Newsletter No. 282
December 2023

Copy date for the next Newsletter is Thursday 1 February

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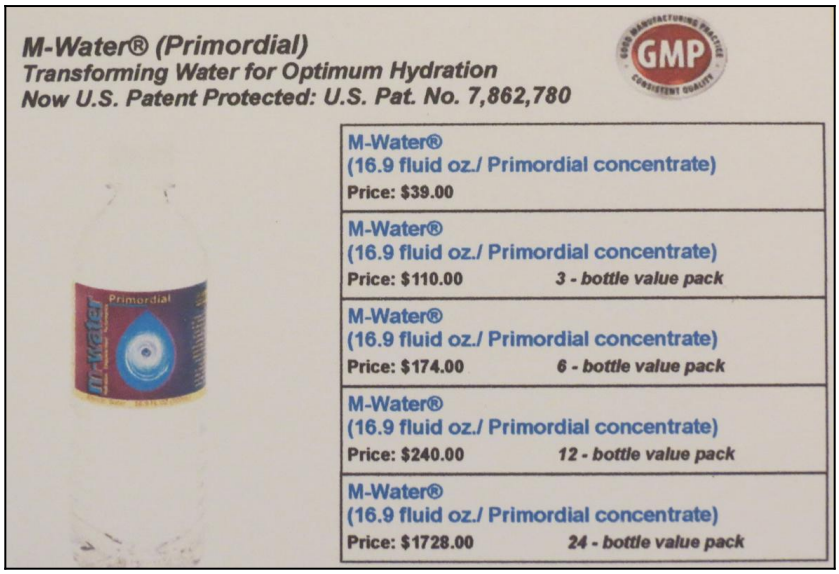

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For enquiries about field and geoconservation meetings please contact the Field Secretary. To submit items for the Newsletter please contact the Newsletter Editor. **For all other business and enquiries please contact the Honorary Secretary.** For 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.

Monday 11 December *(Indoor Meeting, 7.00 for 7.30 start):* Members' Evening and Christmas Social. This is our annual chance for members to share their geological experiences in a sociable atmosphere with a Christmas buffet provided by the Society.

Saturday 13 January 2024 *(Geoconservation Day and Winter Walk):* 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 9.45 for 10.00 (Grid ref: SO 974 893), nearest PC: B69 1NH. Directions: from Birmingham New Road (A4123) turn left on to Tower Road if coming from Birmingham, right if coming from Wolverhampton. Just after Bury Hill park, turn left onto St Brades Close and park. Wear old clothes, waterproofs and stout footwear, and bring gloves. Tools are provided but feel free to bring your own. Bring a packed lunch. Hot drinks provided. We undertake geoconservation work up to 1.00/1.30. After lunch we will take a **winter walk on the Rowley Hills**, finishing around 2.00/2.30.

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.

Saturday 10 February *(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 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.

Saturday 9 March 2024 *(Geoconservation Day):* **Saltwells National Nature Reserve.** TBC whether these works will be undertaken under the guidance of the reserve wardens or on our own. **It is therefore imperative that you inform the field secretary of your intention to attend these works.** Meet at the Nature Reserve car park (grid ref: SO933869) on Saltwells Lane, 9.45 for a 10.00 start. Wear old work clothes, waterproofs and stout footwear or wellies. Please bring gloves and garden tools: hand brushes, trowels, loppers, secateurs, forks and spades if you have them. Either bring a packed lunch or hot food can be obtained from the Saltwells Inn adjacent to the car park. Finish at 2.30.

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

Saturday 6 April *(Field Meeting):* **Castleton, Derbyshire looking at the limestones in Cave Dale and the sandstones and landslip on Mam Tor.** Led by Albert Benghiat (Shropshire Geological Society). Further Details 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

Woolhope Naturalists' Field Club - Geology Section

Friday 15 December: 'Mortimer Landscape of North Herefordshire'. Speaker: Kate Andrew.

Friday 19 January 2024: 'Martley Rock - a Victorian Gem Unearthed'. Speaker: Dr. Sue Hay.

Non-members of the Club pay £2. Visit: https://www.woolhopeclub.org.uk/meetings Friday lectures are held in the Town Hall, Hereford at 6.00. Non-members are welcome.

Teme Valley Geological Society

Monday 22 January 2024: 'The earliest Humans in the British Isles - the geological context'. Speaker: Prof. James Rose, Royal Holloway University.

Talks take place in Martley Memorial Hall at 7.30. Non-members £3. For further information email: martleypfo@gmail.com or visit: https://geo-village.eu/

Open University Geological Society, West Midlands

Saturday 16 December: Workshop - Igneous Petrology Practical Laboratory Day School.

Saturday 13 January 2024: Workshop - Sedimentary Petrology Practical Laboratory Day School.

Saturday 10 February: Workshop - Metamorphic Petrology Practical Laboratory Day School.

All workshops are led by Alan Richardson at Lickey Hills Country Park Visitor Centre School Room from 10.30 to 3.45. For more details and booking contact Alan: alanrichardson.geo@gmail.com

Manchester Geological Association

Wednesday 10 January 2024: 'Worms and Wonders: Silurian 3D Soft-Bodied Fossils'. Speaker: Dr Mark Sutton (Imperial College London).

Wednesday 24 January: 'Deformed Dirt: research on the deformation caused by glaciers and ice sheets'. Speaker: Prof Emrys Phillips (British Geological Survey).

Both talks are from 7.00 to 8.00. For more information: http://www.mangeolassoc.org.uk/ or contact lectures@mangeolassoc.org.uk

Warwickshire Geological Conservation Group

Thursday 18 January 2024, 7.30 - 9.00: 'Palma Eruption'. Speaker: Dougal Jerram.

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.

Geological Society, West Midlands Regional Group

Tuesday 9 January 2024: 'Determining the relative "value" and sustainability of the UK's in-situ dinosaur track sites'. Speaker: Dr Kirsty Edgar, University of Birmingham.

Lectures are being held at Mott MacDonald, 10 Livery St, Birmingham, B3 3NU and by Zoom. They commence at 6.00 for 6.30. For further details please contact the Group Secretary at: geolsoc_wmrg@live.co.uk Click here for website.

Shropshire Geological Society

Wednesday 13 December: 'Critical Raw Materials for the Energy Transition: Lithium'. Speaker: Kathryn Goddenough, BGS.

Wednesday 10 January 2024: 'Shrinking glaciers, dynamic proglacial response: glaciofluvial landscapes in a time of glacier retreat'. Speaker: Philip Marren, University of Chester.

Meetings commence at 7.15 for 7.30. Lectures are now being held in hybrid form, in person at the University Centre, Shrewsbury, as well as by Zoom. 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

East Midlands Geological Society

Saturday 13 January 2024: 'Celebrating the Origins of Animal Life: Building a UNESCO Global Geopark in Charnwood Forest'. Speaker: Dr Jack Matthews.

Saturday 10 February: 'Diamond Geology'. Speaker: Dr Tony Waltham.

Non-members are welcome and should register with the secretary. Meetings will be held at 6.00 in the Geography Department of Nottingham University, which is in the Sir Clive Granger Building. Further info: www.emgs.org.uk or email: secretary@emgs.org.uk

Editorial

As we come to the end of 2023 it's good to reflect on the many activities which have involved BCGS during the last year. Notable amongst these has been the Glacial Erratics Project which has involved many BCGS members in volunteer work, and towards the end of the project, in a very wet but well attended field trip in the Illey Valley! Andy has given us a full report in this issue (below). The project has now finished, but there is a strong possibility that a glacial erratic themed Black Country project may follow, and we hope this will provide another opportunity for BCGS volunteers. Andy's final field trip report for 2023 gives a comprehensive account of the trip led by Les Drinkwater around the Saltwells NNR highlighting some of the most recent finds there.

Please note all the dates for the forthcoming indoor meetings and geoconservation sessions. We look forward to - and depend on - your support in all our activities and events. We have a full programme up to the end of April. Next on the schedule is the Members' Evening on Monday 11 December which has a full programme of short items for your entertainment - and the buffet to add some Christmas festivity!

Please don't forget that we are still looking for more of you to serve on the BCGS committee, and especially for someone to take over from Alan Clewlow as Meetings Secretary. We thank him for keeping things going until we can find someone to take over.

Finally, in this issue we have a suitably light-hearted Musing from Mike for the festive season. Enjoy! Happy Christmas to you all. ■

Julie Schroder

Field Meeting Reports

Saturday 22 July *(Field Visit):* Glacial Boulder - Trail 8: The Illey Wilderness Trail. Led by Julie Schroder.

The Background

We met Julie and John on a very wet and mild day along with some other members of the Glacial Erratic Boulders team at Woodgate Valley Country Park at 11.00.

The project 'Birmingham's Erratic Boulders: Heritage of the Ice Age' was sparked from the interest of former BCGS member, Roland Kedge, who had found and noted numerous boulders in and around South Birmingham. Julie became interested following a field trip around Wolverhampton's erratic boulders in 2010, but before this, former BCGS Chairman Alan Cutler had requested that Society members report any boulders known to them in 2006. Jumping to the summer of 2021, Julie found herself representing the BCGS on the project steering group which had successfully won the backing of Heritage Lottery Funding, under the lead of Professor Ian Fairchild (Emeritus Professor, University of Birmingham School of Geography, Earth and Environmental Sciences, and current Chair, Herefordshire and Worcestershire Earth Heritage Trust).

Eight trails have been produced during the project: 5 on foot, 1 cycle trail, and 2 trails with cycle and walking options, and there is an additional 'Accessibility Leaflet': ►

- Trail 1: The Roland Kedge Trail - starts in Northfield and goes to Birmingham University
- Trail 2: The Louis Barrow Trail - around the Bournville area and Cadbury's factory
- Trail 3: Around Kings Norton - Kings Norton station, Kings Norton and Masefield Square
- Trail 4: The Urban Fringe Trail - a short walk around Woodgate Valley Country Park
- Trail 5: Three Hills Challenge - around Frankley (cycle and walking trails)
- Trail 6: Around Bromsgrove and Tardebigge - Cycle Route
- Trail 7: Boulders by Bike - a Cycle Route around Birmingham
- Trail 8: Illey Wilderness Trail - a long walk around Illey, from Woodgate Valley Country Park

On 12 August 2023 Trails 4 and 8 were officially launched with walks starting from a stand at Woodgate Valley Country Park.

The Trail route and Landscape Setting

By the time of our field trip (which pre-dated the launch), 7 trails were in circulation and Trail 8 was at the printers. Our event followed Trail 8, starting from Woodgate Valley CP on Birmingham's western fringe adjacent to the M5 motorway. The trail continues westwards along the Woodgate urban fringe, before passing over the M5 motorway into the rural lowlands forming the Illey Valley, then southwards through Illey Village. At its southern limit, the trail performs a loop before returning northwards, crossing the M5 once more, and returning via the Woodgate Valley CP extension before coming back to the main country park. The trail covers around 5¼ miles and takes in 7 numbered boulder sites with additional stops to look at the local geological context.

During the 19th century, it was realised that the glacial boulders found around Birmingham were different from the granite ones being found in the northern part of the Black Country and further north, which came from Scotland and the Lake District. The Birmingham boulders were mostly volcanic tuffs that resembled the rocks forming the Arenig mountains in North Wales, roughly 80 miles to the west. The granite boulders to the north, it was realised, were placed during the last (Devensian) ice advance that came as far south as the northern West Midlands. The Arenig boulders resulted from a much earlier ice advance, most likely the Anglian, around 450,000 years ago as ice moved eastwards from the Welsh ice cap.

The view across Trail 8 to the Clent Hills on a nice day

The Woodgate area is situated on relatively flat and elevated ground at roughly 190m with ground elevations sloping gently away towards the north-east at Woodgate Valley Country Park, and towards the west into the Illey Valley. Walking west from Woodgate Valley Country Park and along the urbanised Lye Close Lane, we soon passed over the regional watershed. Here rainfall would flow westwards as surface water via daylighting streams into the Illey Valley, then via the River Illey northwards to the River Stour, then west and south into the Severn at Stourport, and eventually out to the Bristol Channel. Many streams rise on the western scarp slopes leading into the Illey Valley, making it very wet and muddy. ►

The Illey Valley boulders are incredibly hard and formed from volcanic activity around 450Ma, during the Ordovician, when the UK was situated approximately 60° south of the equator and formed part of the micro-continent of Avalonia. Their composition and character make these boulders very different from the granite glacial erratics found further north. These boulders comprise very fine, grey and occasionally reddish volcanic felsic tuffs belonging to the Arenig Series, which the British Geological Survey (BGS) defines as "a mixed suite of basalts, rhyolites and sedimentary rocks". These rocks may also show layering or flow banding and have been interpreted as representing pyroclastic flow and fall deposits. Inclusions representing earlier country rock or products from previous eruptions can also be found within these boulders as small clasts, which may weather out to leave a depression in the boulder. During the 19th century, the local Woodgate area was home to thousands of cottage nail makers. It is understood that the nail makers would sometimes use glacial erratics as anvils because they are so hard.

Locality 1 - a boundary stone with a bench mark

Crossing over the M5 and down a green lane, the first boulder we came to, at Locality 1, formed a stepping stone to a stile and was used as a boundary stone. On the top there is a small, carved indentation representing an Ordnance Survey bench mark. Due to the rock's hardness, they were unable to carve the traditional line and arrow and so had to make do with an indented depression. Often this would have been accompanied by a nail or metal disc. At our first location a registered spot height of 555.5 ft (or roughly 169.3m) AOD has been recorded. Similar volcanic tuff boulders to this are also seen at Locality 2 (another boundary/bench mark stone), 3 (The Stepping Stone), 5 (Illey Pastures) and 6 (The Warstone?).

At Locality 4 (Lowlands), we came across a very different erratic boulder that turned out to be dolerite (or microgabbro) from the Rowley Hills. Like the Arenig erratics, it is anticipated that this boulder arrived by the same ice movements. The last Locality (7) at Broadhidley Wood, is another very different erratic boulder from those seen previously. This one is a quartz boulder produced from hydrothermal deposition within fractured bedrock. Large quartz veins are common to the North Wales area and the Arenig Mountains, which is where this boulder is likely to have originated. Quartz veining on a smaller scale could also be seen in some of the other volcanic erratic boulders.

The Geological Setting

Locally, Woodgate and the Country Park are underlain with superficial glacial till deposits, or in modern nomenclature 'diamicton' which also extends to just west of the M5 motorway. According to the BGS, these deposits comprise "unsorted and unstratified drift, generally overconsolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier. It consists of a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape". These deposits were formerly known as 'boulder clay'. Such deposits are very likely to have contained the glacial erratics seen along the various trails. The Illey Valley itself is predominantly devoid of superficial deposits apart from some shallow hilly clay-wash and soil creep, or head, on the steeper valley slopes.

The local bedrock underlying the area generally includes sandstone and mudstone strata belonging to the Alveley Member (part of the Salop Formation) and the underlying Halesowen Formation. The ►

BGS describes the younger Alveley Member as "red mudstone and sandstone, fine to medium-grained with thin 'Spirorbis' limestone beds and pedogenic limestone". This stratum generally underlies the area to the east of the M5 motorway with a small section also extending partly westwards beyond the M5 and Woodgate.

Locality 6 - The Warstone? - No respite from the rain!

The older Halesowen Formation is described as "grey-green, micaceous sandstone (litharenite), and grey-green mudstone, with thin coals and limestone beds known as the 'Spirorbis' limestone, with local intraformational conglomerate, strata may be reddened, locally". This stratum generally underlies the area to the west of the M5 and the Illey Valley. Together, the local topography and interbedded sandstone and mudstone nature of this stratum is likely to account for the various streams seen daylighting on the eastern slopes of the Illey Valley and feeding westwards into the River Illey.

Both the Alveley Member and the Halesowen Formation date to the late Carboniferous when tectonic forces from the south were causing the local landscape to rise. The consequence was to form expansive low-lying flood plains over which various rivers and fluvial channels meandered prior to the Variscan Orogeny. Not only did this event, and the earlier Caledonian Orogeny, result in deforming the landscape, it also established a network of roughly north to south and east to west trending faults that have carved the modern landscape up into a series of fault-bounded blocks. Therefore, locally in the modern landscape, the older Halesowen Formation has been faulted up against the younger Alveley Formation. The River Illey itself appears to exploit such a fault as it flows from south to north.

Broadhidley Wood boulder before...

Exposures showing the Halesowen Formation sandstone and, in places, washed out glacial gravels can be seen along the trail in stream beds and roadside cuttings at Locality 2 - Coopers Wood, 4 - Lowlands and Illey House Farm.

...and after cleaning

The Friends Group for Broadhidley Wood and other local people are very proud of their quartz glacial erratic boulder, which has added a nice touch to their rural green space. According to Julie, many of the boulders they came across on this project were overgrown or lost and neglected like the one in Broadhidley Wood. Therefore, it is hoped that the Glacial Erratics Project will bring these boulders to the public attention and ensure they will be cared for and conserved in the future. To this end, it is hoped that the public will champion the glacial erratics around Birmingham.

Whilst Julie and John take a break from this project as it comes to an end, it is understood that rumblings are being made for a similar project across the Black Country. I would like to congratulate Julie and John on their hard work and thank them very much for an enjoyable day, despite the weather. For more information on the project's origins, members are directed to newsletters: ►

- Black Country Geological Society Newsletter No. 258, December 2019.
- Black Country Geological Society Newsletter No. 267, June 2021, with project up-dates in most BCGS Newsletters from then until issue No. 282, October 2023.
- Birmingham's Erratic Boulders website (https://erraticsproject.org/).

Our field trip followed: Glacial Boulder Trail 8, 'Illey Wilderness Trail' - Woodgate Valley Country Park to Illey Pastures.

- All 8 trail leaflets are downloadable from the BCGS website or the Erratics Project website: https://erraticsproject.org/
- Printed copies of the leaflets can be obtained at BCGS meetings, or from the H&W Earth heritage Trust. Contact them at: eht@worc.ac.uk

Wednesday 16 August: *(Evening Field Visit):* Saltwells NNR. Led by Les Drinkwater.

We met Les on a mild and sunny evening at the Nature Reserve car park on Saltwells Lane to start at 6.30. The aim was to look at various new discoveries that have been made along the tub line to Brewins cutting in recent years following fresh excavation works.

Between Highbridge Road and Brewins cutting, the wardens and friends group have recently been working hard to clear vegetation and open up the tub line to make it a more pleasant place to walk and to benefit wildlife. This has included hiring a mini excavator, using Natural England funding, to remove spoil and form fresh exposures in three areas along the tub line leading to Brewins Cutting. In the wardens' hut education room, Les initially showed us rock and fossil specimens recently found in Doultons Claypit and along the tub line exposures.

Specimens at the Wardens' Base, Saltwells NNR

Lepidodendron Stigmaria

First were plant remains from the Coal Measures strata in Doultons Claypit. These included the Stigmaria, or root, from a *Lepidodendron* preserved in ironstone and multiple fronded leaves from a plant called *Chordites*, preserved in sandstone *(see photos right and below)*. The *Lepidodendron* would have grown to between 30m and 40m in height and would have been a common site within the forested Middle Carboniferous swamps. Complete specimens of these and other Carboniferous plants are extremely rare and only parts are generally encountered, which include trunk, leaves, roots or fruits that all have different names. The ironstone preservation of the Stigmaria suggests it formed in an anaerobic swamp where the organic plant remains acted as a nucleus for the iron to precipitate around. The sandstone containing the *Chordites* leaves indicates deposition in a more fluvial environment where the plant was quickly inundated with sediment to preserve the detail seen in the fossil.

The next specimen was dolerite, or microgabbro, from the intrusion found along the tub line and towards Brewins Cutting in the Dudley No. 2 Canal. This rock was intruded towards the end of the Carboniferous, during tectonic uplift from the Variscan Orogeny and represents one of several such bodies intruded at the time. Others include the Rowley Hills, Barrow Hill and in Shropshire, Brown Clee and Titterstone Clee hills. This microgabbro specimen also included the sandstone country rock into ►

Chordites

which it had been intruded, showing clearly the contact between the two rock types. The intrusion at the reserve has been found to be much coarser (medium) grained towards its southern end and finer towards the northern (Brewins Cutting) end. This indicates a difference in cooling rates along the intrusion from north to south.

The third specimen was greenish, fine-grained shale also from the tub line exposure along from Doultons Claypit. This muddy rock contained three different small articulate brachiopod species along with coral and trilobite fragments. Belonging to the Silurian Ludlow Shale, from around 420Ma-425Ma, this tub line exposure connects the Saltwells reserve to Wren's Nest, where it occurs in the Snake Pit (Geosite 1 in the Wren's Nest geology trail), in contact with the underlying Wenlock limestone. However, between Wren's Nest and Saltwells around 15m of the Ludlow Shale stratum is missing. The stratum formed under low energy marine conditions where fine mud could settle out and brachiopods could live quite happily buried in the muddy substrate. These species are known as 'articulate' because the two valves had teeth and hinges to hold them together.

Sitting stratigraphically above the Ludlow Shale, is the Downton Castle Sandstone Formation (aka Gornal Grit), which is seen in the newly created exposures along the tub line up to the Brewins Cutting on Dudley No. 2 Canal. We were shown a sample of this stratum that contained a different variety of brachiopod called *Lingula*. Unlike those in the Ludlow shale, these are inarticulate. This means they have muscles holding together the two shell valves with a long foot, or pedicle, protruding from the rear. This pedicle would have enabled the animal to pull itself down into the sandy substrate. Although previously believed to have been present at the Saltwells reserve, their presence within the rocks here has only very recently been confirmed. *Lingula* dates back to the Cambrian and occurs throughout the fossil record to the present day. Indeed, the Japanese consider it a delicacy. However, their presence throughout the fossil record unfortunately means that they are not a good species to use for dating rocks.

The presence of *Lingula* combined with the nature of the Downton Castle Sandstone provides valuable information about the potential environmental conditions at the very end of the Silurian period. They occur at a time when seas were becoming shallower and plants were beginning to colonise dry land. However, there is some debate as to whether this stratum represents a fluvial deposit or a marine sand bar. Cross-bedded sandstones recorded in layers overlying those containing the *Lingula* fossils suggest that the latter marine sand bar option was most likely.

There is a trace fossil that supports the marine sand bar idea and cyclic submerging and exposure from the sea. The evidence can be seen as circular bumps on the sandstone surface and faint tubular structures. These are ancient U-shaped worm burrows are like those seen on beaches today created by ragworms and lugworms. The sediment forming the tube is harder than the surrounding rock, which has ►

Fossil worm burrows

weathered away to give the bumps seen. Unfortunately, the soft bodied worm and upper parts of the burrow which would have been seen at the surface, have not been preserved.

The Field Trip Route

From the wardens' base, we walked along the tub line route past Doultons Claypit and the original tub line exposure, crossing Highbridge Road and continuing the route all the way up to the Dudley No. 2 Canal and Brewins Cutting.

Stopping to look over the Doultons Claypit, Les discussed its history and the coal and clay extracted from here in the 1800s, which was used to make clay pipes for sewers. The clay was extracted and loaded onto tubs pulled along tracks along the tub line before being loaded onto barges at the Dudley No. 2 Canal and shipped off to the Doulton brick and pipe works at Bumble Hole, near Rowley. Better sewerage was required in response to a cholera and typhoid epidemic that broke out in the mid to late 1800s. The production used salt glazing to give brown earthenware sewer pipes, which itself caused bad pollution and health problems and was banned by the 1970s/80s. Saltware pipes were then replaced with concrete and in more recent times, plastic pipes have been employed.

Continuing along the tub line to the Ludlow Shale exposure, Les explained about the geoconservation works that had gone on at this location. Partial cleaning shows the difference between an exposure that has and has not been subjected to geoconservation works. Despite being described as a shale the exposure here is of olive green well-bedded sandstone that has an apparent dip towards the south and an actual dip towards the west. This is due to these rocks belonging to the left hand limb of the Netherton anticline, the plunge of which is to the south in accordance with the apparent dip. These rocks contain brachiopod fossils and calcareous nodules that formed during later diagenesis.

New tub line Exposure

Folding is likely to have commenced during the Caledonian Orogeny at the end of the Silurian period when the area lay on the edge of a shallow tropical sea with the Laurentian continent to the north. Later folding and faulting is likely to have occurred during the Variscan Orogeny at the end of the Carboniferous. The shallow seas at the end of the Silurian were a lot muddier and murkier than the shallow tropical and clearer marine conditions that gave rise to the earlier Wenlock Limestone during the mid-Silurian and seen at Wren's Nest. Environmental conditions at the end of the Silurian are more consistent with shallow shoreline conditions leading to more terrestrial ones. The first plants would have started to colonise the land but were little more than 2cm to 3cm tall 'tuning forks' in appearance.

Crossing Highbridge Road, we came to the three more recent exposures along the tub line that have been created through hiring an excavator and voluntary people-power from various groups including the Friends of Saltwells NNR and the BCGS. The exposures generally exhibit orange-brown sandstone layers belonging to the Downton Castle Sandstone Formation. They show the same southerly dip as the underlying Ludlow Shale and the layers are thinner towards the top and become thicker towards the base. The Downton Castle Sandstone Formation marks a further transition away from a marine ►

environment to a more terrestrial one with sand being deposited either within river meanders or, more likely, as sand bars within an intertidal zone.

microgabbro streamer in sandstone bedrock

The new exposures have also revealed that the microgabbro intrusion, prominent towards the Dudley No. 2 Canal and Brewins cutting, extends much further south than originally thought. The molten rock has pushed out streamers along the sandstone bedding planes to form thin sills that, due to exposure at the surface, are breaking down and turning reddish brown because of their iron content. Where the molten rock has contacted the sandstone it has baked it hard. Tectonic movements have created faults within the host sandstone rock which can be seen when trying to line up the bedding. At one such fault, a thin microgabbro streamer can be seen following the sandstone bed and performing a step to continue following the same bed on the other side of the fault. This suggests that the faulting occurred during earlier Caledonian Orogeny earth movements with the microgabbro being intruded during the Variscan Orogeny.

The main microgabbro mass can be seen at the northern end of the tub line. As we reached this end, Les explained about how the laden tubs from Doultons Claypit were offloaded into barges floating on the now infilled basin adjacent to the canal. When constructing the canal and original Brewins Tunnel, the microgabbro posed a real headache and slowed progress considerably. The original Brewins tunnel was only wide enough to take one barge at a time, which posed problems when the canals became busier later on. Consequently, the tunnel was demolished to make way for the wider cutting seen today that helped to speed up the flow of barge traffic.

Walking along the cutting and beneath Brewins Bridge, we stopped at the well known exposure where the reddish Silurian Downton Castle Sandstone meets overlying bluish grey Carboniferous beds. The unconformable contact between them undulates. The Carboniferous beds comprise coarse and angular sandstone grains containing gravel, cobbles, and occasional coal fragments that represent a roughly 100 million years time gap. Together, the succession shows a transition from a shallow marine shoreline at the end of the Silurian to an erosional surface in the Carboniferous with rivers cutting down into the earlier landscape. Later the rivers flooded that landscape producing the swamps and deltas under which the Coal Measures strata were deposited. The unconformable contact and time gap between, represents the missing Devonian Period when the region formed part of a terrestrial landscape following the Caledonian Orogeny. The eroded material from this landscape can be seen today in Scotland and South Wales as the Old Red Sandstone.

With the sun setting, Les finished the visit at the Brewins cutting exposure and we walked back along the tub line to the wardens' base. I would like to thank Les for a very interesting evening and update to the recent findings coming out of the reserve. Judging by the vegetation that had grown up around the Brewins Cutting exposures, it was clear what our next geoconservation day at the Reserve would involve. ■

Andy Harrison

Mike's Musings No. 48

Waterblurbs - a severe case of marketing waffle

As I suggested in my last piece, the bottled-water industry has a promising future. The average annual consumption per person in the UK rose from just 0.5 litres in 1980 to 16 litres in 1988 and 31 litres in 2010. This trend has continued apace, rising further to a peak of around 50 litres in 2021 and again in 2023, with a slight wobble in 2022. UK consumption is far less than many of our continental neighbours (about one third of the EU average, Italy leading the way with almost 250 litres) and a good many other nations around the world, Singapore taking pole position, guzzling a whopping 1129 litres each per year! As someone who is quite happy with water from the tap, I find these figures remarkable. People moan about the cost of living and their water bills, but are quite happy to spend exorbitantly on water from an industry less tightly regulated than water companies.

It is also worth noting, in an age when there is so much concern for the environment and the heavy demand we, the human species, place on it in so many ways, that for every litre of bottled water we use, 1.32 litres of water have apparently been used to produce it in the first place. Then there is the further issue of all the plastic the industry requires to sustain it, and the extra environmental cost of production, transport, delivery to the point of purchase and ultimate disposal.

How has this situation come about? Surely it can't be down to the marketing moguls who smother the labels with ludicrous prose to convince us that the contents are so much better for our health and well-being. Whilst researching my last piece, and indeed for many years previously, I have gathered a number of these labels, mainly for the analytical information detailing the principal constituents, but my eyes were soon drawn to the lyrical descriptions that accompanied them.

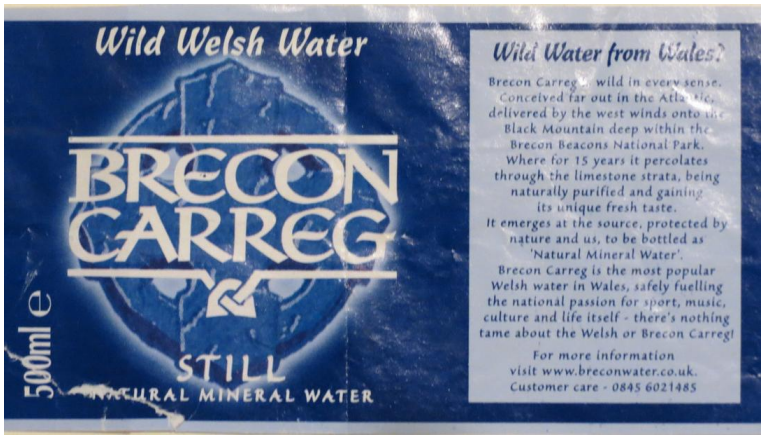
Following the example from past copies of the 'Geoscientist' magazine (formerly an entertaining read!), I refer to these as 'waterblurbs', and in a light-hearted and festive spirit of the season, I'm happy to share some of these with you now:

"*It is not ordinary water, it is extraordinary, it is a Pyoerian* (Pierian?) *spring. There is a ceaseless, inexhaustible supply* (questionable). *The water is mellifluent, diaphanous, limpid, luminous, transparent, pellucid*" (sounds like someone has invested in Roget's thesaurus). It goes on... "*You can drink it with impunity, it is the aqua vitae; the elixir of life. It is vitalising, animating, resuscitating, exhilarating, enthusing, sustaining, refreshing, invigorating*" (more help from Roget?), "*delightful and delicious to bath* (sic) *in*" ►

(in the hope of selling you a bath-tub full?)... "*it gives lustre and brilliancy to the eyes and grace to the skin. Sweeter, better water it was never your fortune to touch before. It has been the great problem of the antiquary what was the nectar of the gods and goddesses! but we have it here in this water, it contains all essence of health and life*" (actually it contains, typically, calcium, magnesium, sodium and potassium, chloride, sulphate, nitrate and bicarbonate, and occasionally iron, fluoride and silicate... in varying amounts) but that's not all... "*it contains a large quantity of latent heat and natural electricity. It will strengthen your digestive functions. Dr. Hunter said it was the most valuable spring he had found anywhere*" (valuable for whom one wonders?).

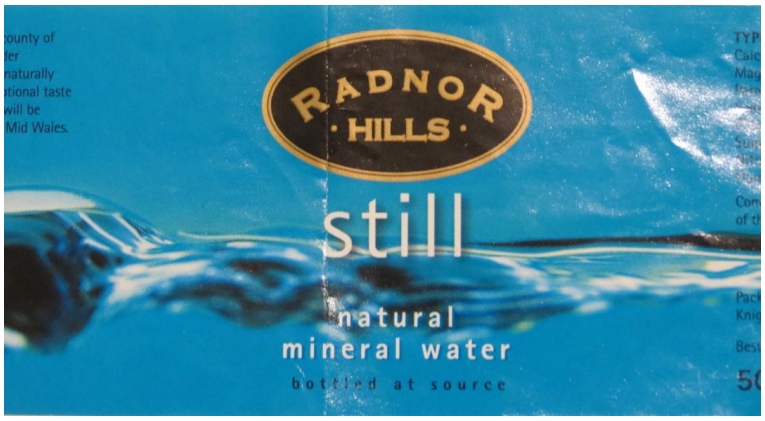
That, admittedly, comes from a 19th century description of the waters of the White Wells, Ilkley, but it sets the tone and suggests that over-zealous advertising isn't a new phenomenon.

"*Brecon Carreg Natural Mineral Water owes its purity to the filtrations through the rock strata of Milstone, Basalt Grit and Sandstone* (sic) *in aquifers some 240 feet deep beneath the mountains... [these strata] acting as perfect water filters, cleaning and purifying the water resources... the water itself is relatively low in minerals, a feature of its purity - and so has a clean fresh taste*". However, their own analysis shows this water is no 'purer' than most other bottled waters!



Alternatively: "*Brecon Carreg is wild in every sense. Conceived far out in the Atlantic, delivered by the west winds onto the Black Mountains deep within the Brecon Beacons National Park*" (Bannau Brycheiniog by recent decree!) "w*here for 15 years it percolates through the limestone strata, being naturally purified and gaining its unique fresh taste... safely fuelling the national passion for sport, music, culture and life itself*" (all unique, of course) "- *there's nothing tame about the Welsh or Brecon Carreg*". Nor, as it happens, is there anything especially unique about the mineral content. A curious change in the geology from one label to another, but with the same remarkable result. A fresh and pure end product whatever the bedrock, which makes one wonder why the geology is even worth mentioning.

Meanwhile, in the neighbouring Radnor Hills: "*the source lies in the old county of Radnorshire. In this very under populated area, the water is able to filter naturally through layers of rock to achieve its exceptional taste and purity*" (but no hint of freshness here!). "*As you enjoy this product you will be consuming one of the natural wonders of Mid Wales*". This brand helpfully instructs you how to access the ingredients... *"remove dust cover and pull top"*, which reminds one of the non-PC Irish joke about Guinness bottles having "open other end" helpfully printed on their undersides! ►



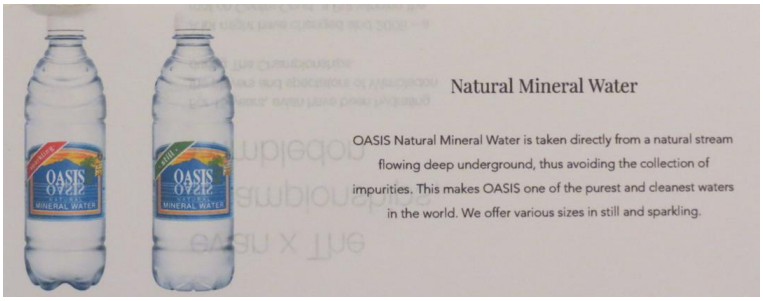
By contrast, north of the border, the Scots seem to make do with simpler rhetoric. "*This water comes from Sainsbury's own Caledonian spring situated in the Campsie Fells above the village of Lennoxtown. Over the centuries the Scottish rains have laid down an underground source of pure natural mineral water with a taste and purity renowned the world over*" whilst Scotland is also "*the source of Highland Spring Natural Mineral Water, the very essence of natural purity*". Dull reading by comparison - but, as ever, emphasising the vital qualities of 'naturalness' and 'purity'.

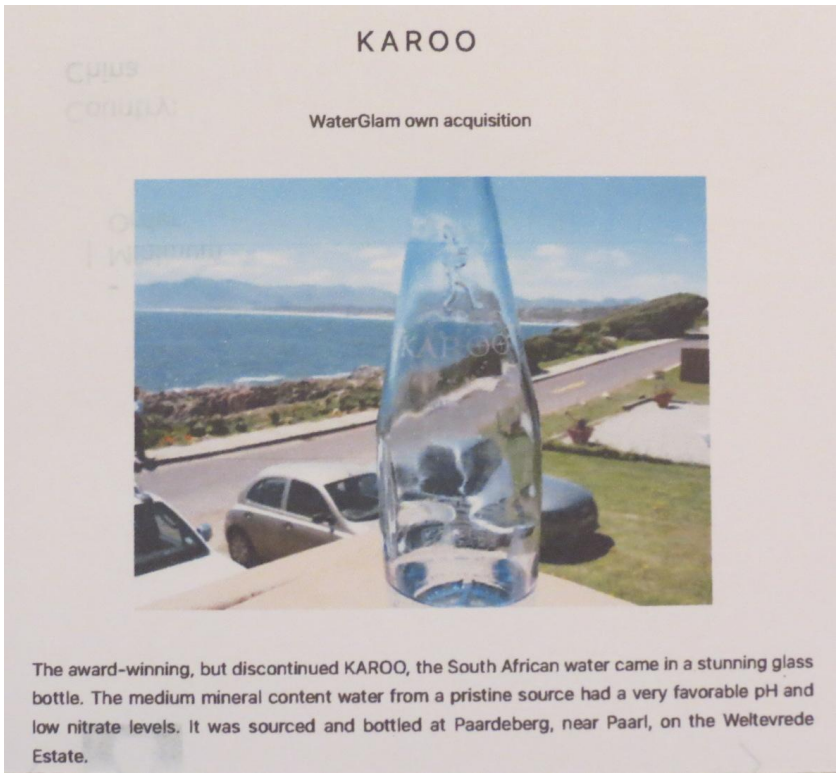
The French concentrate more on the physiological benefits; thus "*[Evian] water that is of balanced mineral content serves to stimulate the cells of the cerebral cortex and hippocampus, significant factors in the preservation of the intellectual faculties...*" clearly a must for the marketing mind to function effectively! Perhaps the real energy, as in their competitor, comes from the fact that "*thousands of years ago, the Auvergne volcanoes erupted in a spectacular demonstration of their power. Nowadays, the natural power is harnessed in every bottle of Volvic*".

Across the pond, still other factors are of importance. "*For over 16,000 years*" (note: considerably longer than in the case of Brecon Carreg) "*the water interacts constantly with the granite and crystal-lined faults deep within the protective Idaho Batholith.* (!) *Over eons,* (no less!!) *this interactive dance between pristine water and crystalline rock* (largely chemically inert) *causes the natural mineral levels to rise and fall*" so, take your pick. "***Trinity*** *Bottled Water represents our vision of what water would be like at a point deep in this hydrological cycle*" and my vision is of a lot of irrelevant gobbledegook and pseudo-science.

Not to be outdone, the Texan 'Premium Purified Water' has "*enhanced taste from minerals*". (Wow!) "*Texas Crystal originates deep underground... brought through an orifice without any surface or atmospheric exposure. It is never chlorinated*" (fair comment in respect of tapwater, I suppose). "*Texas Crystal provides seven barriers of purified protection, absolute quality and safety*".

Moving on swiftly to Africa, but in similar vein of Hadean depths, cleanliness and purity we find that "*[Namibian] Oasis water is taken directly from a natural stream flowing deep underground thus avoiding the collection of dirt as water rises through the surface earth - this makes Oasis* ***one of the purest and cleanest waters in the world***" apparently ignoring the filtering effect idolised by other purveyors. ►





From South Africa, with more than a nod to Heineken, comes Karoo Mineral Water "*where scorched earth and relentless sun through deep dolorite* (sic) *rock lifting time's fossil feel, flows water from the spring, lose yourself - drink from the mainstream and feel it touch the places no other mineral can reach*". Honestly, who writes this stuff.

Inevitably, there are also cases of 'lost in translation' with some of our overseas sources. For instance, from Kenya comes Grange Park Mineral Water *(see photo on p14)* which "*is naturally purified by passing through Trychites* (Trachytes?) *Tufts* (Tuffs?) *Phonolotics* (Phonolites?) *and Canoic* (Cainozoic?) *Volcanic layers of semi acquiffers* (sic) *found in Kerichwa Valley. This unique natural flirtation process makes [our] water so pure, safe and clear that makes it delightful to drink*".

Likewise: "*Ocean Deep Blue drinking water originates from the late paleozoic rock formation of deep sea, 1500 metres below sea lever* (all sic). *Clean and pollution free, natural quality and natural mineral matters, it can power you rapidly*". So, back to the themes of 'naturalness' and 'empowerment', and whilst in the Orient: "*from the spectral straths of the Hunnasigiriya Central Mountain Ranges of Sri Lanka,* ***mount springs*** *captured the birth of* ***virgin waters*** *with that blend of Celestial goodness to all of its other extra terrestrial origin to give you* ***the only*** *nature-intended, life-giving,* (lip-smacking, thirst quenching...?) *totally* ***complete answer to thirst scientifically proven that the contents of this bottle was created and not made***". Seriously... I didn't make this up!!

Also on the market these days, we can find Primordial M-Water™ that describes itself as "*a* ***perfect living water*** *concentrate that is imbued with super coherent life supporting primordial vibration and energy as well as super coherent molecule clustering*". All this for just $39.00 a bottle (16.9 fl. oz.). I expect sales to rocket now you, too, are suitably informed. *(See front cover photo – beware of buying the "24 - bottle value pack"!! Ed.)* ►

Well, we seem to be heading in the direction of absurdity, so I'll give the last words to our friends "down under" where water said to have "*dripped off the backs of dinosaurs*" is being bottled in a small Australian town called Mitchell, tapping water from the Great Artesian Basin, "*a source up to 250 million years old*". I shouldn't add the tired old gag about being consumed within 3 days, but I've done so anyway [!], although it won't hurt to repeat the exhortation on an Indonesian bottled water to "*store in a cool, clean place, avoid direct sunlight* ***and strong, smelly things****"!* Sound advice for a healthy life!!

Merry Christmas. ■

Mike Allen

After reading this I'm sticking with H_2O courtesy of Severn Trent! I'm more inclined to believe their waterblurb "UK water is amongst the very safest and cleanest in the world" (Ed).

Wishing you all a very Happy Christmas

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