

Field trip to County Durham Permian at Castle Eden Dene on Sunday 9<sup>th</sup> August 2009.  
Leader Dr Eric Johnson

This proved to be a popular trip, and a large group of fourteen assembled at Oakerside Dene Lodge on a fine Sunday ready to explore the wild beauty of the Dene. Castle Eden Dene is the largest of eight very deep valleys or gorges cut into the Magnesian Limestone of County Durham following the last glaciation, and is renowned for its unique woodland, some of which has survived from ancient times, the steep valley escaping clearance by man. The Dene is renowned for its abundance of yew trees, although ash is the dominant species, which grows well on boulder clay. Large oak and elm are also present alongside the more recent introductions of beech and sycamore.

We passed through the kissing gate and entered a steep valley surrounded by dark woods which lent a mysterious atmosphere to the start of the walk, noting the proliferation of equisetum plants by the wayside as we went, a small reminder of their Carboniferous ancestors. We followed the path west to Gunner's Pool Bridge, which was reconstructed by the Burdon family to support the Lodge. This crosses a spectacular narrow ravine, about 100ft deep, which follows the path of a minor fault, seen as parallel fractures along the stream bed, the erosive power of the water exploiting the weakness of the shattered rock at this point. There is a downthrow of about 10m to the south, leaving a steeply dipping footwall on the north side of the stream, exposing the buff-coloured horizontal beds of dolomitic limestone.

We continued east, the ravine widening, and amongst the dense vegetation one could see the thick layer of boulder clay dumped on top of the magnesian limestone by the ice covering from the last glaciation which extended across much of northern Europe 18,000 years ago. We stopped at an opening in the trees caused by a landslip, noting mature trees to one side, and the more recent recolonisation by oak, ash and lime to the other. The path continued high along the side of the gorge, allowing us to admire the view across the tree tops, until we arrived at a corner which gave us a good view of the castle itself, largely rebuilt by the merchant Rowland Burdon around 1760 on the site of an older fortified house dating back to mediaeval times. In post-war times the castle was refurbished by the Coal Board and is now converted into apartments. Throughout the nineteenth century (and even earlier) the Dene was managed as a source of timber and lime to support the rapidly growing local industry, and was also a popular place for people to visit for recreational purposes, including game hunting. However, over time, maintenance of the footpaths became an increasing problem, and with a change in fortune of the Burdon family in the 1950s the Dene eventually passed into public ownership and was declared a Local Nature Reserve, eventually being opened to the public in 1971.

Crossing Castle Bridge we encountered an exposure of the Ford Formation of Middle Magnesian Limestone, now seen in the lower parts of the cliff. During the late Permian, County Durham was situated on a land-mass north of the equatorial belt. Land subsidence took place, allowing the tropical Zechstein Sea to break through from the north to form a shallow tropical basin which extended from the Pennines eastwards as far as Poland. In the tropical climate that prevailed, thick sequences of carbonate deposits formed on the western shore, cropping out in a sinuous belt of reef-facies up to 5 km wide from Sunderland to West Hartlepool.

These deposits comprise dolomites and dolomitic limestones of lagoonal, reef and basin facies, the former thickening eastwards to form a shelf edge ridge or reef structure before tapering off steeply into a fore-reef talus or apron in the basinal facies. Lagoonal facies occupy most of the outcrop to the west, these back-reef facies forming a series of soft, pale cream, granular dolomite beds of variable thickness, indicating layers of lime-rich mud which accumulated on the shallow sea floor 290 million years ago. The beds are scattered with small cavities ranging from a few centimetres up to a metre across, the result of sulphate minerals such as gypsum and anhydrite which readily dissolve. Diagenetic changes have also taken place in which half of the calcium has been replaced with magnesium, with calcite building up in many of the fissures and cavities. Although these deposits are shelly with several species of gastropods, brachiopods and bivalves, their distribution is variable and much of the original structure has been lost.

As we proceeded further down the Dene, we took a short diversion into Blunts Dene to see a recent landslide caused by water flowing through sands and gravels of a preglacial valley which destabilises the overlying boulder clay. The landslip is further exacerbated by water which is undercutting the reddened sediments of the slump.

We returned to the footbridge and examined the boulders in the dry stream bed – a result of the stream having found an alternative underground route. The boulders were large and rounded, having been transported considerable distances by the ice-sheets, mostly from Northumberland. The most frequently found ones were of dark grey Carboniferous limestone, some with coral remnants, and others were of porphyritic andesite from the Whin Sill. There were many rocks of local origin. Lunch was taken whilst examining these rocks.

Crossing the footbridge and proceeding further east, we caught occasional glimpses of the buff coloured bedded limestone, keeping our eyes open for the more massive pale cream dolomitic limestone of the overlying reef beds. A little further on we came across a huge rock which had toppled down from the cliff above, known as ‘The Devil’s Lapstone’. Legend has it that the Devil dropped the stone, and indeed it would not have looked out of place in a ‘Lord of the Rings’ setting, with its strangely shaped tree and roots which growing out of it. It turned out to be a very large block of reef limestone, crystalline and massive, covered by lichens and with very little evidence of fossils. When formed during Permian times, it would have consisted of algal mats and bryozoans, both of which are poorly preserved following recrystallisation.

A few yards downstream we encountered two smaller blocks of fallen limestone, which lay side by side, almost touching, known as ‘The Kissing Frogs’. These also formed part of the reef limestone, and although it is heavily dolomitised, we were lucky enough to find a few possible traces of shells.

We climbed the steep steps up the side of the Dene, and made our way back to Oakerside Lodge ready to move on to view the Easington raised beach.

Mavis Gill

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