# EXCURSION

## Weekend Field Excursion to the Forest of Dean

Leader: P. Coones, School of Geography, University of Oxford.

**25th-27th June 1993**

The structurally compact nature of the Forest of Dean basin enables a field party to adopt a stratigraphically ordered introductory itinerary which affords a clear grasp of the geology without presenting logistical difficulties or necessitating overlong journeys between stops. Furthermore, the majority of geological localities in the Forest proper are easily accessible, as they lie on Forestry Commission land in this, the country's first National Forest Park. It is to be hoped that this happy state of affairs will continue. Plentiful opportunities for study are offered by the many quarries (both working and abandoned), mines and railway cuttings, although some of the older sites are now overgrown, obscured, or threatened with new and often controversial uses (Standing, 1987). Fortunately, several are designated SSSIs or the property of the Gloucestershire Wildlife Trust (GWT). The stratigraphy of the Forest is shown in Figure 1 of the accompanying bibliographical review (pp. 119-131 of this volume), where references to papers cited in the report may also be found.

**Friday 25th June**

The party assembled at the Hunsdon Manor Hotel, Weston under Penyard, where the leader gave an informal introductory lecture, distributed hand-outs and maps, and outlined the programme. The localities visited during the excursion are shown on Figure 2 of the accompanying bibliographical review.

**Saturday 26th June** (Old Red Sandstone and Carboniferous Limestone)

**1. Ross-on-Wye** (SO 597 241)

The bluffs above the River Wye, extending between The Nursery and Lower Cleeve along the side of the A40 above Wilton Bridge, expose strata high up in the Brownstones (Lower ORS) dipping gently ESE on the western limb of the southward-plunging Howle Hill Syncline. The section is figured in De la Beche (1846) and has been described and interpreted by Allen (1971, 1974c, 1983a) and Williams (1978). They envisaged rapid aggradation on migrating sand bars of low relief in shallow, unstable and probably braided rivers; downstream shifting of bars was accompanied by intense local scouring. The cross-bedded sandstones are locally conglomeratic and contain exotic pebbles, mainly of Welsh Lower Palaeozoic origin. Towards the south-western end, a change in local sediment transport direction, from south-westerly (parallel to the cliff) to southerly or south-easterly (obliquely to it), was inferred by Williams (1978). The section raises questions relating to the use of analogues, the interpretation of selectively preserved and subsequently modified sedimentary features, the nature of the events recorded (and those not), the timescales involved, and the magnitude and frequency of the processes responsible.

**2. Rock Wood, Hope Mansel** (SO 6265 1870)

A small roadside quarry on the southern rim of the Hope Mansel Dome near Horn Hill Farm exposes the Quartz Conglomerate (Upper ORS) and associated deep red, coarse and pebbly sandstones with indications of current bedding, suggestive of the deposits of braided gravel-bed streams (Allen, 1971, 1974a). The dip is 20-25° SSW. The U-shaped outcrop across the plunging anticline, though narrow, is readily traceable in the field, here as elsewhere, as a wooded or otherwise uncultivated strip of land marked by a line of crags or boulders (the Perlieu Woods). The pebbles are mainly of vein quartz with occasional quartzite, infrequently of decomposed igneous rocks and jasper; some are broken across.

The impressive view from the lane ranges across the set of NNE trending folds affecting the ORS and Carboniferous Limestone as they emerge from the overlying Coal Measures. The structures also provide a textbook example of inverted relief but with interesting refinements. The denuded Hope Mansel Dome (Brownstones) lies to the north, with the upstanding masses of the complementary Wigpool Syncline (Carboniferous Limestone) and Howle Hill Syncline to the east and west respectively; the latter is more gentle than the former, being further from the Malvern Axis, and a Coal Measures outlier rests directly on the Lower Limestone Shale. The residual core of the Hope Mansel Anticline is composed of tough sandstones, the presence of which is reflected in the rising ground of the Lea Bailey; above these stratigraphically are weaker 'marls' which, cropping out around the denuded core, have been exploited by streams on its flanks (Dury, 1959, p.19, fig. 7). The Lea Bailey is not completely isolated by these curving valleys, however, for the headwaters of the two principal encircling streams (which flow round it in opposite directions), although close to meeting, are still separated by a col near Bailey Lane End on the south-eastern (Wigpool) side.

**3. Upper Soudley Railway Cutting** (SO 6545 1045)

The intra-ORS unconformity is not clearly apparent in the Forest, especially on the eastern side of the basin where the Brownstones approach their maximum thickness. Thus in the old railway cutting of the Forest of Dean Branch of the GWR at Upper Soudley, the Quartz Conglomerate rests on the Brownstones seemingly conformably. More bands of conglomerate separated by pebbly sandstone, and buff sandstones and mudstones of the Tintern Sandstone Formation, are exposed further up the cutting, the dip being approximately 65° WNW.

The Brownstones thin westwards, however; near Mitchel Troy, west of the River Wye, the Quartz Conglomerate rests directly upon rocks of the St Maughan's Formation and the overstep by the Upper ORS is complete.

**4. Chimney Scowles, Upper Soudley** (SO 6513 1058)

The eerie, cavernous pits located on the edge of Staple Edge Wood are typical examples of the surface excavations for iron ore known in the Forest as 'scowles'; of indeterminate date, but often ancient in origin, they frequently contain narrow entrances to

the primitive mines ('old men's workings') which predate the 'modern' (Victorian) era, when crop workings were superseded by deep mining by shaft. At the base of the face of iron-stained and open-textured Crease Limestone, the chief repository of Dean's iron ores, is a low opening leading to underground workings. The operations became large scale in the mid-nineteenth century under the name of Perseverance Iron Mine, the shaft of which descended to a depth of 110m, all four levels being driven in the Crease Limestone; additionally, the older Findall Level (Scilly Point) acted as a free drainage level (Sibly and Lloyd, 1927, p.35). The remarkable chimney is a hot air ventilation furnace, connected to Findall in pre-Perseverance days and perhaps dating from the early nineteenth century or even before (Court and Standing, 1979). Perseverance was abandoned in 1899, having produced some 370 000 tons of ore since 1841. The mine is situated on the eastern side of the basin, where it worked strata dipping 60° WNW; it is of interest to note that, in common with other iron mines in the Forest, the ore bodies diminished with depth, and that the three principal levels encountered lean or barren ground at their southern extremities, where they run beneath the Coal Measures cover. These facts lend support to the view that the iron-bearing solutions descended from above and that the Coal Measures acted as an impermeable barrier to them.

**5. Stenders Quarry, Mitcheldean** (SO 6595 1820)

Formerly known as Wilderness Cement Works Quarry, Stenders Quarry SSSI (GWT) contains a partially overgrown but still impressive section displaying the complete succession of the Lower Limestone Shale and its junction with the underlying Tintern Sandstone Formation, marked by alternating beds of sandstone, shale and impure limestone (Stubblefield, 1937). The quarry, abandoned in 1918 (GTNC, no date), is situated on the steep eastern limb of the plunging Wigpool Syncline; the strata dip WSW at 58°. They exhibit minor folds with anomalous asymmetry, which Mason (1977) ascribed to gravity sliding of the competent Carboniferous Limestone off the breached May Hill Anticline, the incompetent Lower Limestone Shale acting as the lubrication horizon. The section was described in great detail by Sibly and Reynolds (1937), but their ninefold subdivision proved to be of restricted application elsewhere in the district. The highly fossiliferous shales, limestones and dolomitized limestones have long been noted for their rich shelf faunas of ostracods, bryozoans, calcareous algae, crinoids and brachiopods, including the rhynchonellid *Macropotamorhynchus (Camarotoechia) mitcheldeanensis* Vaughan (Wethered, 1886a, 1888; Nicholson, 1888; Macfadyen, 1970; Burchette and Riding, 1977). Burchette (1977, 1987) in his studies of lithofacies associations in the Lower Limestone Shale and the shoreline environments which they represent in terms of evolving barrier-lagoon complexes within the transgressive regime, interpreted the Stenders succession as a transition from a shallow shelf (Limestone Division) through lagoonal sediments to deeper water shelf muds (Shale Division) and, finally, dolomitized calcarenites (Burchette, 1987, p.243).

**6. Lower Dolomite (Roadside) Quarry, Plump Hill** (SO 6613 1715)

A series of quarries on Plump Hill formerly enabled a field party to work its way up through the whole succession of the Carboniferous Limestone (Gardiner *et al.*, 1934), but many of the exposures, together with a similar set located to the sides of the Stenders Road out of Mitcheldean (further northwards along the strike) have unfortunately become obscured since the time of Sibly and Reynolds's paper in 1937. Practically the full thickness of the Lower Dolomite is revealed, however, in the large roadside quarry (a GWT reserve). Finely crystalline dolomite, blue-grey to purplish-brown in colour, displaying characteristic saccharoidal texture and fresh faces sparkling with dolomite crystals, dips 65° W; the joints, trending in the opposite direction, are a much stronger visual feature than the bedding planes (Fig. 1). The west face contains coarsely crystalline crinoidal beds (Reynolds, 1934), within more finely bedded dolomitized limestones, the lithologies of which differ markedly from the massive, uniform dolomite of the rest of the quarry. Rose (1937), noting that in the Wye valley the base of the overlying Crease Limestone consists of crinoidal limestone, was minded

**Fig. 1.** Western side of the Lower Dolomite (roadside) quarry, Plump Hill, looking north. The steep westerly dip is more clearly apparent than is the case in the central part of the quarry, but the bedding planes are still prominent. The more thinly bedded strata present at the top of the Lower Dolomite are well displayed on the left (hammer for scale, lower centre).

to include the aforementioned beds, encountered at the top of the Plump Hill Lower Dolomite, with the Crease, which in the iron-ore field has been dolomitized. The contrast is so striking and evident that such a conclusion is hard to resist. Tiny residual exposures of the Crease and the Whitehead limestones can still just be traced in the rough ground to the west of the quarry.

**7. Edgehills Sand Quarry, Merring Meend** (SO 661 168)

Near the summit of Plump Hill is Edgehills Sand Quarry SSSI, where the Drybrook Sandstone, dipping 62° WSW, was formerly worked for sand. The sequence is dominated by sandstones, varied and colourful, with subordinate shales and conglomerates. The Drybrook Sandstone has usually been interpreted as a fluvio-deltaic deposit, produced perhaps by a river debouching its load into a shallow sea (George, 1958). Jones (1984), however, rejected this model, noting that the sandstones are mature (probably recycled) and that the braided stream deposits are emplaced directly upon the underlying algal Whitehead Limestone, which was formed in extremely shallow, near-emergent conditions; he detected no intervening deltaic facies. Jones identified a variety of environmentally significant lithotypes: lenticular sandstones and conglomerates (bars and channel fills of braided stream origin), lenticular mudrock units (abandoned channel fill), planar or sheet sandstones (littoral strand plain) and carbonaceous mudrocks with thin coals (supra-tidal mudflat and swamp). Atta-Ntim (1984) interpreted the basal conglomerates and the muds as the deposits of distal alluvial fan and shallow marine sandflat environments respectively. Jones and Atta-Ntim accounted for the facies pattern as the product of a tectonically controlled localized shoreline regression, consequent upon late Dinantian reactivation of the Malvern Axis, superimposed upon a eustatic transgressive-regressive cycle.

The bedding-planes of the tabular sandstones at Edgehills show signs of very shallow water deposition; rootlets and trace fossils are plentiful. At the top of the succession, now partially obscured by slumping, lie the sandstones, carbonaceous mudrocks and thin sooty coal comprising the controversial Edgehills Sandstone. The mudstone underlying the coal contains an allochthonous 'flöznahe'-type (coal swamp) macroflora of equisetes and lycopods (Cleal, 1986b).

Near the north end of the quarry (SO 6603 1684) is the shaft of Edge Hill (Westbury Brook) Iron Mine, sunk in 1837 with levels in the Crease Limestone (Kendall, 1893, p.131); the total output from its continuous operation between 1843 and closure in 1893 approached a million tons of ore.

In the evening, the leader gave an illustrated lecture on the landscape of the Forest of Dean, concentrating on mining and related aspects of industrial history.

**Sunday 27th June** (Coal Measures)

**8. Howbeach Slade Quarry** (SO 6465 0905)

A forest track leaves the Blackpool Bridge-Upper Soudley road at SO 6537 0888 and runs westwards at right angles to the strike, crossing successively the outcrops of the Brownstones, Quartz Conglomerate (angular blocks of which are much in evidence), Tintern Sandstone Formation and Lower Limestone Shale, before reaching Howbeach Slade Quarry SSSI. Here the Lower Dolomite, formerly worked for roadstone, is extensively exposed, dipping WNW at 65-70°. As at Plump Hill, the joints are pronounced, and stress features are discernible. In the upper level of the quarry (SO 6463 0903), shales and sandstones of the over-stepping Trenchard Formation, dipping gently (15-20°) in the same direction, rest upon the uneven, eroded surface of the steeply tilted Lower Dolomite, providing a spectacular demonstration of the intra-Carboniferous unconformity. The lower beds of the Trenchard Formation are missing, showing that the unconformity is also characterized by overlap.

Some 300m further along the path to the west-south-west (SO 6438 0886) is the recently driven drift of a new free mine working the Coleford High Delf; the seam is exposed at outcrop (Fig. 2).

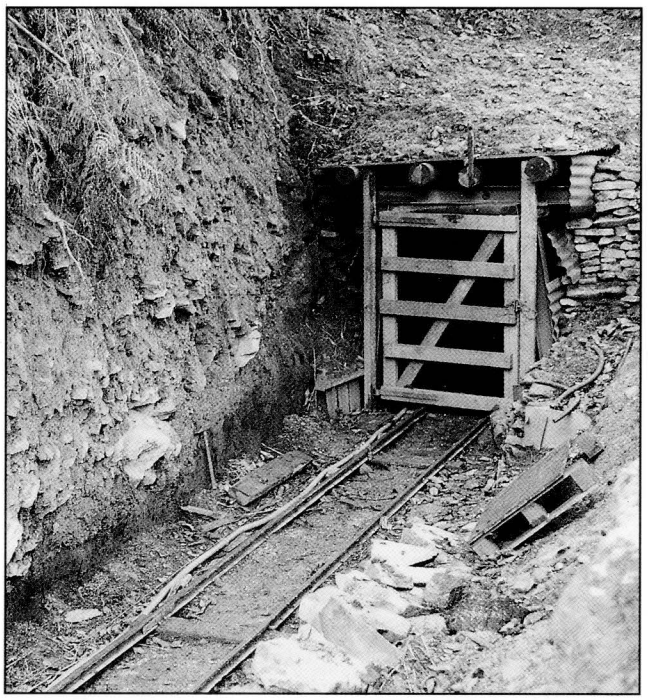

**Fig. 2.** Free mine west of Howbeach Slade. The top of the Coleford High Delf can be seen behind the hammer; above it, here much fractured and disturbed and now partially obscured, lies the sandstone roof which generally accompanies the seam, especially at outcrop.

**9. New Fancy Colliery Spoil Tip** (SO 629 095)

New Fancy, located in the central part of the coalfield, worked the lower ('productive') division of the Supra-Pennant Formation; the shaft was sunk to a depth of 262m to the Parkend High Delf (Lowery), cross-measures from the pit bottom intersecting the lower seams. The colliery produced some 3.5 million tons of coal between 1832 and its closure in 1944. The size of the tip was reduced in 1961, when two-thirds of it was removed for use as foundation material for the Llanwern steelworks near Newport. Subsequently landscaped, the summit affords an excellent panoramic view of the Forest of Dean basin, an especially striking structural

feature being the Staple Edge Monocline, which gives rise to a prominent escarpment to the east. Although most of the tip was burnt and then grassed and planted, small exposures of shale remain, yielding fragments of plant fossils, especially pteridosperms (Arber, 1912a; Crookall, 1930; Spinner, 1964).

**10. Cannop Ponds and Bixslade Stone Works** (SO 6075 0995)

The Bixslade Works of the Forest of Dean Stone Firms Ltd at Stonyhill Green prepare stone for building, paving, ornamental and restoration purposes. Here great blocks of Pennant Sandstone from Bixhead quarries are sawn, worked and finished. These stone works, which have enjoyed a chequered history (Anon, 1899; Leary, 1986; Standing, 1987) are the last surviving in the Forest, and appear very much as they would have done in the early part of the century. They are situated at the southern end of Cannop Ponds, created *c.* 1825 to provide water power for the Parkend ironworks. The ponds lie in the floor of the flat-bottomed valley which extends along this portion of the Cannop Fault Belt. The deep tributary valleys (slades) which dissect the straight and steep western side were exploited for the advantages they afforded to coal-miners working the Yorkley and Coleford High Delf seams by level and shaft, to enterprises quarrying the massive Pennant sandstones lying between the two seams and through which the slades descend, and for the transportation of the coal and stone (and, in Bixslade, ore) by tramroad. The Bixslade tramroad, using horse power, was still functioning after the Second World War!

A favourable combination of structure and relief further assisted mining operations, for The Ridge, a N-by-W trending anticline situated on the W side of the Main Basin with its axis running obliquely across the line of the slades, brings the Coleford High Delf to the surface in Wimberry Slade and Howlers Slade, where the outcrops form inliers, and near to the surface in Bixslade. Further west is the complementary Worcester Syncline, and three outliers of the Yorkley seam, some 75m above the Coleford High Delf stratigraphically, occur immediately to the west on the planed summits of the truncated spurs constituting the interfluves between the slades. The main outcrop of the Yorkley runs along the western slopes of the Cannop valley, descending the sides of the slades to 'V' downvalley. Next to the stone works is the entrance to Miles' Level (SO 6070 0995), a cross-measures level driven in the early nineteenth century to the Yorkley and the Coleford High Delf.

**11. Mine Train Quarry** (SO 6015 1010)

Situated a short distance up Bixslade, this quarry is worked for a much valued pinkish-red to red-brown lithofacies of the Pennant Formation associated with joint-veins of iron ore (Leary, 1986; Standing, 1987). The Birch Hill Mine (SO 6017 1014) extracted ore spasmodically between 1906 and 1932 (Sibly, 1919; Court and Standing, 1975). The belt of ore-bearing ground in the Pennant Formation of Barnhill Plantation is exceptional, for the Coal Measures are barren elsewhere, iron ore being confined to the Carboniferous Limestone. Trotter (1942, p.75) interpreted the deposits as yielding definite evidence that the ore-bearing solutions came from above, for the ore bodies are confined to the crop of the measures associated with the Yorkley seam and do not occur beneath, implying that the descending solutions were trapped by the argillaceous measures immediately below the Yorkley coal.

**12. Bixhead Quarries** (SO 597 107)

Occupying an extensive area at the top of Bixslade, this large complex of abandoned and working quarries provides excellent sections in the gently dipping, massive sandstones of the Pennant Formation lying below the Yorkley seam (Fig. 3). Quarrying of these

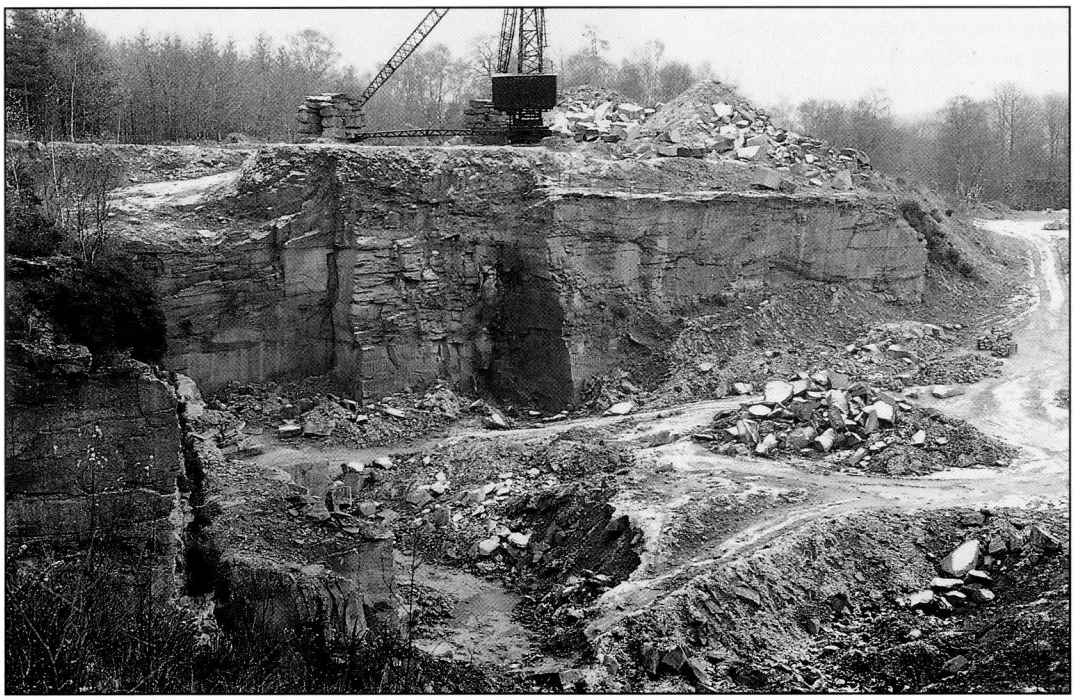

**Fig. 3.** Bixhead quarries.

**Fig. 4.** Quarry face displaying cross-bedded Pennant sandstones, Bixhead.

thickly-bedded units ('posts') has taken place here for at least 500 years (Standing, 1987); the stone was popular in the last century for civic and municipal buildings, docks and engineering structures (Anon, 1899). More recently, it was used in the construction of University College, Aberystwyth, and Berkeley Power Station (Leary, 1986). Pennant Formation sandstone of this type is valued for its strength and workability; the pseudo-matrix of soft metamorphic fragments gives good cohesive strength without being excessively hard for cutting (Gayer and Stead, 1971). It is also prized for its resistance to weathering and its variation in colour. Especially regarded are the types known as 'Blue Pennant' and 'iron vein'; in the latter case, iron staining has produced delicate rose- and salmon-coloured stone. The sandstones are predominantly litharenites/ subgreywackes, arranged in thick cross-bedded units with discontinuous levels of erosion, channel bases being marked by shale and melange units (Gayer and Stead, 1971; Stead, 1974). The sedimentary structures are well shown in the weathered faces (Fig. 4), notably at the western end of the working quarry (SO 5966 1089). Carbonaceous debris and plant remains, including some large casts of stems, occur.

### 13. Wimberry Slade (SO 593 122 — 604 122)

The Pennant Formation sandstones were also quarried at the head of Wimberry Slade. The Coleford High Delf was worked at depth in Wimberry Bottom in the Cannop Fault Belt by Cannop Colliery (1909-60) and, in the Slade itself, by the older Wimberry Colliery and Hopewell Pits; the outcrop in the inlier was mined by numerous adits. Despite recent attempts to fill in and obliterate the Hopewell-in-Wimberry shaft at SO 5951 1212, which reached the Coleford High Delf at a depth of 30m, the top is still visible, skilfully constructed in blocks of Pennant Formation sandstone. With its awesome overgrown quarries, abandoned shafts and levels, crumbling walls and abutments, tramroad stone sleeper blocks, and still active free mines, Wimberry Slade is the quintessence of the landscape of the Forest of Dean coalfield.


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