WALKING IN THE YORKSHIRE DALES, JUNE 1999

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Geology can be studied earnestly, to the exclusion of everything else or investigated as opportunities present themselves (and to any degree between the two extremes). So it was in June 1999, when Gill and I spent our holiday near the Yorkshire Dales National Park. Walking, driving, even just sitting in the area meant that the local geology played a huge part in our enjoyment. It is possible to study the rocks of the Dales, albeit at a simple level, without subjecting non-geologists to endless geologizing. In many places the rocks are so imposing and dramatic that even the uninitiated become, for a time, keen to learn about their surroundings. Like the four walkers, who wondered why I was carrying some 'stones' down the side of Penyghent. When it was explained that the 'stones' were representative of two types of sediment laid down during two varying environments, the Carboniferous Limestone and the Millstone Grit, their walk was delayed for some time until the simple sequence of sedimentation was understood, and why some of the 'stones' I was carrying contained plant remains. Or, when Gill and I, following the River Nidd, came on the spot where it disappears into its bed with a noise like a rushing wind. And why? - because it had left the Millstone Grit and met the Carboniferous Limestone at Goydon Pot. But it was not just ordinary Carboniferous Limestone - it was crowded with huge Productid brachiopods, corals, crinoid material, much preserved in black chert. Even Gill was moved into collecting specimens and carrying them the three miles back to the car.

The rock sequences in the Yorkshire Dales are relatively simple, being Ordovician and Silurian rocks overlain by Carboniferous Limestone, followed by Millstone Grit. The older rocks are not exposed except in a limited area in the south west, just north of Settle. The whole of the rest of the National Park is Carboniferous, with the Great Scar Limestone overlain by the Yoredale Series, the latter covering probably 80% of the area. The remaining exposed rock is the Millstone Grit, which forms most of the highest points and the dales of the south east, namely Nidderdale and lower Wensleydale.

The Yorkshire Dales and our own Mendip are similar in some respects. They are of Carboniferous Limestone much of it being highly fossiliferous, with potholes, disappearing and re-appearing rivers, classical bedding in cliffs and exposures. The dissimilarities are, however, striking. The Dales are much more extensive than Mendip, with deep glaciated valleys showing large expanses of bare rock as ledges, cliffs, scree and, notably, limestone pavements.

What are the factors that have affected the Yorkshire Dales? Following deposition of the Silurian rocks, the Caledonian Orogeny uplifted and folded them, with a granite mass rising under Wensleydale to form what is called the Askrigg Block, and causing igneous dikes to strike through the old rocks. During our holiday, we visited Harrogate which is famous as being one of the earliest spa towns in Britain. I was puzzled why the town, totally surrounded by Carboniferous rocks, produced so many sulphurous wells, which can be sampled at the Pump Room. (Our friend, taking advantage of the chance, pronounced the waters as 'foul - like rotten eggs'). Of course, when I discovered there was a granite under us, I made the connection - granite mass - thermal waters - hydrogen sulphide - it fitted in.

Following uplift of the Askrigg Block, the Silurian massif was planed off to produce a platform on which the nearly horizontal beds of the Great Scar Limestone were deposited. This now dominates the scenery, particularly in the south of the Park. Overlying it, the Yoredale Series forms the limestone and sandstone stepped valleys typical of upper Wensleydale and Swaledale. On the high fells, the Yoredale Series are overlain by the Millstone Grit capping which can be seen on the high points of Ingleborough, Penyghent and Whernside. To the south and west, the series of

Craven faults and the Dent fault cause major changes in the sequences, with the Middle Craven Fault producing the famous features of Malham Cove and Goredale Scar.

Of course the topography we see today is not just the product of the Carboniferous System, but are the results of long periods of glaciation from 500,000 to 12,000 years ago. During our holiday, our activities allowed us to examine at first hand the results of these events.

Malham

One of the most visited, photographed and 'written about' parts of the Yorkshire Dales (particularly by school pupils) is Malham Cove. It is highly picturesque as well as being spectacular, geologically.

Our walk started in the village of Malham and led us along a farm truck in a NNW direction to Pikedaw Hill. The high walls lining the track were composed of limestone and millstone grit blocks and guided us gently up, away from the crowded village. Leaving the track, we climbed more steeply, following a footpath up a shallow valley. To our right, the hill rose fairly steeply, covered in large blocks of limestone while, on our left, the slope was more gentle but covered only in coarse vegetation typical of acidic conditions. As we neared the head of the valley, it became clear that we were following the Middle Craven Fault - limestone to the north, millstone grit to the south. Near the top, an old adit was the first sign of the old mine workings which litter the top of Pikedaw Hill, allowing us to look for minerals but confining us to sparkly quartzitic gangue. From here, we took a right turn which led us firmly on to the limestone hills, and, as we dropped slowly down in a NNE direction, limestone pavement became increasingly the main feature of the landscape. After a mile or two across the area (called Ewe Moor - judging by the huge numbers of sheep and lambs, it has been used for this purpose for, maybe, hundreds of years, so hence the name), we climbed down the steep pathway into the dry valley of Watlowes. Here, rushing rivers of meltwater had carved the steep sided valley but now, the river is underground. Quite suddenly, we came out on to the limestone pavement (photo 1) which tops the magnificent rock amphitheatre of Malham Cove, with its superb examples of clints (blocks) intersected by grikes (deep fissures) in which damp loving plants were growing, exploiting the micro-climate sustained by the grikes. The Cove is 70 metres (230 feet) high and probably formed by a combination of erosion by ice and water, plucking and scouring the rock to produce the wide bowl of the face (photo 2). Today, no water flows over the cove, except in severe flood, but issues meekly from a small cave in the centre of the bottom of the cliff. It is thought that the original cliff of the cove was formed by movement along the Middle Craven Fault, and that erosion has moved the face northward away from the fault line.

We climbed carefully over the limestone pavement and down the footpath on the west side of the cove, from where superb views of the cliff and its surroundings can be obtained. Peregrine falcons, nesting on the east side, wheeled above us, calling to the young all the time, while the wooded bottom of the cove supported a whole group of other birds, notably willow warblers and blackcaps which have been so badly reduced in number elsewhere.

The geology of Malham Cove is relatively simple. The top plateau is in Great Scar Limestone, and includes the Cove Limestone and overlying Gordale Limestone, all of which lie nearly horizontal. The last forms the narrow gully of Gordale Scar, one and a half miles to the east of Malham, where a small stream passes through a dramatic gorge, carved by the ice, but now occupied by a spectacular tufa deposit laid down by the stream. Our walk did not take us to Gordale Scar - that's for a future visit.

Photograph 1: Malham Cove Limestone Pavement

Photograph 2: Malham Cove

Penyghent

One of the aims of our holiday was to see the hills and dales followed by the Settle to Carlisle railway line, and to visit one of the monuments to the steam age - Ribblehead Viaduct.

It was a grey morning in Settle, but the busy atmosphere of the town and market place dispelled the gloom. It is built entirely of Millstone Grit, with the oldest building, 17th century, constructed of cleanly cut and fashioned heavy blocks, giving it an imposing, sombre presence amongst the smaller houses and shops. After Settle, we set off up Ribblesdale, stopping at Stainforth Force (photo 3), a large waterfall on the River Ribble, to see the tea-coloured water tumbling down the limestone steps into a deep, trough-like plunge pool. In the village, a small road leads up the hillside and flattens off on to a plateau formed, on both sides, by limestone pavements which themselves lead towards ledged hillsides. Where the plateau widens out into a broad U-shaped valley, a footpath, part of the Pennine Way, leads up to Penyghent (photo 4). Most of the way is gently undulating and then, just east of a group of potholes in the limestone, the path begins to rise more steeply until it reaches the base of the imposing face of Penyghent. Here, the climb becomes one of picking your way over the scree of limestone until, quite suddenly, the path levels out on to a ledge for a short distance. This is not just the top of a limestone bed but can be clearly seen as the junction of the Yoredale Series and the overlying Millstone Grit (photo 5). The vegetation changes from grassy sward with flowering, lime loving plants to coarse Purple Moor Grass and heathers typical of acidic uplands. The surface is littered with slumped blocks of the Grit, and amongst the smaller loose scree are pieces which contain fossil plant remains - leaves, stems, fragments of root - very reminiscent of plant remains in our local Pennant Sandstone. After a quick climb to the plateau of Penyghent, to look at the view, particularly of the huge quarries to the west where the limestone and Silurian sediments are extracted, the return was made downhill, meeting, on the way, the walking party referred to at the beginning.

The rest of our day was spent mostly in the car, but we took a walk around the area of Ribblehead Viaduct (photo 6). This 23 span bridge, 105 feet high, carried the Settle to Carlisle railway line over Batty Moss, and is constructed from Millstone Grit quarried and dressed in the immediate area - a place of pilgrimage for all railway enthusiasts. It was under the spans that we found a small piece of chert which was riddled with the hollowed out moulds of Carboniferous fossils.

Photograph 3: Stainforth Force

Photograph 4: Penyghent, with limestone pavement in foreground

Photograph 5: Penyghent - Carbonifierous Limestone to Millstone Grit junction

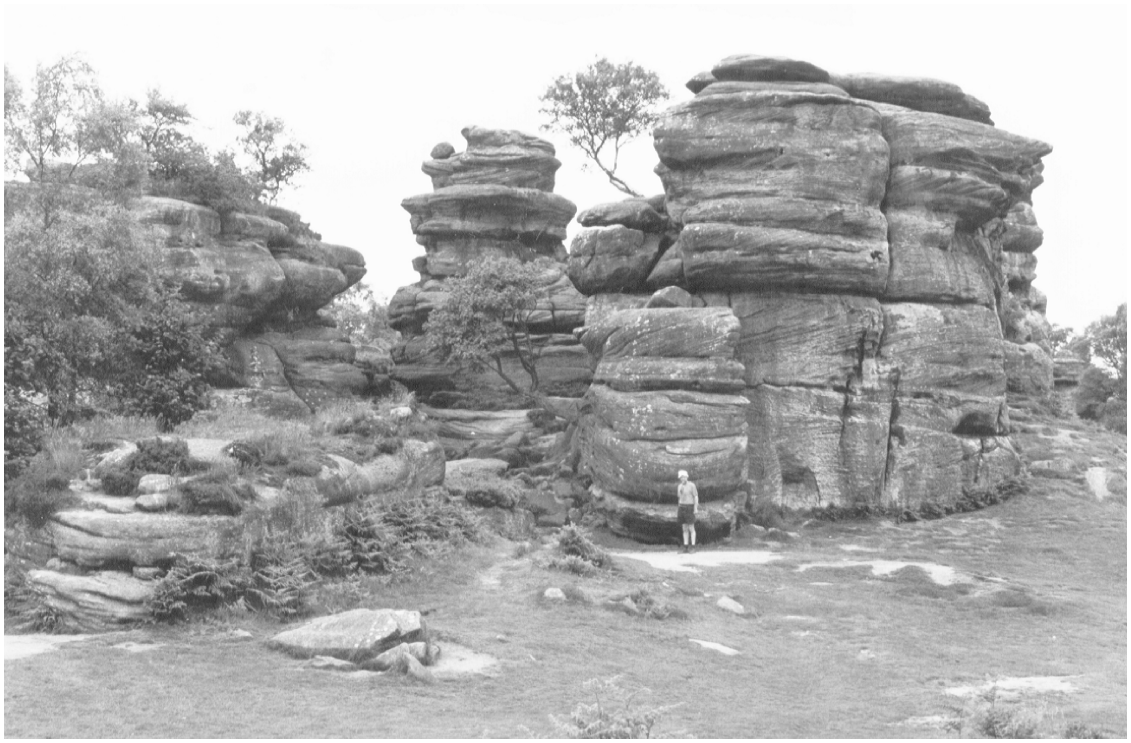
Aysgarth and West Burton
Aysgarth lies in Wensleydale and is famous for the sequence of beautiful waterfalls which start below the church and extend eastwards for about half a mile as the River Ure drops over a series of limestone benches and shales. Our walk went over the road bridge from where the top waterfall can be watched. Here a kingfisher flew under the bridge and skimmed the water as we passed. The patch to the churchyard climbed steeply and was paved with slabs showing superb fossil burrows meandering over the surfaces - pity they were such huge slabs! After a mile or two, the path which had led us into Bishopdale and the village of West Burton, climbed up the ledged side of the dale over Yoredale Series limestone. Over us, Carlton Moor, of Great Scar Limestone, seemed to stretch up and up. Beside us on the steep slope, fossiliferous pieces of limestone containing brachiopods, particularly of Spirifera species, corals and crinoids, lay all around us. At the top of the first slope where the hill levelled out for a few yards, we turned abruptly northeastwards where a green lane followed ledges of highly crinoidal limestone for a mile or two. The rock has been used for walls in the lane and fields and has been beautifully weathered, showing clearly that it contained little else but crinoid debris. It also appeared to be bleached, showing white in places where lichens had not colonised it, posing the question - why were some areas not supporting lichen while others around were?

Our return to Aysgarth took us down from the ledge of Dove Scar past the remains of a little limestone chapel built by the Knights Templar in the 12th century, and then to the River Ure, about half a mile below the road bridge, walking back along the bank beside the series of waterfalls. The best time to see them is when the river is in flood but, as it was, we could clearly see how the river had eroded the thin shales between the thick beds of limestone, causing them to away, leaving the series of steps in the river bed. It was a lovely spot and understandably a very popular attraction.

Brimham Rocks
To the east of the National Park, overlooking Nidderdale and three miles from Pateley Bridge is the picturesque spot called Brimham Rocks. Hardly above the surrounding land, providing fine views of Nidderdale with Harrogate in the distance. The attraction is the collection of weird and fascinating shapes eroded from the Grit towards the end of the last Ice Age. Unlike the Grit elsewhere, it was gently bent, rather than folded, into a shallow saucer shape. The bedding, therefore, dips slightly towards the centre of the 'saucer' imparting much greater stability and preventing eroded blocks from falling outwards. A network of paths winds around the piles of rocks, providing a good opportunity to examine cross bedding, ripples and fining and coarsening sequences. The paths lead to a well-presented visitor centre where the formation of the rocks is clearly shown in a permanent display. There is also a board with a panoramic representation of the view, with the fanciful names given to each rock formation by the Victorians, superimposed on each mound of rocks in the picture. In the visitor centre are reproductions of photographs taken when huge numbers of tourists, brought by 'charabancs', thronged the rocks. It has, clearly, been a tourist attraction for a long time, particularly in the days when a journey of just a few miles from town was a great day out. Now, under the protection of the National Trust, vehicle access is denied, and conservation of the area is being actively pursued (photos 7 and 8).

The holiday was enjoyable (complimented by dry but not hot weather) providing an interesting and diverting introduction to the Yorkshire Dales. Next time, we must spend time in the northern section, around Swaledale and the mining areas.

Photograph 6: Ribblehead Viaduct



Photograph 7: Millstone Grit Formations; Brimham Rocks