



# The Black Country Geological Society

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# Newsletter No. 222

## December 2013

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**Copy date for the next Newsletter is  
Saturday 1st February 2014**

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.

<p><b>Linda Tonkin,</b> <b>Honorary Secretary,</b> 4 Heath Farm Road, Codsall, Wolverhampton, WV8 1HT. ☎ 01902 846074 <a href="mailto:secretary@bcgs.info">secretary@bcgs.info</a></p>	<p><b>Andy Harrison,</b> <b>Field Secretary,</b> ☎ 01384 370 188 Mob: 07973 330 706 <a href="mailto:fieldsecretary@bcgs.info">fieldsecretary@bcgs.info</a></p>	<p><b>Julie Schroder,</b> <b>Newsletter Editor,</b> 42 Billesley Lane, Moseley, Birmingham, B13 9QS. ☎ 0121 449 2407 <a href="mailto:newsletter@bcgs.info">newsletter@bcgs.info</a></p>
<p>For enquiries about field and geoconservation meetings please contact the Field Secretary. To submit items for the Newsletter please contact the Newsletter Editor. <b>For all other business and enquiries please contact the Honorary Secretary.</b></p>		

## 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.**

**Please let Andy Harrison know in advance if you intend  
to go to any of the field and geoconservation meetings.**

**Monday 9th December (Indoor meeting, 7.00 for 7.30 start): BCGS Members' Evening and Christmas Social.** There will be four short presentations from BCGS members, with time before and between presentations to socialise and enjoy the Christmas buffet provided by the Society. This is also an opportunity for you to bring along your treasured geological specimens for all to see - and perhaps for some help with identification. This is an evening not to miss!

**Monday 27th January (Indoor Meeting): 'Testing the Bytham River hypothesis'. Speaker: Professor Philip Gibbard,** Cambridge Quaternary Department of Geography.

**Sunday 2nd February (Conservation day): Springvale Park, Wolverhampton,** vegetation clearance. Meet at 10:30 for 11:00 at the end of Ettingshall Park Farm Lane just off A459. Wear old clothes, waterproofs and stout footwear. Please bring gloves and garden tools; loppers, secateurs, forks and spades if you have them. Also bring lunch. Finish at 14:30.

**Monday 24th February (Indoor Meeting): 'The Precambrian Fossils of the Long Mynd, Shropshire'. Speaker: Dr Alex Liu,** Henslow Junior Research Fellow (Girton College), Department of Earth Sciences, University of Cambridge.

**Sunday 2nd March (Conservation day): Barr Beacon.** Meet at 10:30 for 11:00 at the entrance on B4154 Beacon Road, opposite Bridle Lane (the southern entrance to Barr Beacon) Grid ref: SP060 967. Wear old work clothes, waterproofs and stout footwear. Please bring gloves and garden tools; loppers, secateurs, forks and spades if you have them. Also bring lunch. Finish at 14:30.

**Monday 24th March (Indoor meeting, 7.00 for 7.30 start): AGM** followed by **'From the Depths: how Speleothems reveal Quaternary Climatic History'. Speaker: Professor Ian Fairchild,** Head of School of Geography, Earth and Environmental Sciences, University of Birmingham.

**Saturday 12th April (Field meeting): Barrow Hill and other Geoconservation sites, led by Andrew Harrison.** Joint trip with the Warwickshire Geological Conservation Group. Starting at Barrow Hill, we will then visit Springvale Park, Barr Beacon and Rowley Quarry. Meet on Vicarage Lane, Barrow Hill Nature Reserve, Grid ref: SO 915894, at 10.30 am. Bring packed lunch and stout footwear. From Barrow Hill we will need to car-share due to restricted parking at Springvale Park and Rowley Quarry. From Barrow Hill we will head to Barr Beacon Quarry first. Please contact the Field Secretary (details above) to show your interest in attending.

**Monday 28th April (Indoor Meeting): 'Wine, Whisky and Beer: the role of Geology'.**  
**Speaker: Professor Alex Maltman,** University of Aberystwyth.

**Saturday 10th May (Field Meeting): Visit to the Oxford University Museum of Natural History.** Led by **Professor Paul Smith** (Museum Director). Details tbc.

**Tuesday 13th May (Indoor Meeting at Wolverhampton University starting at 6.30)**  
**Speaker: Professor Hazel Rymer,** Open University. This is a joint meeting with the West Midlands group of the Geological Society. Details tbc.

**Monday 22nd September (Indoor Meeting): Forensic Geology** (title tbc). **Speaker: Dr Haydon Bailey FGS,** Senior Vice President of the Geologists' Association.

**Monday 20th October (Indoor Meeting): The Island of Rum, Diary of a 60 Million Year Old Magma Chamber in 2014.** **Speaker: Dr Brian O'Driscoll,** Keele University.

**Monday 17th November (Indoor Meeting): The Galapagos - geology, fauna and flora.**  
**Speaker: Dr Les Riley,** Consultant Stratigrapher.

## 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.

### Herdman Society Symposium

**Saturday 22nd February 9.30 - 5.00: 'Geoscience Frontiers 5'**

A day of lectures at the Sherrington Lecture Theatre, University of Liverpool, and wine reception from 5.00 - 6.00. Full details will be published in early January. The charge to non-students will be £10, which includes programme, buffet lunch, tea/coffee and wine reception.

**Prof Brian Bluck** (Glasgow): 'Putting Scotland together: the role of the Old Red Sandstone'.

**Prof Simon Conway Morris** (Cambridge): 'Eight evolutionary myths: The closing of the Darwinian mind?'

**Dr James Hammond** (Imperial): 'Science without borders: Unravelling the mysteries of Mt. Paektu Volcano, North Korea'.

**Dr Katherine Joy** (Manchester): 'Moon impacts: unravelling the history of inner Solar System bombardment'.

**Prof Tim Lenton** (Exeter): 'Revolutions that made the Earth'.

**Prof Andrew Scott** (Royal Holloway): 'Wildfire: The burning issue - the geological history of fire'.

Persons interested in attending should contact Helen Kokelaar, e-mail: [herdman@liverpool.ac.uk](mailto:herdman@liverpool.ac.uk)

### North Staffordshire Group of the Geologists' Association

**Thursday 9th January: The Big Chill... Life, death, and destruction, a story from the end of the Ordovician.** Speaker: Keith Nicholls, Chester.

**Thursday 13th February: Rebuilding terrestrial ecosystems after the end-Devonian mass extinction: a major turning point in terrestrial evolution.** Speaker: Prof. Sarah Davies, Leicester.

All talks are held in William Smith Building, Keele University, at 7.30. Further information at: [www.esci.keele.ac.uk/nsgga/](http://www.esci.keele.ac.uk/nsgga/)

## Shropshire Geological Society

**Wednesday 8th January: Escape from an earthquake.** Speaker: Dr Richard Hamblin.

**Wednesday 12th February: Water along fault zones.** Speaker: Sian Loveless.

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/](http://www.shropshiregeology.org.uk/)

## Warwickshire Geological Conservation Group

**Wednesday 15th January: Mud - a guide to drilling for Oil.** Speaker: Hugh Jones (Warwick).

Venue: St Francis Church Hall, Warwick Road, Kenilworth CV8 1HL. For more details visit: <http://www.wgcg.co.uk/> or contact Ian Fenwick [swift@ianfenwick.f2s.com](mailto:swift@ianfenwick.f2s.com) or 01926-512531. There is a charge of £2.00 for non-members.

## Woolhope Naturalists' Field Club - Geology Section

**Friday 24th January: 'Structural mapping and interpretation of a complex unconventional gas discovery'.** Speakers: Dr Tim Wright & Sarah Pearce, Consultant Geoscientists at Merlin Energy, Ledbury.

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](mailto:svh.gabbros@btinternet.com) or visit their web site: [www.woolhopeclub.org.uk/Geology\\_Section/default.htm](http://www.woolhopeclub.org.uk/Geology_Section/default.htm)

## Lapworth Lectures

**Monday 20th January: 'Preserving natural stone. Importance in economy and architectonic heritage'** Speaker: Dr Lola Pereira - University of Salamanca, Spain.

Lectures at 5.00 in the Dome Lecture Theatre, Aston Webb Block A - Building R4, University of Birmingham. All are welcome to attend and there is no admission charge. For further information phone: 0121 414 7294 or visit: <http://www.lapworth.bham.ac.uk/events/lectures.shtml>

## Mid Wales Geology Club

**Wednesday 19th February: 'The Origins of Life'.** Speaker: Dr Geoff Steel.

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

## Teme Valley Geological Society

**Monday 9th December 7.30pm (in the Crown pub): Volcanoes in the Solar System.** Speaker: Dr Paul Oliver.

**Monday 27th January 7.30pm: What Crystals in Ash can tell us: Examples from Mount St. Helens.** Speaker: Thomas Jones.

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 Janet Maxwell-Stewart, 01886 821061

## Manchester Geological Association

**Wednesday 11th December at 7.00pm: Mining the Yard Seam in New Mills in the 18th and 19th Centuries.** Speaker: Dr Derek Brumhead MBE, Manchester Geological Association. Coffee, tea and biscuits will be available from 6.30pm.

**Saturday 25th January - The Broadhurst Lectures: The 'Avian Dinosaurs':** Latest Research on some early fossil birds:

**Secrets of Archaeopteryx revealed by Synchrotron Analysis.**

Speaker: Dr John Nudds, University of Manchester.

**The Gliding Flight of Feathered Dinosaurs and the Evolution of Bird Flapping.**

Speaker: Dr Gareth Dyke, University of Southampton.

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

## Editorial

The autumn season got off to a good start with a very informative field trip to Charnwood, then two enjoyable and well-attended indoor meetings in October and November. There have been two rather different clearance sessions so far. At the Himley cutting on 2nd November the small work force made a very satisfying difference to the exposure of the Bridgnorth Sandstone after clearing masses of vegetation, and at Barnt Green Road Quarry in the Lickey Hills on 24th November, the aim was to remove as much of the accumulated scree as possible to re-expose the spectacular structures in the Ordovician Lickey Quartzite formation. Both days were enjoyed by those who took part, but it would be good to see more of you getting involved in this important work.

Please note the slight change in format on p.2 showing the contact details of Society Officers above the Future Programme. Please follow the instructions and try to make sure that you contact the correct person for your enquiry.

I'm pleased to have received permission to re-print Hannah Townley's article (below) about the recent up-grading of Barrow Hill and Tansey Green to SSSI status. Please note that a field visit has been organised in April next year to include this very important site - and Barrow Hill is also subjected to a bit of topical humour from your Chairman! (p.6) ■

A Happy Christmas and New Year to you all.

*Julie Schroder*

## Volcanic masterpiece is new SSSI

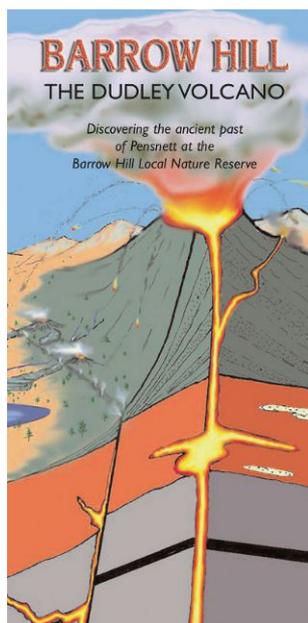
**Barrow Hill and Tansey Green, in the West Midlands, was notified as a geological Site of Special Scientific Interest in April 2013.**

The site was selected because it shows an exceptional example of a volcanic vent with associated deposits and it is internationally important for the presence of the oldest anatomically preserved conifer-like stems. It forms part of a network of sites demonstrating igneous activity across Great Britain during the Carboniferous Period.

Around 315 million years ago, the area where Barrow Hill now stands lay at the southern edge of a vast tropical river delta swamp. The sediments deposited in these swamps form the Coal Measures. ►



*Examining the volcanic deposits at Barrow Hill SSSI. Photo by Colin Prosser*



Earth movements and faulting at this time allowed magma to rise up through the crust and intrude these sediments. At Barrow Hill, surges of ash and lava erupted from a volcano. Conifer-like plants growing on the slopes of the volcano were buried by a gentle, but rapid ash-fall deposit that preserved them in life position at Tansey Green. The heat from the ash charred the outer bark, but the internal structure has been well preserved, making them the oldest three-dimensional conifers discovered in the world so far.

The Barrow Hill part of the site was previously declared a Local Nature Reserve (LNR) by Dudley Metropolitan Borough Council. The site is of high recreational value for local people and many footpaths cross the site. There is a self-guided trail and leaflet describing the geology of Barrow Hill and Tansey Green, produced by The Black Country Geological Society - [Barrow Hill – The Dudley Volcano](#). ■

*Dr Hannah Townley, Natural England*

Article courtesy of Earth Heritage ezine, for free digital version visit [www.earthheritage.org.uk](http://www.earthheritage.org.uk)

## Dudley Volcano Erupts! Eyewitness report - courtesy of Dr. Who!

About twenty years ago, a volcanic plug in an old worked out quarry, with nearby ash deposits, was identified right next to Russells Hall Hospital in Dudley. A volcanic ash deposit was also found less than half a mile away at Tansey Green. It had all the characteristics of its searing origin as molten magma at 1000 degrees and more. This is a deposit of loose, unconsolidated lapilli (Italian: little stones), called tephra initially, but after the passage of 300 million years or so, it is now a tuff deposit, containing very weathered volcanic bombs. It also contains the earliest known fossils of a conifer with complete internal cellular structure. These conifers were growing in situ when they were buried in hot ash which charred them but amazingly preserved their internal structure.

By kind permission of Dr. Who, we borrowed the Tardis to enable our reporter to witness an eruption, some 300 million years ago:

"The sky is lit by brilliant flashes of lightning playing around an enormous column of black smoke from which great sheets of glowing ash are falling. A bright red line snakes down the volcano's side as a fiercely hot stream of lava relentlessly pours out of a jagged, fiery fissure near the summit.

A sudden violent explosion rents the air and a vast plume of smoke, gas, shattered glowing lava fragments, and incandescent dust shoots up into the heavy looming sky.

Several large gleaming lumps of lava, rounded and streamlined by their brief flight, hit the dusty surface nearby with a loud squelchy splat.

The sea is steaming as hot ash hits the water surface, pock-marked with falling chunks of glowing lava, mixed with phreatic explosions erupting great columns into the air.

The wooded western side of the volcano has disappeared under thick layers of hot ash, every tree buried deeply in the smoking, sulphurous piles of fragmented lava. A vast, rolling, billowing cloud of glowing dust suddenly roars down from the summit, hitting the shallow sea, boiling it into enormous hissing masses of steam, producing a sound as if ten thousand steam engines opened their valves together. ►



I jump back into the Tardis as, without a warning sound, I see in the corner of my eye an unimaginably vast billowing cloud of evil grey dust radiating heat so intensely that it is scorching my face and hands, and approaching faster than the speed of sound. Just in the nick of time I close the doors as the pyroclastic flow charges with overwhelming force - but engulfs just an empty space as the Tardis screeches into the present." ■

Gordon Hensman

## Field and Conservation Meeting Reports

**Sunday 20th October: Charnwood Forest Field trip - Part 2.** Led by Mike Allen, BCGS.

This return to Charnwood Forest followed the field trip undertaken for BCGS in October 2012. Following overnight rain, the day was warm and windy with broken cloud, sunshine and showers. We met around 10:00am in the services car park off Junction 22 of the M1, where Mike provided a brief recap on the region and its geology.



*Cliffe Hill Quarry*

Charnwood Forest itself is nestled between Leicester, Coalville and Loughborough. The local area is relatively elevated and comprises gently undulating isolated hills, including Cliffe Hill, Spring Hill, Beacon Hill and Bardon Hill (the highest at 180m). The surrounding landscape is relatively low lying and flat with the Thringstone Reverse Thrust fault separating the rocks of Charnwood Forest from the Coal Measures of the Leicestershire Coalfield over to the west.

Underlying Charnwood Forest are rocks belonging the Charnian Supergroup, which are Precambrian and Cambrian in age. The Supergroup is split into three main groups, including the Blackbrook Group (oldest), Maplewell Group (middle) and the Brand Group (youngest) - see table below. When mapped out these rocks trace the outline of a large folded structure, the Charnwood Anticline, which accounts for the elevated topography of the area. ►

AGE	GROUP	
PERMO-TRIASSIC	MERCIA MUDSTONE GROUP (Cliffe Hill Quarry)	
	CHARNIAN SUPER GROUP	
CAMBRIAN	BRAND GROUP	Swithland Greywacke Formation, undivided
		Hanging Rocks Conglomerate / Stable Pit Quartzite (Charnwood Golf Course)
PRECAMBRIAN	MAPLEWELL GROUP	Swithland Camp Conglomerate
		Bradgate Tuff Formation, undivided (Billa Bara, Cliffe Hill and Markfield Quarry)
		Sliding Stone Slump Breccia
		Park Breccia
		Buck Hills Greywacke
		Dacites and Andesites
		Charnwood Lodge Agglomerate
		Beacon Hill Tuff Formation, undivided (Beacon Hill Park)
		Benscliffe Agglomerate (Felsitic Agglomerate)
	BLACKBROOK GROUP	One Barrow Breccia
	Blackbrook Formation, undivided	

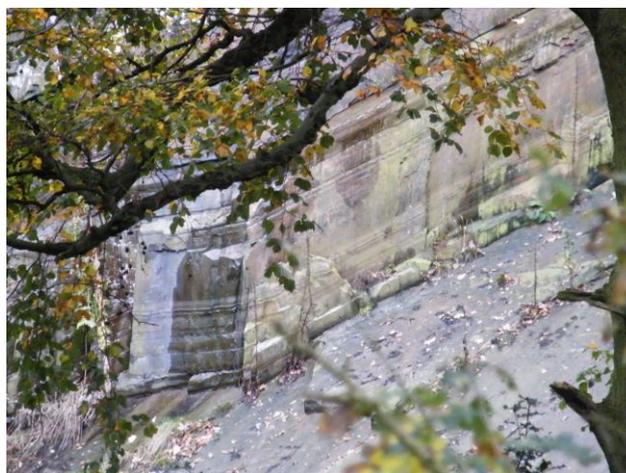
Our visit centred on three locations dotted around Junction 22 of the M1: Billa Bara, Cliffe Hill and Markfield Quarry, and two locations further north: Beacon Hill Park and Charnwood Golf Course. The rocks at these locations generally consist of volcanic deposits and granodiorites belonging to the Precambrian Maplewell Group, and represent the southern limb of the Charnwood Anticline.

The volcanic deposits mostly comprised fine-grained dark and pinkish-grey, weathered black and yellow-white, thinly laminated fractured tuffs with vertical quartz veins. Closely to moderately spaced weathered cleavage and fractures, gave the tuffs an appearance of bedding. Tilting of these laminations and fractures is indicative of local minor folding on the main fold limb of the Charnwood Anticline. Also quartz slickensides on fracture surfaces provide evidence of past local sliding events.

The granodiorites, belonging to the Markfield diorite / granodiorite, comprise dark, coarse crystalline rocks rich in red / pink-brown feldspar and other dark minerals. These intrusive acidic rocks form part of the Markfield Succession, which is part of the South Charnwood Diorite complex occurring within the upper parts of the Maplewell Group.

Together these rocks form a Precambrian / Cambrian landscape that hints at ancient volcanic arcs, shallow seas and episodes of tectonic deformation. Through the Palaeozoic these rocks formed part of a landmass, or craton, which became part of the former St George's Land. Ancient wadis, cut into this landscape during the Triassic, were later filled with layers of red-brown and green-grey Mercia Mudstone, and we saw great examples of these at Cliffe Hill Quarry (see photo above).

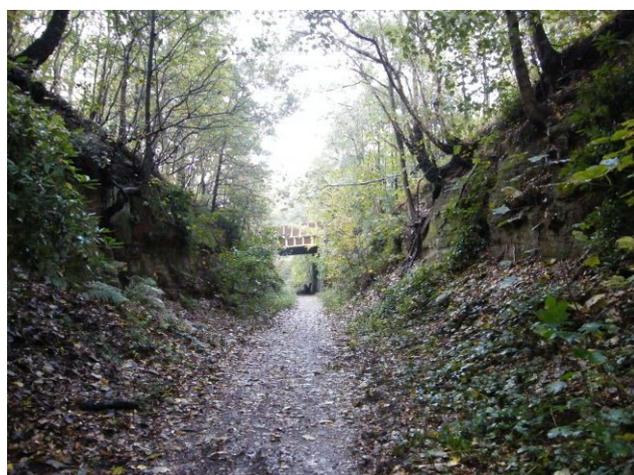
Our final location for the day was a wooded track bordering Charnwood Golf Course. Through the trees and bracken we caught sight of the rather weathered, algae covered Cambrian Hanging Rocks Formation, part of the Bradgate Member. It was on these rather unimposing rocks that in 1957 local schoolboy [Roger Mason](#) discovered the fossil that makes this site so important, [Charnia masoni](#). It is unknown exactly what this organism was or how it lived, but it was the first of its kind to be discovered and has been followed since with many varieties both locally and around the globe. To help protect this site a representative peel of these rocks has been taken and can be seen on display in Leicester museum.



*Cambrian Hanging Rocks Formation where Charnia masoni was discovered by Roger Mason*

I would like to thank Mike for another very interesting day.

### **Saturday 2nd November: Geoconservation Day, Himley Railway Cutting**



*Himley cutting before clearance*

Organised in partnership with the Baggeridge Country Park (BCP) Rangers this visit was the first visit for BCGS members. The section of cutting we visited, between the Himley Plantation and Wombourne, is approximately 250m long and situated between two over-passing bridges.

The Great Western Railway Company built the railway between 1912 and 1925 to serve the rural area between Dudley and Wolverhampton, via Wombourne, Himley and a small Halt at Lower Penn. The former railway covers a distance of approximately 14km (9 miles) and fell victim to Dr Beeching in June 1965. Today, walkers, cyclists and horse riders use the route for more leisurely purposes. ►

We met the BCP Rangers at 10:30 in the car parking area off Himley Lane on a cold, cloudy, damp and windy morning. Luckily the cutting provided some good protection from the elements. The Rangers are responsible for looking after the length of this former railway line, but its length makes this task very difficult. The Rangers undertook clearance work some years previously, however the cutting has since become heavily overgrown, with brambles, trees and scrub leaving only a hint of the hidden rock faces beneath.



*Himley cutting after clearance*

From the cars we walked northwards along the former railway route to the southern end of the cutting. Once set up we started clearing vegetation, from approximately 50m of cutting, exposing high walls of red-brown Permian Bridgnorth Sandstone Formation. Sweeping concave cross-bedding defines stacked sequences of barchan desert sand dunes that comprise the cutting walls.

BCGS have been given permission to go back and undertake more clearance work at this site, which is also in need of ongoing maintenance. I would like to thank the BCP Rangers for their time and the provision of cups of tea and look forward to helping out with more work in the future. ■

*Andy Harrison*

## **BCGS lends a hand at Barnt Green Road Quarry**

*This quarry is one of two cared for by the Lickey Hills Geo-Champions under the Herefordshire and Worcestershire Earth Heritage Trust's 'Champions project'. Although outside the normal area covered by BCGS, the quarry is not far from the Rubery Cutting where members of BCGS have already done some clearance work with the Geo-Champions and other volunteers from the Lickey Hills Country Park. The report below was written by BCGS member Adrian Wyatt for the Champions web site, and we are grateful for permission to re-print it here. Ed.*

For more information about the Lickey Hills Geo-Champions see: <http://ehtchampions.org.uk> ►



*The clearance at Barnt Green Road Quarry begins*

By 10.30 on Sunday 24th November the regulars at the Lickey Hills Visitor Centre were momentarily outnumbered by volunteers eager to start the 2nd conservation day of the season. An amazing 25 people signed the attendance register! After collecting the tools and equipment and packing the 4 x 4 the group made haste to Barnt Green Road Quarry. On this occasion support came from the Black Country Geological Society, the Gloucestershire Geology Trust, the West Midlands Regional Group of the Geological Society, local students, together with the Lickey Hills Geo-Champions and Steve Hinton (Senior Ranger, Lickey Hills Country Park).



*Bernard studies the 'feature'*

Work included removing vegetation and scree from the main West face of the quarry and carefully digging down and around the recently discovered 'feature' on the south face. Later, more adventurous activity was undertaken on the upper south face. This was led by Steve with the aim of revealing the bedrock in the area of the fault. Although it seemed crowded and there could have been a case for "too many cooks", it all turned out well, with everyone taking it in turns to do their bit.



*Excavating the 'feature'*

In the end, was anything achieved? Well, we can see more solid rock face, so that must be good! As to answering questions held over from last time, that's not been so successful. The 'feature' has grown in size and still poses many questions. Why does it look different? We are certain it is Lickey Quartzite Formation, the same as the rock surrounding it. Are the original bedding planes disturbed or are they still there? Is it a slip plane or joint surface of some sort; or is it connected with the faulting? There is talk of a gathering of clinometers for a mass survey of all the bedding planes in sight. Yes, it might help to tackle this from a different angle! Well done to everyone who came, hope you all enjoyed it. ■

*Adrian Wyatt*

## When the Earth Shook Trinidad

The evening of 11th October 2013 was similar to most Friday nights in Trinidad. My wife and I decided that a night in was needed and an early night highly desirable, but our 'early night' was disrupted. We were rudely awoken by a violent shaking and loud rumbling, similar to a large freight train rattling past.

The whole house was shaking, side to side and up and down; it was an earthquake! However, unlike the previous earthquakes I had experienced in Trinidad it seemed to go on forever, although the shaking probably only lasted 30 seconds. My heart was racing, the dogs next door were barking. We had rushed into our bathroom and donned dressing gowns and slippers. "What do we do now?" questioned my wife. I had to admit that I had no real plan and the house was still shaking like a ship on heavy seas. Suddenly the shaking and the noises stopped. Was it over? What next? Aftershocks? How big was it? How much damage had been done?

Almost immediately the phone began to ring. Our neighbours, many of whom had lived here for 30 years plus, were sharing their experiences via WhatsApp group chat: "Wow that was a big one." But the strongest thread seemed to be, "biggest I've ever experienced!"

With no apparent damage and with the power still on, we endeavoured to go back to sleep, but the earthquake was unsettling. It had lasted much longer than other earthquakes we had experienced in Trinidad. Previous quakes had only lasted about 10 seconds at the most, but this was different. We had been woken by it, and it had lasted long enough for us to start moving around the house knowing we had no idea what we were supposed to do. ►

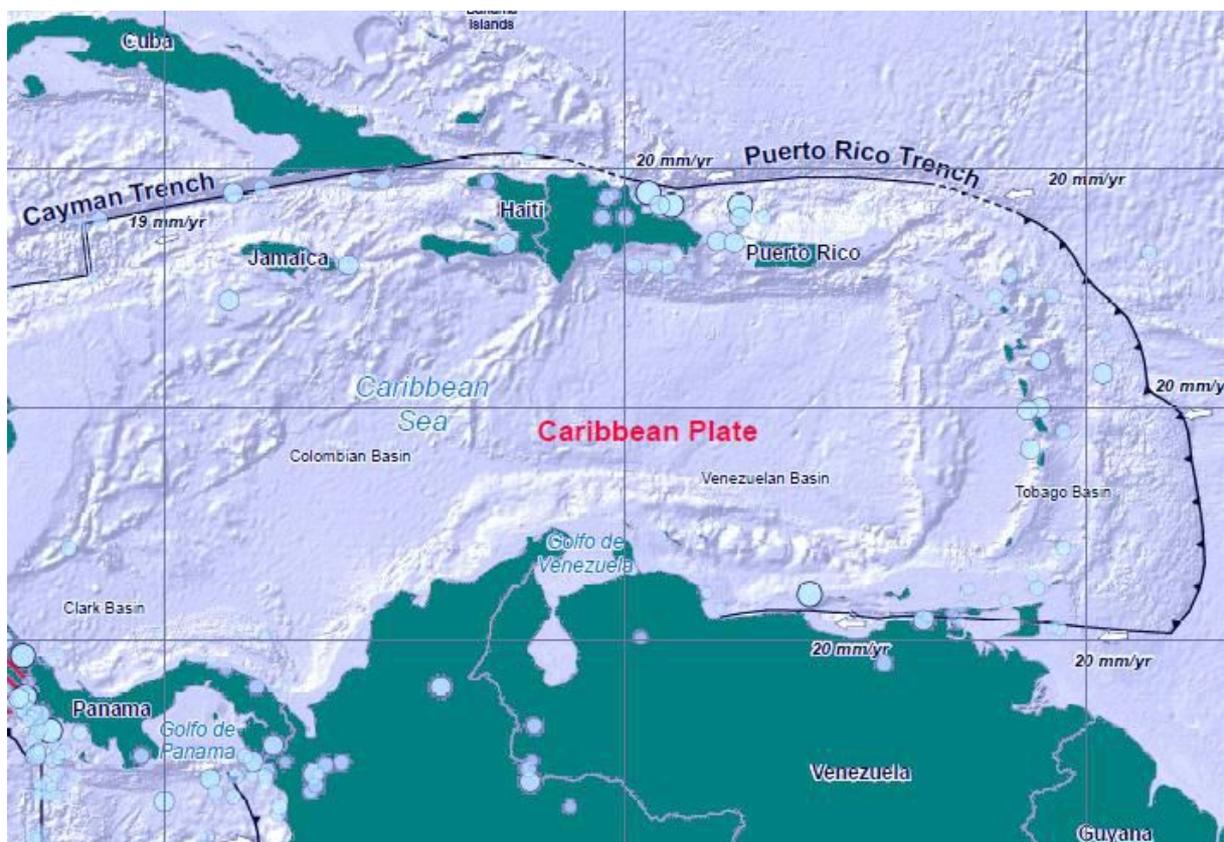
On the radio the next morning we learned that the University of the West Indies (UWI) recorded the earthquake as of magnitude 6.4 occurring at 10:10pm local time. The event was located at 10.86°N 62.12°W, north-west of the Paria Peninsula, Trinidad and offshore Venezuela. The epicentre was at a depth of 60km and approximately 50km away from our home. Only minor damage and few injuries were reported, although several areas had suffered power outages. The United States Geological Survey (USGS) later issued a report lowering the magnitude estimate to 6.1. Apparently UWI often has higher readings than the USGS. Magnitudes 6.0 - 6.9 are still classed as strong earthquakes.

The USGS reports on the earthquake can be found at:

<http://comcat.cr.usgs.gov/earthquakes/eventpage/usb000kbhi#summary>

The great depth at which the earthquake occurred was probably the reason why little damage was recorded; the shock waves travelling up from depth cause the buildings and ground to move up and down in phase. Had the earthquake been shallower with shock waves moving more horizontally causing differential displacements the damage would undoubtedly have been greater. We were lucky! July through to December is also the wet season here and landslides are common after heavy rains. September and October have been relatively dry so perhaps we were doubly lucky.

Trinidad is the southern most island in the Lesser Antilles; it straddles the Caribbean and South American plate boundary. The northern part of the island, where I live, rides on the Caribbean plate and has an eastward motion of about 2mm/year while the southern part of the Island rides westwards on the South American plate.



*From the U.S. Geological Survey*

The edges of the Caribbean plate form a large eastward facing arc. A line of north-south volcanic islands formed by the subduction of the Atlantic Oceanic crust and large lateral strike-slip faults form the northern and southern boundaries.

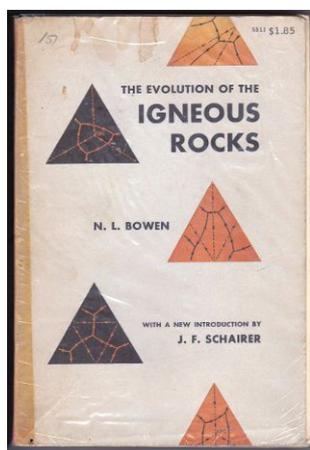
The earthquake we experienced was associated with the lateral movement on the southern boundary of the Caribbean plate. The 12th January 2010 Haiti earthquake (Magnitude 7.0) was associated with movement along thrust faults related to the northern edge of the same plate. ►

After doing some research I discovered that since 1900, the largest earthquakes to occur along the southern Caribbean plate region were the 29th October 1900 M7.7 Caracas earthquake, and the 29th July 1967 M6.5 earthquake near this same region. Although on 21st October 1776 an earthquake near Antigua ~M7.9 caused total destruction of all masonry buildings in Trinidad and the complete destruction of the (then Spanish) colonial economy, the casualties and cost unknown and lost to history.

How does this make me feel? As a geologist I feel cheated having slept through part of the earthquake and not really being fully awake to appreciate the power and awesomeness of the event. My emotions are however somewhat shaken; the event has shown me how fragile and vulnerable the built environment is to these natural events and how unpredictable they are. Lying in bed afterwards trying to go back to sleep, I began wondering if there would be more aftershocks. I realised that living through a major earthquake, where the aftershocks occurred for months afterwards, must be a really terrifying and unsettling experience; one I hope never to experience. ■

Graham Hickman

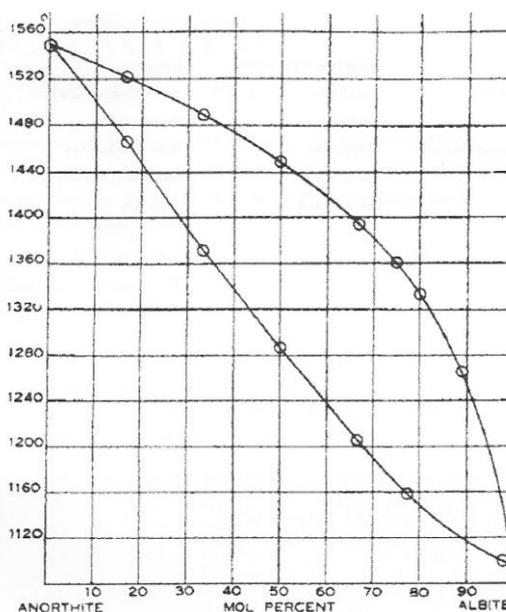
## Geobabble



There is another important geological centenary for this year, and if you glance at the accompanying diagrams, you may recognise phase diagrams. If you have studied geology to A-level or beyond you are bound to know about phase diagrams, and perhaps hated them. Palaeontologists and soft rock sedimentologists however, might switch off now.

Since the days of Hutton, geologists have recognised that igneous rocks were once molten, and that they consisted of different minerals. Feldspars are important constituents, and the chemical composition and structure of the common rock-forming minerals was known at the turn of the nineteenth century. However, there are vast arrays of textures within rocks of similar chemical composition; why are there layered igneous rocks? Why are some crystals zoned? 'The present is the key to the past' is a key phrase in geological investigations; find a modern environment that is producing a similar rock and draw conclusions about the ancient one. This is fine for sediments but not for igneous rocks such as granites; you cannot see granite solidifying from a melt. ►

In 1913, N. L. Bowen published a paper based on laboratory experiments where igneous rocks, or mineral combinations, could be melted in high temperature ovens at high pressure. He represented his results using a phase diagram, and his original diagram of 1913 is shown (right). The vertical axis is the temperature, °C, and the horizontal axis represents the plagioclase feldspar series, between Anorthite ( $\text{CaAl}_2\text{Si}_2\text{O}_8$ ), and Albite ( $\text{NaAlSi}_3\text{O}_8$ ). There are three 'phases' in the diagram; above the top line is liquid, below the bottom line is solid, and between the two is a mixture, i.e. crystals and a melt. As the temperature falls, the composition of the crystals changes and in certain situations they may be removed leading to 'fractional crystallisation'. A horizontal line on the diagram will show the crystal composition (bottom line) that is in equilibrium with the melt (top line). It is beyond the scope of Geobabble to explain the detail of such a diagram; you must use a textbook or ask a member who has studied igneous petrology, but if the crystals are removed, by sinking for example, you can change the final composition of the melt. ►



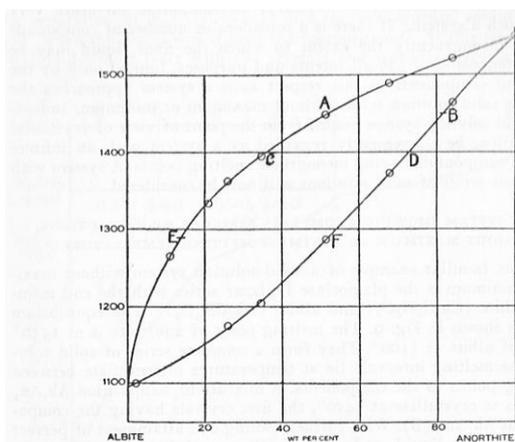


FIG. 9. Equilibrium diagram (after Bowen) of the system, anorthite-albite.

Bowen completed many other investigations, with many different combinations of minerals and published a classic book in 1928. The cover of my 1956 reprint is shown (*above*), much used and repaired. You will notice that on the cover there are triangular phase diagrams, plotting three end members, and you can plot more than three and use diagrams in three dimensions. The diagram for the Anorthite/Albite system is also illustrated (*left*), and as you can see, for some reason Bowen has reversed the x axis.

Phase Diagrams have moved on a great deal since 1956, and this month I noticed a new book entitled 'Phase Diagrams for Geoscientists' by Tibor Gasparik. This gives the results of 1,700 experiments at pressures of 4 GPa (gigaPascals) and at temperatures of 1500 – 2500°C. A few too many phase diagrams for me! ■

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## References

The sources I have used for this Geobabble are Bowen's book and a blog by David Bressan, who is a freelance geologist; you can find him on [blogs.scientificamerican.com/history-of-geology/](http://blogs.scientificamerican.com/history-of-geology/). He is always very interesting and you can follow him on Twitter @David\_Bressan. The book by Tibor Gasparik is published by Springer. ISBN 978-1-4614-5776-3, priced at £117.

Bill Groves

## Members' Forum

### Favourite Websites

I'd like to share a very interesting site with members:

<http://www.rhyniechert.com/ddfossils.html>

This is a great educational and commercial site with amazing fossils, particularly of small specimens and microfossils. Whether you're interested in window shopping or looking to buy an iconic specimen, there's something for most people with a geological taste.

The site shows some fascinating fossils from the Permian and Triassic periods. In addition it offers a wide variety of things from the Palaeozoic through to the Tertiary, for instance: invertebrates, conodonts, ostracods, sharks, amphibians, reptiles, pelycosaurs, dinosaurs, mammals, meteorites, Rhynie chert plants, polished sections and samples from the KT Boundary! These specimens can easily be examined with a hand lens and offer someone with a stereo microscope and/or a compound microscope a great opportunity to examine the micro universe, such as the bone structure of the Permian pelycosaurs! ■

Steven Birch

*Have you any favourite geological web sites? Please let me know, and we can make this a regular feature for the Members' Forum. Ed.*

**What do you call a dinosaur with an extensive vocabulary?**

***A thesaurus***

**A puzzle from our Field Secretary, Andy Harrison**

Can anyone identify this peculiar object, discovered at East Garston Downs, Berkshire?' ■



*Please send your suggestions to the Newsletter Editor (details on p.2) for inclusion in the February issue, when Andy will also reveal the real identity of the mystery object. Ed.*

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