Reading Geological Society

Peak District Report

Monday September 19th 2022 –
Thursday September 22nd 2022

Led by Peter Jones, University of Derby
Vanessa Banks, BGS
Jim Riding, BGS

Monday 19th September

Bees Nest Pit, Brassington - led by Peter Jones and Jim Riding

Grid ref: SK 241 546

In the morning we travelled to Derbyshire to meet up at 1.30 pm with Peter Jones and visit the Bees Nest Pit and the Harboro' Rocks near Brassington. This visit had been organised by Peter Jones who had arranged parking for us in the nearby brickworks and for Jim Riding of the British Geological Survey, an expert on the site, to show us around.

The Bees Nest Pit is a deep sand pit which was exploited by a local brickworks because of the correct balance of sand and clay. The bricks could be made by pressing the sand into moulds and firing them. The sand grains were coated with kaolin and the clay content was sufficient for refractory bricks.

Fig. 1 Bees Nest Pit

The pit is set in a countryside of Carboniferous Peak Limestone that has been dolomitised and is one of about sixty "pockets" of the Brassington Formation of Miocene age (dated by palynology). Apart from an outlier near St. Agnes in Cornwall and a dissolution pipe in Anglesey, these sands are the biggest Miocene deposits in the UK. (Fig. 1)

The deposits in the pit are dipping towards the centre indicating that the beds have collapsed or subsided into a depression in the Carboniferous limestone and there are three distinct members. The lowest is the Kirkham Member which is a loose, cream-coloured sand about 70 m thick with occasional well-rounded pebbles of quartzite and other rocks typical of Triassic age. Above this is the Bees Nest Member which consists of 6 m of red and green interbedded marls. Both are unfossiliferous. Above them is the Kenslow Member which is quite thin and contains fossil wood and pollen. The wood is coalified to between peat and lignite. Pollen from a similar pit was dated to Late Miocene (9-7 Ma - Tortonian). At one side of the pit there is a slab of Carboniferous Bowland Shale which must have existed above the limestone and collapsed into the quarry. (Fig. 2)

Fig. 2 Kenslow Member wood

The "pockets" contain all that remains of the Brassington Formation. All deposits above the Carboniferous limestones had been eroded away (Permian) leaving a surface of the limestone eroded to a basin in which the Brassington Formation was later deposited (Miocene) - possibly in a lake. The glaciations also eroded away all material above the level of the surface of the limestone including the Brassington Formation, only leaving behind the deposits which had already sunk into the sinkholes. Some "pockets" also have some glacial head.

Harboro' Rocks

Grid ref: SK 242 552

The Harboro' (or Harborough) Rocks form a long dolomitised limestone cliff north of the Bees Nest Pit. The cliff runs NW–SE just north of the High Peak Trail and can be reached by the path from Manystones Lane between the car park (to the east) and the works (to the west). (Fig. 3)

Fig. 3 Harboro' Rocks

Dolomitization of limestone occurs where a calcium ion in calcite has been replaced by a magnesium ion. Dolomite refers to the mineral CaMg $(CO_3)_2$ and to the rock produced by dolomitization (although this may be called dolostone). The replacement molecules are smaller than the original pair of calcium carbonate molecules and the size differences add up to an increase in porosity, cavities and the destruction of detail of structures and fossils. It is thought to occur when fresh water and sea water both pass through the lime-stone or when sea water intrudes the limestone followed by evaporation.

Fig. 4 Bedding, cross-bedding and conjugate jointing in the dolomitised limestone

Jim showed us different examples of the effect of dolomitization on the limestone. The rock was very rubbly and showed the almost complete obliteration of structures though traces of bedding and some conjugate faults remained. At various places there were also finger-like structures which would have been burrows (trace fossils) in the original limestone and there were occasional (but rare) remnants of brachiopods and corals. Some cavities were where iron had weathered out and given a slight buff colour to the rock. (Fig. 4)

When we got close to the cliff face we could see mine adits and other traces of the Colconda Mine. This was worked for about 150 years for lead. A cave, the size of a modern living room, was once home to a miner's family and described by Daniel Defoe. It had access to the mine and cave system in the rocks and is now a tourist attraction.

The rocks are massive with very few obvious partings, many forming benches, tens of metres high, and stretching the whole length of the exposure. It was suggested that these were erosion surfaces at the then sea level and were cut according to the rise and fall of sea level due to the state of glaciation.

Report and photos by Roger York

References:

Pound and Riding, Miocene in the UK! on a little-known Miocene sedimentary unit in the southern Peak District (Derbyshire)

Peter T. Walsh, Vanessa J. Banks, Peter F. Jones, Matthew J. Pound & James B. Riding, 2018, A reassessment of the Brassington Formation (Miocene) of Derbyshire, UK and a review of related hypogene karst suffusion processes

Tuesday 20th September

Lathkill Dale - led by Vanessa Banks

Morning

Grid reference for start of walk: SK 15694 66439 Postcode: DE45 1JG

Aim: to explore the geology, geomorphology, hydrogeology and mineral workings of a fluvio-karstic dendritic valley in Lathkill Dale – a site of special scientific interest in the Derbyshire dome. (Fig. 5)

Period covered: Brigantian Carboniferous deposits and current day tufa deposits. The lavas seen at the end of the afternoon lie within the Monsal Dale Limestone.

Regional stage	Formation
Brigantian	Eyam Limestone
	Monsal Dale Limestone

NB: the Asbian age of the Bee Low limestone formation beneath this sequence was debated during the previous day's visit to the Bees Nest pit.

Fig. 5 Map of the Lathkill Dale walk (Source Natural England)

Geomorphology: This west to east traverse down Lathkill Dale began at Monyash and ran parallel to the road to Over Haddon then southeast to the end of the walk at Conksbridge. Vanessa asked us to imagine we were walking down under a sea which had deepened from west to east and reflected a carbonate shelf environment. She pointed out the accumulations of coral rich oolitic limestones compared to the structureless micritic mud mounds that could be seen as tabular outcrops along the sides of the valley. These mounds deepened as the walk progressed eastwards.

The limestone platform lies at the centre of the Derbyshire dome and dips eastward under the Bowland shale. Within the Eyam limestone local bedding dip reflects the reef surface at the time.

The morning session included a detour into Ricklow Dale and quarry where we viewed the contact between the Monsal and the Eyam formations. (Fig. 6)

Fig. 6 View of the Eyam Limestone

Many thanks to Vanessa and members of the group who supported others through the steep descent down the steps out of Ricklow Dale. (Fig. 7)

The group continued along the valley floor before stopping for lunch at the Lathkill Head Cave. The cave was a dry cave during the visit, full of huge boulders. (Fig. 8)

Fig. 7 View of Lathkill Dale from the top of the steps out of Ricklow Dale

Fig. 8 Lathkill Head Cave

Hydrogeology: The Lathkill river is an autogenic river as its source and the whole length of flow lies within the Carboniferous. Lathkill Dale and Ricklow Dale are now dry valleys as the water table often recedes below the river level. Possible reasons for this include soughs and adits created to dewater the mines and the karst substrate.

Mineral workings: Vanessa pointed out the 'rakes' which followed faults (strike slip) and scrins which followed veins. We examined scree deposits left from mining and found minerals, corals and brachiopods.

Description of rocks:

The Monsal Dale limestones are shallow carbonate shelf deposits formed during cyclic periods of regression (progressive shallowing). They are pale and marked at the top by a cherty shell bed full of brachiopods in a concave up position. (Fig. 9)

The Eyam Limestones are pale to mid grey micritic reef limestones (knoll, flat and apron reefs). The mud mounds have a micritic core with crinoidal flanks.

Fig. 9 Discussion about the channel deposit in the Monsal Dale Limestone

Discussion

- The nature of the paleoclimate during the ‘pause’ in the deposition of the Mondale Limestone which allowed the upward development of the mud mounds
- The shape of the mud mounds at the start of the walk (tabular) compared to those at the end which were more conical similar to those now found at the Stone Centre and in Vietnam
- The difference between stromatolites which have algal growths throughout compared to the mud mounds which are structureless
- Why the Derbyshire dome was not affected by the last interglacial in the Devensian although the flanks of the dome to the west and east were affected
- How the miners dewatered the mines
- The origin of the minerals in the rakes and scrims – thought to originate from percolating water from the shales in the Coal Measures to the East
- The dip of the thinly bedded Eyam Limestone which reflected the original slopes of the reef flanks at progressive stages
- The economy of the lead mining in the area researched by Rieuwerts (2000)
- Modern tufa (calcrete) development at the waterfall and in the base of the riverbed
- Styolites in the limestone indicating periods of pressure as they solidified

Fossils found

- Corals – single and colonial
- Brachiopods – including Gigantoproductids

Report by Angela Snowling, photos by Philip Snowling

Tuesday 20th September 2022

Lathkill Dale (continued)

Afternoon

While taking lunch at Lathkill Head Cave, Vanessa explained that the cave is usually taken as the source of the river although during the winter, springs occur further westwards towards Monyash and flow into the river. The cave system extends to Ricklow/Ferndale. The river generally only flows outside the cave from October to March so was dry on our visit, though a stream generally flows at the bottom of the cave. David Ward reported seeing it on a previous visit flowing right across the path before turning eastwards down the dale. The floor of the cave is associated with the base of a shell bed. During lunch, hunts took place for minerals with barytes and galena being found.

There were discussions on the formations of scree and chert:

> Scree: created by rock fall following freeze / thaw conditions. In Derbyshire some of these scree slopes are cemented especially in the mining areas.
>
> Chert: at Bakewell the chert beds reach 6m in depth. The conditions require specific Eh/pH levels at a depth of 2-6m below sea level. Sources of silica for the chert include diatoms, spicules and radiolarian blooms. Here silica from various sources is released to form a siliceous ooze on the sea floor. Later sediments squeeze the ooze and as quartz is the first to crystalise under the pressure, chert is formed. Iron in the solution will produce a pink or red coloured chert. Nearby at Cowden there is a chert layer interbedded with the limestone and was mined for use in the ceramics industry.

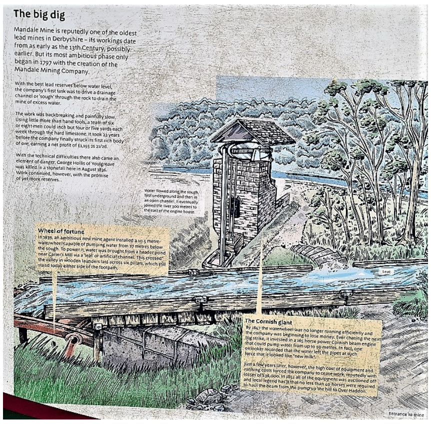
Continuing our walk along the dale we observed other river sources, for example from Cow Dale and more springs. As mentioned previously, parts of the Lathkill River do not flow year round; hence is known as a ‘bourne’.
Eventually we came to the section of the river which is perennial. The water rises at about 9° C via a fault to create a bubbling spring. We stopped at a tufa bench to look at the accretions where the rocks and vegetation were both covered in calcium carbonate; tufa. (Fig. 10)

Fig. 10 Tufa covered veg in river

With water in the river all year round and with increasing flow, industry grew along the river banks. At Carter’s Mill we observed the mill race.

We continued to Bateman’s House. James Bateman was a mining agent who originally built the structure to disguise his Dakeyne pumping engine. This new water driven machine was designed to remove water from the mine and pump it into the River Lathkill. Some of us clambered down the vertical iron steps to take a look at the shaft. (Fig. 11)

Fig.11 Bateman’s House



More industrial archaeology was seen at Mandale. Mining had been taking place since 13th century with the main mine being developed in 1797. The best reserves of lead being below water level; barytes is the gangue material. As with most mines in the district, water in this deep shaft mine was a problem, so a Cornish steam driven beam engine was imported to remove the water. This was achieved by pumping the water through channels designed and built for the purpose, initially underground and then at the surface. These channels are known locally as soughs, some of which run for several hundreds of metres and a few, several miles. (Fig.12)

Fig.12 Mandale Mine

Further down the river at Lathkill Lodge we observed rocks of Carboniferous plateau lava in the wall.
At various points along the river more springs add to the water flow. Along this stretch weirs had been built to manage the river flow and to maintain a sufficient level of water to farm fish.
After the main weir the water changes colour in several places to become blue. It is not known why! There are two theories; first is that the manganese in the water is causing the discolouration and secondly that it is just an optical effect of the tufa on the riverbed. (Fig. 13)

Fig.13 Weir and blue water

It was a long, tiring but enjoyable day and so following a bit of driving around little single track lanes to get people back to the parked cars we returned to Matlock enjoy cocktails, beer and dinner!

Report by Ailsa Davies, photos by Ailsa Davies

Wednesday 21st September

Morning

Derwent Valley, Mining Museum and Temple Mine – led by Peter Jones and Dr Lynn Willies

Grid ref. SK 2938 5800

Derwent Valley

We started the day at the car park in Matlock Bath then walked along the A6 to observe the characteristics and geological history of the Derwent Gorge.

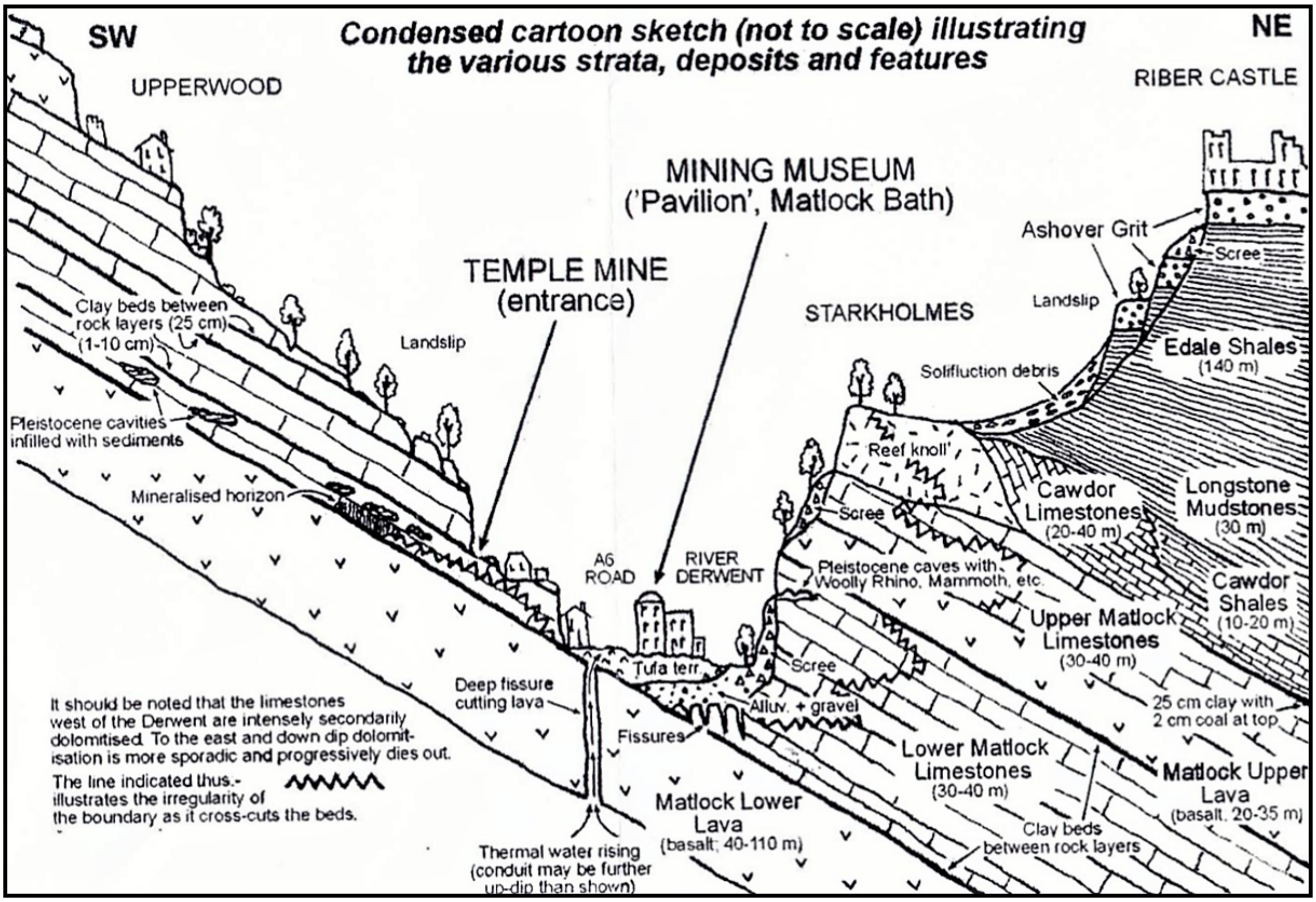


Fig. 14 Sketch section through Matlock Gorge at Mining Museum

Tufa forms in warm springs circa 20°C. Some tufa deposits date from the Pleistocene. One section of tufa, south on the A6 from Matlock Bath, has bedding and contains fossils – gastropods and bivalves. The renowned 10 foot tufa face in front of the New Bath Hotel is a limestone scree deposit, now cemented by tufa to form a calcrete. This was formed by water flowing through the limestone in the Pliocene. Much of the calcrete was used for building stone and is used locally in buildings and for garden features in stately homes. (Fig. 15)

Fig. 15 Tufa cemented limestone

Tufa is still being formed in places, but not on such a large scale as heretofore. There is an example where a spring is feeding a lily pond and the tufa is in the process of forming and hardening, covering the vegetation. (Fig. 16 and Fig. 17)

In Victorian times people came and left objects in the water and returned in a few years to find them "petrified" i.e: actually covered in tufa.

Fig. 16 Tufa covered vegetation

Fig. 17 Examining Tufa being deposited

Peak District Mining Museum

Clare Herbert introduced us to the Peak District Mining Museum, which opened in Matlock Bath in1978 and is operated by the Peak District Mines Historical Society. It began because of an engine found in a Derbyshire mine which would have been lost if not rescued.

It is the 1819 Wills Founder water-pressure pumping engine which was half-buried in silt some 360 feet underground in the Winster mine shaft and it now forms the centre piece of the museum. On arrival we were first shown a short video of the mining which took place and then had an opportunity to examine the varied collection in the museum, including the Howie Mineral Collection.

Temple Mine

Dr Lynn Willies of the Peak District Mines Historical Society led us in Temple Mine. The mine re-opened in the 1980s and is open for visits by appointment.

Dr Willies described some of the local geology responsible for the emplacement of the minerals including the Bonsall fault and the partial dolomitization of the limestones. In the Pleistocene, meltwater pushed through the limestones under hydrostatic pressure causing fracturing, which sometimes meant the miners were able to take out sediment from existing caverns to get at the minerals before having to excavate the rocks.

The main rock types in the mine are a dolomitised limestone with basalts and shales. The formations are Upper Matlock lava, limestone, Lower Matlock lava with Edale shales above and below the lava. The mineralisation is related to the contact between the dolomitised limestones, the lavas and the flow of fluids between them. The main mineralisation is below the Edale Shales. In the mine, above the lavas, are aquicludes formed by volcanic ash and white clays which formed barriers to the fluids flowing through.

The main ore is galena which occurs in rakes (mineralised wrench faults), flats, pipes (infilled or metasomatised stratiform deposits) and in widened joints known as scrins. Fluorite (calcium fluoride) was also mined as it is used as a flux for smelting. Demand for this fell away in the Great Depression of the 1920's but resumed at the beginning of the Korean war as demand for steel increased. Other minerals found are sphalerite, calcite and barite.

Fig. 18 David in the engine

As we travelled through the mine, we were shown various items that had been rescued. These were the engine which pulled the wagons (Fig. 18), some of the tools that were used in the mine (Fig. 19) and the replica shutes used to send the mined rock down to the wagons (Fig. 20).

Fig. 19 Tools used in the mine

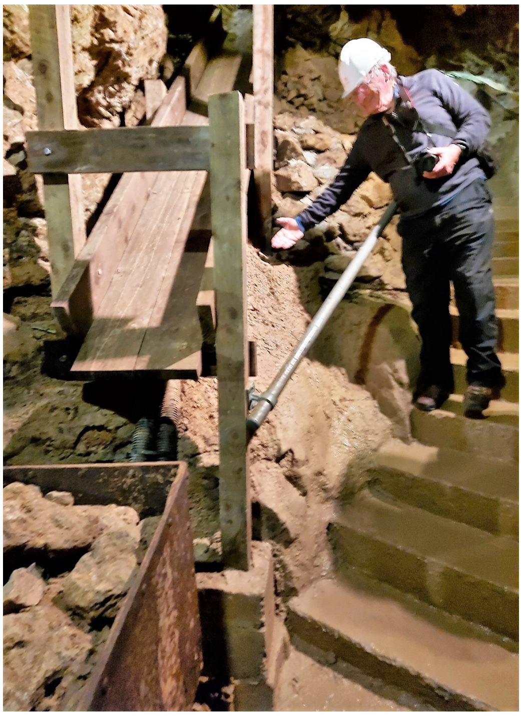


Fig. 20. Shutes

Lynn gave us a description of a typical day for the miners:
The mining shift started at 07.00 to clear the floor of rock mined the previous day. At about 09.00 they would have breakfast. Afterwards they would collect the drill and set up. The mucker continues mucking to clear space before the next blast and the driller drills into the rock to make the holes for the gelignite and fuses. The blast would create vast clouds of nitrogen oxides and this meant it had to be left to settle until the next day. Mine owners paid for quality and quantity of ore.

Once outside the group were given the opportunity to pan for 'gold' – an activity designed for visitors (Fig. 21)

Fig. 21 Panning for gold

Report by Susan Barr, photos by Roger York, Carole Gregory, Peter Jones and Edmund Shirley

Wednesday 21st September 2022

Afternoon

Bonsall, Tinker's Shaft and the Derwent Valley led by Peter Jones

Grid Ref. SK 2802 5794 (Starting point: Clatterway, Bonsall)

Purpose: to view the topography and geological features visible from above the gorge at Matlock

The starting point was a car park in the floor of a dry valley in permeable limestone. Peter explained the regional geology, consisting of three types of limestone beneath millstone grit; further to the east this is overlain by the coal measures. We discussed the origin of such features, and two possibilities have been put forward: sub-glacial action or a drainage system in overlying rocks which had cut its way down as they were eroded.

Bonsall itself was a mining village and we ascended on a miners' track to the church, along walls of yellowish dolomitised limestone. The church itself is of millstone grit with some limestone. Up to about 1700 it was clear that all gravestones were of local limestones and sandstones. Subsequent monuments included slates, and after 1900 granites and basalts, reflecting improved transport capabilities.

We then walked along Ember Lane, the name a clue to the geology which comprises a dolerite plug in a Carboniferous-age volcanic vent. We were able to observe basalts and ashes in the wall blocks, some of which were brecciated, usually associated with the explosive eruptions of sticky acidic rocks.

At the top of the hill at a viewpoint we could see a pronounced scarp to the east. Peter described the regional geology consisting of a limestone plateau overlain by softer Edale shales dipping into the Ecclestone valley, topped by harder Ashover grit, which had eroded to form the scarp.

A short diversion took us through the farmyard of Ember Farm, where there is a small exposure of vesicular basalt (the lower Matlock lavas). This may indicate rapid solidification, perhaps from an under-sea vent.

We then walked in a north-westerly direction with Masson Hill on our left, traversing a heavily wooded area concealing old mine workings in the area known as the Heights of Abraham. The opencast workings of Coalpit Rake (which continues for several miles) were clearly visible (Fig. 22).

Fig.22 Coalpit Rake

Fig. 23 Tinker's Shaft

As we approached our destination of Tinker's Shaft (Fig. 23), we passed through an area strewn with dolomite blocks, possibly the remnants of a dolomite tor destroyed by glacial activity. Tinker's Shaft was originally sunk to gain access into the great chamber of Masson Cavern, previously a lead mine and then a source for fluorite, but in Victorian times opened to the public. The head of the shaft has been made into a superb outlook point over the Derwent gorge, from which we were able to observe Matlock Bath below overshadowed by the High Tor reef limestone, and Riber Castle situated higher still on hard Ashover grit on the opposite side of the gorge. We then retraced our steps to Clatterway and returned to Matlock.

Report and photos by Edmund Shirley

Thursday 22nd September

Black Rocks, Cromford – led by Peter Jones

Grid ref: SK290 557

The party met at the National Stone Centre (NSC) where there was paid parking. Our leader for the morning was Dr Peter Jones, of the NSC and Geologist's Association. Peter explained that the NSC included seven quarries worked in the Eyam Limestone and that the High Peak Trail – using the course of the railway – linked it to Middleton Top to the north and to Black Rocks to the south.

We walked north for 500 metres, where Peter pointed out a chamber beside the track containing cogs 2m diameter, part of the haulage system for moving trains up the incline to Middleton. Initially this was a mineral line but also became the site of the first passenger train in 1830. We retraced our route to the NSC, where, looking south over the NSC we could see the Ecclesbourne Valley – clearly far too wide for the stream in it and, significantly, "U" shaped. It seems very likely that this was glaciated.

The geological sequence here is Carboniferous Limestone (the Eyam Limestone Formation) overlain by Carboniferous Shales (the Bowland Shale Formation) and topped with Millstone Grit (the Ashover Grit). At this point, we were on the limestone, as evidenced by the walling and the lime kilns in the car park.

Fig. 24 Example of gravestone

Further along in a southerly direction, we could see that increasing amounts of sandstone appeared in the walls. This took two forms - rough pieces of material or worked blocks. These blocks often had holes 3 cm diameter drilled into them, they were track supports from the railway.

The next landmark was Steeple Grange Station – now a depot for the narrow gauge railway and also a place where a junction allowed access to Steeplehouse Quarry. Steeplehouse provided 120,000 limestone headstones, to be used in British war graves following the First World War. (Fig. 24) Soil in the fields here is a brown colour, the result of being derived from glacial deposits. Clays resulting from weathering of shales were worked from near here for use in the Carsington Reservoir.

Behind the station, we could see mine dumps and Peter said that this was the Cromford Moor Mine, which worked on the Gang Vein, of which more later. Interestingly, there were nice clumps of Cyclamen beside the track and we remembered that there were many excellent clumps in the wood at the NSC. Peter did not know whether these were natural, of had been introduced.

About 1 kilometre from the NSC, we arrived at Black Rock Dumps - a considerable dump of mining waste, almost entirely limestone, therefore indicating that the miners were working mainly in this rock.

Careful examination on hands and knees resulted in collection of the 6 minerals common to this dump. These were galena, sphalerite, fluorite, baryte and pyrite. Most members scored about 60% in their collections. (Fig. 25)

This mine exploited the Gang Vein – a major east/west rake - and was worked to 420 feet at the deepest point. This rake was a complex structure accessed from several shafts. One, 150 metre from the Dump, exploited the Godbehere vein, an offshoot of the Gang Vein. As always, water was a problem, and soughs were dug from the Ecclesbourne and Derwent valleys to drain the workings.

Fig. 25 Group on the spoil heap

Fig. 26 View from the top of Black Rocks.

Black Rocks are an upstanding mass of Millstone Grit, a pale reddish colour close up, darker when viewed from a distance. The party cautiously made their way to the top of the rock and looking north, we had a view up the Cromford Valley towards Matlock Bath. (Fig. 26)

Peter pointed out the limestone hills on each side of the valley and explained that the valley was probably a glacial channel.

Of particular interest was the village of Starkholmes on the east side of the valley, where rock falls in the millstone grit and rotational faults in the shales are contributing to potential geological disasters.

After a group photo on Black Rocks, we returned to the NSC, where a typical "thanks" was given to Peter, for all his efforts in organising and leading an excellent visit. (Fig. 27)

Fig. 27 Group gathered on Black Rocks

Report by David Ward, photos by David Ward and Peter Jones