and also occurs in Coates and Stretton Westwood quarries amongst others. Jack's Soap lithofacies comprises highly nodular, very irregularly bedded, blue-grey limestones that are separated by thin (5 cm and less) shale partings. It is gradational with the Bluestone lithofacies, though usually contains fewer fossils. Coates Quarry and Farley Quarry (1.5 km north-east of Much Wenlock) have examples of this type. Somewhat thickly bedded (up to 30 cm), light blue-grey argillaceous, pelmatozoan limestones with 2 cm shale partings make up the Measures lithofacies; fossils are fairly common. It is found towards the top of the formation and has been recorded from Stretton Westwood, Lea and Coates quarries, at least. The Gingerbread lithofacies is formed of pelmatozoan-rich limestones that are white or cream-coloured when fresh but are normally decalcified, brown and honeycombed. It occurs at the top of the formation and is exposed in, for example, Coates and Lea quarries; fossils are quite common.

The bioherms of the Much Wenlock Limestone Formation have attracted the attention of geologists since the time of Murchison (1839) and Lyell (1841) in the first half of the 19th century and Crosfield and Johnston (1914) in the early part of the 20th; more recently, the work of Scoffin (1971; see also Abbott, 1976; Riding, 1981) in particular has led to an understanding in modern terms of the origin, morphology and distribution of these organic buildups.

Maximum bioherm development is at Hilltop although two small 'outlier' examples occur at Easthope (see Greig *et al.,* 1968), 1 km in front (south-west) of the largest of them. The bioherms can be observed in many of the quarries, Coates Quarry (Figure 4.34) being perhaps the best; small biohermal structures can also be seen in the Harley Hill Road section. The bioherms occur at various levels in the limestone, though they are scarce in the bottom 15 m and are more common and larger near (3–10 m below) the top. Their average width and thickness are 12 m and 4.5 m respectively, with the Hilltop reefs being some 100 m wide and 20 m thick. The larger bioherms tend to be irregularly outlined, the smaller ones bilaterally symmetrical with their upper and lower surfaces convex and their lateral margins interfingering with the bedded inter-reef limestones. The preferred orientation of reef growth, as indicated by their maximum width, is NE–SW.

The basal lenses of many bioherms have a distinct composition of abundant pelmatozoan remains as well as bryozoans, brachiopods and small corals which, when clustered together after death, formed a slight positive area on the sea floor onto which colonizing organisms attached themselves. Clay accumulation seen between the bedded limestones inhibited growth on the reef margins and so controlled reef shape, and the tops of the bioherms often coincide with bentonite horizons. Talus beds (coarse skeletal debris) and pelmatozoan flanking beds, both reef derived, sometimes provide a gradational, not sharp, passage from reef to bedded limestones.

The bioherm organisms consist of two main groups: the frame builders and binders and the loose skeletal bodies within the reef pockets. Tabulate corals (e.g. *Heliolites, Favosites, Halysites*) are the dominant frame builders, with stromatoporoids (*Actinostroma, Stromatopora, Labechia*), bryozoans (*Hallopora, Rhombopora, Fistulipora*) and branching rugose corals (e.g. *Entellophyllum*) assisting. Tabulate corals, stromatoporoids, bryozoans, calcareous algae and similar micro-organisms (e.g. *Girvanella, Rothpletzella* and *Wetheredella*) and, most importantly, stromatolites, bind and cement the bioherms. The bioherm interstices have pelmatozoan ossicles and brachiopods, with some ostracods, gastropods and trilobites.

Fossils of all the above groups from the Much Wenlock Limestone Formation of Wenlock Edge have figured in systematic and related palaeontological studies. For example: brachiopods in the papers of Davidson (1866–1871, 1883) and Bassett (1970–1977); trilobites in Owens (1973) and Thomas (1978); corals in Lonsdale (1839), Edwards and Haime (1854), Jones (1936) and Powell and Scrutton (1978); bryozoans in Owen (1969); and algae in Johnson (1966). Shergold and Bassett (1970) recorded from this formation 32 species of brachiopod, 17 corals, 4 stromatoporoids, 2 trilobites, 2 gastropods, 1 bivalve, and unidentified pelmatozoans and bryozoans. With respect to microfossils, Aldridge (1975, 1976) has investigated conodonts from the limestone; Siveter (1978, 1980) and Lundin *et al.* (1991) ostracods; Dorning (1981b) and Dorning and Bell (1987) acritarchs; Dorning (1981c) chitinozoans; and Aldridge *et al.* (1981) microfossils in general.

In terms of the graptolite sequence the Much Wenlock Limestone Formation, the lower part at least, belongs to *ludensis* Biozone (Bassett *et al.,* 1975; see Longville–Stanway site report). A zircon fission-track date of 416 ± 9 Ma was obtained from a bentonite from Coates Quarry (Ross *et al.,* 1982). Contact of the formation with the underlying Coalbrookdale Formation and the overlying Elton Group is seen, respectively, on Harley Hill and in Stretton Westward Quarry (Figure 4.35).

Interpretation

The bioherms of Wenlock Edge were deposited on the outer edge of a shallow shelf, facing the deeper water slope and graptolitic shale facies of the basin to the west (Scoffin, 1971; Bassett, 1974a, 1989a; Hurst *et* ed., 1978; Holland, 1992). Small bioherms also occur elsewhere on the shelf, for example the Malverns and May Hill to the south, and at Dudley and Walsall to the east. At Dudley, on the inner shelf, limestone deposition is believed to have commenced slightly earlier than at Wenlock Edge, during the *lundgreni* (not *ludensis*) Biozone (Bassett, 1976; see also Corfield *et al.,* 1992). Sea-level curves constructed for the Silurian indicate a shallowing in latest Wenlock times, not only for Eastern Avalonia of which the Welsh Basin, the Welsh Borderland and central England were a part, but also globally (e.g. Johnson *et al.,* 1991). A global warming at this time has also been postulated (Jeppsson *et al.,* 1995).

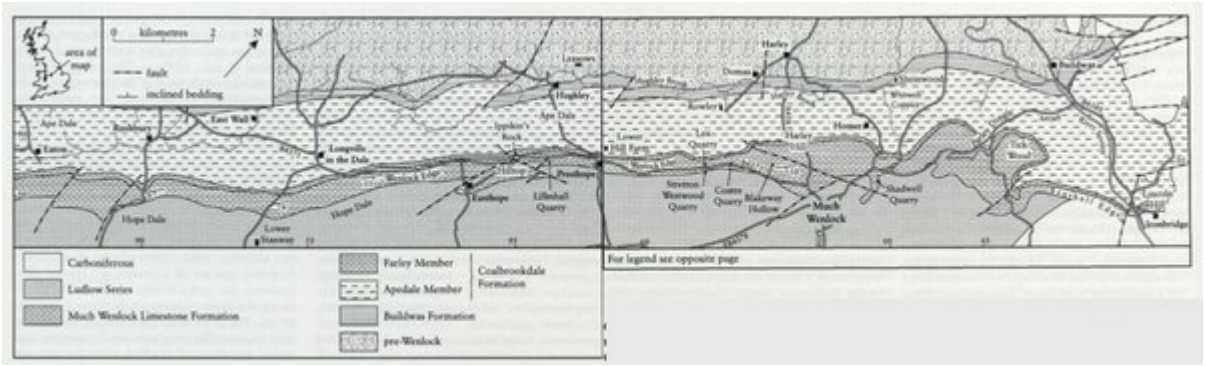
In size and shape the Wenlock bioherms are closely analogous to present-day patch reefs within the subtropics (Scoffin, 1971). They grew in fairly quiescent waters, the presence of blue-green algae (*Girvanella*) indicating depths of up to about 30 m. Many of the reefs rest on clay-rich sediments, the evidence suggesting that reef growth outwards onto soft muddy sediment, from the initial basal lens, was possible. The upper margins of the reefs seem to have been at variable depths as wave-generated talus bands are only associated with some of them. They probably had an elevation above the sea floor, which itself was fairly horizontal or slightly undulating, of between 0.5–3.0 m. Water circulation was adequate for coral growth, but not for major marine erosion — finely branched colonial organisms occurring in growth position. Local accumulations of clays indicate periodic water cloudiness. The constancy in composition of the reef fauna through time suggests that there was no marked change in water depth, though there is evidence of considerable shallowing at the end of the Wenlock, as indicated by the seaward spreading of the reefs at this time. Termination of the reefs in the latest Wenlock coincided with extreme shallowing and the formation of the pelmatozoan (Gingerbread) gravel facies. Mud-cracks, even, have been recorded from beds high in the succession (Colter, 1957).

The Easthope-Harley Hill site is complemented in particular in the type Wenlock area by the Longville-Stanway site, which exposes the non-reef facies of the Much Wenlock Limestone Formation, and the Lincoln Hill site to the northeast in which the fossils of this unit are especially well preserved.

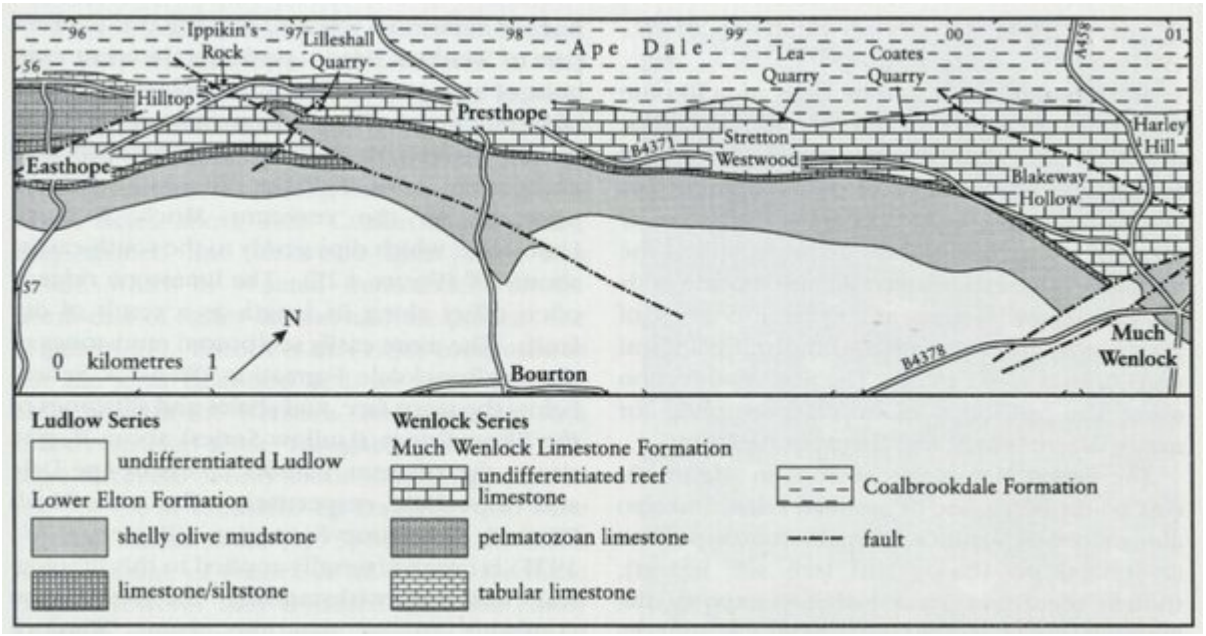
Conclusions

This is a site of international importance for the Wenlock Series. It has great stratigraphical, palaeontological, palaeoecological and sedimentological significance and is regularly used by research workers in these subdisciplines and by pupils of geology at all levels. Since the time of Murchison the Silurian ground that it covers and the fossils that it has yielded have been dis cussed in numerous publications. Biohermal structures are better developed here than in any other British Silurian locality, these providing a special focus of study. The site thus displays the classic reef facies of the Much Wenlock Limestone Formation in the type Wenlock area and has, on Harley Hill, the designated base of this unit and that of the underlying Farley Member, Coalbrookdale Formation. It also contains the type localities of many invertebrate species.

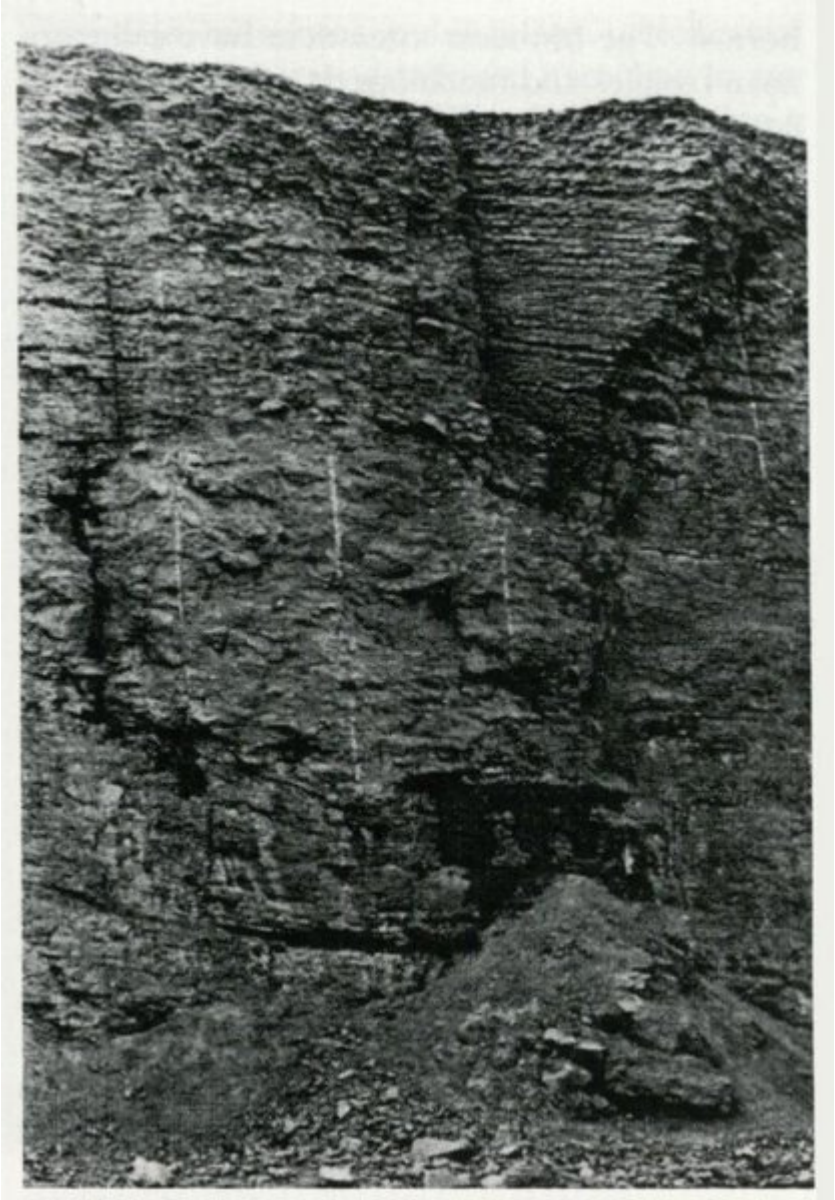
References



(Figure 4.27) Geology of the Wenlock Edge–Benthall Edge area between Eaton and Ironbridge, Shropshire (after Bassett et al., 1975).



(Figure 4.33) Easthope-Harley Hill, Wenlock Edge, Shropshire. Lithofacies distribution in the Much Wenlock Limestone and Lower Elton formations of the reef area between Easthope and Much Wenlock (after Shergold and Bassett, 1970).



(Figure 4.34) Bioherm, about 6 m wide by 4 m thick, within bedded limestones, Much Wenlock Limestone Formation, Coates Quarry Easthope–Harley Hill site, Wenlock Edge, Shropshire. (Photo: Derek J. Siveter.)

(Figure 4.35) Lower Elton Formation overlying Much Wenlock Limestone Formation, Stretton Westwood Quarry, Easthope–Harley Hill site, Wenlock Edge, Shropshire. (Photo: Derek J. Siveter.)