5 The Carboniferous rocks of upper Nidderdale

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Purpose

To examine rocks of the Millstone Grit Group (Namurian) and underlying limestones of late Dinantian age.

Logistics

A one-day excursion in two parts requiring transport by car. Part (Locality 1) is at Brimham Rocks, southeast of Pateley Bridge. Part 2 (Localities 2–9) is in Upper Nidderdale, above Lofthouse, beyond which there are no shops or inns. Information about food and toilet facilities is given in the itinerary.

The area around Scar House (Localities 5–9) is owned by Yorkshire Water. A permit must be sought in advance for groups of more than eight people to visit this area from Mr R. Baxter, Yorkshire Water, Western House, Western Way, Halifax Road, Bradford, BD6 2LZ. Ample notice, a minimum of three weeks, should be given for the permit. There is a further restriction on Locality 5: access is only possible from August till February inclusive.

Note: Safety helmets should be worn in the quarry at Locality 5.

Maps

O.S. 1:50 000 Sheet 99 Northallerton & Ripon; B.G.S. 1:50 000 Sheet 51 Masham.

Geological background

Upper Nidderdale lies in the southeastern part of the Askrigg Block, an area of Carboniferous strata gently tilted towards the east. A local fold is seen near Limley (Figure 5.1). The dale is located at the northern end of the main Millstone Grit outcrop of the Central Pennines, which extends southwards to Kinderscout. The sequence of sandstones and mudstones are much thinner than in the Bradford–Huddersfield area to the south. There are also fewer bands of mudstone with goniatites, the zone fossils of the Namurian. The underlying rocks of late Dinantian (Brigantian) age are of a modified Yoredale type and appear in inliers along the valley bottom in three separate locations. Individual limestones farther north in Swaledale are separated by thick mudstones and sandstones, but these beds attenuate progressively southwards, so that in Nidderdale limestones are separated only by thin mudstones. A widespread unconformity at the base of the Millstone Grit cuts out the highest Yoredale limestones progressively south-southeastwards. Thus at Scar House Dam the surface rests on the Underset Limestone, whilst farther south at Lofthouse it lies on the underlying Three Yard Limestone.

Quarries in upper Nidderdale have furnished much of the stone for the three large reservoir dams built to supply Bradford and now managed by Yorkshire Water. The specific weathering characteristics of the gritstone are well seen at Brimham Rocks, and of the Middle Limestone in the gorge of How Stean. There is a good opportunity to view the deltaic and pro-delta sedimentation of the Millstone Grit sandstones.

Excursion details

Start the excursion at Brimham Rocks. Approach via a southward turning on the B6265 Pateley Bridge–Ripon road [SE 212 670] signposted to Brimham Rocks, where a pay car park is located on the right.

Locality 1, Brimham Rocks [SE 208 646]

The spectacular natural cliffs and tors of Brimham Rocks are carved out of a plateau of Lower Brimham Grit (mid-Namurian). ***Do not hammer the rocks***. On a clear day York Minster (41 km) and Drax Power Station (57 km) are visible.

From the car parks, follow paths along the west-facing craggy escarpment in coarse and very coarse-grained feldspathic sandstone. The cliffs show many c.1 m units of cross-bedded sandstone deposited in fast-flowing delta channels of a river system originating in northern Scotland and Norway. Fretted shapes due to differential cementation can be seen, as well as scattered quartz pebbles. At the visitor centre, Brimham Lodge, built in 1792 as a shooting lodge for Lord Grantley, a video presentation on the rocks can be viewed. Refreshments and toilets are available nearby.

Follow the footpath on the north side of Brimham Lodge towards the east. Some of the more bizarre rock shapes are seen here in the 19 m thick grit. The Idol is an *in situ* part of the bedrock with a massive top and a tiny plinth. The greatly undercut base may owe its formation partly to wind erosion after the Devensian glaciation. The Druid's Writing Desk is a mushroom-shaped stone on the escarpment edge. The many tors, like the Dancing Bear, were probably shaped in part by freeze-thaw acting on joints in the grit just after the Devensian glaciation. Return to the car parks past Middle Crags, where further tors with fretted bedding can be seen.

Return via the B6265 to Pateley Bridge, where the Nidderdale Museum may be visited (see p. 203). Drive northwards from Pateley Bridge to Lofthouse, turning right into the village (public car park on the right).

Locality 2, Lofthouse [SE 1005 7358]

Immediately uphill take a path from the left side of the road to a footbridge over the River Nidd. Exposures in Middle Limestone form the foundations of the bridge. Proceed up the west bank for 60 m to view a cliff in the uppermost 4 m of the Middle Limestone, overlain by 1.35 m of mudstone, containing a rib of limestone near the top. The mudstone contains small brachiopods, bryozoa and crinoid columnals. Some 140 m upstream from the footbridge the mudstone is 1 m thick, still with a limestone layer. At both points the Five Yard Limestone is exposed above, with cherty beds in the upper portion. Proceed a further 60 m to a waterfall in Five Yard Limestone and exit to the private road. Walk up the road until a coppice flanks the road on the right. Enter the field by a gate 60 m before the wood and descend to the River Nidd. The Three Yard Limestone with grains of green glauconite can be seen in the river bed, but the underlying mudstones are not well exposed. Within the wood are exposures of the lowest beds of the Grassington Grit, a coarse-grained cross-bedded sandstone. Southwards from here, the Grassington Grits are well developed, but they pass into mudstones with thin sandstone to the north, along the flanks of nearby Coverdale. Return along the private road and cross the footbridge into Lofthouse.

Locality 3, How Stean Gorge [SE 094 735]

Turn right towards Middlesmoor at the junction at the foot of Lofthouse village. A left turn to How Stean Gorge and caves is signposted. There is an admission charge. The feature of interest is a deep gorge with safe walkways for viewing the deeply fretted cliffs in the upper beds of the Middle Limestone (Figure 5.2). An underground stream can be seen on the south bank emerging from the cave known as How Stean Tunnel. On the north bank is the entrance to Tom Taylor's cave, through which it is possible to walk 180 m and emerge near the car park. However the cave is not lit and torches are needed. Further extensive caves, suitable only for expert exploration, are shown on the plan which can be purchased at the cafe (toilets available).

Locality 4, [SE 0992 7647]

Rejoin the road and turn right briefly, before turning left up the private road to Upper Nidderdale. En route, look right to view the landslip of Thrope Edge, with a steep back scar. Continue northwards past a limestone cliff to the portal of an old railway tunnel, where there is parking [SE 0992 7647]

Descend directly eastwards through the stiles to the River Nidd where the base of the Middle Limestone, resting on mudstone, is seen on the river bed [SE 0994 7639] close to the axis of the Limley Anticline. The delicate tracery of the

compound coral *Orionastraea garwoodi* var *pristina* can be observed 1.5 m above the base of the Middle Limestone. About 100 m upstream the River Nidd sinks into Manchester Holes, a depression in the river bed; close by on the east bank a cave entrance is seen in which the roaring waters can be heard. Do not explore this cave since water levels can surge without warning. The waters emerge 3 km downstream, below Lofthouse at Nidd Heads. Extensive underground passages, all in Middle Limestone, and completely water filled near Lofthouse, have been explored.

Return to the tunnel mouth where in cliffs to the south the greater part of the Middle Limestone is seen dipping southwards on the southern limb of the Limley Anticline. Just south of the tunnel mouth, 2.4 m of dark grey limestones rich in the large brachiopod *Gigantoproductus* are seen close to the axis of the Limley Anticline. The bulk of the fossils are in the original growth position, with the larger, convex (pedicle) valve facing downwards and the concave (brachial) valve acting as a lid. Some 3 m above the top of the *Gigantoproductus* beds and immediately beside the eastern wall of the tunnel, scattered specimens occur of the 1 cm long egg-shaped blastoid *Orbitremites*. Higher strata are continuously exposed almost to the top of the Middle Limestone which is here unusually thick and includes the beds seen in the How Stean gorge. These are grey and light-grey limestones, commonly with crinoid debris. There is a further 1 m thick *Gigantoproductus* bed, a fossil rarely found at so high a level in the Middle Limestone of the Yorkshire Dales. In contrast the lower band is very extensively developed. A picnic spot is available at the south end of the cliff.

Rejoin the cars and drive up the Nidd Valley almost to Scar House Dam. Park in the visitor car park on the south side of the valley.

Locality 5, Carle Side Quarries [SE 063 776]

Walk across the dam to the north side and ascend the old incline to Carle Side Quarries (access restricted to August till February inclusive). The three levels of the quarries were developed in 1920–34 to provide stone for the construction of Scar House Dam, which has a concrete core and masonry face. The dam trench was excavated in the highest Yoredale strata and the Grassington Grit Formation. In their heyday the quarries employed 400 men. Looking southwards, another old quarry visible on Rain Stang was open in 1904–15 to provide stone for the Angram Dam, farther up the valley. Note the great landslip of Woodale Scar beneath this quarry, formed by freeze-thaw at the close of the Devensian glaciation. Also one can see the dramatic right-angled bend of the Nidd 4 km to the east. This may mark the point of capture of the eastward-flowing proto-Nidd by a southward-flowing stream.

The lower sandstones of the Scar House Formation in the quarries at Carle Side were deposited by voluminous density currents beyond the mouth bar of a river. These are followed on the second level of the quarry by prodelta sand lobes with flute marks on some bedding planes, shown well in fallen blocks from above a bush high on the face. Ascend the dumps to the highest quarry level where medium-grained channel sandstones are displayed. At the undulating base of the higher channel a conglomerate with abundant siltstone rip-up clasts is well seen. Higher strata are thinly bedded mouth bar sandstones, overlain by mudstones. The skyline feature is in Lower Follifoot Grit.

Traverse the hillside westwards from the highest quarry levels along the top of the feature in the Red Scar Grit. Blocks from the upper half of this grit include abundant crinoid columnals and rarely the brachiopod *Spirifer*. Walk to the second stream, Stand Syke, which drains to an angular embayment in Scar House Reservoir.

Locality 6, Stand Syke [SE 0509 7784]

Here, traces of the Woogill Coal, named after the next major stream east of Carle Side quarries, can be seen in the grit. It has been extensively worked by adits and some shafts in Colsterdale to the north, ever since the days of Fountains Abbey. Much of the Colsterdale Marine Beds, some 3 m in thickness, are seen, and the Colsterdale Limestone 2 m above the Red Scar Grit is very fossiliferous. The limestone has weathered to an ochreous orange-coloured 'gingerbread' and contains the zonal goniatite *Cravenoceratoides nitidus,* besides *Anthracoceras paucilobum, Dimorphoceras* and fish remains. Shaly mudstones above the 0.30 m thick limestone have yielded *Eumorphoceras bisulcatum*. The 2 m thick mudstones beneath the limestone yield a bivalve fauna. Descend the hill using the gates (do *not* climb the wall) along the rim of Stand Syke, passing cliffs in the Nidderdale Shales which underlie the Red Scar Grit. These beds contain rare thin sandstones and are generally lacking in marine fossils. Join the track and walk east to Scar House Dam. Cross the dam

and follow the track on the south side of the reservoir for 350 m.

Locality 7, The stream 50 m east of Scar House Gill [SE 0638 7654]

The stream 50 m east of Scar House Gill [SE 0638 7654] exposes the Cockhill Marine Band, 1.65 m of very dark mudstone containing bivalves, notably *Caneyella membranacea* and *Posidonia vetusta,* at the base of the Nidderdale Shales. The zone goniatite *Cravenoceras cowlingense* occurs sparsely in the mudstone, and as three-dimensional specimens in limestone nodules near the middle of the mudstone. Other forms, reminiscent of a Yoredale-type fauna, occur in the mudstones, notably crinoid columnals and small zaphrentoid corals.

Cross westwards into Scar House Gill, where the marine band is less well exposed but includes the nodular limestone with goniatites. The overlying Nidderdale Shales consist of 72 m of almost continuously exposed mudstones with a few thin bands of fine-grained sandstone. There are no seatearth bands and fossils are scattered plant debris. Above, the Red Scar Grit is in two leaves. The lower leaf is a feldspathic sandstone with seatearth bands near the top, overlain by 0.04 m of attenuated Woogill Coal. The mudstones immediately above the coal yield *Lingula*. The upper leaf of the Red Scar Grit is a cross-bedded medium-grained compact sandstone with scattered crinoid columnals weathering out as voids.

Locality 8, [SE 0680 7737]

Traverse eastwards along the lip of Nidderdale for 600 m with a fine view across the valley to Carle Side quarries. On the horizon to the north are two outliers in Libishaw Sandstone (midNamurian), Great Haw and South Haw. En route, cambering effects can be seen on the valley edge, where clefts have opened up behind tilting bodies of sandstone [SE 0680 7737]

Where the track to Middlesmoor intersects the traverse, the two leaves of the Red Scar Grit are well exposed and split by the 0.90 m thick Woogill Coal, worked here by adit. Just east of the track, the upper leaf of the grit is nearly 9 m thick, double the thickness in Scar House Gill and characterized by cross-bedding sets 9 m high and channels within the rock unit. Return downhill to the Scar House car park, using the track.

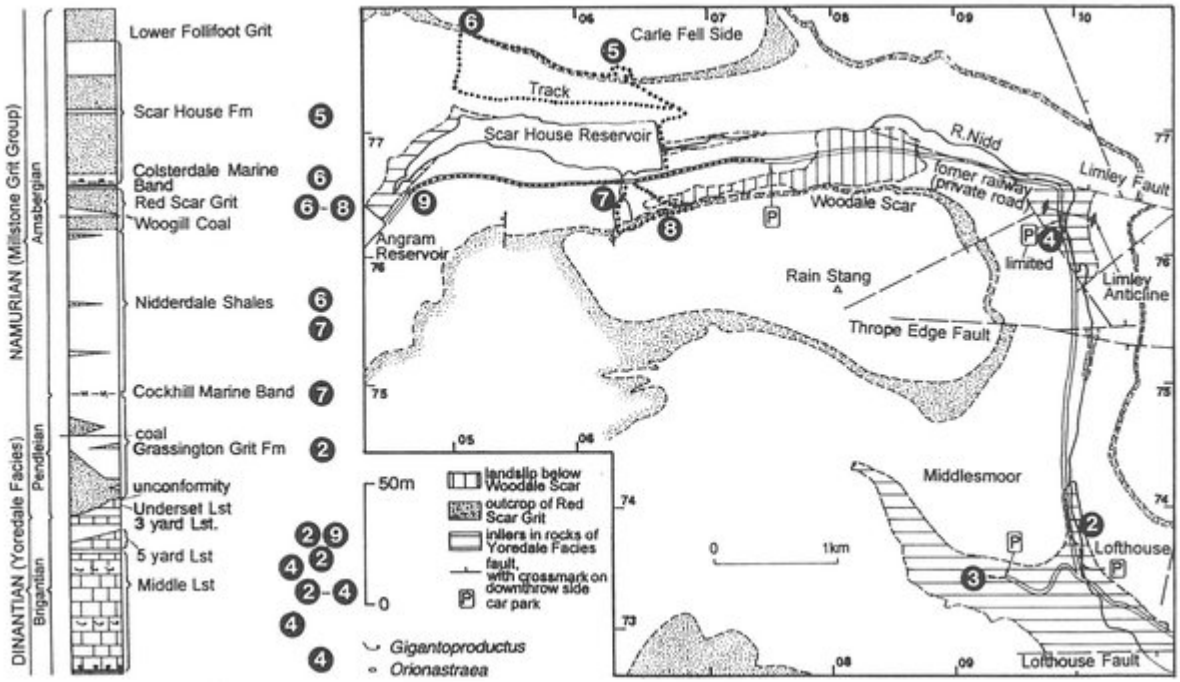
Look upwards to the scar in the lower leaf of the Red Scar Grit, which contains undulating channel systems. Above the cliff are vast boulders from the upper leaf which have detached due to the cambering effects observed earlier.

Locality 9 [SE 046 766]

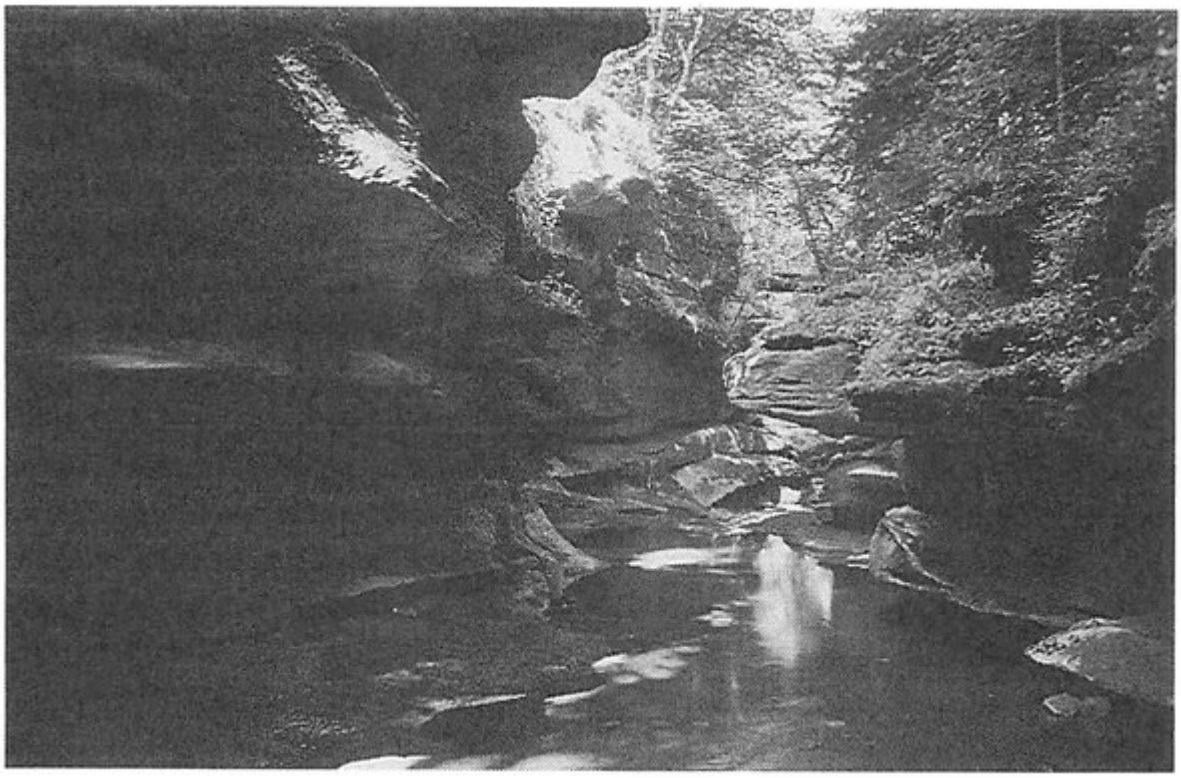
Walk along the road towards Angram Reservoir (cars are not permitted along this stretch) and descend to the south bank of Scar House Reservoir, 300 m down-valley from the Angram Dam. Care is needed, because the exposure is close to the bank of Scar House Reservoir. The sequence consists of 3 m of fossiliferous shaly mudstones with siderite nodules, overlain by 5.4 m of unfossiliferous shaly mudstones, capped by 3.6 m of Three Yard Limestone. This is the type locality of the trilobite *Weberides barkei,* usually found as headshields, tails or body segments, rather than complete specimens. Also present are zaphrentid corals, bryozoa and a variety of brachiopods and bivalves.

Return to the car park, with views along the road of Scar House Dam, the great landslips below Woodale Scar and finally the major bend in the River Nidd 4 km downstream.

Bibliography



(Figure 5.1) Geological map and succession for upper Nidderdale.



(Figure 5.2) The Middle Limestone in How Stean gorge, deeply fretted by water erosion (Locality 3). Photo: B.G.S.