Newsletter No. 280
August 2023

Contents:

To find out more about this photo - read on!

Copy date for the next Newsletter is Sunday 1 October

Mark Jeffs **Honorary Secretary,** honsec@bcgs.info	**Andy Harrison,** **Field Secretary,** ☎ 07973 330706 fieldsecretary@bcgs.info	**Julie Schroder,** **Newsletter Editor,** 42 Billesley Lane, Moseley, Birmingham, B13 9QS. ☎ 0121 449 2407 newsletter@bcgs.info
For enquiries about field and geoconservation meetings please contact the Field Secretary. To submit items for the Newsletter please contact the Newsletter Editor. **For all other business and enquiries please contact the Honorary Secretary.** For more information see our website: bcgs.info, YouTube, Twitter: @BCGeoSoc and Facebook.		

Future Programme

Indoor meetings are normally held in the Abbey Room at the Dudley Archives, Tipton Road, Dudley, DY1 4SQ, 7.30 for 8.00 o'clock start unless stated otherwise.

Visitors are welcome to attend BCGS events but there will be a charge of £1.00.

Wednesday 16 August *(Field Visit):* Saltwells National Nature Reserve Update. Led by Graham Worton. Meet at the Nature Reserve car park (Grid ref: SJ 934 868) on Saltwells Lane for a 6.30 start. The visit will include a look at the new discoveries being made at the Nature Reserve. Finish around 8.30 followed by a drink at the Saltwells Inn for those wishing to attend.

Monday 18 September *(Indoor Meeting):* 'The life and work of Sir Arthur Russell'. Speaker: Roy Starkey.

To the mineralogist and mineral collector Sir Arthur Russell needs little introduction. The honorific 'Sir' is not a knighthood for public service but the result of him becoming the 6th Baronet Russell of Swallowfield in Berkshire, a hereditary title created for his great-grandfather Sir Henry Russell (1751-1836). One might be forgiven for imagining that his family background would have bestowed upon him a comfortable lifestyle, but the reality was rather different. He was by nature a frugal person with the common touch, equally at home with miners and quarrymen as he was with the mine owners and landowners that paid their wages. This talk, which draws upon more than four years' research for a recently published book, will provide an overview of Arthur's family background, his contributions to the study of British mineralogy and the wonderful specimens contained within his collection. Minerals were his life and the talk will celebrate the diversity of colour and form, of chemistry and structure, and the rich geological and mining heritage of these small islands that Sir Arthur was proud to call his home. *(See the BCGS website programme for a fuller version of Roy's abstract. Ed.)*

Saturday 7 October *(Geoconservation Day):* Wren's Nest. Directed by the reserve wardens. Meet at 10.30 at the wardens' office at the end of Fossil View, off Wren's Hill Road (GR: SO 93699 92118). Park along Fossil View. The day will involve scrub clearance. Bring gloves, stout footwear and packed lunch. Wardens will provide tools, hard hats if necessary and a hot drink. Finish around 2.30.

Monday 16 October *(Indoor Meeting):* 'Erratic Tales'. Speaker: Ian Fairchild (University of Birmingham and Herefordshire & Worcestershire Earth Heritage Trust (HWEHT).

I will start the lecture by giving some examples of erratic boulders in the UK, Iceland and the Alps which provide us with interest and instruction about geological processes. Over the past two years, the Black Country Geological Society has partnered with the HWEHT, the Birmingham Open Spaces Forum and the Lapworth Museum of Geology to deliver the Heritage Lottery Funded project 'Birmingham's Erratic Boulders: Heritage of the Ice Age'. The legacy of this project includes much better documentation and visibility of these boulders in SW Birmingham and NE Worcestershire, the creation of eight walking and cycling trails, a programme of public engagement events, and a website, erraticsproject.org which includes two essays on the historical study of the erratics by Julie Schroder. The nature of these stones, through their exotic nature and sometimes impressively large size makes them attractive to the public and a means to foster pride in the local area. There is scope for further projects in other geographic areas to build on this interest. The original enthusiasm for documenting boulders and mapping glacial flowlines barely survived WWI. The Birmingham geological memoir barely mentions them, yet they are the most widespread evidence for deep time processes visible to the public and remain of considerable scientific significance. *(See the BCGS website programme for a fuller version of Ian's abstract. Ed.)*

Saturday 11 November *(Geoconservation Day):* Portway Hill, Rowley. In collaboration with the Friends of Rowley Hills and the B&BC Wildlife Trust. Meet at St Brades Close just off Tower Road at 10.00 (Grid ref: SO 974 893, nearest PC: B69 1NH). Directions: from Birmingham New Road (A4123) turn left onto Tower Road if coming from Birmingham, right if coming from Wolverhampton. Just after Bury Hill park, turn left onto St Brades Close. Wear old clothes, waterproofs and stout footwear. Please bring gloves. Tools will be provided but do feel free to bring your own. Also bring a packed lunch. Hot drinks will be provided. Finish around 1.30.

Monday 20 November *(Indoor Meeting):* 'Origins of Starfish and their relatives'. Speaker: Aaron Hunter.

Asterozoans, including starfish and their close relatives, the brittle stars, are amongst the most instantly recognisable and iconic marine animals. They are a dominant and successful group of living echinoderms based on their diversity, abundance and global distribution. Despite their ecological success and a fossil record spanning more than 480 million years, the early evolution of asterozoans remains a mystery. New discoveries from France and Morocco have begun to resolve this mystery. We look at the earliest common ancestors of the 'Bat Star' somasteroids and their Cambrian descendants, including a new fossil from the exceptionally preserved Fezouata biota in Morocco, which is the earliest starfish-like animal so far recorded in the fossil record. We then follow these exceptional fossils through the Ordovician, as true starfish and brittle stars appear and show how they rapidly diversified during the biotic revolution we call the Great Ordovician Biodiversification Event.

Saturday 9 December *(Geoconservation Day):* Saltwells NNR. Details tbc.

Monday 11 December *(Indoor Meeting):* Members Christmas meeting.

Saturday 13 January 2024 *(Geoconservation Day):* Portway Hill, Rowley.

Monday 15 January *(Indoor Meeting):* 'A Recipe for Disaster'. Speaker: Dr. Ekbal Hussein (Remote Sensing Geoscientist at the British Geological Survey).

Globally, two thirds of deaths arising from natural hazards in recent decades were caused by geological hazards. But how and why do natural hazards turn into disasters? In this talk Ekbal will explore this question through the lens of one particularly troublesome hazard: earthquakes. The death toll for a given earthquake magnitude (and mechanism) will depend not only on geographic location, but also the social vulnerability of communities and the quality of the building stock. But these are dynamic features of evolving societies, which means earthquake risk varies in time and space. This talk will compare and contrast global trends in earthquake fatalities and aim to extract common themes that exacerbate the impact of natural hazards, and consider where and why these turn into disasters. Ekbal's research focuses on the use of satellite imagery to understand earth processes, particularly those related to natural hazards such as earthquakes, landslides and subsidence. Ekbal is an advocate for holistic multi-hazard approaches to understanding and managing the impact of disasters to society.

Monday 19 February *(Indoor Meeting):* 'A very British summer in the late Triassic: the Arden Sandstone Formation of the English West Midlands and the dawn of the dinosaurs'. Speaker Prof. Stuart Burley.

The Arden Sandstone Formation of central and western England is a thin but conspicuous arenaceous unit within the Late Triassic Mercia Mudstone Group. Sedimentological and palaeontological data point to lacustrine depositional conditions, in contrast to the red desert mudstones above and below which were deposited as continental dryland desert floodplains. The Arden Sandstone records deposits of the lake margins and may be the high stand lateral equivalent of the halite and gypsum deposits which formed in the lake centre. The Carnian age of the Arden Sandstone potentially links it to the Carnian Pluvial Episode, marking the coalescence, spread and freshening of the formerly saline desert lakes, and deposition of sandy, fluvial and lacustrine deposits during the wetter climate that prevailed for at least a million years.

Monday 18 March *(Indoor Meeting):* AGM and talk tbc.

Monday 15 April *(Indoor Meeting):* 'Geology of the Chiltern Hills; new data & new interpretations'. Speaker: Dr. Haydon Bailey (Geological Adviser, The Chiltern Society).

The Chiltern Hills are underlain by Chalk, predominantly lithostratigraphic units traditionally called the Lower and Middle Chalk (the latter now the lower part of the White Chalk Group) capped by the Top Rock - Chalk Rock complex. It is this series of chalk hardgrounds which effectively forms the spine of the Chiltern Escarpment. The Chalk dips gently into the London Basin, and the overlying basal Tertiary succession provides minor outliers around this northern rim of the basin. The other major geological event we have to recognise in this area is the re-routing of the Proto-Thames River during and following the Anglian glaciation, some 450,000 years ago. This created the landscape we currently see in much of the southern parts of the Chilterns. Geological mapping of the region by the BGS over the last ten years and ground investigations resulting from the ongoing construction of the HS2 High Speed rail link have greatly added to our knowledge of the regional geology. Add to this the recognition that subsurface movement of water through the chalk is far more prevalent than previously identified, then this means that we're still learning a whole load more about the geological development of the hills which form the northern margin of the London Basin.

Other Societies and Events

Birmingham Heritage Week 8 - 17 September

There are numerous events to choose from during Birmingham Heritage week. Below are short summaries of three geology-themed activities which are free and may be of interest. For more details and booking (essential) go to the Heritage Week website: https://birminghamheritageweek.co.uk/

Friday 8 September - 10.00 – 1.00 Guided Walk on Erratic Boulder Trail 1- The Great Stone Inn to the University of Birmingham. Led by Julie Schroder.

Monday 11 September - 10.30 – 12.30: Birmingham Building Stones Trail 1 – The Town Hall to the Cathedral Square. Led by Julie Schroder.

Lickey Hills Heritage Weekend

Saturday 16 September, 11.00 - 4.00. In Warren Lane Quarry guides will be present to show you the WW1 Bilberry Hill Gun Proof Range and introduce the Lickey Hills geology.

Sunday 17 September, 11.00 - 1.00. 'A Walk Through Time'. Led by Dave Green. Meet at the Lickey Hills Country Park Visitor Centre, Warren Lane, Lickey B45 8ER. A free guided walk around the Lickey Hills geology trail.

Warwickshire Geological Conservation Group

Saturday 19 August, 10.00 – 4.00: Field Trip: Hill Farm, Maxstoke & Corley Rocks. Leader will be Mike Allen or Stuart Burley. Contact Julie Harrald to register interest julieharrald@googlemail.com

Thursday 21 September, 7.30 – 9.00: Evening Lecture: Stromatolites: Making Mountains out of Microbes. Speaker Prof. Ian Fairchild.

There is a charge of £2.00 for non-members. Indoor meetings are both live at St Francis, Kenilworth and by Zoom. For more information visit: http://www.wgcg.co.uk/ or email: WarwickshireGCG@gmail.com.

Abberley and Malvern Hills Geopark 20th Anniversary – Geofest 2023

This year is the 20th anniversary of the Abberley and Malvern Hills Geopark. The annual Geofest is running from 27 May to 3 September. More on the Geofest Calendar here: http://geopark.org.uk/pub/category/geofest/

For further information go to: http://geopark.org.uk/ or contact the BCGS Field Secretary, Andy Harrison *(details on p.2).*

Open University Geological Society, West Midlands

S**aturday 2 September, Field Trip Day: National Stone Centre, Wirksworth, Derbyshire.** Visting National Stone Centre to see Limestone Quarries and wall building materials from around the country.

Saturday 23 September, Field Trip Day: Lickey Hills Country Park, Rednal, Birmingham. The aim of this event is to see Ordovician quartzites, folding and faulting in the Country Park. Grid Ref: SO 996 754.

Both events are from 10.30–4.00. For more details contact: Dave Green, davepgreen@btinternet.com

Manchester Geological Association

Saturday 2 September (Sunday 3 September if weather unreasonable), Field Trip: Bonsall, Derbyshire. Leader Dr Mike Allen. An excursion to explore the volcanic rocks above Bonsall Village, one of the four Peak District Carboniferous volcanic centres.

For more information: http://www.mangeolassoc.org.uk/ or contact outdoors@mangeolassoc.org.uk

Mid Wales Geology Club

Wednesday 16 August: Introduction to North-West Scotland Geology. Speaker: Chris Simpson.

Further information: Tony Thorp tel. 01686 624820 and 622517 tonydolfor@gmail.com
Web: http://midwalesgeology.org.uk Lectures start at 7.15 via Zoom.

Shropshire Geological Society

Wednesday 13 September: Dolomite: the problem child of carbonate sedimentary geology. Speaker: Cath Hollis (Manchester University).

If you wish to attend please contact Albert Benghiat: 07710 421 581, email: SGS.chair@hotmail.com
Further information: http://www.shropshiregeology.org.uk/SGS/SGSEvents.htm

Editorial

This issue brings much new information about our programme of events, including detailed abstracts from our speakers. Please follow directions to the website where abstracts were too long for the Newsletter. We thank Alan Clewlow for continuing to do such an excellent job as acting Meetings Secretary, but I must emphasize that we are in need of someone to come forward and take on this role as soon as possible.

A meaty report from Andy Harrison reminds us of the wonderful May Field Visit to the Dowards and the Wye gorge. If you weren't there, I hope that Andy's report will whet your appetites *(p.8)*. News from ►

our Chairman, Graham Worton reveals that he has been busy with inspectors from the UNESCO Global Geopark team, and we hope for news of a satisfactory outcome in due course *(p.7)*. The Erratics Project report heralds completion of the eight Erratic Boulder Trails in and around SW Birmingham, as our partnership project 'Birmingham's Erratic Boulders: Heritage of the Ice Age' draws to a close. Don't miss the final Trail Launch Day on 12 August with another chance to take part in a guided walk on Trail 8 'The Illey Wilderness Trail', with leaflets now available *(p.13)* if you missed the wet but well-attended pre-launch BCGS Field Trip following this trail. Finally, Mike's Musings brings us another angle on the concept of 'volcanoes'.

We hope you will enjoy the Newsletter. Please let us know your views on all the events and activities we organise on your behalf, but above all, come along and enjoy them, bring others with you and encourage new people to become members of BCGS. ■

Julie Schroder

Black Country UNESCO Global Geopark

Revalidation Mission Meeting

From 18 – 23 July our Chairman, Graham Worton, in his capacity as lead officer for the Black Country Geopark, was busy hosting a delegation from the UNESCO Global Geopark network. Their mission was to revalidate the Geopark's credentials as a worthy member of the UNESCO Global Geopark network. Such missions normally take place every 4 years, but only 3 years have elapsed since the Black Country Geopark was admitted to the UNESCO Global Geopark family. This happened to be in the middle of 2020 during the darkest days of the Covid Pandemic, when it was impossible to embark on planned projects and public initiatives. The delegation consisted of two inspectors, one from Uruguay and the other from Spain.

During the three day tour of significant geosites in the Geopark, Graham was keen to promote BCGS as the leading local geological society, and the role of BCGS in Geoconservation work at some of the geosites in the Geopark. With this in mind, he invited BCGS Committee representatives to meet the inspectors. Your editorial team (Julie and John Schroder) were able to meet the team to coincide with their early evening visit to West Park in Wolverhampton. This gave us a chance to explain the partnership of BCGS in the Glacial Erratics Project, and its potential to act as a catalyst for a possible spin-off project in the Black Country, most likely under the umbrella of the UNESCO Global Geopark.

We were also able to assess the state of the glacial erratics displayed in West Park. Since the BCGS field visit with Graham way back in March 2010, there has been some deterioration, with some original signage missing and the boulders in need of a face-lift. Could this be a geosite worthy of BCGS geoconservation work - if this is possible to organise?

An Arenig ash (felsite) boulder in West Park, Wolverhampton in March 2010

Since the Revalidation Mission, Graham reports that it was an intensive process, but he's hopeful of success, with a few recommendations for things to concentrate on for the next few years. The next steps are that the evaluators will write a formal report by ►

15 August which will be presented at the Global Geopark Network session in Morocco in the first week of September. Graham should hear something at this point, but it won't be until the Spring 2024 meeting of the UNESCO executive in Paris that the final decision will be known. ■

Graham Worton and Julie Schroder

Field Meeting Report

Saturday 20 May (Field Visit): Little Doward and King Arthur's Cave. Led by Jim Handley (EHT Champion for the Dowards and King Arthur's Cave).

Introduction

We met Jim at the car park near Doward Park campsite on a warm, sunny day. Little Doward and King Arthur's Cave are amongst the 19 sites chosen for the 'Community Earth Heritage Champions' project by Herefordshire and Worcestershire Earth Heritage Trust, with funding from the National Lottery Heritage fund and Natural England. Each site has a Champions community group that carries out conservation work, promotes the site's use to local people within the parish and monitors the site for any changes in condition. The Champions aim to view the environment holistically in order to understand the relationships between geology, ecology and archaeology. Jim is a Champion for the Doward Hills and King Arthur's Cave.

Our visit involved a 4 mile (6.5km), guided circular walk along undulating woodland paths and the River Wye looking at the relationships between the landscape, associated geology and some local heritage.

Location and Geography

Little Doward and its neighbour, Great Doward, form the Doward Hills (in Welsh: Deuarth Fach, meaning 'two little hills'), which lie within the parish of Whitchurch, South Herefordshire roughly 4km north-east of Monmouth. Covering the hills is a patchwork of woodlands, hedgerows, small fields, pastures, wildflower meadows and heath land all forming important wildlife habitats.

Rising to 221m in height, Little Doward is crowned with an Iron Age hill fort. Great Doward, to the east, rises to around 200m and is topped with several buildings and woodland, which includes Lord's Wood to the south-east. Separating both hills is a roughly north-south trending dry river valley. To the north-east, the northern slopes of Great Doward undulate towards Symmonds Yat. The southern and western slopes of Great and Little Doward fall sharply into the Wye Valley Gorge and towards the A40. The River Wye flows in a large sweeping loop past Symmonds Yat, the Doward Hills and continues south towards Monmouth on its way to the Bristol Channel.

Lord's Wood, Seven Sisters Rocks, quarries, caves (including King Arthur's Cave), an ancient settlement and a landscaped deer park once belonging to MP and industrialist, Richard Blakemore, can all be found on the steep southern slopes.

Geology and Stratigraphy

Other than a thin ribbon along the bottom of the gorge, the river terrace and alluvial deposits associated with the River Wye, the Doward Hills are generally devoid of superficial deposits. Various sandstone, limestone and conglomerate strata from the Lower Carboniferous to the Upper Devonian form the underlying bedrock geology. Together they represent a transition from low-lying, river ►

dominated terrestrial environments to warm, shallow tropical seas and back to fluvial conditions on a marine influenced coastal plain. The various strata lying beneath the Doward Hills include:

Cromhall Sandstone Formation: Formerly known as the Drybrook Sandstone Group, this stratum represents the youngest rocks in the area at around 290 Ma (Lower Carboniferous). The British Geological Survey (BGS) GeoIndex (website: www.webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=CHSA), describes this stratum as 'brown and red fine- to coarse-grained quartzitic sandstone with subordinate mudstones and sparse thin limestones' and 'grey and red coarse-grained quartzitic sandstones, sandy crinoidal and oolitic limestones, mudstones, siltstones and grey seatearths arranged in cyclic sequences'. This stratum formed within a mainly fluvial environment on a marine influenced coastal plain.

Llanelly Formation: Formerly known as the Whitehead Limestone, the BGS Lexicon describes the Llanelly Formation as 'well bedded, peritidal, cyclic micritic to grainstone limestones with green clay inter-beds at base, overlain by ooidal grainstone and capped by green and red-mottled clay palaeosol'. The stratum includes breccia/conglomerate layers, massive bioturbated carbonate mud layers, a stromatolite layer and infilled channels.

Gully Oolite: Underlying the Llanelly Formation is the Gully Oolite (formerly known as the Crease Limestone). This stratum comprises a massive yellow-brown weathered grey, oolitic limestone, which is heavily jointed and locally cross-bedded. Eroded and infilled channels can be seen at the contact between the Gully Oolite and the overlying Llanelly Formation.

Both the Llanelly Formation and Gully Oolite date to the Lower Carboniferous, Visean Stage (347 Ma to 331Ma) when the area lay south of the equator. They were deposited under shallow, sub-tropical marine conditions on the northern margins of the Rheic Ocean, which teamed with life.

Barry Island Limestone: Formerly known as the Lower Dolomite or Black Rock Limestone Formation, the Barry Island Limestone belongs to the Lower Carboniferous Limestone Series. It is described as 'thin- to thick-bedded, dark grey to black, foetid, fine- to coarse-grained skeletal (mainly crinoid) packstones with subordinate thin beds of shaly argillaceous skeletal packstone and mudstone'. Within such limestone-rich muds deposited under low oxygen conditions, calcium is replaced with magnesium prior to lithification. This dolomitisation process tends to adversely recrystallize any calcium carbonate, into magnesium carbonate and consequently makes fossils within such rock layers rare.

Avon Group: Formerly known as the Lower Limestone Shale, the Avon Group forms the base of the Lower Carboniferous Limestone Series. The BGS describes this stratum as 'interbedded grey mudstones and thin- to medium-bedded skeletal packstones with one to several thick units of ooidal and skeletal grainstones'. This stratum represents sediments deposited under low energy conditions on a mid to inner continental shelf or ramp.

Tintern Sandstone Formation: This stratum belongs to the Devonian Upper Old Red Sandstone dating to around 363 Ma. According to the BGS lexicon it is described as 'buff-yellow sandstone with local lenticles of pebbles and subordinate marl partings'. Of terrestrial origin, these rocks were likely to have been deposited within fluvial or lacustrine environments.

Huntsman Hill Conglomerate: Otherwise known as Quartz Conglomerate, this stratum also belongs to the Upper Old Red Sandstone and represents the oldest rocks seen on the Little Doward trail. The BGS describe this stratum as 'red-brown medium- to coarse-grained pebbly sandstones and quartz pebble conglomerates with some mudstone interbeds'. ►

This stratum was deposited from a massive braided channel, probably close to the sea and carrying a sediment load that varied depending on the conditions. It is believed that the channel carried material from a long eroded mountain chain over 150 miles north, where Snowdonia is located today, and deposited it over a vast area. The stratum has been recorded at Usk, Abergavenny, Blaenavon, the Gower and Gloucestershire.

The Little Doward Trail

1. Lord's Wood Quarry Nature Reserve

From the car park, heading south for a few hundred metres we first stopped at Lord's Wood Quarry Nature Reserve. Forming a large terraced hole with sheer cliff faces sunk into the surrounding woodland, the quarry was historically worked for roadstone. Today, it belongs to Herefordshire Wildlife Trust and is home to various flora, raptors, insects and fungi.

Lord's Wood Quarry

The quarry walls nicely expose approximately 10m of the Llanelly Formation. Rock layers are tilted at 16° towards the south-east, which reflects the general stratigraphic dip direction for all strata underlying the Doward Hills. This has caused the oldest rocks to occur beneath Little Doward and progressively younger rocks occurring east-wards beneath Great Doward. Underlying the Llanelly Formation in the quarry bottom is the Gully Oolite with eroded and infilled channels cut into the surface at the boundary with the overlying Llanelly Formation.

2. Seven Sisters Rocks, Lord's Wood and the Biblins

Continuing south from Lord's Wood Quarry, we followed wooded trails to the Seven Sisters Rocks with views overlooking the Wye Gorge. Today, only five limestone outcrops remain from the original seven which gave the viewpoint its name. Here, Jim described the complexities involved with how and when the River Wye formed. Whilst meandering southwards across the Herefordshire plain and down to the Bristol Channel, the Wye loops from soft to hard geology and back to soft again. Between Symmonds Yat and Monmouth, the river has carved a steep-sided gorge into the local rocks. The land flattens out slightly at the Biblins, located on the southern tip of Lord's Wood and Great Doward. The various strata, through which the river has cut, do not appear to have impacted its course. ►

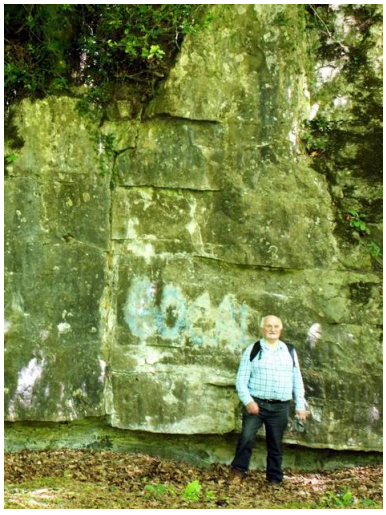
The Wye Gorge and the Biblins from The Seven Sisters Rocks

It is thought that the river originally meandered over a flat floodplain close to the sea and cut vertically downwards into the surrounding landscape fairly recently following the last Ice Age. However, it is unclear whether the river cut into the landscape due to falling sea levels, the land rising or a combination of both. Whatever the reason, the river was rejuvenating and wanted to cut down to reach sea level, thus creating the sub-vertical gorge seen today. The wider section at the Biblins is the only exception, and this may be due to the river interacting with weaker rocks. From our vantage point, we could see how the river had cut down into the former plateau and superimposed the current drainage pattern onto the landscape. However, what triggered the relative movements that formed the gorge and when this happened remains unanswered.

Tufa deposits at the Biblins

Continuing south-eastwards from the Seven Sisters, through Lord's Wood and climbing slightly, we reached the highest point on the trail. Sandstone boulders and outcrops littering the woodland floor were our only glimpse of the Cromhall Sandstone Formation. This stratum overlies the Llanelly Formation and represents the youngest rocks seen in the area. From here we descended to the Biblins where the gorge widened as a level grassy ribbon around the river meander. In winter this area is prone to flooding and in the summer is home to the Biblins Adventure Centre and campsite. Leaving behind the Cromhall and Llanelly Formations and the Gully Oolite, here we had descended into the underlying and older Barry Island Limestone (Lower Dolomite). This stratum occurred as steep and towering tree covered cliffs along the Biblins' northern edge. Hidden in the trees, Jim showed us an irregularly shaped tufa deposit that originated from a small carbonate rich spring, called the Dropping Wells, which drained from the limestone above. Precipitated carbonate from the spring water has encrusted accumulating mosses growing on the rock face to create the tufa. We had lunch on the grassy riverside looking over to Lady Park Wood on the south side of the river.

3. Wye Valley Walk and southern slopes of Little Doward



Barry Island Limestone

After lunch, we followed part of the long distance Wye Valley Walk west then north around the base of the Doward Hills and below the Seven Sisters. The steep gorge walls and trees quickly returned as we left the Biblins and followed the path with the river immediately to our left. In the trees, we could see the Barry Island Limestone in steep walls forming the northern side of the gorge. Crossing the remains of inclined planes leading to the river and a boundary wall, revealed that we were walking through a former quarry and into the grounds of the estate once owned by MP Richard Blakemore. The Barry Island Limestone was historically worked for various uses including as a building stone, as mortar, plaster and limewash, and burnt to form quicklime used to sweeten soils and for iron making. The quarried limestone was transported on rails via the former incline to waiting boats before being shipped off along the Wye. Abundant timber for charcoal was used to fuel lime kilns to make slaked lime, as at the Little Doward Lime Kiln which we visited on our route. Lime kilns were once a very common feature along the Wye Valley during the 18th and 19th Centuries. ►

Little Doward Lime Kiln

MP Richard Blakemore enclosed the land on the southern side of Little Doward, identified as Deer Park in 1833, and started reshaping it into picturesque paths, carriage rides, follies and points of interest. In particular, the paths and rides were designed to follow crags that emphasised the scale of the local geology to impress visitors and guests. This included dressing up natural caverns and employing people to act as hermits living in them.

Shortly after crossing the estate boundary, we ascended the wooded, southern steep slopes of Little Doward. After a few hundred metres we reached an exposure known as the 'Quartz Conglomerate Cliff'. As the name suggests, the exposure comprised cyclic beds of fine to coarse conglomerate with inter-beds of cross-bedded coarse sandstone belonging to the Huntsman Hill Conglomerate. These Upper Devonian rocks were the oldest strata we saw on the trail. The coarse conglomerate layers were deposited following flash floods when the river's energy was at its highest, with the sandier deposits being placed under lower energy conditions. The regional dip of these beds and overlying strata are a result of tectonic forces rippling the bedrock into folds and basins following the Variscan (or Hercynian) Orogeny. This includes the Forest of Dean Basin located to the east.

Huntsman Hill Conglomerate

Walking east and ascending from the Quartz Conglomerate Cliff, we passed progressively younger exposures belonging to the Tintern Sandstone and back to the Barry Island Limestone. Along the way, we passed 'Lower Dolomite Cliff' where the Wye had carved and worn the Barry Island Limestone as it cut through the landscape in the past. Continuing west, we came to the lower part of the Iron Age fort that forms the summit to Little Doward. Here Jim showed us an example of a limestone pavement within the Gully Oolite which glaciers had worn smooth, possibly during the Anglian Glacial period. The Community Earth Heritage Champions have had to work hard to keep the pavement clear of vegetation. Water-worn fissures, or grykes, have cut through the pavement splitting it into blocks, or clints. On the surface, coral traces hint at this stratum's origins as a coral reef within a warm tropical sea during the Lower Carboniferous *(see front cover photo).*

4. King Arthur's Cave

Heading east along wooded paths and past water-worn limestone cliffs, our last stop was King Arthur's Cave. A short sharp incline brought us to the caves, which form three sizeable caverns carved out of the Gully Oolite. The caves are amongst many examples in the area, which, along with the water-worn cliffs are a testament to the river having cut down through the landscape in the past, dissolving and smoothing the limestone. The name King Arthur's Cave was only conjured up to attract tourists.

Historically, several archaeological digs have been undertaken at the cave, the earliest by Rev. W. S. Symonds in June 1871. This dig was very much a case of gettting as much stuff out as possible without sifting through it. The result was to create a large spoil mound with a steep incline at the front of the caves. Subsequent digs went through the spoil and unearthed many interesting archaeological finds ►

King Arthur's Cave

that have since been scattered between various museums. The last investigations were undertaken during the 1990s. Findings yielded evidence of human settlement of the caves going back 25,000 years to the Late Palaeolithic. Ash from two hearths near the cave entrance has been dated to around 12,120 years ago. The original Symonds investigation also unearthed remains from two burials dating to the Romano-British Period. Many mammal bones were also excavated during the digs, which indicate historic changes in climatic conditions. These include woolly mammoth, woolly rhinoceros and cave bear which would have tolerated colder, glacial conditions, and red deer, horse and hyena that indicate warmer, interglacial periods with the development of forests. We had a quick look inside the caves, which clearly show their water worn origins. However, today there is little evidence of their use during prehistoric times.

From the caves, we followed a wooded path north-east and back to the car park and the camp site shop, where we enjoyed an ice cream before heading home.

I would like to thank Jim for a very enjoyable and full day. More information relating to Little Doward and King Arthur's Cave Community Earth Heritage Champions sites can be found on the Champions website: ehtchampions.org.uk The Champions project leaflets and information panels are all on the Champions website.

For Lord's Wood Quarry see also: https://deeptime.voyage/resources/lordswood/ ■

Printed leaflets and guides:

• Herefordshire & Worcestershire Earth Heritage Trust Landscape and Geology Trail Leaflet - Explore Wye Gorge.
• Herefordshire & Worcestershire Earth Heritage Trust, Community Earth Heritage Champions Project Guide - Little Doward.
• Herefordshire & Worcestershire Earth Heritage Trust, Community Earth Heritage Champions Project Guide - King Arthur's Cave and Quarry.

Andy Harrison

Birmingham's Erratic Boulders: Heritage of the Ice Age

Erratic Boulder Trail Series - completed!

A significant part of the Erratics Project has been to research and develop eight walking and cycling trails which link into manageable groups the erratic boulders of SW Birmingham and Bromsgrove. I'm pleased to report that all eight trails are now completed, printed and available to download from the Erratics Project website.

Trail 6, for cyclists and walkers 'Around Bromsgrove and Tardebigge' was launched at the Bromsgrove Carnival in July, and Trail 8, the 'Illey Wilderness Trail' was given a pre-launch airing as the basis of the BCGS field trip on Saturday 22nd July. In spite of heavy rain and a discouraging forecast for the day ►

Huge Arenig ash boulder at Locality 6 on Trail 8

we were delighted to welcome a total of 13 people at this event. Undaunted by the weather, as the guide for the event, I was pleased that all participants stayed the course of this long and sometimes challenging walk. If you missed it, please come and join us for another walk on the trail at the official Erratics Project launch on 12 August, 10.30 - 2.30 starting from Woodgate Valley Country Park. For full details and booking via Eventbrite (essential) please click this link. The Illey Wilderness Trail holds a special place for BCGS, as the only trail in the series which is based largely in the Metropolitan Borough of Dudley.

With all eight trail leaflets completed, maybe it is time to start looking towards the Black Country for the next episode: how many more Arenig boulders from the Anglian Ice Advance are to be found in the Black Country? (There is one in West Park - see p.7.) Where is the dividing line south of which no Devensian erratics have been found? Many boulders were saved (i.e. in West Park and Wightwick Manor) during the late 19th and early 20th centuries, just as they were in Birmingham, but are they known about today? How many more can be brought to the attention of the public?

Through the current Erratics Project and particularly through the records saved by H.W. Crosskey and the Erratic Blocks Committee (see Newsletter 279), it has become evident how important the Midlands were to the history of glaciology. It is surely time to celebrate this legacy in 'Devensian' territory, as well as in the mainly 'Anglian' territory of the current project. ■

Julie Schroder (BCGS rep. Erratics Project steering group)

For more information:
https://erraticsproject.org/ https://www.facebook.com/birminghamerratics
https://www.twitter.com/erraticsproject https://www.instagram.com/erraticsproject

Mike's Musings No. 46

Not all Volcanoes go Bang!

We are all familiar with the subject of vulcanicity. Hardly a week passes without some story of a mountain somewhere blowing its top and creating mayhem for those unfortunate to be living nearby. Even the less effusive style of volcanic activity can leave a trail of disruption in its wake - ash clouds interfering with aviation for instance. But geologists also recognise another variation on the 'volcano' theme which doesn't involve ash, lava or 'fireworks', but which nevertheless can be more than just a nuisance to mankind, and which similarly involves the expulsion of fluids (liquid or gas) from a state of containment under pressure.

In the sedimentary world the fluids in question are normally water-based: groundwater mixed with mud or sometimes sand, but cold rather than hot or incandescent. We see structures indicative of fluid escape in the sedimentological record which are usually on the small scale, but which can very occasionally reach 'epic' proportions. Indeed such structures are not uncommon in parts of the geological record, and usually suggest a rapid rate of sedimentation such that entrained fluid doesn't ►

get quietly displaced but instead builds up within the sediment until a critical threshold of internal pore fluid pressure is reached. This results in a rapid, forceful 'outburst' breaking through the sediment surface.

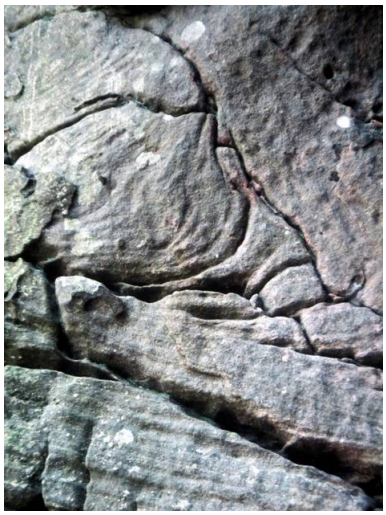


Figure 1. De-watering structure in Thirlestane Sandstone at Arbigland, Solway Coast

We can create similar conditions on a sandy beach at the seaside when we tread the sand surface, causing the sand grains to rearrange themselves beneath our feet into a denser form of packing, thereby releasing entrapped seawater. As a result we find ourselves sinking a little into the sand. This becomes a serious situation when the sediment is 'quick' or so highly charged with fluid that we find ourselves sinking in to a dangerous degree! Some areas around our coastline are notorious for such 'quicksands'. Similar conditions can build up in boggy or marshy environments: we have perhaps all heard of the fictional Grimpen Mire on Dartmoor in the well-known Sherlock Holmes tale 'The Hound of the Baskervilles' - based on the all too real situation of Fox Tor mires.

Figure 2. De-watering structure in Ash Fell Sandstone, Ash Fell, Ravenstonedale, Cumbria

Where this is all leading to is the recognition of such environments and processes in the sedimentary record. Undisturbed sediments build up an orderly laminated or layered series of deposits. But if disturbed, either by the small-scale action of local loading or by the more impressive shaking of the ground by seismic activity, the organised lamination will be disrupted, as in two examples seen in Figs. 1 and 2.

Slightly more impressive are instances of so-called sand or mud 'volcanoes'. Two such examples I have come across occur in Jurassic and Carboniferous sedimentary sequences respectively. Perhaps the best known are to be found on the foreshore at Kilve, Somerset (accessible by a short walk from a road that ends with a car park near an old oil retort house). They occur on the wave-cut platform (GR: ST 1505 4462), readily accessible at low to medium tides, in the familiar, gently dipping, alternating limestone / mudstone couplets of the Lower Lias. Four such 'volcanoes' can be seen in a small area of beach in Fig. 3. Seen at closer quarters, each 'volcano' can be seen to consist of a sub-circular fringe of upturned limestone / mudstone beds with a central core of completely disrupted sediment, in some cases with a covering of tufa still preserved (Fig. 4). In other cases the tufa cap has been eroded to reveal the core of the structure (Fig. 5). In two of the 'volcanoes' a mud-breccia has also been formed containing clasts of apparently foreign sediment and disarticulated crinoids and microfossils. One of the 'volcanoes' actually consists of a 'nest of three', possibly interfering, structures (Fig. 6). Some evidence for the contemporary release of methane has been reported from isotopic analysis of the tufa deposits *(see G.D Price et. al., Proceedings of the Geologists' Association #119, 2008, p.193-201)*. ►

Figure 3. General view of several mounds on the foreshore

Figure 4. Close up of one mound with tufa cap preserved

Figure 5. Single mound with part of the tufa cap and core sediment eroded

The other example of such activity comes from a series of localities along the Clare coast of Ireland between Loop Head and Fisher Street, a distance of about 40 miles. They occur in sandy sediments deposited in a mighty river delta (something on the scale of the modern Mississippi) during Namurian, mid-Carboniferous times *(see W. D. Gill & P. H. Kuenen, Quarterly Journal of the Geological Society of London #113, 1957, p.441-460)*. The sediments are broadly described as being turbiditic in character, with the development at particular horizons of slump sheets or channels in which many sand 'volcanoes' developed. Five principal locations are described, not all of which lend themselves to easy access - I visited just two of them. The precise disposition, character and number of such structures varies greatly from one place to the next, the largest 'volcano' having a diameter of about 50 feet, but more typically they range between just 1 and 4 feet in diameter.

Figure 6. 'Nest' of three, interfering? mounds

Figure 7. Disturbed / slumped sediments in the Central Clare Group turbidites (Namurian)

At Fisher Street there is plenty of evidence of sedimentary disturbance, with slump-bedding to the fore (Fig. 7), but with only one volcano-like structure being particularly obvious to me (Fig. 8)! Better examples, and plenty of them (Fig. 9), are present on the foreshore at a location called Freagh Castle by Gill and Kuenen, accessible via a none-too-obvious motorable track to the top of the cliffs, in this case relatively low but with limited parking at the end! This is off the Ard Freagh coastal loop road north of Spanish Point. Several volcano-like mounds litter the uneven wave-cut platform, and show clearly the restricted interval of disturbed sediment (Fig. 10), some with well-defined central 'vents' (Fig. 11). ►

Figure 8. 'Sand Volcano' in turbidite sediments of the Central Clare Group (Namurian)

Whilst ancient examples appear to be relatively unreported in the geological literature, mud volcanoes are alarmingly common in the modern world. The Wikipedia article on the subject provides many examples from all continents except Antarctica (no doubt due to the ice cover). It even mentions the possibility of examples on Mars. Nor are such examples confined to the small dimensions I have illustrated from the geological past. Wikipedia tells us that they can range up to 700 metres in height and 10 kilometres in width!

Figure 9. General view looking south across wave-cut platform: four 'volcano-mounds' stand out

Mud volcanoes are particularly abundant in orogenic belts and subduction zones (i.e. tectonically active regions) including 'genuinely' volcanically active regions and areas where hydrocarbons (oil and gas) are present, such as Iran and Azerbaijan; indeed they are often associated with the release of methane. In other parts of the world methane is held in the ground in the form of clathrate hydrates, threatening to become destabilised by changing climatic conditions and making the problems of global warming still worse: a so-called 'feedback loop' (methane being an even more potent greenhouse gas than carbon dioxide).

One particular disaster demonstrates that we meddle with such ground conditions at our peril. The Sidoarjo mud flow in Indonesia has been actively pouring out mud since it was disturbed by drilling for oil in 2006 *(see YouTube)*. Whole villages have been lost beneath a tide of mud discharged from the well, and it took several years to bring the problem under some level of control, but still it spews out more mud requiring containment. In fairness, I should also add that the company concerned attributes blame to an earthquake, and they may even have a point. The 1945 Makran earthquake (offshore, some 100km south of Karachi) apparently triggered a mud volcano which led to the formation of four new small islands in much the same way that Surtsey, Anak Krakatoa, or many other islands (recall my article on Graham Island: *Newsletter 231, June 2015*) have been born by 'genuine' volcanic action.

So, if you do happen to visit Kilve or the Clare coast to witness these seemingly innocent features from the past, just bear in mind their modern, much more fearsome, counterparts. ■

Mike Allen

Figure 10. 'Sand volcano' seen furthest in Fig.9...

Figure 11. ...revealing the central 'vent'