Wren's Nest

[SO 937 920]

Introduction

Within the South Staffordshire Coalfield, Silurian rocks crop out in the Walsall and the Dudley districts. In the latter area they make up, from NNW to SSE, the en-echelon periclines of Hurst Hill, Wren's Nest Hill and Dudley Castle Hill. These three small inliers have Wenlock strata at their centres, their flanks being formed of Ludlow and sometimes P■ídolí age rocks which in turn lie unconformably beneath, and are (Wren's Nest and Hurst hills) in part faulted against, Carboniferous deposits. The upper Ludlow and P■ídolí sediments only occasionally appear from beneath the cover of Coal Measures.

The geology of the Wren's Nest area has been described since at least the time of Murchison (1839, 1854; (Figure 4.4)) and Jukes (1859). Later accounts have included those of Lapworth (1889a), Whitehead and Eastwood (1927), Butler (1939), Whitehead and Pocock (1947), Hamblin *et al.* (1978), and Cutler *et al.* (1990). Discussion on the stratigraphy and age of the strata here occurs in Bassett (1974a, 1976), Hurst (1975b), Hurst *et al*. (1978), Dorning (1983), Cocks *et al.* (1971, 1992) and Corfield *et al.* (1992). The Wren's Nest has, historically, figured in field meeting reports, for example those of Lapworth (1889b) and Hill *et al.* (1936). Aspects of the sedimentology of the site have been tackled by Oliver (1981), Ratcliffe (1988) and Ratcliffe and Thomas (1999).

Butler's (1939) study of the Wren's Nest remains the most comprehensive, it having been subject to only relatively modest revision subsequently. The Silurian succession of the inlier as described by him includes the uppermost part of the 'Wenlock Shale', the whole of the 'Wenlock Limestone' and the basal part of the 'Lower Ludlow Shales'. He divided the 'Wenlock limestone' into Basement Beds, Lower Quarried Limestone, Nodular Beds, Upper Quarried Limestone and Passage Beds. Later formalization of lithostratigraphical terms has seen the introduction of the Coalbrookdale, Much Wenlock Limestone, and Lower Elton formations for the major units; the minor divisions of the Much Wenlock Limestone Formation are now regarded as members, with the Basement Beds and Passage Beds being subsumed into the Lower and Upper Quarried Limestone members respectively (see Bassett *et al.,* 1975; Bassett, 1977; Dorning, 1983; Lawson and White, 1989; Cutler *et al.,* 1990).

Hurst (1975b) established the Birmingham Siltstone Formation for the lowest 10 m of shales above the Much Wenlock Limestone Formation at Wren's Nest, the type locality, and also for the equivalent 10 m of shales at Wenlock Edge and the lowest 3 m of these shales at Ludlow. He considered this formation to be of Wenlock age.

However, the introduction of this unit, the nature of its demarcation, and the notion that it is entirely Wenlock in age are all points that have been questioned by subsequent authors, almost all of whom have recognized only the Lower Elton Formation above the Wenlock Limestone (see Bassett, 1976; Dorning, 1983). The one exception is the relatively recent correlation chart of Cocks *et al.* (1992), in which the Birmingham Siltstone Formation was again used, but only for the Dudley–Walsall column and there only doubtfully shown as partly Wenlock.

The geology and palaeontology of the Wren's Nest are inextricably linked to limestone mining, which began in the Dudley area at least as early as the 17th century, firstly for agricultural and then for industrial purposes (Hamblin *et al.,* 1978). Extraction developed from opencast quarrying to subterranean workings, the limestone at depth being transported away via underground canals. All these activities provid ed the collectors and authors of the day, both in this country and abroad, with a great abundance and variety of wonderfully preserved fossils. This is reflected in the myriad of publications in which specimens from here have been described, figured, and used to establish new taxa.

The names of Dudley and the Wren's Nest in particular have, then, become synonymous globally with exquisite fossil material from the Silurian (Wenlock Series). This reputation is perhaps based especially on the trilobites (Figure 4.5) and crinoids from here. All major British museums boast superb collections from the site, and numerous foreign national

repositories house 'Dudley' specimens too. The importance of the Wren's Nest was formally recognized in 1956 when it was declared a National Nature Reserve, the first such for geology in the UK. The site also has regional stratigraphical significance for rocks of late Wenlock to earliest Ludlow age.

Description

Wren's Nest Hill takes the form of a hog's-back ridge about 1.5 km long. It comprises a central, fairly tightly folded core of Coalbrookdale Formation, the succeeding Much Wenlock Limestone Formation dipping away from this at moderate (in general about 45–60°) to steep (about 80°) angles (Figure 4.6), (Figure 4.7). End-Carboniferous (Hercynian) movements gave rise to this folding, and also to faulting. A main fault runs north–south and downthrows to the west; it has a NW–SE trending offshoot across the centre of the pericline, offsetting strata on the eastern flank. A reverse fault, sub-parallel to the main one, affects the Upper Quarried Limestone Member and the Lower Elton Formation on the south-west side of the site. The former quarrying operations mirror the structure of the inlier: a series of concentric, deep cuttings that correlate with the Lower and Upper Quarried Limestone members, these being separated by an intervening ridge formed by the more impure Nodular Member (Figure 4.8).

Butler (1939) constructed a detailed, composite type section of the stratigraphy of the Wren's Nest based on exposures on its south-western side, in the vicinity of the old lime kilns and the Seven Sisters Cavern. Most of these outcrops have through degradation, infill or loss of access become unavailable since his time. New exposures through the succession ((Figure 4.6), localities 1 and 2) were created in 1977 when, on the eastern side of the hill, a trench was cut through the Nodular Member and adjacent quarry faces up and down section were cleaned and extended by the then Nature Conservancy Council (NCC). These and other exposures are maintained and constitute part of a geological trail around the reserve. The summary description that follows is largely of this NCC section ((Figure 4.9); see Hamblin *et al.,* 1978; Cutler *et al.,* 1990). The thickness, composition and palaeontology of the various lithological units may vary slightly in other parts of the site.

The Coalbrookdale Formation is probably represented here by the basal 0.17 m of pale greenish-grey mudstone. An 8 cm limestone band marks the base of the Lower Quarried Limestone Member, which is about 16.2 m thick and generally made up of bedded limestones, with shale partings occurring particularly near its base and in its upper part. The brachiopods *Antirhynchonella, Atrypa, Eospirifer, Gypidula, Howellella* and *Strophonella,* and the corals *Paleofavosites, Stelliporella* and *Ketophyllum* were recorded from the lower limestone horizons (formerly the upper part of the Basement Beds) of this member. In its upper 1.5 m stromatoporoid colonies are abundant, and its top is marked by a 26 cm thick limestone bed.

The Nodular Member is some 31 m thick and consists of nodules, limestone lenses, and silty shales. Up sequence the nodules become less coarsely crystalline, less pure and more laterally continuous. Bentonites occur at about 6 m and 9.7 m above the base of the member. Fossils are more common in its upper two-thirds. Corals, including *Favosites,* the brachiopods *Amphistrophia, Atrypa, Coolinia, Eospirifer, Gypidula, Meristina* and *Strophonella,* and fragments of the trilobites *Calymene* and *Dalmanites* have been collected.

The Upper Limestone Member has a thickness of 8.6 m. Its lower and upper parts have shale layers up to 10 cm thick, with more massive, coarsely crystalline limestone beds occupying the middle part. Fossils are uncommon, though *Atrypa, Strophonella, Calymene* and the coral *Acervularia* occur, and there is a stromatoporoid-rich level immediately above these more massive beds. The uppermost part of the member (formerly the Passage Beds) consists of 1.3 m of pale grey silty shale with thin limestone bands and nodules.

The 13 m available of the Lower Elton Formation (localities 1 and 6) also comprise grey, silty shales, though these contain fewer limestone bands and nodules than the uppermost part of the Upper Limestone. Bentonites are present at 2.12 m and 3.82 m above the base.

Bioherms have been noted from all three members of the Much Wenlock Limestone Formation at the Wren's Nest (Butler, 1939; Cutler *et al.,* 1990) though none was recorded from the 1977 trench section or the immediately adjacent exposures. These isolated, lens-like, unstratified reefal structures are generally about 2–3 m high and 3–5 m wide. Such

an example, in the Lower Quarried Limestone Member, forms one of the pillars of the Seven Sisters. The largest recorded from the Dudley area is that from the Nodular Member of the canal basin, Castle Hill, measuring about 6 m high by 40 m wide. The bioherms are formed of colonies of tabulate (*Favosites, Heliolites, Syringopora, Halysites*) and rugose (*Acervularia*) corals, and solitary rugose corals (*Dokophyllum*), together with bryozoans (*Hallopora, Fistulipora*), and stromatoporoids (*Stromatopora, Actinostroma*). Of these framebuilders the main ones were the tabulate corals, especially *Favosites* and *Heliolites.* Framebinding organisms include encrusting calcareous algae (*Girvanella, Wetheredella, Rothpletzella*), tabulate corals (*Alveolites, Thecia*), stromatoporoids (*Labechia*) and 'net' bryozoans (*Fenestella*). Arching of the bedded limestones above a bioherm and, depending on its size, sagging of the beds below it, are typical, as are thin argillaceous partings (some bentonitic) separating growth phases.

The interstices of the organic framework are variously infilled with coarsely crystalline limestone, which is composed mainly of crinoid fragments, together with micrite. Organisms unassociated with framebuilding or framebinding occur here, and in the bedded, inter-reef limestones too. Brachiopods are sometimes found in clusters, and include *Strophonella, Eospirifer, Gypidula* and *Leptaena.* Species of the *Sphaerirhynchia wilsoni* Community (Hurst 1975a, 1975b), a nearshore carbonate level bottom assemblage, are typical. Molluscs such as the gastropods *Acroculia* and *Poleumita,* the bivalves *Goniophora* and *Pteronitella,* and the orthocone *Dawsonoceras* are also characteristic, if less common, faunal elements.

Over 30 trilobite genera are known from the Much Wenlock Limestone Formation of 'Dudley', this location often being that cited in 19th century texts and acting as a proxy for 'Wren's Nest'. Of these genera, species of *Calymene, Dalmanites, Encrinurus, Acaste* and *Proetus* are amongst the most common. The site has yielded a rich echinoderm fauna, many of the taxa being specific to it within the UK. There are over 60 species of crinoids belonging to such genera as *Clematocrinus, Periechocrinus* and *Gissocrinus,* the material including scores of articulated specimens. Asterozoans, cystoids and carpoids also occur. Conulariids, tentaculitids and cornulitids are present, as are machaeridians. Very rare graptolites assigned to *Monograptus flemingii* are known from largely unspecified levels within the Much Wenlock Limestone Formation, though one of them is known to come from 2.4 m above its base (Butler, 1939; Bassett, 1974a, 1976). An abundant and diverse microfauna and microflora of ostracods, conodonts, chitinozoans and acritarchs has been recovered. Trace fossils (burrows, trails) are present through much of the sequence.

In total, over 600 species have been described, figured or cited from the Wren's Nest-Dudley area, and approaching 200 of these have it as their type locality (Cutler *et al.,* 1990). The following list gives merely an indication of the taxonomic range and historical nature of the publications that have made use of material from here.

- General palaeontology — Murchison (1839), M'Coy (1851c), Salter (1873), Etheridge (1888)
- Brachiopods — Davidson (1869), Bassett (1970a, 1972, 1974b, 1977), Hurst (1975a), Cocks (1978)
- Stromatoporoids — Nicholson (1889)
- Bryozoans — Owen (1969)
- Corals — Edwards and Haime (1854), Sutton (1964)
- Conulariids — Slater (1907)
- Crinoids — Miller (1821), Bather (1890, 1891a, 1891b, 1892), Ramsbottom (1950, 1951, 1952), Watkins and Hurst (1977), Donovan and Sevastopulo (1989)
- Cystoids — Paul (1967)
- Asterozoans — Spencer (1918, 1922)
- Trilobites — Mortimer (1750), Briinnich (1781), Brongniart (1822), Salter (1865), Lane (1971), Owens (1973), Thomas (1978, 1981), Siveter (1980, 1985, 1996), Morris (1988)
- Gastropods — Donald (1905)
- Graptolites — Elles and Wood (1913), Butler (1939), Strachan (1971), Bassett (1976)
- Ostracods — Siveter (1978, 1980)
- Polychaete worms — Thomas and Smith (1998)
- Conodonts — Aldridge (1985)
- Microflora and chitinozoans — Eisenack (1977, 1978), Dorning (1983), Dorning and Bell (1987)

- General micropalaeontology — Aldridge *et al.* (1981)

Sedimentological features that variously occur in different members of the Much Wenlock Limestone include oncoids, ripple marks, cross-bedding and sun-cracks (Ratcliffe, 1988; Cutler *et al.,* 1990).

Fossils from the Lower Elton Formation of Dudley include the graptolites *Saetograptus* cf. *varians, S. colonus, S. chimaera chimaera* and *Monograptus uncinatus,* all of which were recovered from unknown levels within it (Bassett, 1976). The same formation yielded to Hurst (1975b) brachiopods of his *S. wilsoni* Community. Also, Hurst (1975b) assigned brachiopods from a level or levels purported by him to be at least 10 m above the base of the formation, from a locality 1.6 km north of Wren's Nest (Whitehead and Pocock, 1947), to the *Dicoelosia* clastic community. Brachiopods from the Lower Elton Formation exposed during the 1977 excavations (Hamblin *et al.,* 1978) belonged to *Amphistrophia, Atrypa, Eospirifer, Leptaena, Leptostrophia, Meristina, Protochonetes,* and *Strophonella.*

Interpretation

The base of the Much Wenlock Limestone Formation at Dudley is, on the basis of the *M. flemingii* record from 2.4 m above this level, no younger than *lundgreni* Biozone age (Bassett, 1974a, 1976). However the age of the upper part of this formation here is equivocal. Bassett (1976) thought it most likely that it belongs to the *ludensis* Biozone, and that, probably, some part of the overlying shales of the Lower Elton Formation does also. Hurst (1975b) also suggested that at Dudley the *ludensis* Biozone extended upwards into these shales, specifically to a level about 10 m above the limestone where he said a transgression occurred. Hurst believed this deepening event could be recognized on the basis of a switch from the *S. wilsoni* to the offshore *Dicoelosia* clastic community, and that it was present and synchronous throughout the Welsh Borderland area. Further evidence on the age of the Much Wenlock Limestone at Dudley was given by Corfield *et al.* (1992), who suggested on the basis of carbon isotope analysis that the *G. nassa* Biozone might be represented there, by the lower part of the Nodular Member.

The base of the Much Wenlock Limestone Formation at Ludlow and Wenlock Edge is known to lie in the *ludensis* Biozone (Holland *et al.,* 1969; Bassett *et al.,* 1975; Bassett, 1989a) and it is thus diachronous between these two areas and Dudley. Evidently, in late Wenlock times, limestone and patch reef development began slightly earlier in the Dudley area than in the Wenlock and Ludlow districts to the west (Bassett, 1976). The graptolites from the Lower Elton Formation of Dudley suggest a *nilssoni* to *scanicus* Biozone age for these sediments (Bassett, 1976). In the Wenlock and Ludlow areas this formation belongs to the *nilssoni* Biozone (Bassett, 1976; Lawson and White, 1989).

In late Wenlock times the Dudley area was located on the (inner) carbonate platform area (Bassett, 1974a; Hurst *et al.,* 1978; Ratcliffe, 1988; Holland, 1992; Ratcliffe and Thomas, 1999). Throughout this area the sea was becoming shallower during deposition of the upper part of the Coalbrookdale Formation, was shallow when the Much Wenlock Limestone formed, and deepened again when sediments of the Lower Elton Formation were laid down (see e.g. Bassett, 1976; Siveter *et al.,* 1989). The Wren's Nest bioherms, and also those formed elsewhere on the platform such as the ones on Wenlock Edge, are analogous to the Recent patch reefs of the tropics and subtropics (Scoffin, 1971; Cutler *et al.,* 1990). The water energy conditions present during the growth of these Silurian reefs varied between quiet to strongly agitated, with occasional evidence of sub-aerial exposure. Influx of bentonitic or terrigenous sediment sometimes led to reef death.

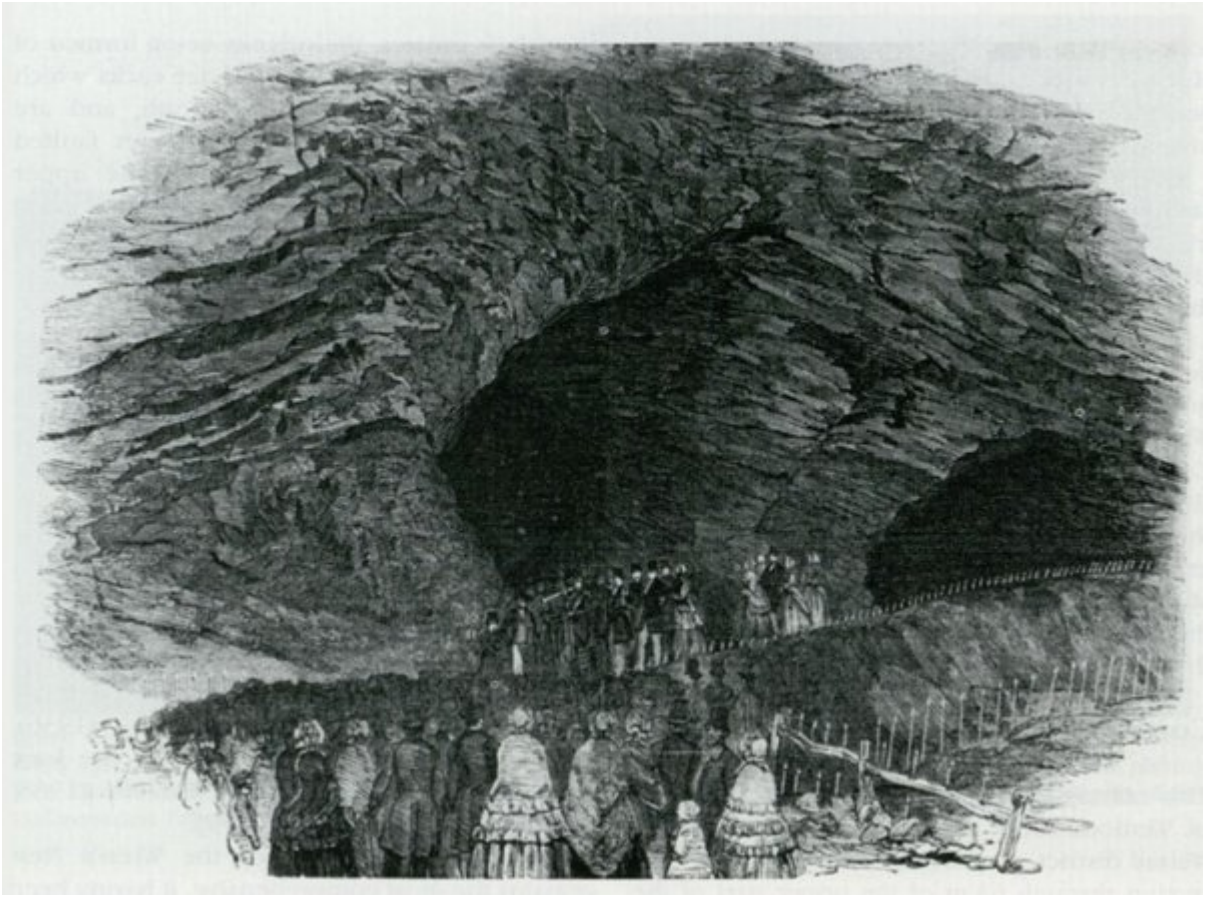
Related network sites include Daw End in the nearby Walsall area; Easthope-Harley Hill, Longville-Stanway and Lincoln Hill in the type Wenlock region; Burrington in the Ludlow district; and Little Hill, Linton Quarry, Hobbs Quarry, Cilwrgi Quarry and Cwm-Ton in the various Silurian inliers of the southern Welsh Borderland. All these localities have exposures of the Much Wenlock Limestone Formation, or a local limestone correlative of it.

Conclusions

Wren's Nest Hill exposes an upper Wenlock sequence from the top part of the Coalbrookdale to the top of the Much Wenlock Limestone formations. During the late Wenlock, the Dudley area was part of the inner carbonate platform. In early Ludlow times the Lower Elton Formation, comprising slightly deeper water sediments, was deposited in the region.

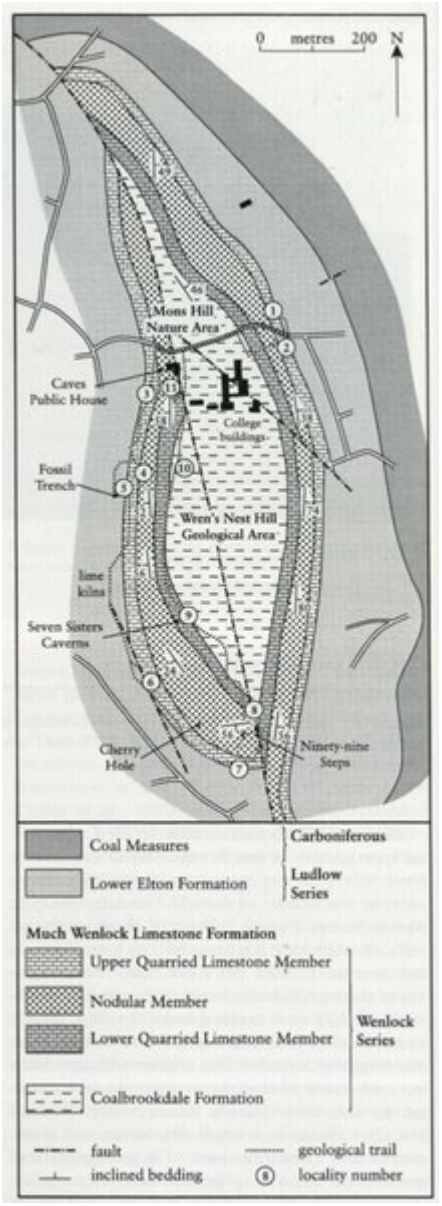
The site is of outstanding palaeontological importance for rocks of Wenlock age in Britain and as such is one of the country's most notable geological localities. It has a worldwide reputation for the exceptional preservation, abundance and diversity of the invertebrates it has yielded, both macro- and microfossil, from at least the mid-18th century. Fossils from the Wren's Nest have been figured and discussed in countless publications, nigh on 200 species having it as their type locality. It is used as a teaching laboratory from school to undergraduate levels. The site falls within the highest rank for conservation purposes.

References

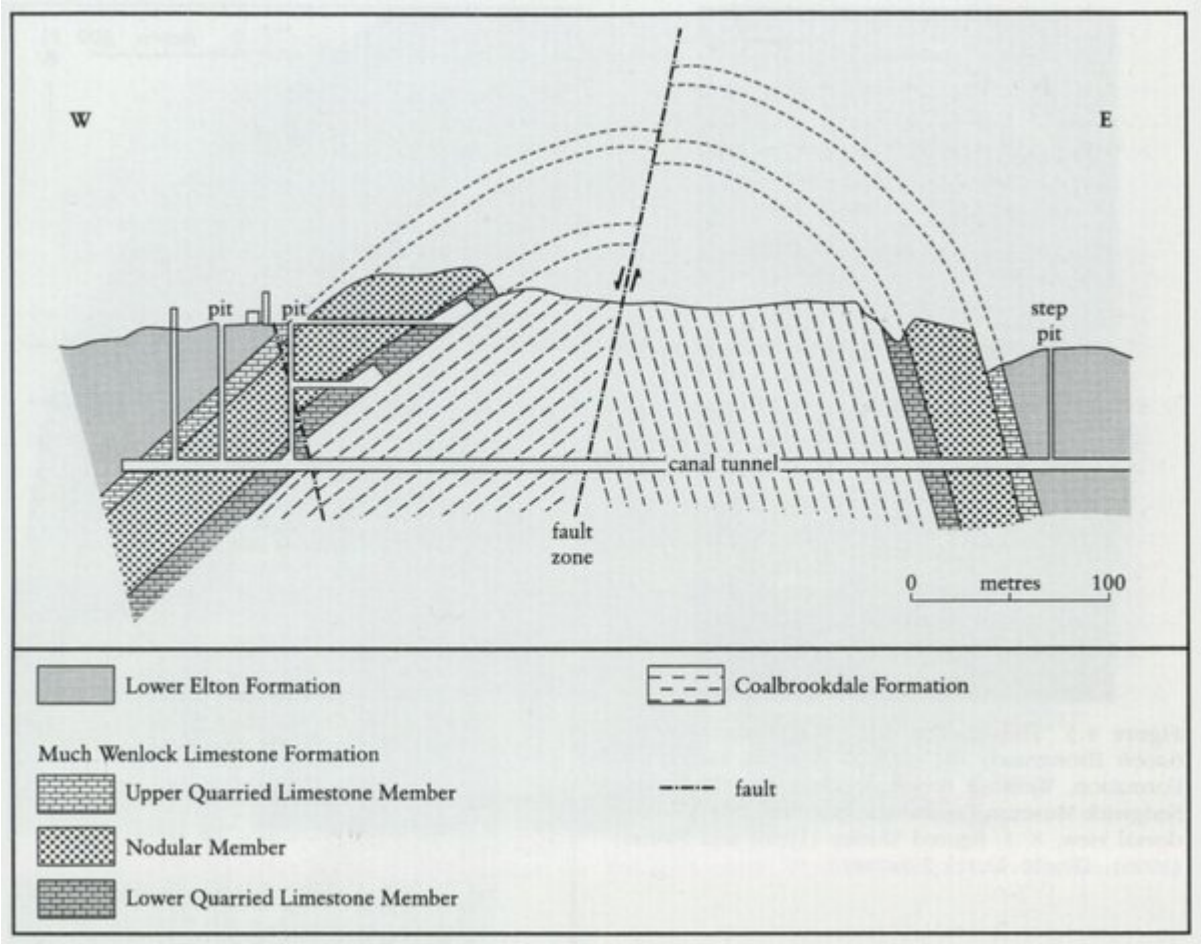


(Figure 4.4) A lecture by Sir Roderick Murchison in the 'Dudley Cavern', West Midlands. From The Illustrated London News, September 22nd, 1849.

(Figure 4.5) The 'Dudley Bug': Calymene blumenbachii Brongniart, 1817, Much Wenlock Limestone Formation, Wenlock Series, Dudley, West Midlands. Sedgwick Museum Cambridge specimen (SM A3225); dorsal view, x 1; figured Shirley (1936) and Siveter (1996). (Photo: Derek J. Siveter.)

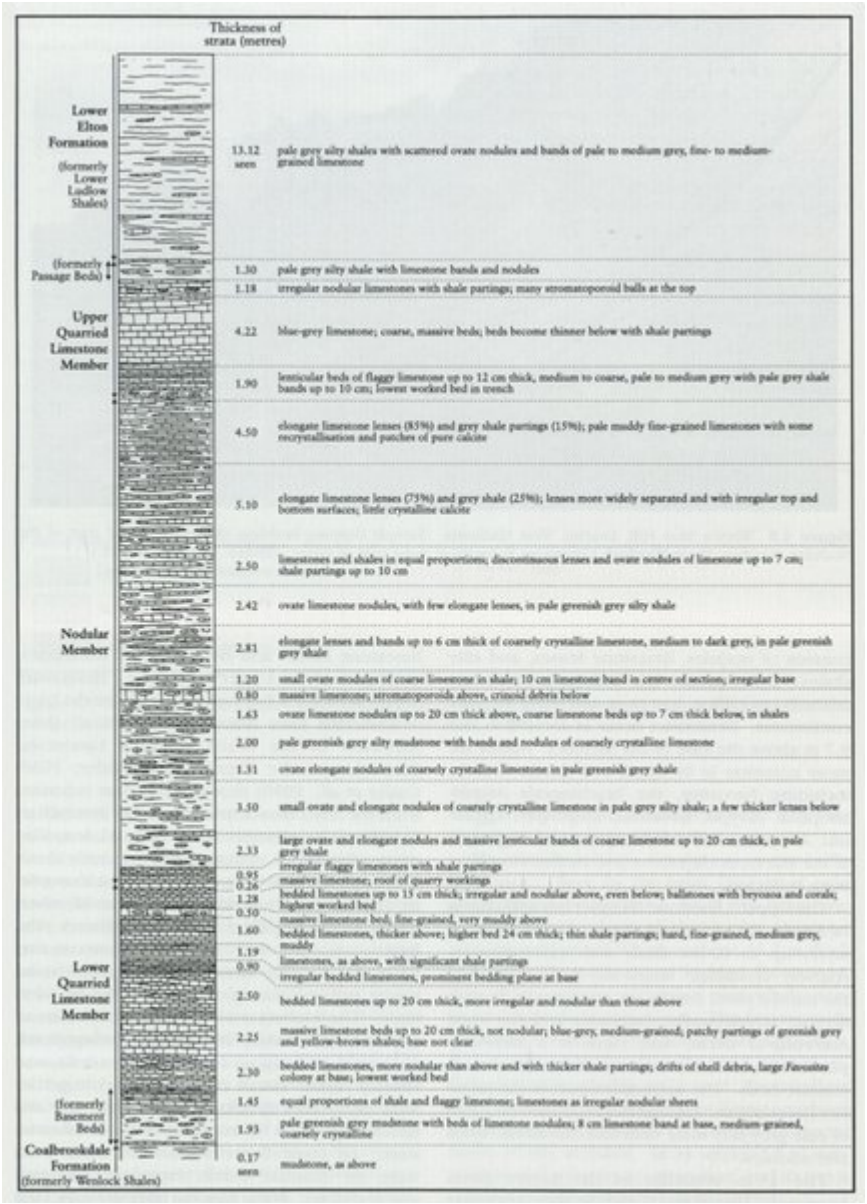


(Figure 4.6) Geology of Wren's Nest Hill, Dudley, West Midlands (after Cutler et al., 1990).



(Figure 4.7) Wren's Nest Hill, Dudley, West Midlands. East–west cross section taken at about 400 m south of the college buildings (after Hamblin et al., 1978 and Cutler et al., 1990).

(Figure 4.8) Wren's Nest Hill, Dudley, West Midlands. Steeply dipping bedding planes of upper part of the Nodular Member, Much Wenlock Limestone Formation, west side of inlier. (Photo: Derek J. Siveter.)



(Figure 4.9) Wren's Nest Hill, Dudley, West Midlands. Succession in the 1977 NCC cutting and adjacent exposures (after Hamblin et al., 1978 and Cutler et al., 1990).