

# Geology: Field Trip Reports

## Geology Group – Meadowhead to Brincliffe Edge 19<sup>th</sup> September 2019

On a day that turned out to be warm and sunny day, after a cloudy start, 15 members of the Group arrived at Morrisons supermarket at Meadowhead and, while we waited for the eventual absentees to turn up, we had a look at a few maps.

These showed the position of the Greenmoor Rock on our route – as well as others showing the meanders of the River Mississippi by Harold Fisk, which everyone found fascinating.



After explaining the purpose of the field trip, to explore the variations of lithology in the

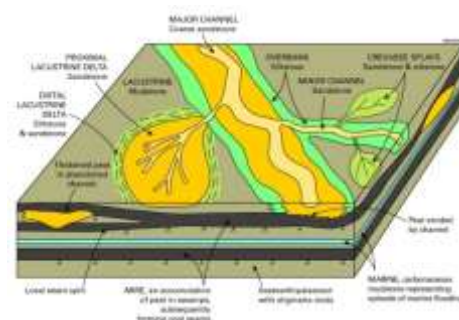
Greenmoor/Brincliffe Edge Rock and to relate its topography and geomorphology to its outcrop, as shown on the maps, we started our walk at the gates to the delivery area at the rear of Morrisons, which occupies a large former quarry.

Unfortunately, although a letter to their Community Champion asking permission to gain access to this area had been sent well in advance, as requested during the recce that Scott and Paul undertook back in April – when we were provided with access by the duty manager – we did not get the opportunity to examine this excellent exposure of the Greenmoor Rock close up.

Instead, peering through the gates and also studying a good rock exposure on the

outside, Scott handed out another handout that helped the Group to understand the vertical and lateral variation seen within the sandstones, sandstones, mudstone and shales - the principal components of the Upper Carboniferous strata in Sheffield and the east side of the Pennines.

We then set off to Graves Park, where we examined the flaggy sandstones that outcrop in a former quarry, which some members recalled being converted into an outdoor theatre in the past. Moving on to Cobnar Wood, we briefly discussed the formation of the steep sided valley before continuing across the Grenoside sandstone to the Graves Park ponds.





The ponds occupy another steep side valley, which has been cut by the principal stream in Graves Park, and we followed this down towards Cobnar Wood, stopping to look at various exposures in the valley sides and the stream beds.

We diverted briefly to look at what have been described as lynchets, but which the Group thought were probably related to old field boundaries.

Walking through Cobnar Wood, we continued to observe the various fine grained rocks that outcrop in its slopes – as well as the occasional sandstone – but, due to the slight change in route resulting from our early departure from Morrisons, we missed the thin bed of clay that had been identified during the recce.

At the playground at the Woodseats entrance to Graves Park, we stopped for lunch before continuing our walk through Woodseats to look at various examples of building stones in some of its historic buildings.

By look at the colours, size and thickness of the blocks and the presence, or otherwise, of horizontal laminations, we soon learned the difference between the Greenmoor Rock and other sandstones quarried in Sheffield.

Stopping at the back of the Big Tree pub to rediscover the course of the stream that we had been following through Cobnar Wood, we quickly walked along the Chesterfield Road, stopping only at The Dale, to discuss brickmaking in Sheffield, and at Wetherspoon's "The Woodseats Palace" – where I am sure that the clientele here must have wondered why we wanted to stop and look at the Ordovician volcanic green slate, which is used for cladding.

Continuing down the A61 to Homebase/Dunelm, where we discussed the features in the quarry face at the old Woodside Brick Works, Scott then provided further explanation of the concept of dip and strike, before leaning too hard on the temporary fence made of steel mesh and nearly falling down the hill.

Whether or not certain members of the Group had thought that Scott had lost his grip, or that they didn't fancy the walk to Brincliffe Edge, a few members decided to retire early to their nearby homes at this point.



Nonetheless, the stalwarts carried on down to the Heeley Retail Park, where we then inadvertently had to share space with a car full of people on a remote part of the car park – who appeared to be up to no good - at a point where a fantastic example of spheroidal weathering coincided with a verdant spring line.

The crowding principle worked very well on this occasion, with the said car repositioning itself to carry on with the dealings that we had previously interrupted. Refreshing ourselves at Costa Coffee, we then crossed the River

Sheaf before stopping again at Marden Road to look at a rock exposure on the Abbeydale Road, which Dave proposed as a possible cliff that had been formed by the River Sheaf.



Walking up through Brincliffe Woods, again a diversion from the original plan, we stopped again at Quarry Lane to look at a wonderful exposure of Greenmoor Rock, where Scott and Dave took dip and strike measurements from the well exposed bedding planes, using Apps on their mobile phones.

Although there were one or two points of interest still to see, we considered it a good place to end the formal proceedings of the day and the Group finally disbanded, leaving Scott, Dave, Nicky and Jean to finish off the walk with



a brief exploration of the old quarries on Brincliffe Edge, before catching buses on Ecclesall Road.

**Scott Engering**

**Photos by Scott Engering and Anne Fowles**

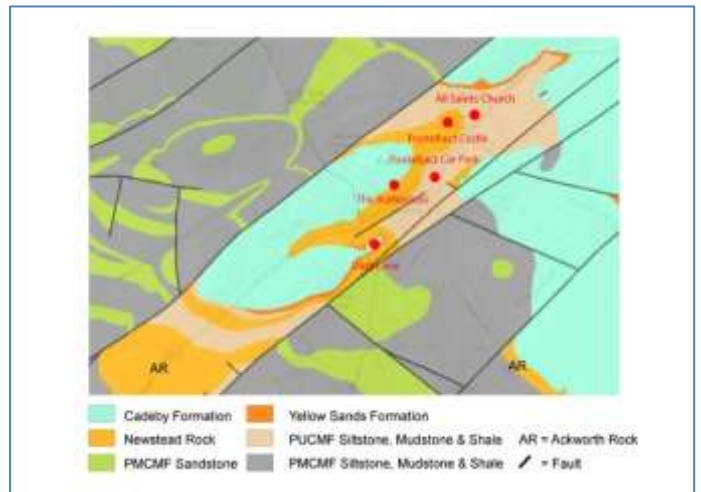
**8<sup>th</sup> October 2019**

## Geology Trip to Pontefract – 19<sup>th</sup> June 2019

23 of us met at the pay and display car park to find that the payment machine had been stolen - a good start to the day!

Scott, the leader, handed out a geological map and briefly explained how the distinctive ridge has been controlled by the subsidence and faulting of the Earth's crust.

Our plan was to see the Upper Carboniferous Newstead Rock and the overlying Permian Yellow Sands Formation and Cadeby Formation.



Starting the walk at the rock face behind Stringers Coaches, Scott made the most of his umbrella by

using it to point out the red staining in the Newstead Rock, formed by the interaction with oxygen rich groundwater that once percolated down through the rocks during the hot and arid Permian Period.

We then made our way up Southgate, where we briefly stopped at the site of the now inaccessible Pontefract Hermitage and our guest for the day, Adrian Pope, told us about the history of Pontefract Priory, that was situated on land that is now the Pontefract Valley Gardens.

After a brief discussion about the formation of the valley in which the park is set and the mediaeval burgage plots on the opposite side of the road, we set off to Dark Lane to examine exposures of the Yellow Sands Formation.

In this part of Pontefract, it was extensively mined using the pillar and stall method for use in the glass making industry and as moulding sand in iron foundries. In several places, the collapse of the pillars has led to severe problems of subsidence with houses built on the land above.

The exposures on Mill Hill Lane and Dark Lane are heavily overgrown with ivy but Adrian had kindly invited the Group to examine the spectacular exposure of the Yellow Sands Formation in his garden.



Here, a thick bed of the Yellow Sands Formation is topped with Magnesian Limestone – a dolomitic limestone - that contains a series of cavities known as vughs.

The limestone was deposited in an evaporating body of water in which gypsum sometimes formed as nodules. This soluble mineral was later dissolved to leave the hollows in the limestone, which are often lined with crystals of the mineral dolomite.

The sand was deposited by wind in a desert, with the individual grains being rolled around to make them round, and when we rubbed the sand between our fingers the grains felt smooth.

We could also see large scale cross-bedding - evidence that the sand was formed into dunes, and in places there has been leaching out of the iron.

Without doubt, this is one of the most interesting sites visited by the Group and everyone greatly appreciated Adrian's invitation to closely study it.



We then

set off to the old town of Pontefract where we had a quick look at the building stones used in the Buttercross and St. Giles' church, before spending ten minutes in Pontefract Museum. Here, we saw some fine Bagleys Glass, a painting of Pontefract Castle before it was demolished and the magnificent Art Nouveau tiles and mosaic in the reception.

A trip to Pontefract is not complete without buying some Pontefract Cakes and the shop in the magnificent old market building did some good business with our Group.

We then went into the Town Hall to have a quick look at the original plaster cast model of Admiral Nelson's death scene, for moulding the bronze casting on Nelson's Column, and then made our way down to Pontefract Castle where we had lunch.







Scott spent most of his lunchtime collecting the entrance fee for the dungeon tour, only to discover that they would not take cash and that he would be sent an invoice instead, but he did eventually manage to grab a bite to eat. After finishing lunch, a few of us had a quick wander around the castle. The afternoon session started with a walk down Castle Garth to All Saints church, stopping very briefly to look at the foundations of the Saxon church.

The history of All Saints church is closely intertwined with that of Pontefract Castle during the English Civil War. The castle was sieged three times and was at various times held by both the Royalists and Parliamentarians, with the opposing forces occupying the church. Its ruinous condition is the result of bombardment and the stripping of the lead from the roof – purportedly to be melted down to make ammunition.



We had a good look at the various building stones, especially the original soft sandstone that has a very unusual pattern of weathering and the hard gritstone that was used to restore a large part of the tower.

Scott briefly talked about work he had undertaken here for the archaeologist and architect involved in the last phase of restoration. He explained the general principal that stone used for repairs should possess similar physical characteristics to the original stone and the consensus was that the gritstone used here was therefore not appropriate.

There was also a discussion about the aesthetic merits of the new addition to the church by George Pace in 1967, built in brick and concrete, again with the conclusion that it was completely out of character.

Having had a look at the ruins, we headed back up Castle Garth and stopped to examine the repairs to the castle boundary wall with sandstone from Scotch Corner and dolomitic limestone from nearby Wentbridge.

Once back at the castle, we spent some wandering around the grounds at our own leisure before finishing our day with a tour of the dungeon. Originally excavated during the 11<sup>th</sup> century as the magazine, it has since been used for miscellaneous storage purposes and for keeping prisoners during the English Civil war, many of whom scratched their names into the walls.

For the geologist, its unweathered and relatively clean surface enables the reddened muddy sediments to be clearly distinguished; however, on this occasion, the battery in our guide's lamp had very little charge and we could barely see this; however, we still had an enjoyable tour, learning about its history, and it was a good way to end the day.





Photos by Paul May, John Schofield, Linda Jackson and Scott Engering.

**Scott Engering**  
19<sup>th</sup> July 2019



## The Building Stones of Leeds – 20th February 2019

On the first field trip of the year in 2019, on a generally dry day, 19 of us arrived in Leeds, by either the park and ride and train, to explore the Building Stones of Leeds.



Starting at Holy Trinity church, which was opened especially for us at 10:30 am, we were given a brief, but very interesting talk on its history by Richard Butterfield – the Director of Development and Operation at the Leeds City Parish.

After a quick look at characteristics of the Rough Rock in the walls of the church and the stone in the new building, we then headed down Boar Lane – stopping briefly to look at the wonderful Time Ball Buildings.

At the Corn Exchange, we stopped again to look at more Rough Rock, the very coarse grained stone from Bramley Fall quarry, which has been used to build Kirkstall Abbey and

very many buildings in Leeds ever since. Popping inside for a couple of minutes to admire its interior – and for some of us to use its facilities – we then carried on to Leeds Minster.

Stopping at the boundary wall, where the East Bar, and memorials provided examples of Millstone Grit and Portland limestone, which was weathered to expose the oyster shells contained within it.

Also, several blocks of gritstone showed graded bedding, which enabled us – with Paul taking the lead - to determine whether the blocks were placed the right way up or upside down.



An unexpected service being held in the Minster gave us the opportunity to look at the monuments in the north aisles of the church, as well as look at a geological map of Leeds and the book, the Building Stone Heritage of Leeds, which Scott had brought along.

When the service eventually finished, we had a good wander around the church to look at various marbles, the colourful Salviati mosaics, a knight's effigy and the C10 Leeds Cross.



Although the hospitality provided at Holy Trinity church and Leeds Minster was greatly appreciated, it set us back a bit on the planned itinerary and hurriedly looking at the old grave slabs that covered the railway embankment in Penny Pocket Park, we then briefly stopped outside the new Victoria shopping centre to debate the pros and cons of the modern architecture that can be seen here.

Finally arriving at the Victoria Quarter, the 'jewel in the crown' of the Leeds shopping district, we took a very



quick look at the polished larvikite on the exterior and, once in the arcade, we then spread out to discreetly examine the marble columns on the posh shop fronts.



Gathering around to discuss this brecciated marble, with its very diverse range of colours and textures, Anne then surprised us all by exuberantly pointing out a large ammonite in a Rosso Verona marble plinth, before Scott had a chance to point this out to the rest of the group.



We then discussed the marble columns, which could possibly be Breccia di Seravezza from the Apuan Alps in Tuscany – and repairs that have been undertaken with painted plaster, before taking a late lunch.

Reconvening, we quickly looked at some stone seats, where the consensus was that the most interesting feature was the Portland Roach, a variety of Portland limestone that was formed on an ancient beach, with the large fossil gastropods known as 'Portland screws' dissolved away to leave large voids.



Moving on to Albion Street, to avoid the rush of people, we huddled into a corner to take a very quick look at the Starbucks, which is built out of Millstone Grit that was quarried from three different sources.

Cutting through to Park Row, where various granites have been used in the kerbs, plinths and facades – we soon discovered that it is not easy to accommodate a group here at lunchtime on a Wednesday.

Despite Scott's effort to avoid this during the planning of the walk, we all managed to get in the way of an innocent bystander, who only wanted to use a cash machine while we were stood – motionless - admiring magnificent the stone frieze of Abtech House on the opposite side of the road.

In his inimitable style, Paul immediately defused the situation with a witty comment - from a lofty height.







Carrying along Park Row, we paused very briefly to see some Guiting stone (very unusual in the north) in a nondescript office building and to note the damage to Park Row House - through the use of a very strong solution of hydrofluoric acid in its cleaning. We then moved on to the war memorial on The Headrow, where we saw the copper staining and learned about 'saccharoidal texture', which is a feature of marble when exposed to the elements.

We then all delighted in the marvels of the Tiled Hall Café and the adjoining Leeds Central Library, with its columns made of various Devonshire marbles and pink Peterhead and grey Rubislaw granite and intricate carving of Caen limestone from Normandy in the lobby.



We further explored the Hopton Wood Stone on the staircase, with its wonderful heraldic beasts, but the weather had by then collapsed and we next took shelter under the portico of the adjoining Leeds Town Hall.



While learning about the various varieties of Millstone Grit used here, we were all surprised that we were sharing this space with a wedding party and their photographer.

Here we finished the day by observing the very poor condition of the Portland limestone lions outside the town hall, one of which contained a large nodule of resistant chert.

## Visit to Magpie Mine – 21<sup>st</sup> March 2018

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27 members of the group (including 2 visitors) turned up on a fine day, but with a piercing cold wind amongst the remaining snowdrifts.

We were met by Keith Gregory of the Peak District Mines Historical Society, which now runs the site. He took us around the site and explained it's history.



Magpie Mine was the last working lead mine in Derbyshire and is probably the finest remaining example of a 19<sup>th</sup> Century lead mine. It is now a scheduled monument.

The history covers 200 years and we saw numerous shafts – now fortunately capped.



This was the earliest – just depression with a raised rim now.



Keeping the workings free of water was a constant problem, so a Newcomen pumping engine was erected in the main shaft, which is 724 ft deep. It is drained by a sough, which discharges into the River Wye above Ashford. It is large enough to take boats and we saw some photographs of these at the end of the tour. The ruins of the engine house are still impressive.

There were lots of lead veins in the area and a number of competing teams were working at the same time extracting ore. We heard about the infamous "Magpie murders", when 3 men from a rival group were suffocated by a fire set by the Magpie men. The men were cleared at Derby Assizes, but the widows cursed the mine, which later ceased to prosper.

It continued to be worked intermittently, when the price of lead warranted it and was last in use in the 1950s. The winding gear from that period is still in place.



It was a fascinating visit and several of us repaired to a local hostelry for lunch and further discussion afterwards. It was suggested that that this should be a feature of future visits...

## A Short Walk Around Green Moor - July 2017

15 of us met at the wasp infested information boards opposite the Ivy Millennium Gardens, once Tim and Scott finally arrived after a very lengthy diversion that took them all around the houses!

The village of Green Moor was once famous for the production of vast amounts of paving stone – an industry that was at its height during the 19<sup>th</sup> century and which was in such great demand in London that it had its own Greenmoor Wharf in Southwark named after it; however, all quarrying activities ceased in 1936 and very many of the quarries have since been infilled.



*An example of dry stone walling in the Greenmoor Rock*

Starting our tour with an explanation of the physical characteristics of the Greenmoor Rock, and how its fine lamination make it easy to split and turn it into paving and roofing stone, we stopped at the new Stoneway Manor housing estate – where its history of Geological Conservation was briefly described.

Moving westward along Green Moor Road, another brief stop was made at the old school building, where there is a good example of the differential use of the Greenmoor Rock. The walls are built with this thinly bedded sandstone, but a more massive variety is used for the dressings – quoins, lintels and jambs – to provide structural strength.

Stopping again a little bit further down the road, where Paul gently castigated Scott for talking too much, we discussed the geomorphology of the Don Valley where, unusually, the gradient of the landscape reflects the dip of the underlying rocks. It was also noted that there were no



streams or other obvious means for the land to drain but, unfortunately, nobody had a good explanation for this.

We paused outside Hunshelf Hall – dated c.1746 - where there are several fine Eucalyptus trees and the Greenmoor Rock contrasts strongly with the Welsh slate that has been used to re-roof it a century later.



*Greenmoor Rock and Welsh slate at Hunshelf*

*Hall*

Moving on to the old road stone quarries at Don Hill Height, the views here are very impressive. The escarpment slopes down to the valley bottom, in which Stocksbridge is set, and the Millstone Grit moors can be seen in the distance.



*Differential weathering and a fine example of dry stone walling at Don Hill Height quarries*

Here, the very irregular bedding is differentially weathered to highlight the ripples and there are very distinctive orange coloured hollows, which reflects the iron content of this rock.

At the top of the quarry, where the bedrock is turned into subsoil, some extremely skilful dry stone walling seamlessly merges with the natural rock.

Leading the way, Tim then battled through shoulder high bracken towards the Isle of Skye quarry. On the way, given the opportunity to expand on the introduction to the

geomorphology that had been provided earlier in the walk, Paul then gave us an excellent explanation of the landscape that was presented before us. Greenmoor rock, being sandstone, is acidic and provides an ideal habitat for bracken and gorse and contrasts strongly with the vegetation that grows on the shale.



*Battling through the bracken at Don Hill Height*



*Blocks of ripple marked Greenmoor Rock at the Isle of Skye Quarry*

At the Isle of Skye quarry, although the way marker could not be properly used due to the low visibility available on this day, we discovered several large blocks of Greenmoor Rock - where ripple marks could easily be demonstrated.



Walking back towards Green Moor village, all of us enjoyed seeing the black Hebridean Sheep in the adjacent field, where the boundary wall here is constructed with massive blocks of Greenmoor Rock. After a few moans about the fact that we had not stopped for lunch by now, a short detour led us to the remains of an old track, which would have taken stone from the Isle Skye quarry down to the bottom of the hill – to the River Don - where its journey to London and other places would have started.



*The Green Moor Delph RIGS in 2011*

Moving on to the Green Moor Delph quarry, which has now been designated as a RIGS (Regionally Important Geological Site) and is managed by Hunshelf Parish Council, the rock exposure here provides an excellent example of large scale cross-bedding and foreset beds.

Although now protected within the Town & Country Planning system, the rapid growth of vegetation that surrounds sites like these provides an ongoing problem of maintenance and it is to the great credit of Hunshelf Parish Council that they are taking action to conserve it.



*Exploring the Old Pump House at Green Moor*

We finished off our walk at Ivy Millennium Green, where the most hardy members of the Group were able to sit down and eat their packed lunches, before some of us took advantage of a unique opportunity - provided by Barry Tylee - to explore the Old Pump House, which was once used to provide essential water to the village of Green Moor.

Eight of us who were adventurous enough, and not so tall, went down to the bottom of the well to closely examine the plumbing but, for all of the other members of the Group who were not able to do this, various specimens of iron nodules and ganister were left on a large rock in Ivy Millennium Green to inspect at their leisure.

Many thanks to Barry Tylee and his assistant for tidying up the area around the Old Pump House, providing the information boards and guiding us safely down to the well head and back.





*Finishing the walk around Green Moor at Ivy Millennium Green*

## **EYAM circuit**

**April 2017**

16 members – a good turn out – got to Eyam car park on time. Evan Paul was early!

The group visit to Eyam Museum was better than I thought it may be. The rest must have agreed as we all spent a good 45 mins looking at the exhibits and watching a video presentation. Most was, of course, about the plague but the exhibits on mining and Geology were better than I had anticipated. Thanks to all – except Pater! – who remembered to bring the exact money for the entrance fee.

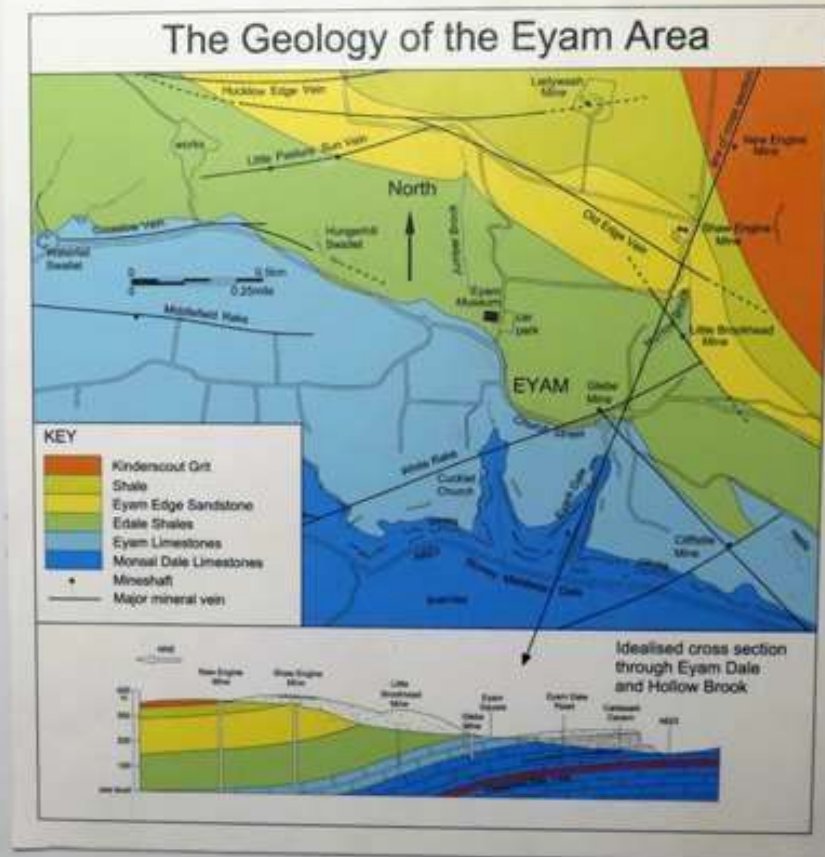
Peter paid his penance by being entrance fee monitor!

We welcomed Chris Hobson and Theresa Maxwell to the group.

Geology map in the museum

and the shale which  
Church Street. To  
ches away into the  
walls and dissected  
the limestone dips  
ale and sandstone.  
between Church  
the steeper scarp  
stone. A further  
derscout Grit, a  
yam Moor.

eral veins, the larger  
smaller branches  
are everywhere, even



The walk was due north, up the steep slope, then east parallel with Ladywash Mine, then south back down into Eyam. Two main rocks make up this route. We started on Edale Shale then moved onto Eyam Edge Sandstone. The limestone only appears in Eyam itself – just to the south and lower in height than our starting point. The first stop was Old Ladywash Mine, evidenced by a waste tip. The shaft had passed down through the shale to the underlying limestone where lead ore was mined. At some point walking up the rough road we passed from the shale to the sandstone. Some members were very inventive in trying to find the junction. However there were three bits of evidence seen: (a) change in slope angle from steep on the shale to steeper on the sandstone (b) a change of tree type with beeches on the sandstone (c) some sandstone boulders (bedrock?) appearing on the track. Gold star for observation!!

Going east near Ladywash mine were great views south over the limestone plateau and the large limestone quarries of Stoney Middleton Dale. Ladywash Mine was working until 1979. Up to late 1800s lead was mined. Other minerals that came up to the surface were not wanted then. These are called gangue minerals. One was fluor spar and this became wanted much later so was mined – mainly from the waste tips. At Ladywash the shaft goes down 728ft ( 222m ) before it reaches the top of the limestone. A further 30ft took it to the main lead ore vein.



At the road junction close to Monpesson's Well is the tip from Shaw Engine Mine. We scratched around in the tip and found various rocks and minerals through which the shaft had passed - some Carboniferous limestone, calcite ( both of which reacted to HCl acid ), barytes and quartz. A nice vug was picked up by David – a gap in the rock which allowed hot fluids to cool and crystallise to show good crystal shapes. These were probably shapes called dog tooth spar.



*Vug allowing crystals to grow*

The sandstone outcrop shows good bedding planes, maybe some thin bands of shale along some of the bedding planes and thinner beds at the top of the exposure – probably due to pressure release along with weathering. The sandstone here is covered in tiny shiny flecks of mica. This came from granite rocks being eroded from mountains far to the north at the time of deposition. The mica was transported here by rivers where it built up into a sheet of mica over a vast area. It was later buried, ground into small flakes and incorporated into the sandstone. Clever isn't it!?

Sedimentary structures in the quarry – bedding planes of varying thickness. Note



effect of weathering.

Now down into Hollowbrook where we noted how deep and steep sided was the valley. Paul suggested – not very convincingly – that this may be due to the land rising up after the ice age which led to rivers and streams eroding much quicker. Maybe the two rock types are important?

Sandstone is more resistant than shale to weathering and erosion and would give a steeper sided valley? The jury is out!

A short detour took us to the unremarkable exposure of the Edale shale below Little Brookhead mine. Then on to Eyam – some eggs for sale at a farmhouse, pointed out



by Peter who then was muscled out of the queue to be left with none for himself! Then on to see the effects of the landslip on the Eyam to Grindleford road. The slope here is mobile as it is on the Edale shale – a weak and fractured rock on a steep slope. Locals say this road will never reopen.



*Landslip in the last year.*

### **10th Anniversary trip: Burbage Valley, February 15th 2017**

Twenty three members, new and old, assembled at the Fox House Inn for a short walk into the Burbage Valley, as our way of celebrating the 10th anniversary of the U3A Geology Group. The turnout on a grey day in February was surprising: 23 members! Among that total were several “founder” members and some on only their 1st or 2nd meeting.

The day was led by Andy, one of the founder members. His plan was to take a view of the wider landscape and relate that to the underlying geology. This was thwarted by the low cloud and mist: Plan B was required.

A half hour walk took us to the packhorse bridge over the Burbage Brook. The brook has cut through the Carboniferous Millstone Grit Series to reveal the shale beds lying between the Upper and Lower Leaves of the Chatsworth Grit. Andy then told the group how these shales were very similar to those of the Edale (or Bowland) Shale, which is a major target for companies seeking to exploit shale gas by underground fracturing (“fracking”). It is during the deposition of these rocks that the methane is trapped between the thin “sheets” of clay minerals and can only be released by breaking the rock apart. Potential fracking sites are currently being proposed in North Derbyshire (Marsh Lane, Eckington) and Misson (Notts.). Permission has been given for a site near Pickering (North Yorkshire). Andy showed a plan of the “high value” target areas, which cover large tracts of the north of England, where the shales lie at considerable depths, as deep as 10,000ft below ground.

The group then moved on to the Burbage quarries, which exploited the Chatsworth Grit for over 200 years, mainly in the production of millstones. These coarse sandstones (“gritstones”) were deposited by massive rivers flowing south from a mountain range in what is now Scotland. The massive beds of gritstone were examined: some individual beds up to 30ft thick, which would have been deposited in one continuous sequence. Examples were seen of how the quarrymen split the huge blocks of stone using only hand tools. The main technique was “plug & feather”, using simple steel wedges; a technique still in use today to produce high quality natural building and paving stone.



*BURBAGE QUARRY*

Time was moving on so we retired to the Fox House Inn for a celebratory lunch. Andy gave a brief account of the formation of the group back in 2007, and its activities and progress to date. In commemoration of the group’s founder, the late Dan Higbid, a floral hanging basket was presented to Pauline Higbid, with our additional thanks to Pauline for hosting all but one of the Group’s Christmas socials.

Andy Wright



## Chee Dale, 17th August 2016

On a beautiful hot sunny day in August, 17 or so SU3A geology group stalwarts set off from the former Midland Railway Station at Millers Dale (completed in 1863) to explore yet more Limestone of the Peak District, of the Dinantian Epoch - a sub division of the Carboniferous period about 330 million years ago when this part of the UK lay in a sub tropical zone with a shallow sea. This area of the Wye valley is referred to as what?? We walked to the old East Buxton Limestone Quarry, now a nature reserve to view evidence of rising and falling sea levels. What was this evidence? plus fossils of coral and various shell creatures.



*THE OLD*

*DRESSING FLOOR OF THE QUARRY. BEDDING PLANES SEEN IN THE QUARRY WALLS*

Between layers of limestone were thin bands of Mudstone probably formed from the settling of volcanic ash. We spent some time exploring the area of the quarry and found great examples of Lithostrotion ( a colonial coral ) and Rugose ( a solitary coral ).



THREE 'KEENIES' LOOKING AT THE

CORAL

HILARY JUST HAVING A REST



PAUL LOOKING ON ASKANCE

PAULINE'S HANDS MAKE A USEFUL SCALE TO SHOW OFF THE COLONIAL CORAL CALLED

LITHOSTROTION

We then made our way past the old lime kilns which ceased production in 1944 to the viaduct and a descent to the river Wye. More fossil evidence in the cut blocks of Limestone adjacent to the steps down to the river. A quick hello to the brave souls descending the viaduct with ropes and then walk into Chee Dale on the way finding evidence of a Basaltic flow giving an indication of some volcanic activity in the area. This was the point where springs bubbled out at the surface. There must be lava on the valley floor at this point – an impermeable layer. We were confronted by sheer cliffs of Limestone and evidence of undercutting by melt water during the last ice age. The mass of Limestone has a dip West to East as part of an Anticline which had its crest just west of our return point in Wye Dale. A series of large rock cut stepping stones were negotiated each of us helping the other through.





*THE NOT SO INTREPID GROUP HOPING PAUL*

*WILL LEAVE THEM ALONE AND WALK THE OTHER WAY*

We then made our way past the old lime kilns which ceased production in 1944 to the viaduct and a descent to the river Wye. More fossil evidence in the cut blocks of Limestone adjacent to the steps down to the river. A quick hello to the brave souls descending the viaduct with ropes and then walk into Chee Dale on the way finding evidence of a Basaltic flow giving an indication of some volcanic activity in the area. This was the point where springs bubbled out at the surface. There must be lava on the valley floor at this point – an impermeable layer. We were confronted by sheer cliffs of Limestone and evidence of undercutting by melt water during the last ice age. The mass of Limestone has a dip West to East as part of an Anticline which had its crest just west of our return point in Wye Dale. A series of large rock cut stepping stones were negotiated each of us helping the other through.

There is a very sharp bend in the river in the Dale and it is speculated that a former meander in an old river seeped its way through the Limestone. Also the geology map showed us that there are faults at this point. Is the sharp bend fault controlled? We passed beneath a short viaduct and continued via another set of stepping stones to the next viaduct to ascend to the old railway track bed. After reaching the railway we made our way back to Millers Dale thinking of the Navvies boring their way through this terrain and now a very pleasant cycle track for all to enjoy. The two tunnels of Chee Tor were cut through very hard Limestone and until LMS days were unlined. One of the buttresses to the tunnels comprised of Gritstone brought in from another area of the line. We had planned to visit the other quarry to the East of Millers Dale but had no time due to the time taken to negotiate the stepping stones, listening to Paul pontificating and searching for Pauline's walking pole that she had left behind in the river. Who retrieved it? Give that man a medal.

## Harborough, 15th June 2016

June's trip was attended by 14 people – a good turnout in view of a suspect forecast. We were delighted to welcome Peter Jones from Derby University Geology Department who has done, and continues to do, research into the Tertiary deposits near Brassington. A reminder of part of the Geological column:

Tertiary  
Cretaceous  
Jurassic  
Triassic  
Permian  
Carboniferous, Etc

The Tertiary itself is divided into:

Pliocene  
Miocene  
Oligocene  
Eocene

NB youngest periods are always written first in a list. Complicated isn't it!!!!

In this area there are no deposits from Cretaceous, Jurassic, Triassic or Permian. Any Triassic or Permian rocks have been eroded away through time.

### **Dolomitic Limestone**

At the car park we saw "normal" Carboniferous limestone and Dolomitic limestone next to each other. Exposure to top right ( note browner colour ) and down the joints is dolomitised limestone. Between is "normal" limestone – some showing fossils and reacting with gusto to HCl.





*FRAGMENTS OF FOSSIL CRINOIDS*

Dolomitisation is the introduction of magnesium into the calcite molecule. The growth of these dolomite crystals replaces calcite grains. This process destroys most fossils if they were present so the fossils in the picture above cannot be in dolomitic limestone. Magnesium rich fluids percolated in the past through joints and weaknesses and were absorbed by adjacent limestone. The question is where did these come from? In the past we thought they came from overlying Permo-Triassic rocks since eroded. Peter was able to update us on the latest idea which is that they came from underlying older rocks – mainly shales – from the south. The jury is out on this!! Isn't it complicated!!

### **Bees Nest Pit**

A short walk to the east brings us to Bees Nest Pit.



Peter Jones explaining how these lighter clay/sand deposits were formed in this hole. Note the lake in the bottom of this pit and the other side of the hole shown by tree on far side. You can also see several members trying to work out the diagrams that Paul issued. Dave Popplewell has obviously given up!



*TERTIARY FOSSIL WOOD FRAGMENTS*

These are Tertiary deposits that sank into a collapsed cave system under the limestone surface in Tertiary times – probably in the latest period – the Pliocene. If so they are the furthest north in the UK that we can find Pliocene deposits. This is RARE, UNIQUE and EXCITING !!!

We can date these deposits from the tree bark fossils found in it:

### **Harborough Rocks**

A short drive north brought us to Harborough Rocks. Paul only gave us 10 mins for lunch!

These crags are made of dolomitic limestone which was a darker colour than unaltered limestone and was heavily pitted with cavities from chemical solution activity.





*DESCENDING FROM HARBOROUGH*



*ROCKS. TIM LOOKING VERY CASUAL*

*DAVE ON A DOLOMITIC CHAIR SURROUNDED BY HIS ENTOURAGE*

For the sake of our archaeological members – John, Linda and Vince – we looked for early Iron Age pits on the ledge we are walking on above. Well – talk about in the eye of the beholder! Pottery and bones from that period have been found here so the evidence can be seen – in Sheffield museum!

### **Longclifffe Quarry**

This visit coincided with the rain. The first hour was a presentation from Chris Wainwright about the quarry. It is very pure limestone – some of the purest to be found. It is widely used in the chemical industry, animal feed, plastic manufacturing ( as an inert filler – whatever that means! ) lime on fields, glass, paint etc. It is 150 acres in area and up to 260m deep – no, that can't be right!!! They quarry 1 million tonnes/year and there is a 30 million tonne life. 150 workers ply their trade here.

We then went to see the big stone crusher at work.



*LORRIES FILLING UP POWDERED*



*LIMESTONE FOR DISTRIBUTION*

*SLOSHING THROUGH A MUDDY CATWALK MODELLING THE LATEST GEAR FOR GEOLOGISTS*

A day full of variety, some expert input and a ridiculously short lunch stop!

## **Brimham Rocks, 18th May 2016**

After a long drive from Sheffield 13 members of the group assembled in the car park at Brimham Rocks at 11:15. This was despite the best efforts of West Yorkshire Highways Department in closing one of the access roads and being very lax with their diversion signs.





We had our first look at the rocks as we walked through them to the visitor's centre. The centre and refreshments kiosk were closed but they were expecting us and we assembled in a room at the back of the centre with Roman Soltan. Roman is a geology graduate of Leeds University and has done a lot of research on Brimham Rocks. He is co-author of a paper entitled 'Interpreting complex fluvial and barform architecture: Carboniferous Central Pennine Province, Northern England'. Don't ask me what it means. He talked to us for three quarters of an hour about the origins of Brimham Rocks and his research before we had lunch and ventured outside to look at the rocks. Roman is a very knowledgeable guide but a lot of what he said was too detailed and complex for me to fully comprehend. I am sure however that there are certain members of the group who found it very interesting.

Brimham Rocks is a fascinating landscape of giant gritstone rocks several of which have been given names over the years. It was in the Domesday Book as Birnebeam – a wooded area - and was given by Roger de Mowbray to the monks of Fountains Abbey. The monks cleared the woodland for grazing. After the dissolution of the monasteries it passed through many families until it came into the ownership of the Grantley estate in the 18th century. In the late 18th century the rocks attracted a lot of visitors. Some came on special trips in the omnibus and some came by the newly running train and walked the couple of miles from Dacre Bank. In 1862 the tenant, Richard Weatherhead, was advertising tours around the rocks for sixpence a head, along with teas and refreshments. When he retired in 1882 William Brown took over. William Brown was killed in a tragic accident at the rocks. Meeting the 2 o'clock coach from Harrogate he climbed up outside the coach for a lift back to Brimham House. Unfortunately the driver couldn't see him and he was crushed against a rock. The National Trust took over the site and built facilities in the 1970's.



Brimham Rocks are made from gritstone laid down between 430 and 380 million years ago. During the ice age a glacier created Nidderdale Valley creating a deep U-shaped cross section. The hard millstone grit resisted this glacial erosion and was left exposed as the softer rocks were cut away by the moving ice before it finally melted around 10,000 years ago. The softer rock and shale was then further eroded by sand-blasting and weather to leave stacks of millstone grit. The rocks were formed in the same way as the Peak District grits by a huge delta system from the north that first reached the Brimham area and progressed further south to cover the Peak District.



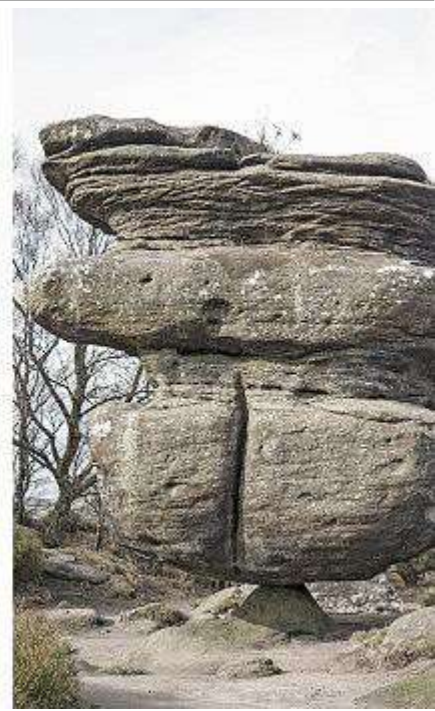
LINDA TAKES A PHOTO OF THE

DRUID'S WRITING DESK OR ET AS IT IS CURRENTLY KNOWN



A VIEW OVER THE ROCKS





*THE IDOL ROCK IS A HUGE BOULDER RESTING A SLENDER COLUMN*



Roman took us right round the site. Here is is demonstrating his technique for measuring the flow and direction of the water.

One interesting feature was a cleft in the rocks with a perfectly formed circular form on both sides of the cleft. Vince has a theory about how this was formed and has emailed Roman who is going to discuss it with his colleagues.



*A VIEW OVER THE ROCKS*



The formal part of the visit finished around 3:30 and people either had a further look round the rocks or made their way back to the car park and on to home.

John Scholey

I am indebted to the Guide Book to Brimham Rocks and Vince for the brief historical and geological notes included in the above.

### **Curbar Edge, 18th November 2015**

Sixteen of us – obviously those made of sterner stuff – set out with our leader Linda. She will expect me to remind everyone that we didn't actually set out with her as she had forgotten her coat and had to go home for it. So, we had to make do with Vince,



her sidekick, until she caught up. It was a very blustery day and we were intent on exploring this Millstone Grit edge.



*PEBBLES LAYERS WHICH*

*WERE PROBABLY DEPOSITED DURING FLOODS OR STORMY CONDITIONS* Vince reminded us, once again, of his distinction between a grit and a sandstone. I hope everyone has got that by now!!

Then we battled our way into the teeth of the gale to examine a face of a rock that Vince drew our attention to. There were some curved lines on it – a sedimentary structure. In his inimitable fashion he left us pondering about why the layers were curved like this. Then on to look at different weathering rates on rocks that were thickly and thinly bedded.





*RIPPLE MARKS – A SEDIMENTARY*



*STRUCTURE FORMED ON AN ANCIENT BEACH*

*JOHN STRUGGLING TO KEEP HIS HAT ON IN THE WINDY CONDITIONS WHILE THE GROUP  
TRIES TO LOOK AT SOME SANDY FRAGMENTED BEDDING*



*WE HAVE TO STAND AWAY FROM THE EDGE*

*TO BE ABLE TO SPEAK AND HEAR EACH OTHER*





Next came the squiggly bedded rocks – not a geological term but nevertheless very descriptive. Various intelligent guesswork suggestions all missed the mark. The answer ( this time! ) from Vince was that the deposits in a certain stage of their formation, would have been capable of a certain amount of movement, bending, plastic flow. At this point they had been disturbed eg by an earthquake. The vibrations would have distorted the layers to give us this crinkly looking layers that we saw.





GOOD EXAMPLES OF THE

MORE USUAL CROSS BEDDING IS ALSO TO BE FOUND ON CURBAR EDGE

Then on to a really good stone circle with a double bank. There are 2 entrances and it is a solstice circle because you can line up the 2 entrances at the winter solstice and the sun will shine exactly along the line of the entrances at sunset.



*LARGE STONES THAT ONCE FORMED A CIST*

*(STONE LINED GRAVE) IN THE CENTRE OF A LARGE BURIAL MOUND DATING FROM THE*



*BRONZE AGE*

We just have time to see the stone circle when rain sets in and we decide to hike back to the cars and call it a day. We will have to visit Eagle Stone another day. Next time I go along Curbar Edge I will revisit the archaeological sites in better weather. Many thanks to Linda for opening our eyes.

## **Haworth Geology Trip, October 2015**

Thirteen of us arrived at 11.15 – well I was 5 mins late – to start the walk to look at sedimentary structures, three types of rock, fossils and some industrial archaeology on Penistone Hill. The walk was just uphill from the Haworth parish church.



*PAUL TAKING THE REGISTER – VINCE PAYING*



*NO ATTENTION!*

*PAUL SHOWING THE*

*THICKNESS OF ONE OF THE SHALE TYPE BEDS*

The first stop was Dimples Quarry. The main rock is a Carboniferous sandstone. One face also had siltstones and mudstones. Some were very carbonaceous and – with the eye of the beholder – we “saw” a thin layer of coal. The deposition environment therefore must have been river for the fine grained sandstone and then very quiet water for the mud and siltstones and also some shallow water for trees to grow to give us the carbon rich layers.

On the other side of the old quarry was a face of massive sandstone, quite fine grained. In it was some smoothed and scratched surfaces as shown below. These are scratches made along a fault plane where the two blocks of rock had moved horizontally or near horizontally. In so doing they scratch the surface. These are called slickensides. Also on this face were some fossil plants.

Next came the squiggly bedded rocks – not a geological term but nevertheless very descriptive. Various intelligent guesswork suggestions all missed the mark. The answer ( this time! ) from Vince was that the deposits in a certain stage of their formation, would have been capable of a certain amount of movement, bending, plastic flow. At this point they had been disturbed eg by an earthquake. The vibrations would have distorted the layers to give us this crinkly looking layers that we saw.





*THE SMOOTHER SURFACE HERE SHOWS THE*



*SLICKENSIDES*

*THIS IS AN IMPRESSION OF A*

*BRANCH*

Amongst the pile of rejected rocks on the quarry edge we found cross – bedding and an old land surface shown by hollows where pebbles had been weathered from. Another old river/stream surface was shown by deposits of larger grade material on one face of a stone block.

Further round the moor the view was related to the geology by Scott who had his own map!



*VINCE SHOWING OFF HIS CROSS BEDDING*



*SCOTT EXPOUNDING HIS KNOWLEDGE TO AN*

*IMPRESSED PAULINE AND PING AND AN UNINTERESTED PAULINE AND MARGARET*



*BOB AND MARGARET LUNCHING. NOTE THE*

*CROSS BEDDING BEHIND THEM!*

Then on to the quarry past the site of an old coal mine and a water pump to take water up to the steam cranes that operated in the quarry in the second half of the 19th century. This has to be one of the best examples I have seen of cross – bedding or, as an unnamed member likes to call it, false bedding! So impressed by the structures were Bob and Margaret that they decided to use the said structures to lean on whilst lunching.



*A CLOSER LOOK AT THE CROSS BEDDING*



*AN EVEN CLOSER LOOK*

The rock here is fine –grained so the water in which it was deposited will not have been moving too rapidly. It also showed flakes of mica on the parting planes – a sure sign of relatively calm waters. Mica flakes are so light and thin that they would not be deposited in turbulent water ( thanks for that tip Vince ).

There were a few examples of quarrying marks in some of the boulders as we wound our way back down to Haworth, a cup of tea and a slice of cake.

The End

## **Crosland Moor Quarries, Huddersfield, Sept 16th 2015**

This tour of the sandstone quarries and stone cutting sheds was provided by the operators: Johnsons-Wellfield Ltd, who looked after us superbly. Only six of us made the early start to get to the quarries for a 9am start, but the early morning departure was well worth it! We were blessed by a bright, sunny and warm day.

The Crosland Moor quarries have been the source of high quality sandstone for over 200 years. They currently cover some 250 acres, including one new quarry, three operational quarries and many areas currently undergoing or have completed restoration. The sandstone is from the Rough Rock, the uppermost member of the Millstone Grit Series, of Carboniferous age. After a safety briefing and wearing our hi-vis vests and hard hats, we were taken by minibus on a tour of the quarries.



Tim looking into a vug and giving it some thought! Can he see some minerals in the holes? Note in this, and the previous picture, the absence of bedding planes. The rock reacted only very slightly with HCl.



*TYPICAL QUARRY FACE: DIFFERENT TYPES*



*OF SANDSTONE*

*IMPLEMENTS USED TO PULL*

*THE STONE BLOCKS OUT OF THE QUARRY FACE*

The first quarry seen was just in its infancy: soil and subsoil had been stripped and the upper layers of weathered rock were being removed. In this locality, the Rough Rock is about 80ft thick. This quarry will be in production later this year and should continue in production for ten years or so.

The operational quarries were then visited. The thickness of commercial stone in each quarry varies tremendously, as would be expected with a deltaic sediment, but is typically 20-40ft thick. The sandstones are generally cross-bedded, in a variety of directions, well jointed and fractured. The sandstones are interbedded with dark shales varying from a few inches to over 15ft in thickness. The sandstone blocks are extracted by pulling them out of low quarry faces using hydraulic excavators. Blasting is never used, as the largest blocks possible are needed. The shales and siltstones are set aside and used to infill older quarries.



STONE BLOCK BEING SPLIT BY PLUG & FEATHER



TECHNIQUE.

STONE MASON SPLITTING BLOCKS TO

PRODUCE HIGH QUALITY RIVEN PAVING. About 250 tonnes of stone blocks are dispatched to the saw sheds each day. Some blocks are split by hand, using the age-old *plug & feather* technique. Stone masons use hammer & chisels to produce high quality *riven* blocks & paving.

We were impressed by the 10ft. diameter diamond-tipped circular saw used to cut down the rough blocks. As the stone blocks get smaller, smaller saws are used for different end products. Many different products are produced: ashlar (top quality), walling, riven (split) paving and roofing, drystone walling (lowest quality). All offcuts from the sawing are crushed to different grades of aggregate (gravel). Some rock is crushed down to sand grade: going full circle to when it was deposited by the rivers!



*TEN FOOT DIAMETER DIAMOND TIPPED SAW*



*COMPUTER CONTROLLED STONE CUTTER*

Near the end of the tour, we were impressed by the latest technology: computer controlled stone cutters and laser-guided robotic cutters. These high-tech machines are programmed and operated by trained stone masons. The robots can cut stone in 3-D, to produce amazing structures, such as the stone planters/seats in Tudor Square, Sheffield. It was good to see the company investing in the future: we met two of the three apprentices, learning the traditional skills of the stone masons and quarrymen, and applying those skills through the latest computer technology.





*ROBOT STONE CUTTER IN ACTION*



*FOSSIL TREE STEM IN THE QUARRY*

Maintaining the U3A Geology tradition, we retired to the nearby (appropriately named) Sands Inn for refreshments, before the drive back home.

My thanks to Tim Gummer and Hilary White for the photographs.

Andy Wright

### **Variations on a Theme Boston Spa Trip, 15 July 2015**

Well, in the end there were 13 of us on the day. A sudden flurry of people said "Yes" a few days before the trip. Did the good forecast play a part I wonder??!!

The W Yorks Geology Trust had done us proud. I had been in contact with them - they wrote the guide - and they left about 20 copies of the guide for me to pick up in the local hardware shop. I was tempted by a few screws but settled just for the guides. I will bring spares next time.

We walked down Deepdale to the R Wharfe. Deepdale may be a meltwater channel cut towards the end of or after the ice age. It was steep sided and had a flat floor - both good signs of such a channel.



*JOHN GIVING CLOSE ORDER*

*TO THE EXPOSURE*

Tim looking into a vug and giving it some thought! Can he see some minerals in the holes? Note in this, and the previous picture, the absence of bedding planes. The rock reacted only very slightly with HCl.



TIM LOOKING INTO A VUG AND GIVING IT



SOME THOUGHT!

AH! THE TRUSTY HCL

REACTING ON A MINERAL - CALCITE OR DOLOMITE

We deduced ( with the aid of our leaflets! ) that we were looking at an algal mound formed in Permian times. Then continent of which the UK was a part, lay about 20N of the equator. On the edge of a shallow, evaporating sea. Sediments were deposited to form dolostone ( the old name is magnesian limestone ). Sometimes sea algae grew in shallow water, trapped limey mud and could build up into mounds several metres high. This is an algal mound and we were looking at one!

The vugs are really solution hollows where liquids drained out of the mounds at dissolved some of the dolostone to leave behind a small hole, or vug. ( Someone pointed out that this is a really good Scrabble word! ).

On the way down a path Bob slipped and cut his arm. This is the first accident I can remember. I was covered because in my risk assessment I had said look out for Bob - he is a risk. Whilst I was pointing out various fascinating aspects in the cliff, Bob had acquired a posse of nurses. There were no less than five ladies fussing over him instead of listening to my pearls of wisdom! Anyway they patched him up.





*BOB'S ARM AFTER BEING*

*DRESSED BY FIVE NURSES*

On downstream to the next exposure. It was a scramble up to it, only attempted by Linda. I'm pleased because it meant I could use her for scale.



*LINDA HANGING ON FOR*

*DEAR LIFE TO A TREE ROOT*

You can see some bedded rocks in the bottom left of the photo. Maybe there is another algal mound above the beds or maybe the beds above have weathered to a sandy coloured material. We needed an expert to have an hypothesis about this - Vince and Andy where were you in our hour of need?

The rocks here ? so the leaflet said, were oolitic. Well, if so, they were hard to see!

Over the river we came to an abundance of fossil worm tubes in the dolostone.



*A LONGITUDINAL WORM TUBE*

A longitudinal worm tube. Most were end on and many had crystalline edges that reacted. The rocks here were bedded so not an algal mound.

On to a quarry on the north bank. Not an oft visited area as we had to fight our way through brambles and nettles. Dave led the way - in his shorts!! I expect he got Margaret to give his legs a good rub down later.

So what were the variations on a theme?

The "?theme" was magnesian/dolomitic limestone. The variations were: Algal mound, bedded rocks, some with vugs, some solid bigger beds used for building stone, some fossiliferous, areas of oolitic deposition,...

Paul May

## **Geological Wanderings around Malham 17 June 2015**

Despite a poor weather forecast and long travel time 6 of us (plus Jasper the hound) headed north to Malham. Some of us had time to visit the National Park Centre and see the exhibits but by 11.00 we were all met and decided to head off in an attempt to outflank the 8 coach loads of school children who were queueing for the toilets and ready to thwart our plans for a quiet day's geology.

We followed the Pennine Way south to Mires Barn, from where we had a good view of the white limestone cliffs of the cove and the contrasting landscapes of the upland limestone pasture, compared to the wooded lowlands of the younger Bowland Shales. The Great Scar limestone of the uplands was formed approximately 300 million years ago from compressed shells and skeletons of sea creatures, under a shallow tropical sea. During the Carboniferous era massive earth movements caused faulting and lifting so that the limestone was forced up above the level of the Bowland shales and Pendle grit to the south of the Mid Craven fault.

The course of Goredale beck led us up to the wooded gorge cut through the reef limestone by the stream. These reefs lay along the southern edge of the main lagoon and outcrops of the limestone were clearly visible in the gorge. With steady rain and man eating midges it felt quite tropical! The school groups were not lingering so we had Janet's Foss to ourselves and were able to see the four metre wide apron of tufa, redeposited limestone precipitated from the mineral rich water of the stream. The smooth apron formed a contrast to the bedded and tilted rocks behind and beside the waterfall. In this area many Norse words survive; a foss is a waterfall, thwaite a clearing in forest and a laithe is an area of pasture.



Janet's Foss sits on the line of the fault; Goredale Scar and Malham Cove have both been eroded back some distance by millions of years of weathering and huge volumes of water which flowed over these features during several ice ages.

Heading for Goredale the cliffs of the massive Great Scar limestone were visible, the base covered in angular screes (resting at 35-37 degrees, at 38 degrees they become unstable!) which were again a relic of the very cold temperatures and freeze thaw weathering which occurred around the time of the ice ages. At the base of the cliffs was a clear spring line where underground water bubbled through watercress to form Goredale Beck. In Goredale Scar the spectacular 100 metre gorge was revealed with the river flowing across tufa, through the "window" in the rocks and down in a series of waterfalls.





We spend some time considering the lower beds of limestone, they appeared to be vertical, although that didn't make sense, but certainly the erosion was shattering the rocks into small, angular blocks. Group Homework; what is happening here?

Tufa was clearly being deposited along the bed of the stream as well as on the waterfalls. It had been thought at one point that Goredale might be a collapsed cave but current thinking suggests that it was eroded into a valley, perhaps though a cave system, many millions of years ago. We could see where swirling water might have eroded the walls high on the cliffs when meltwater from retreating ice sheets came racing through the gorge, carrying boulders and stones which would erode the cliffs even more efficiently.

At this point it was decided to stop for lunch; it being the most sheltered part of the walk and an overhang provided respite from the worst of the rain.

Jean, the newest member of the group, decided that we were all very intrepid!



*GROUP PHOTO!*

Revitalised we headed north-west from Goredale bridge over the Great Scar limestone; observing on our way the terraced lynchets of an ancient field system and passing through the stone circles and rectangles that were originally huts of a farming community living here some 2,500 years ago.

From the hillside there was a clear view of the line of the Mid Craven fault and the contrasting landscapes either side, looking north we could also see the hills beyond the line of the North Craven fault. Dropping down onto the limestone pavements of the top of Malham Cove we were treated to views of the swooping peregrines, apparently both the peregrines and the kestrels have reared 3 chicks this year.

Limestone pavements are made up of large blocks (clints) divided by deep fissures known as grikes. The pavement in this area was formed when ice sheets 12,000 years ago scraped away the surface debris, leaving the limestone open to erosion. Slightly acidic rainwater drains off the top of the clints and widens the joints and fractures in the rocks by slowly dissolving the limestone. Rare plants hide in the crevices and further erode the grikes. Walking across such ankle-wrenching terrain in horizontal rain was a challenge! Ask Pauline H!



The Cove below us is a huge amphitheatre with cliffs rising 70 metres above the valley floor; it was formed by erosion back from the Mid Craven fault line, probably by a combination of glacial meltwater, ice and some undercutting and subsequent collapse of the cliff face. After the ice ages there were millions of gallons of water flowing across the landscape and a huge waterfall over the lip of the cove. Today there is a spring, one of the sources of the river Aire, which emerges from the foot of the cove. This is a Vauclusian spring...named after similar features in the area of Vaucluse in France.

Above us on the cliffs we could see the same bedding planes and strata of rock that we had noticed at Goredale. There were also the nesting birds (the RSPB set up their scopes so that we could see one of the peregrine chicks sitting on the nest) and a few climbers, also sitting on a ledge!





*VAUCLUSIAN SPRING; FOOT OF THE COVE*



*LOOKING UP AT THE CLIFFS*

## Manifold Valley Walk 20 May 2015

Due to various people being on holiday and the trip being 30 miles from Sheffield, a rather depleted group of eight set off from Wetton Mill, having arrived via the narrow railway tunnel and the glorious scenery of Staffordshire Moorlands. We welcomed Jean, a new member who was “trying us out”.

We were looking at the contrasts between the reef knoll limestones which form angular, resistant outcrops along the valley and the Ecton limestones of Ecton Hill which are thin strata, folded and contorted. At Wetton Mill we looked at the first reef, Nan Tor. Like many other reefs in the valley it had a cave, probably caused by water dissolving and eroding the reef. There was considerable discussion (and few conclusions) about the sequence of events; could sea water have flowed through the reef, did erosion occur when the land was uplifted and rivers caused the erosion? How did conditions change to create the more stratified deposits of the Ecton limestone series? As we walked up the valley along a track there were many small quarries and outcrops showing the folding and dip of the Ecton limestones, all at different angles.



The walk then became something of a flora and fauna walk; chiff chaff, great tits, blackbirds, blackcap, a robin, water avens, wood anemone, sorrel, ransomes, primroses, violets and cowslips. Not forgetting Ron's tulips! (Bluebells) We then started to see mine workings for the Ecton copper mines, some were adit drains and others were access for workers to the deep pipes of copper in Ecton Hill. Those who had been on the trip a couple of years ago to the Ecton Mine were able to explain the workings under Ecton hill. Before we left the valley we found a former quarry where there were huge blocks of consolidated angular shards of limestone. These screens were formed in freezing conditions in the last ice ages and cemented together; the biggest blocks had clearly fallen from higher up the quarry face. A reminder that geological processes continue!

Passing the area by the road where copper was dressed and loaded we walked uphill, past the mine manager's Gothic house and the field study centre. Copper was mined in this area from the bronze ages but its heyday was in the 17th century when the mines were owned by the Duke of Devonshire. Some 400 people worked in the mine or on the dressing floors, some as young as 6. We visited the engine house

where a Boulton and Watt steam engine was installed in 1788 to raise the kibles full of copper ore to the surface from shafts as deep as 300m below ground. The engine house was open for a study group and we were invited inside to see the huge wheel. Close to the main shaft is an artificial mound where another shaft was sunk so that a counterweight could descend to assist the engine when raising heavy loads of copper. The copper was sent to Denby for smelting into brass for various purposes but some was sent to Derby to be rolled into copper plate to protect the hulls of sailing ships in the navy against borer worms. A copper-bottomed guarantee! It was estimated that the Duke of Devonshire profited to the tune of £300,000 from this mine, enough to build the Crescent at Buxton and to pay his wife's gambling debts.



*CLIMBING ECTON HILL FROM THE*

*MANIFOLD VALLEY*

We headed south in a biting wind with squally showers pushing us along! For a while we followed the ridge of Ecton Hill, along the line of the anticline. All along was evidence of mining.

There was one interesting gatepost; limestone with a thin bed of basaltic rock on one side.





The copper beneath our feet was 12% pure (that's high for copper ores!) and filled deep vertical pipes as well as elongated, horizontal veins. It was brought here in solution in hot fluids, probably associated with the heat of folding or of nearby volcanic activity, but no-one really seems to know why copper came in at this point, rather than the more common lead.

Ahead of us were more angular reef knolls, back on the Lower Carboniferous outcrops. The changeover was obvious in the vegetation cover and shape of the landscape. Crossing a boggy area of shales we climbed the grassy slope of the Wetton Hills and headed for Wetton village with its miner's reading room (now a holiday cottage!), cottages owned by the Chatsworth estate and a pub with a warm fire!

Next stop Thor's cave, another solution cave in a reef knoll, eroded by water and probably enlarged by wind. Within the cave archaeologists have found bones of prehistoric man, bears, deer etc. plus a Bronze Age burial. All eight of us scrambled up the polished limestone into the depths of the cave..no mean feat!



CLIMBING IN!

MARGARET GIVING SCALE TO SHOW THE SIZE OF THE CAVE

Finally we descended the 203 steps (so the publican informed us!) down to the valley. Fabulous crinoid fossils in the steps, clearly not a limestone from this valley! More wildflowers and birdsong in the woodland. The river at the bottom was flowing fast, often at this point it has disappeared underground but a few days of heavy rain ensured a surface flow. Along the disused track of the Leek and Manifold railway, now a cycle trail, and back to the car park at Wetton Mill. It's hard to imagine that this peaceful and beautiful valley was once such an industrial site.