Newsletter No. 220

August 2013

The Black Country Geological Society

Contents:

Copy date for the next Newsletter is

Tuesday 1st October 2013

The Society provides limited personal accident cover for members attending meetings or field trips. Details can be obtained from the Secretary. Non-members attending society field trips are advised to take out your own personal accident insurance to the level you feel appropriate. Schools and other bodies should arrange their own insurance as a matter of course.

Leaders provide their services on a purely voluntary basis and may not be professionally qualified in this capacity.

The Society does not provide hard hats for use of members or visitors at field meetings. It is your responsibility to provide your own hard hat and other safety equipment (such as safety boots and goggles/glasses) and to use it when you feel it is necessary or when a site owner makes it a condition of entry.

Hammering is seldom necessary. It is the responsibility of the hammerer to ensure that other people are at a safe distance before doing so.

Future Programme

Lecture meetings are held at Dudley Museum & Art Gallery, St James's Road, Dudley, DY1 1HU. Tel. 01384 815575. 7.30 for 8 o'clock start unless stated otherwise.

Those wishing to attend field meetings please contact our Field Secretary, Andy Harrison, telephone: 01384 370 188, mobile: 07973 330 706 or email: fieldsecretary@bcgs.info

Saturday 28th September 10.00 - 5.00 and Sunday 29th September 10.00 - 4.00. Dudley Rock & Fossil Festival. See boxes below for full details.

Monday 28th October *(Indoor Meeting):* 'Of fossils and fracking - a palaeontologist's guide to shale gas'. Speaker: Dr Liam Herringshaw

Saturday 2nd November *(Conservation day)*: Clearance at Himley railway cutting. Directed by Steve Gallis, Baggeridge Country Park. Meet at the Himley Station car park off Himley Lane (SO 873 910), for 10:30 am. All equipment and tools provided, including a kettle. Bring a packed lunch and sturdy footwear. Please contact the field trip secretary (contact details above) to express interest in attending.

November Indoor Meeting: Date and speaker tbc.

Monday 9th December *(Indoor meeting, 7.00 for 7.30 start):* BCGS Members' Evening and Christmas Social.

Contributors are still needed for this event! Please contact Linda - details below

This is our annual chance for members to share their geological experiences in a sociable atmosphere with a Christmas buffet provided by the Society. We need a few of you to volunteer to do a short presentation - on any topic with geological connections; or perhaps bring along some of your specimens for admiration, discussion and identification. Please don't be shy about volunteering - this is an informal and relaxed occasion: the more contributions we have, the merrier the evening. Please contact our Secretary, Linda Tonkin if you can make a contribution to this event: secretary@bcgs.info

Other Local Events

Rock and fossil identification at Dudley Museum & Art Gallery 11.00 - 1.00 by appointment on the following Wednesdays: 7th, 21st, 28th August and 30th October. Bring along your rock and fossil finds to have them identified by resident experts. Free of charge. Contact details above.

Sunday 25th August, 11.00 - 16.00: Lickey Hills Discovery Day based at Lickey Hills Visitor Centre, B45 8ER and presented by Lickey Hills Geo-Champions in conjunction with Worcestershire Wildlife Trust, South Birmingham Group. All activities are FREE! Guided walks on the Champions Trail at 11.30 & 2.30. Meet at the marquee by the car park. Activities for all the family: quiz; colouring; dig up a fossil; rock and fossil displays. Find out more about Lickey's rocks, plants and animals.

Can You Help at the Dudley Rock & Fossil Festival?

The BCGS stand needs 2 or 3 volunteers present throughout the weekend (details below) and more helpers are urgently needed!

Even if you have no previous experience please volunteer if you can, as soon as possible, so that Linda can organise a rota. Doing a whole morning or afternoon session would be ideal, but an hour or two's help would be welcome. Help would be appreciated on the afternoon of Friday 27th for setting up.

Please contact the Secretary, Linda Tonkin: secretary@bcgs.info or phone: 01902 846074.

Dudley Rock & Fossil Festival

Saturday 28th September 10.00 - 5.00 & Sunday 29th September 10.00 - 4.00

Free for BCGS Members!

Because of the Rock and Fossil Festival there will be no indoor BCGS meeting in September, so we are offering free access on both days to BCGS members to enable you to enjoy the programme of lectures on offer. You should pay for your ticket at the door, then take it to the BCGS stand for a full refund, (£2.60 adults, £1.60 child). Then you can enjoy the whole range of activities and exhibits at both Dudley Museum & Art Gallery and Dudley Town Hall.

This is the largest fossil extravaganza in the Midlands. Exhibitors will be showcasing everything from fossils, and minerals, to gems and jewellery all of which are for sale. Family entertainment including: trilobite racing, geo-art competition, fossil casting and identification, face painting, glitter tattoo, magic shows and story telling. Geology lectures through both days, lasting approximately 40 mins with 20 mins for questions (programme below). Hot and cold food will be supplied and served by Little Devils Diner in the bar area of Dudley Town Hall. Hot and cold drinks are available throughout the day from the bar.

Rock and Fossil Festival Lecture Programme (provisional)

Saturday 28th September

11.00am: Dr Tom Elliot, Consulting Engineering Geologist and former mining advisor to the Black Country Development Corporation: **'Water in the mines'.** The story of the South Staffordshire Mines drainage efforts to take the water from the mines and go deeper into the rocks of the Black Country.

12.30pm: Roy Starkey, former President of the Russell Society: **'Mineralogical Marvels of the UK'.** This beautifully illustrated talk will look at some of the wonders of British mineralogy.

2.30pm: Dr Phil Manning, Manchester University: **'Bright Lights and Dinosaurs'.** The use of modern imaging technology to unlock the hidden secrets of Dinosaurs, in particular, new discoveries from CERN using the synchrotron radiation equipment there.

4.00pm: Ian Henery, Walsall Poet Laureate 2013 - 2014: **'The Poetry of the Rocks'.** The rocks open the mind's eye to worlds of wonder. This presentation will be part performance and part explanation of the inspiration behind new poems dedicated to the Black Country's geodiversity.

Sunday 29th September

11.00am: Professor Derek Siveter, Oxford University: **'Virtual Fossils: soft-bodied sensations from the Silurian of the Welsh Borderland'.** This will be a fantastic journey into the 3D preserved soft bodied fossils of the Welsh Borders.

12.30pm: John Clatworthy, Director of the Lapworth Museum of Geology, Birmingham University: **'The Lapworth Museum of Geology Reborn'.** This talk will show the vision of the final designs for the complete remodelling of the Lapworth Museum, and will give all of us a chance to comment on and influence the geology shown and interpreted in this amazing place.

2.00pm: Adrian Durkin, Exhibition Officer, Dudley Museum and Art Gallery: **'How to be a Dinosaur'.** Fun interactive family talk which looks at what features and attributes make a dinosaur, and looks at modern animals with a view to what has become of them.

More information : http://discover.dudley.gov.uk/events/dudley-rock-fossil-festival-2013/

Other Societies

BCGS members are normally welcome to attend meetings of other societies, but should always check first with the relevant representative. Summarised information for the **next two months** is given in our Newsletter. Further information can be found on individual Society web sites.

Geologists' Association

Saturday 2nd November 10.30 am - 4.30 pm: Festival of Geology, Entrance Free! University College London, Gower Street, London WC1E 6BT. Talks by Prof. Iain Stewart, Prof. Jane Francis, Dr. Suzanne Schwezner, Dr. Maria McNamara.

Sunday 3rd November: Festival of Geology, Field trips: Riddlesdown Chalk Pit near Croydon, led by Prof. Rory Mortimore; Building Stone Walk in the City led by Diana Smith; Walk down the lost river Tyburn led by Diana Clements.

For further details see: www.geologistsassociation.org.uk or phone: 020 7434 9298
or email: festival@geologistsassociation.org.uk

Manchester Geological Association

Saturday 10th August: Fred Broadhurst Memorial Field Trip. Led by Jane Michael. Earl Sterndale - Parkhouse Hill - Chrome Hill. This will involve the steep ascent of Chrome Hill. We will be looking at the limestones and landscape. Total distance around 6 miles and total ascent approx. 700ft.

Further information about outdoor meetings go to: http://www.mangeolassoc.org.uk/ or please contact Jane Michael by email: outdoors@mangeolassoc.org.uk Visitors are always welcome.

Shropshire Geological Society

Thursday 15th August, evening Rockhop: Bishops Castle town building stones. Part of the 'All Our Stories' project.

Tuesday 20th August, morning Rockhop: Quatford and the adjoining Geopark Way. Part of the Abberley & Malvern Hills Geopark Geofest programme, looking at the fascinating geology of Quatford Church, Permian sand-dunes and the Severn Valley.

Saturday 28th September, day meeting: Wentnor and Norbury. Led by David C Smith. Looking at rocks, fossils and landscapes. Part of the 'All Our Stories' project.

Booking for these 3 meetings to reserve a place and obtain joining instructions please contact Andrew Jenkinson; email: andrew@scenesetters.co.uk; telephone: 01938 820 777. Rockhops are primarily intended for beginners to geology. Lectures are generally held at Shire Hall, Shrewsbury, commencing at 7.15 for 7.30. A nominal charge is levied for attendance by non-members. Further info at: www.shropshiregeology.org.uk/

Teme Valley Geological Society

Tuesday 27th August, Cotswold Field Trip. Contact Dr Paul Olver 01432 761693, Free.

Monday 23rd September, 7.30pm: Talk by Jon Clatworthy of the Lapworth Museum. Martley Memorial Hall. Contact Janet Maxwell-Stewart 01886 821061.

Meetings are generally held in Martley Memorial Hall, Martley. £3 non-members or join on day. For more details visit: http://www.geo-village.eu/ or contact John Nicklin, 01886 888318, 0774 977 4432

Warwickshire Geological Conservation Group

Wednesday 18th September, 7.30pm: Curiosity Rover and Martian Geology. Speaker: Prof. Sanjeev Gupta (Imperial College). Royal Spa Centre, Newbold Terrace, Leamington CV32 4EA

For more details visit: http://www.wgcg.co.uk/ or contact Ian Fenwick swift@ianfenwick.f2s.com or 01926-512531. There is a charge of £2.00 for non-members.

Woolhope Naturalists' Field Club - Geology Section

Saturday 21st September: Geology and landscape on the edge of the South Wales Coalfield. Led by Dr Tom Sharpe, National Museum of Wales.

Guests are welcome, but must take day membership of the Club: £2.00. Further information: Sue Hay on 01432 357138, email svh.gabbros@btinternet.com or visit their web site: www.woolhopeclub.org.uk/Geology_Section/default.htm

Mid Wales Geology Club

Sunday 18th August: Middletown Quarry, Welshpool. Led by Tony Thorp.

Wednesday 21st August: Palaeontology with a bite: the fossil history of sharks & rays Speaker: Dr. Sara Metcalf.

Wednesday 18th September: Greenland's ancient Gneissic rocks. Guest Speaker: Professor Bill Fitches.

Sunday 22nd September: Cat's Back, Black Mountains. Guest Leader: Duncan Hawley.

Further information: Tony Thorp (Ed. newsletter & Hon. Sec): Tel. 01686 624820 and 622517 jathorp@uku.co.uk Web site: http://midwalesgeology.org.uk

Herefordshire and Worcestershire Earth Heritage Trust

Through the summer months the H&W EHT and their Geopark partners are running a variety of geology related events, with something for everyone. Below is a selected summary of the remaining 'GeoFest' events. **For full details of 'GeoFest' events and downloadable programme go to:** http://www.earthheritagetrust.org/pub/category/news-and-events

Please book for all events unless otherwise stated: 01905 855184 or eht@worc.ac.uk

Guided Geology and Landscape Walks or Field Trips will take place on:

Saturday 10th August: Martley Parish Geology. 11.00 - 1.00 short walk; **2.00 - 6.00** longer walk. Meet: Martley Parish Hall. Booking: phone 01886 888318 or email: martleypfo@gmail.com
Sunday 11th August: 'Highley to Arley' (all day) Meet at Bewdley SVR station 10.00am.
Sunday 18th August: 'Tour Huntley Reserve with the Geowardens' (morning or afternoon) Meet: Huntley Country Garden Centre. Booking: 01452 864438 or email: info@glosgeotrust.org.uk
Tuesday 20th August: 'Rocks Old and New around Quatford' (morning only). Booking: phone 01938 820777 or email: projects@shropshiregeology.org.uk

For further information about the Herefordshire and Worcestershire Earth Heritage Trust's events and other activities visit their web site: www.earthheritagetrust.org/ or phone: 01905 855184.

Double Honours for Graham Worton

As Keeper of Geology at the Dudley Museum and Art Gallery, and one of our long established members, Graham Worton needs no introduction. It gives me great pleasure to announce that Graham has recently received two prestigious awards for his tireless devotion to the subject he loves, and for his outstanding ability to inspire others. It is heart-warming to read the accolades in the nomination addresses below, and I'm sure I can speak for us all in expressing our pride, and gratitude for Graham's long and ongoing association with our Society. Ed.

The Halstead Medal Award 2013

Open to non-members and members of the Geologists' Association, the Halstead Medal is for work of outstanding merit, deemed to further the objectives of the Association and to promote Geology.

Awarded to Graham Worton at the Geologists' Association AGM, Friday 3rd May 2013

Nomination from anonymous sponsor:

Graham typifies the spirit of the Geological Association at its dynamic best. He lives and breathes geology with involving and inspiring others his reason for being. He devotes his professional life as Keeper of Geology at Dudley Museum and his spare time with the Black Country Geological Society to promoting geology to anyone who will listen, from politicians, through engineers and planners to schools and the general public.

Over the last 25 years plus, he has brought geology to many who would otherwise never have taken an interest or been involved and he has put geology into the heart of the local authority in which he works, setting often quoted examples of best practice in community engagement, geological promotion and geoconservation. He is a regular in the local press with a succession of geological activities and exhibitions at the museum and local geological sites.

He has worked as a professional engineering geologist as well as in the museum world and is involved in geological research as well as in geoconservation, education, public outreach, projects using geology to improve the lives of deprived communities in Dudley. He is a past Chairman of the Black Country Geological Society and the organiser of the long running Dudley Rock and Fossil Festival. In a paper to be published in the PGA (Proceedings of the Geologists' Association) this year, his innovative work developing geological interpretation and in engaging schools, local communities, student volunteers, and deprived youth around the Wren's Nest National Nature Reserve is described and illustrates some really exceptional achievements for geology and people. He has published many populist articles as well as refereed papers, hosted part of the Worcester Conference field visits in 2011, has helped with Rockwatch and gave a lecture on his work to the GA in 2012. Someone once said, "If I had to choose one person to enthuse about geology to save my life, I would choose Graham Worton!"

Graham's response:

I was truly moved and honoured that the Geologists' Association thought me worthy to be this year's Halstead Award winner. The lovely words that were said about me on the night were so very kind and the company so warm that this was a night Sarah and I will remember with real fondness for the rest of our lives. The other award winners were all equally dedicated and talented, and it was humbling to be in their company. The fact that Eric Robinson and Susan Brown received accolades on the same evening (two individuals who I have looked up to and whose friendship, knowledge and wisdom I have valued for many years) made this a very special night for me indeed. ►

The Les Nichol Award

Awarded to Graham Worton on 13th May 2013

The Les Nichol Award is presented by the Midland Geotechnical Society to a Society member who, in the opinion of their peers and the Committee, has demonstrated an exemplary commitment to the profession of Ground Engineering, including geotechnical, geological and geo-environmental perspectives. In particular, the following criteria that epitomise the values that Les represented and looked for in others will be considered:

- The ability to provide sound engineering judgements
- The willingness to embrace new ideas and new techniques
- An unquenchable enthusiasm for the subject of ground engineering

The prize is awarded at the discretion of the Committee, and may be presented annually at the AGM in May. However, the Committee may also decide that in certain years there will be no award, even if there are nominations.

This award was presented for Graham's unceasing passion for geology and applied geology in all its forms over the past 30 years, as a chartered geologist with 17 years of professional geo-environmental consultancy work under his belt.

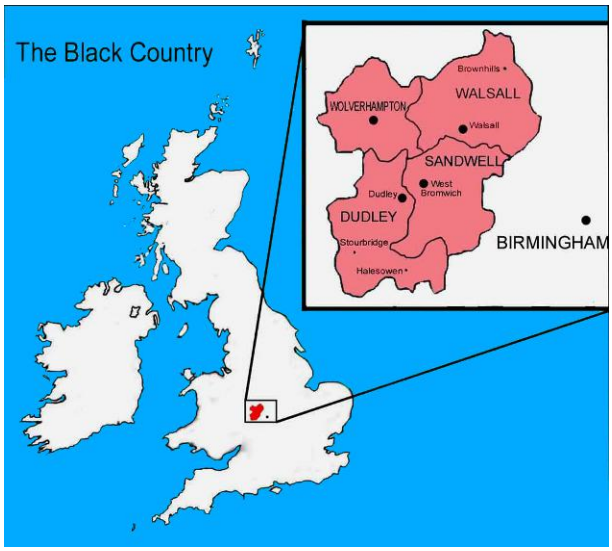
He is currently Dudley Metropolitan Council's Borough Geologist and Keeper of Geology, managing Dudley Museum and Art Gallery, and offering advice and support on many complex geoconservation, geotourism and mining heritage projects. He shares his knowledge freely, and in particular supports and offers professional guidance to younger earth scientists entering the geotechnics field or applying for chartered geologist status.

Graham's response:

Yet again, a real surprise and honour that my peers and betters in applied geoscience should select me for accolade. I was particularly moved by this nomination as Les Nichol was one of the first real characters that I met as a young engineering geologist myself and he helped and inspired me in many projects throughout my career. Like so many of us who got to know Les, we have many good memories and huge respect for the person that he was. Our last project meeting was shortly before his untimely death in 2010 when we were working on the options for the stabilisation of the Step Shaft limestone mine on the eastern side of Wren's Nest. This industry is the poorer for his loss and I am truly moved to receive an award dedicated to Les. ■

Black Country gears up to become a Global Geopark

The Black Country has a very rich geological and mining heritage, many aspects of which are world class and enjoy international scientific accolade. This, however, is not often appreciated locally and its potential to contribute to local pride, better image and the local economy is largely unrealised. The Black Country Study identified that the quality of the environment and the stereotypical negative urban industrial image of the Black Country are significant obstacles to positive and sustainable change. These are seen to impact on sense of worth and wellbeing of those who live and work here and also compromise the potential for inward investment. Widespread changes in attitude both inside the area and outside the area are therefore essential, and the geodiversity of this unique area can be a key element in starting that process of positive change. ►



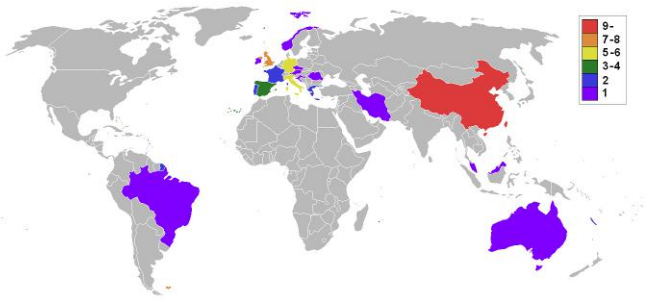
This unique heritage is the product of nature and man's labours. The Black Country and Birmingham formed the world's first industrial conurbation where many huge strides forward in technologies and scientific discoveries happened. Nature's part in this was to endow the Black Country with a richness of the minerals and an ease of extraction (occurring literally at the surface in many instances) that made an industrial revolution almost inevitable in these parts and to a depth and intensity unparalleled elsewhere.

The rocks in the Black Country are very diverse and contain huge amounts of coal, ironstone and limestone which also contain a rich and exceptionally well preserved host of unique fossils (at Wren's Nest National Nature Reserve, for example). Man's contribution has been the myriad of scientific and engineering achievements related to the rocks. These include the drafting of the world's first geological map (Castle Hill 1665), the world's first working mines drainage engine (Newcomen Engine at Conygrea 1712), and many more.

The recognition of global heritage value by formal international designation has never happened for the Black Country's heritage, but that may be set to change, as the Black Country is putting together a European and Global Geopark application that will be submitted later this year.

A geopark is a territory with geological heritage of international significance and a sustainable development strategy with a strong management structure. In the case of the Black Country the territory will be the boundary of the three metropolitan boroughs (Dudley, Sandwell and Walsall) and the City of Wolverhampton. All operate development control under the umbrella of the Black Country Core Strategy and have local planning controls and guidance including, (for Dudley and Walsall) an adopted nature conservation SDP which has specific guidance for geological heritage. Priorities for the geological heritage are set out in the Black Country Geodiversity Action Plan which is drawn up by the four authorities plus additional partners including The Black Country Consortium, Natural England, The Wildlife Trust for Birmingham and The Black Country, and the British Geological Survey.

The Global Geopark Network currently has 89 geoparks in 27 countries; 43 of these are located in 17 European countries with 7 in the UK: the North Pennines and Torbay in England; the Brecon Beacons and Anglesey in Wales; the North West Highlands and Shetland in Scotland; Marble Arch Caves in Northern Ireland.



The world distribution of geoparks as of 2009, Wikipedia.

The Geoparks network charter is focused on respecting, protecting, promoting and researching the geological heritage of its member territories and requires sharing of experience and knowledge. It expects this heritage to be celebrated in its territories, to engage all who live and work there and to connect with education at all levels.

Acceptance into the elite global group of geological territories is an ideal vehicle to raise awareness and respect for the uniqueness of places such as the Black Country. The Global Geopark badge makes a bold statement that you are in a very special landscape and have an international reputation for excellence. The very least that can be expected is that it would create much greater awareness and curiosity about the area, will grab media attention, and alert businesses to opportunities that were unchampioned previously. In doing this, perceptions will change and the regional visitor economy will get a boost. Formal international recognition helps with funding applications and even better, more interesting regeneration might then occur with longer lasting benefits.

There are good examples from across the UK. The English Riviera in the 4 years since becoming a geopark has received £5.4 million direct investment into its geological heritage as a result of the geopark brand. The Marble Arch Caves Global Geopark in Northern Ireland has also received 3.2 million euros in European funding on the back of its geopark badge. There are multiple spin-off benefits across all geoparks ranging from growing community self-esteem, increasing environmental awareness, adding value to the features within the territories, and creating new infrastructure including visitor centres. North Pennines have created a host of new tourism products, linked attractions and amenities in new initiatives. ►

The Future

The Black Country is putting together its application dossier which will be sent into the European Geoparks Network in the application window running between 1st October and 1st December 2013. A provisional response will be given from the network in early 2014 and if favourable, a delegation of scrutineers will visit the Black Country in the late spring/early summer of 2014. The Black Country's case will then be presented to the full network at their annual conference in September 2014 at which point The Black Country will hopefully become the next Global Geopark. ■

Graham Worton, June 2013

Field Meeting Report

Saturday 22nd June 2013: Dudley Canal and the Saltwells Nature Reserve. Led by Graham Worton (BCGS).

Starting at the Dudley Canal Trust Centre the intention of this field trip was to take a canal boat through the tunnels beneath Castle Hill to the Park Head Locks and on to the Saltwells LNR (Local Nature Reserve). Along the way Graham would provide a commentary on the geology and history of the Dudley Canal, before leading a short walk around Saltwells LNR and rounding off the day with a 'pie and a pint' in the Saltwells Inn. Unfortunately, circumstances dictated otherwise and the trip was shortened to a walk and tales around Saltwells LNR. The weather was muggy with showers when we met at the Saltwells Inn car park and remained grey for the rest of the day.

The Dudley Canals and Tunnels

From the Dudley Canal Trust Centre the Dudley Canal heads westwards and soon disappears beneath Castle Hill along the 179m Lord Ward's Tunnel, passing Shirt's Mill Basin on the way. The Canal then daylights within Castle Mill Basin, a former covered limestone mine now open to the elements and the junction of four tunnels beneath Castle Hill. Next, the Dudley Canal continues in a linear south-westerly direction along the 2,900m Dudley Canal Tunnel, which emerges at Parkhead Locks near Scotts Green, before continuing southwards towards Netherton.

Dudley Canal Line No. 2

The section of canal from The Dudley Canal Trust Centre to the Parkhead Locks is known as Dudley Canal Line No. 1. South of Parkhead Locks it becomes Dudley Canal Line No. 2. As it heads towards Netherton and the Saltwells LNR the Dudley Canal follows the ground contours, skirting around Netherton and Primrose Hill. Passing through Brewin's Cutting (at Saltwells) the canal continues onwards to the Netherton Tunnel Branch Canal at the entrance to the Netherton Tunnel and Cobb's Engine House.

Lord Ward's and the Dudley Tunnels were started in 1775 and completed in 1791 to link the Earl of Dudley's limestone workings and Tipton Colliery to the Birmingham Canal Navigations at Tipton. Almost immediately afterwards, work started on the Dudley Canal Line No. 2 to link the Dudley Canal with the Birmingham and Worcester Canal. This was completed in 1798.

The Geology of the Dudley Canals, Tunnels and Saltwells LNR

The approximate 5km length of the Dudley Canal, between the Dudley Canal Trust Basin and the Saltwells LNR, cuts its way through a variety of geological strata which tell the story of the regions geological past, between 427 and 330 million years ago.

The Silurian rocks of Castle Hill, (which also outcrop at Wren's Nest, Hurst Hill and Saltwells), represent the oldest units seen along the Dudley Canal route. Upon entering Lord Ward's Tunnel ►

the first strata seen comprise grey shale belonging to the Lower Ludlow Shale. Progressing along the Dudley Canal Line No. 1 the shale gives way to the Wenlock Limestone Series (Upper Quarried Limestone, Nodular Beds, Lower Quarried Limestone and Wenlock Shale), which increase in age towards the central core of Castle Hill. Once the central axis of Castle Hill is crossed the strata begin to get younger as the sequence is reversed, illustrating the hill's folded nature.

As the Dudley Canal Tunnel progresses SW it leaves Castle Hill and cuts through strata of younger Carboniferous Middle Coal Measures (also known as the Productive Coal Measures). The Middle Coal Measures consist of a variety of rock types, including grey shale, clay, fireclay, sandstone, coal seams, ironstone and marine limestone bands, which belong to the South Staffordshire Coalfield. Coal horizons included within the Middle Coal Measures sequence include the Bottom Coal (lowest down in the sequence), New Mine Coal, Heathen Coal, Thick Coal and Brooch Coal (highest up in the sequence).

To the NE of Springs Mire the Dudley Canal and Tunnel crosses a NW to SW trending fault, which has been downthrown to the SE. On the far side of the fault the Dudley Canal and Tunnel are cut through younger red and purple Etruria Marl, which belongs to the Upper (unproductive) Coal Measures and is also Carboniferous in age.

As the Dudley Canal daylights at Parkhead Locks and winds its way towards Saltwells it once again cuts through Middle Coal Measures strata. At Brewin's Bridge, on the northern edge of Saltwells, a large intrusion of dolerite cuts the Coal Measures strata. This is clearly visible in the wall of the Brewin's Cutting. In an outcrop further along the cutting the Middle Coal Measures are seen overlying the Silurian Lower Ludlow Shale strata. A pebbly, undulating unconformity separates the two strata, representing over 100Ma of missing geological time. Careful observation of the unconformity reveals a thin layer of red and green sandstone, Downton Sandstone, which is also of Silurian age and overlies the Lower Ludlow Shale.

The Wenlock Series indicates that during the Silurian the Dudley region formed part of a warm, shallow shelf sea, with the edge of the continental shelf out towards Wenlock Edge in Shropshire. During this time the Midlands was situated at between 20° and 30° south of the equator. The sea teamed with life and included patch reefs upon which thrived a variety of arthropods, molluscs, echinoderms and other soft bodied animals. Occasional eruptions, from a volcanic source somewhere near Cheltenham, would smother the sea in layers of ash which formed discrete layers of bentonite, each with its own associated death assemblage. Rivers draining a far off continent in the east would introduce clay, silt and sand into the environment, which slowly accumulated to form the mudstones, siltstones and sandstones characteristic of the later Ludlow sequences and Downton Sandstone.

Studies of corals at Wren's nest indicate that during the Silurian Period, the seasons were longer and a year lasted 400 days. During NASAs Apollo missions astronauts left behind mirrors on the Moon. Lasers fired at these mirrors have shown that the Earth and Moon gap is increasing at a rate of approximate 4cm/yr. This indicates that during the Silurian the Moon was closer to the Earth and brighter, which would have impacted upon the tides at the time. Also the land would have been bare of vegetation, which would have had important implications for rates of weathering and erosion.

Towards the end of the Silurian, the Black Country region along with present day Wales was subjected to a lengthy period of uplift associated with the Caledonian Orogeny between 490Ma and 390Ma, and the closure of the Iapetus Ocean. On this uplifted landscape rivers cut their way throughout the Devonian and early Carboniferous periods, producing a terrain upon which the later Carboniferous strata would be deposited.

Carboniferous/Silurian Boundary

During the Upper Carboniferous the Midlands were situated at equatorial latitudes and the Black Country Region was located off the northern coastline of a small landmass known as the Wales-Brabant Island. To the north lay a vast shallow tropical delta crossed with meandering rivers and dotted with forested swamps. ►

This delta, known as the Pennine Basin, stretched from the west eastwards across Europe and into Russia. To the north this basin was bounded by a large continental landmass known as North Atlantis. Rivers feeding off the landmasses to the north and south fed clays, silts and sand into the delta, whilst thick layers of vegetation accumulated in the forested swamps, forming the Middle and Upper Coal Measures strata. During diagenesis, chemical accumulations of iron around organic nuclei led to the formation of ironstone concretions and bands within the Middle Coal Measures.

Towards the end of the Carboniferous, between 380Ma and 280Ma, the region was again subjected to earth movements. The Variscan (or Hercynian) Orogeny resulting from a collision between North America and Europe forced the region to be uplifted. As the Orogeny progressed it caused earlier strata to become folded and faulted, creating the likes of Wren's Nest and Castle Hill. Another consequence of this event was to increase the level of volcanic activity in the region. This caused the intrusion of dolerite into the Coal Measures, as seen at Barrow Hill, Saltwells and Rowley Regis.

The Saltwells Nature Reserve

The Saltwells LNR opened in 1981, and like the Dudley Canals and Canal Tunnel, its origins are linked to the Industrial Revolution. Sitting at the heart of what was once the Earl of Dudley's Estate, the Reserve was extensively worked for coal, fireclay and ironstone from the 17th century onwards. The thick coal was mined at surface and the deeper thinner seams of Heathen Coal were mined with the assistance of two deep shafts. Ironstone was also mined and would be spread over local fields and allowed to weather over the winter, before being picked over by local women known as 'Pit Wenches'.

At the heart of Saltwells sits Doulton's Clay Pit, which survives as a reminder of the legacy of mineral extraction here. It gets its name from the Royal Doulton Company which extracted fireclay from the pit between 1870 and 1940 to manufacture Doulton's sanitary ware. From the pit, 'tubs' were used to carry the fireclay up an incline to the Dudley Line No. 2 Canal at Brewin's cutting. Whilst the mined coal and ironstone was generally used in local foundries, the fireclay was transported to the Staffordshire and Worcester Canal and onwards to the Potteries.

Doulton's Clay Pit

In the 18th century Lady Dudley planted Lady's Wood (now Saltwells Wood), to hide the scars left behind from years of mining. The Reserve gets its name from a former 18th - 19th century brine spa located in Lady's Wood, which supposedly cured many ills. The spa was built after brine rich water was encountered flooding the deep shafts in the 17th century and eventually closed after it became polluted with waste mine water from a neighbouring colliery. The Saltwells Inn is all that remains today. The brine is believed to come from evaporite deposits that accumulated in ancient saline lakes existing on the same Silurian landscape over which the Middle Coal Measures strata were deposited.

Of course, the geology and industrial heritage of the region is only one part of the story. During our walk around Saltwells Graham told many stories of the people that lived here and how the land shaped their lives.

As originally intended, our day ended with a 'pie and a pint' at the Saltwells Inn. I would like to thank Graham for another very interesting field trip and to those members of the Warwickshire Geological Conservation Group, The Woolhope Naturalists Geology Group, Stafford University, the Hull Geological Society and Birmingham University for coming, and hope they enjoyed the day. ■

Andy Harrison

Have a look at our website at: **www.bcgs.info**

The Malvern Hills GeoCentre

In the last issue of the BCGS Newsletter, I made a brief reference to the opening of this welcome new geology centre in the Malvern Hills. Though not on our doorstep, I think many of you may occasionally visit the Malverns, and if you do, you will find a warm welcome and a wealth of geological information to keep you absorbed. I feel that this innovative centre deserves to become better known. It shares facilities with Key IQ Ltd, and I'd like to thank the technical director, Adrian Burden for supplying this article which explains the background. Read on, and go and have a look for yourselves! Ed.

The Malvern Hills GeoCentre is the official visitor centre for the Geopark Way that runs 109 miles from Bridgnorth to Gloucester, taking in some of Britain's most fascinating and indeed oldest geology. The Centre is part of the Wyche Innovation Centre and offers a resource for visitors interested in the area as well as a cafe for lunch, and light refreshments.

The Centre came about because it was perceived that there was a need to disseminate more information about the local natural history and geography to visitors and residents, particularly on the Malvern Hills, which draws over a million visitors each year. Moreover, as the location was adjacent to the Geopark Way and virtually midway between the extremes, it was felt that the Centre could benefit from collaborating with a number of stakeholders keen to engage visitors in the area.

The Wyche Innovation Centre is managed by Key IQ Ltd, a business and technology catalyst that helps small enterprises develop their business. The Centre offers serviced offices and hot desks as well as a community of like-minded entrepreneurs. Such a centre benefits greatly from a cafe area, as it provides a relaxing focal point for people to have a break from work, interact with others and indeed meet clients in an informal environment. This provided the impetus to open the Malvern Hills GeoCentre: combined with a cafe it would complement the activities in the Innovation Centre along with the needs of the local tourism industry. This would help to make the initiative sustainable, as neither the business Centre nor the passing trade of visitors would themselves offer enough of a customer base throughout the year.

To give the GeoCentre an unusual spin, and because space is limited, it was decided to use innovative technology to maximise the appeal of the facility. As such, the wall displays of maps include QR Codes and Near Field Communication chips so that people with suitable smart phones can access more information through the internet using these features as triggers. The majority of the visitor information is disseminated on iPads which access a specially designed website consisting of in depth information, maps, images and links. This format means that it is easy to update and expand on content as more collaborators come on board. It is also possible to monitor what content is frequently visited and how people explore the resource. This information can be used to improve the material and make it easier for popular topics to be easily reached. Already the iPads contain information about the geology, flora, fauna, and history of the area with a particular focus on the Malverns. Much of the content has been provided by collaborators including the Earth Heritage Trust, the Malvern Hills Area of Outstanding Natural Beauty, the Malvern Hills Conservators, the Malvern Hills District Council, the Malvern Spa Association and the Worcestershire County Council Archives and Archaeology Unit. ►

Chris Darmon opening the GeoCentre

Another feature is the 6-screen video wall that offers a digital canvas for multimedia content to be displayed. Examples include videos, photographs, panoramas and news feeds. As people suggest new material, so these can be added with relative ease. The screens also allow presentations to be made and bespoke content to suit particular events to be shown.

Pupils from St. James' School

In order to increase footfall, various events have already taken place at the GeoCentre and more are planned. After the initial opening and launch of GeoFest 2013 the facility has hosted a hands-on geology session, several visits from local schools and some themed events such as Wimbledon on the big screen, that draw in different crowds and expose them to the Centre and its resources.

Future events include a talk about fossils, a visit from a local Rotary Club, a book signing, an artist in residence session and the display of a life sized model velociraptor skeleton courtesy of the Earth Heritage Trust.

The facilities include free wifi, disabled access, baby changing, baby high chairs, free parking and a cafe. Further details of the facilities and opening times are available: http://www.geocentre.co.uk/

Another unusual approach is the way the Cafe that supports the Centre is operated. So that it would be open at both weekends and weekdays, two groups are responsible for the operation. During the week a co-operative called 'Team Jamboree' runs the cafe, giving adults with learning disabilities a chance to serve customers and share profits in the venture. At weekends and on bank holidays, a local entrepreneur, Joanne James, runs the cafe with her team, offering a slightly different menu and enabling the opening hours of the Centre to be extended from 9am to 6pm. More details here: http://www.wyche-innovation.com/index.php/cafe-h2o ■

Adrian Burden, Technical Director, Key IQ

Photos supplied courtesy of Adrian Burden.

Fracking - Hydraulic Fracturing

Gas and Oil extraction from Oil Shales

This subject is very much in the news at the moment, and seems likely to remain so for a long time. This article - by no means exhaustive - is an attempt to explain its main features to members of the BCGS so that we are armed with information and therefore able to make sound judgements, based on the known facts.

History

The origin of this technique seems to go back to 1947 in the United States, with its first commercial application in 1949 in Oklahoma. It was Floyd Farris of Stanolind Oil and Gas Corporation who studied this technique, and this led to the first fracking experiment being carried out in 1947 at the Hugoton gas field in Grant County, Kansas. The process was patented in 1949 by Halliburton Oil Well Cementing Company. In the same year Halliburton demonstrated the first two commercial hydraulic fracturing treatments in Oklahoma and Texas.

What is fracking?

Fracking, or hydraulic fracturing, is the fracturing of localised rock by pressurised liquid. Water is combined with sand, or aluminium oxide and chemicals, and the mixture is injected at high pressure into a well borehole to create small fractures, typically less than 1mm, along which fluids such as gas, petroleum and brine can migrate to the well. When the pressure is released the sand 'proppant' holds the fractures open. ►

Generally, oil shales have a lower permeability than conventional formations, and can only be exploited by means of fracking. One consequence is that there have to be many more bore holes than in conventional gas and oil fields. In 2012, 2.5 million fracking operations were performed on oil and gas wells all over the planet, more than a million in the USA.

Chemicals Used

A study in 2011 identified 632 chemicals which have been used in gas operations, including:
Acids - hydrochloric acid, or acetic acid for initiating and cleaning fractures
Sodium chloride - delays breakdown of the gel polymer chains
Polyacrylamide - minimises friction between fluid and pipe.
Ethylene glycol - prevents scale in the pipes.
Borate salts - maintain fluid viscosity during temperature increases.
Sodium and potassium carbonates - maintain effectiveness.
Glutaraldehyde - used as disinfectant of the water.
Guar gum (water soluble gelling agent) - increases viscosity of the fracturing fluid.
Citric acid - corrosion preventative.
Isopropanol - increases viscosity of fracture fluid.
Methanol

Many of these have carcinogenic and other effects on the human body.

Horizontal Drilling

This goes back to the late 1970's but it really took off in the early 2000's with advances in drilling technology, so that nearly all North Sea wells are drilled at an angle to increase gas and oil extraction, and use fracking techniques.

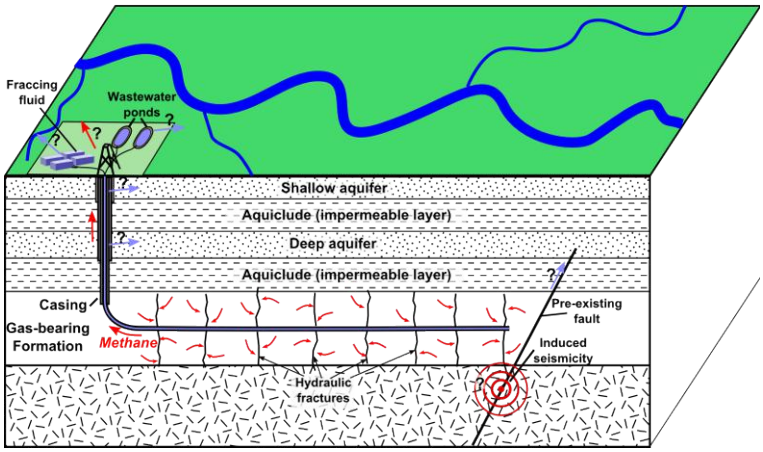


Diagram by Mike Norton, Wikimedia Commons

There can be up to 30 stages (where fracking has fractured the shale rock), along a horizontal bore from the foot of the vertical bore - each one having a radial distance of up to 150 yards.

Economic Impacts

The extraction of oil, and particularly gas, by means of fracking has transformed the energy supplies of the United States and lowered the price to consumers. Deposits of oil shale which were previously considered uneconomic have been successfully exploited for their oil and gas by fracking. According to the International Energy Agency, "the remaining technically recoverable resources of shale gas are estimated to amount to 208 trillion cubic metres, tight gas to 76 trillion cubic metres and coalbed methane to 47 trillion cubic metres". The USA is now largely self-sufficient in oil and gas, making the political dependency of the country on imports from politically unstable parts of the world largely a thing of the past. In fact, it is claimed that it offers Canada and the USA oil and gas security for the next 100 years. Although there is a great deal of uncertainty about how much we have in this country, there is enough to make a considerable impact on our energy supplies at a time when our imports of gas have risen to be just about equal to the falling gas extraction from our own sources.

Environmental Impacts

All extractive industries have an effect on the environment. In the past, these have often been devastating - the Black Country is one of the earliest examples. With an awareness of possible damage to the environment, and with carefully thought out management of the issues, it should be possible to mitigate the worst effects. Rising demand for natural resources due to rising living standards, short term national economic difficulties, and increasing world population may lead to short cuts being taken which could produce great damage to the environment. Arguably, the exploitation of the Athabasca tar sands in Canada, is an example. ►

Water

Fracking uses large quantities of water, for example the average well in the USA uses between 1.2 and 3.5 million gallons. This is likely to be less of a problem in the UK than in the drier parts of the USA. However, Water UK which represents all the water companies, said that shale gas extraction posed a threat if not 'carefully planned and carried out'. They expressed worries that fracking could contaminate drinking water aquifers which lie above shale gas reserves. Water UK says that this could happen with gases such as methane permeating water sources from rocks where it was previously confined, chemicals getting in through cracks created by the fracking process, or by poor handling of waste on the surface.

A joint report by the Royal Society and the Royal Academy of Engineering said the risks could be managed effectively through 'strong regulation'. A warning of dangers posed by the government wanting to relax environmental controls to speed up the process, as had happened in the USA, came from Leicester University.

Atmospheric Pollution

The emissions from fracking are related to methane leaks from the wells. However, according to Dr. David Hookes of Liverpool, methane is 2000% worse than carbon dioxide as a global warming gas. There seems to be disagreement about this figure as many authorities claim it to be 200% and even 25%. This means that small leaks from fracking wells will more than cancel out the so-called gain by using gas instead of coal. The US Department of Energy's National Renewable Energy Laboratory found that shale gas emissions, when burned for electricity, were very similar to those from so-called conventional well natural gas.

Effect on Global Warming

If the country finds an abundant source of gas, there will not be the same urgency to research into green sources of energy production, which will have to be utilised eventually. Unless economic methods of capturing and storing carbon dioxide and other greenhouse gases produced from fossil fuels are developed, global warming will continue (albeit erratically, as much of the extra heat energy is absorbed by the oceans, temporarily reducing measured warming).

Seismicity

Fracking produces microseismic events too small to be detected except by sensitive equipment. However, by late 2012 there had been three instances of quakes being large enough to be felt by people - one each in the USA, Canada and the UK. A report in the UK concluded that fracking was the most likely cause of two small earthquakes - magnitudes 2.3 and 1.4 Richter Scale - during drilling into the Bowland Shales in Lancashire. The United States Geological Survey says that there is no guarantee that larger earthquakes will not occur.

Oil Shales in Great Britain

These are widely distributed, with a broad swathe extending across central England from the North York Moors to the south coast, where they outcrop at Kimmeridge Bay. Some exploitation of these rocks for oil occurred during the First World War. It seems that Jurassic rocks, particularly the Upper Jurassic and the Liassic, contain oil and gas bearing shales which could produce abundant gas.

The Wealden Dome in south east England is another likely region. Some parts of Lancashire underlain by the Bowland Shales have already been examined, but the findings have not been made public, as far as I am aware, and further activity is at a standstill after the two earthquakes which occurred during drilling activities. A few localities in Somerset and Avon, and the Hampshire Basin also have oil shales at some depth. Much of the Pennine backbone of England has oil shales.

The Central Valley of Scotland, especially around Edinburgh has oil shale strata - outcropping in places, and there were also attempts in the past to exploit them. The South Wales coalfield is another likely place to be exploited by fracking. ■

Gordon Hensman

Geobabble

Llangollen, Darwin river cliff

Take a look at the first photograph. It's not very good is it? The editor may have considered removing it. It appears to be a slumped cliff of sorts. There is some bedding high up on the picture, but no scale; every geological photograph must have a scale! I took the picture myself and it was at a locality near Llangollen in Wales, about 2 or 3 kms NW of the town; ref: SJ 20527 44167 on the OS Explorer Sheet 256 - Wrexham and Llangollen. The reason that I had not asked a friend to stand in the picture to give a scale is that we were standing on the west bank of a stream looking eastwards, and we could not get across. This locality is close to the remains of Valle Crucis Abbey and the stream is a tributary of the River Dee, called Afon Eglwyseg. Indeed, Eglwyseg mountain is close by, and most geologists are familiar with the imposing scarp of Carboniferous Limestone north of Llangollen, as shown in the second photograph.

Unconformably beneath the limestone are Lower Palaeozoic, mostly Silurian rocks and in this specific place Ludlovian. A field description of the locality reads: "*The bank facing the abbey consists of Clay slate, which breaks out at regular intervals, striking NW by N, dipping 25° to the NE by N. At different parts of the road the observed beds of diluvium very like Shrops, only no sand; also boulders of trap*." Not my field notes but those of Charles Darwin written on Saturday 6th August 1831. With a couple of geologist friends, one an expert on Darwin, we were hoping to stand on the exact spot where the great man had stood. The beds we were looking at were what Darwin called 'diluvium', recent deposits left in the beds of vigorous streams that were very active at the end of the Devensian. The geology is very complex as base level varied quickly and small lakes were common, all cut into the Lower Palaeozoics.

Eglwyseg Rocks. Photo Eirian Evans, Creative Commons Attribution-ShareAlike 2.0 license.

However, Darwin's tour of Wales was the focus of my visit. In 1831 he was 22 years old and he had just completed his degree at Cambridge with great interests in botany and geology. He already had his eye on possible visits to South America which would result in the Beagle expedition. In the meantime he accompanied Professor Adam Sedgwick for a geological tour of Wales. This might seem an odd partnership; Sedgwick was 46 and has been called 'a muscular Christian' geologist, but there were advantages; Darwin would learn from one of the leading geologists of the time and Sedgwick would have an enthusiastic, strong and intelligent companion. They would also be starting from Shrewsbury, Darwin's home, and this was the first day's geology.

You can follow the tour yourself as Darwin's field notes appear online. They are direct copies of his hand written notes, and take some deciphering. The first stage is to get into http://darwin-online.org.uk/ His field notes are very difficult to find but I followed /content/record?itemID=CUL-DAR5.B5-B16, but it does not always seem to work. However, there has been a paper written on this tour, that is also to be found on the Darwin site:

Barrett, Paul H. 1974. The Sedgwick-Darwin geologic tour of North Wales. *Proceedings of the American Philosophical Society* 118, No. 2 (19 April): 146-164 ►

It has to be remembered that this was the time of the emergence of modern science, indeed the word 'science' was only just beginning to replace Natural Philosophy in the vocabulary. Barrett points out that Sedgwick's field notes and letters indicate a top down 'inductive' science, dealing almost exclusively in geological facts, whereas Darwin has a more deductive approach; not only does he describe the rocks, he suggests reasons, proposes hypotheses and tries to link one science to another, as in the relationships between rock types and vegetation. A 22 year old genius. ■

Bill Groves

Members' Forum

Erratic boulders in Colorado, USA

These photos show the use of large erratic boulders, of which there is a plentiful supply, to create objects which draw the public's attention.

Bottom left, is one which has been cut in half and the cut surfaces polished. They show wonderful veining within a gneiss. It has been set in a public area with a deliberate paved path through the middle which draws people in to look and to touch.

Right, is a granite erratic boulder which has been cut in half and the middle carved and polished. Holes for arms and head, and steps have been cut allowing both tall and short, young and old to get a 'rock look' photo - who can resist!

While somewhat unconventional, these are great examples of getting the public looking at rocks close up, and feeling and experiencing their texture. This can only lead to more people becoming interested in rocks and wanting to learn more about the fascinating world of geology. ■

Graham Hickman

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