Earth Matters

The Newsletter of the Geology Section of the Woolhope Naturalists' Field Club

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Message from the Chairman

AS YOU KNOW, I shall be relinquishing the WGS chairmanship at the end of the current year, and this must be my final fling - so as to speak - although, of course, I hope for future involvement much as usual! It gives me great pleasure and satisfaction to have been in the thick of things from our beginnings, first as your Secretary and then Chairman, and to have witnessed the blossoming and fruition of the Geology Section. Our progress has been quite remarkable!

Paul and I first thought of forming the WGS at a time when there wasn't too much happening on the geological front in our county, other than the Hfds. & Worcs. Earth Heritage Trust. It seemed only too obvious that this could best be addressed through the medium of the WNFC, much as we did, many years ago, when setting up the Woolhope Archaeological Research Section.

Our first step was to 'sound out' the late Peter Thomson (very enthusiastic!) and for me to approach various members of the Woolhope Central Committee, all of whom recognised the need to do more about Herefordshire's geology and were therefore in total agreement. I drew up the requisite paperwork, promulgated the inaugural meeting, and the rest, as they say, is history - and, of course, the Woolhope Club is always very good at that!

Anyway, I've thoroughly enjoyed my periods in office and always look forward to our programme of events, whether they be day excursions, weekends, or longer jaunts in the UK and further abroad. We've certainly had some fascinating trips and experienced great entertainment and edification - thanks to both our own membership and the various guest speakers and excursion leaders. My heartfelt thanks to all of you, and best wishes for the future: long may we continue in the same vein!

Gerry Calderbank, *Chairman*

MARTLEY VILLAGE

by John Nicklin

MARTLEY is a village of around 1200 people, located seven miles west of Worcester. With an area of 4421 acres, it is a rural parish with several small business centres, but otherwise devoted to mixed agriculture - important cider orchards, sheep, cattle, crops. Unusually these days, for a small village, Martley boasts two pubs, post office and shop, garage and general stores. It is an active, dynamic place with a wide range of activities on offer and teams of enthusiastic volunteers behind them - bell ringing to horticulture, rights of way maintenance to the provision of broadband via a non-profit organisation. Lately, though, geology has taken over the lives of a number of parishioners!

Situated astride the East Malvern Fault, to the east is the relatively flat Worcester basin and to the west hillier, more ancient land with the River Teme in its deep valley forming the western boundary and bisecting the plateau. The village is located near the centre of the Abberley and Malvern Hills Geopark, and the parish is a microcosm of this richly geologically diverse area that extends from Bridgnorth to Gloucester. The 109 mile GeoPark Way runs through Martley.

Approaching from the east (Worcester) side, a continuous line of hills is seen. Being mainly limestone, until recently these provided employment in extensive quarries producing agricultural lime, building stones and hard core for roads. The largest, Penny Hill, vastly extended for the M5 construction, was later used as a refuse dump and now generates electrical power from methane, although this too is now coming to the end of its useful life.

The pit in Haffield Breccia on Berrow Hill.

Many readers will be aware that Martley has an unusual geological claim to fame, in that a site known as 'Martley Rock' is designated on the geological map of the area (BGS sheet 182). This small, celebrated corner of Worcestershire has been regularly visited by researchers since it was first noted by Sir Roderick Murchison in 1839. I became aware of it almost as soon as I came to the area in 1992 and was very keen to find out more but not until 2004 did I visit the site in the company of Dr Paul Olver. We dug a small pit to find, just under the surface, the hard, Precambrian rock used for centuries for local road surfacing. This is the northernmost exposure of Malverns Complex. Six years later, on a damp but auspicious day in February 2010, geologists from the Woolhope Club, led by Dr Olver, and the Earth Heritage Trust together with local landowners and users, spent a day tramping, measuring and recording. More than that, a trench was no sooner suggested than it was excavated, around 80m long, with a speed so awesome it is still talked about. What it showed was an amazing, unexpected and beautiful cross section of faults and co-existing varied rock formations within this confined area.

The Nubbins quarry.in Bromsgrove Sandstone.

The revelations from this operation set in chain a series of events culminating in Martley's aim to be the first European Geo-Village in the UK.

Before launching into some slightly more technical aspects of Martley Rock, it needs to be stressed that it is by no means all that Martley has to offer to the visiting geologist. From north to south there are, as noted above, extensive lines of limestone hills - Much Wenlock to the east, Aymestry above the river to the west, with softer shales between, part of a syncline stretching to the Wenlock Edge. The limestones are very fossiliferous with excellent crinoids, corals, trilobites and brachiopods. Small streams running off the limestone show active tufa deposition. An academic study of bentonite layers in the Silurian, some of them 100-150mm thick, is ongoing (Dr David Ray). On a prominent hill, The Berrow, a pit provides a very fine exposure of Haffield Breccia, and above it, hidden in dense woodland is a small area of Highley Formation, formerly mined for poor but nevertheless usable coal. Remnants of the pits remain and we have coal samples in our possession. To the east of the fault line, soils are red and sandstone quarries (The Nubbins, in Bromsgrove Sandstone), their cliffs clearly visible from the road, show where much building stone was extracted

to construct, i.a., St Peter's Church. On lower, western lands, near the river, ploughing exposes red soils once again but of a deeper hue - the Raglan Mudstone of the upper Silurian. At low water downstream of Ham Bridge over the Teme, a reef of this rock can easily be seen.

The unique geology of the area prompted a local group, supported by H&W Earth Heritage Trust and the Woolhope Club, to apply for European (LEADER) funding. Teme Valley Geological Society was formed in 2011 and in its second year has seventy paid up members and 150 on the e-mail circulation list. The society won funding of £26310 for the Martley Geology Project, commencing August 2nd 2011 with the following objectives:

* To produce an illustrated audit of all known sites, 45 listed, 32 surveyed - completed.
* To develop Martley Rock as a visitor attraction - completed.
* To produce primary school educational packs and to train teachers - ongoing.
* To sponsor three evening courses in geology - last one, autumn 2012.
* To foster sustainability through a geotourism initiative - ongoing.

The Society has bold plans for the future. We have landowner permissions to place four additional interpretation boards. We will develop two more trails, run courses and liaise with overseas geo-villages in France and Germany.

The Society has a web site with blog (www.geo-village.eu) and is developing a presence on Facebook. A regular programme of talks and field trips is maintained. The second annual 'Rock Day' was held on 17th November - an exciting occasion with an evening multimedia Jurassic Journey presentation, geology walks, Silurian Morris dancers and cakes.

Multicoloured clays seen in the trench at Martley Rock..

Finally, we give more detail on Martley Rock (by kind permission of H&W Earth Heritage Trust).

Martley Rock straddles the junction between the Palaeozoic and Mesozoic rocks of Britain. To the east of the site Triassic sediments continue, initially Bromsgrove Sandstone Formation and then, further to the east, Mercia Mudstone Formation units. To the west of the trench, Silurian Raglan Mudstone Formation continues which then gives way to Devonian-aged rocks. The site itself lies on the roughly north-to-south line of the East Malvern Fault. Locally this has given rise to the Abberley Hills ridge (Silurian-aged Wenlock and Ludlow rocks) to the north; Berrow Hill (capped with Permian-aged rocks) and Ankerdine Hill (Silurian-aged rocks of the May Hill Sandstone Group) to the south. Martley Rock is crossed by the East Malvern Fault and the complexity of the site is attributed to this.

Thanks are due to Cob House Fisheries for their kind and continuing assistance with the Martley Rock site and support of the geology project.

The Severn valley and the Malverns from Penny Hill.

Key Features of Martley Rock

Malverns Complex Exhibits a mixture of acidic to mafic meta-igneous rocks and shows exposures which are heavily sheared and altered granite/diorite which are also highly weathered. Exhibits a fresh exposure of pink and green mottled intermediate meta-igneous rock. It is the most northerly exposure of the Malverns Complex.

Martley Quartzite Exhibits tectonised, sheared and shattered quartzite exposures. Presents exposures of relatively less friable quartzite. Faulting illustrates a relationship to the East Malvern Fault. Shows complex faulting and thrusting relationships.

Halesowen Formation Displays a section through a wide variety of coloured Halesowen Formation siltstones/clay.

Raglan Mudstone Formation Raglan Mudstone Formation exposed in the floor of a section of trench.

Relationship between, and variety of, geological periods represented
Precambrian, Cambrian/Ordovician, Silurian, Carboniferous, Triassic and Quaternary deposits exposed on site.

Economic geology An example of small scale quarrying for reportedly non-commercial purposes.

THE STANNER-HANTER IGNEOUS COMPLEX

by Dr Susan Hay and Dr Geoff Steel

SINCE OUR ARTICLE in Earth Matters No 6, we have continued to investigate the Stanner-Hanter Igneous Complex. A fire earlier this year on Hanter Hill has cleared the gorse from an area we have long wanted to examine. We think it is now time to update you on our progress in understanding this complex, in particular its emplacement history.

Fig. 1. Three rock types seen on Hanter Hill.

The Stanner-Hanter Complex forms an inlier of intrusive igneous rocks within the Church Stretton Fault. It has been proposed that the complex represents the remnant of a magmatic 'feeder zone' located within the roots of a volcanic arc, i.e. it is subduction related. A recent high precision U-Pb zircon age of 710.8 ± 1.5Ma has been calculated from a biotite microgranite on Hanter Hill. The same authors also found that both the gabbro and granitic material contains older crustal material at least 1300My old.

At first glance it all seems so simple. The majority of Hanter Hill is composed of dolerite that has been intruded by gabbro, and there are also later fine- to medium-grained acid rocks, which are volumetrically much smaller. These three rock types can be seen in very close proximity in the area of this year's fire (Figure 1, in which the hammer's head is immediately below the acid rock). Later dolerites are only found as dykes on the western side of the hill. These are thought to be much younger and will not be considered further.

Fig. 2

However, these different rock types have not formed in isolation. There is a lot of evidence of magma interaction during its ascent and emplacement, some of which we will now describe. The fine-grained dolerite and the coarse-grained gabbro both have the same essential mineralogy, augite (a clinopyroxene) and a calcic plagioclase feldspar. They are likely to have formed from very similar magmas but the dolerites have cooled faster, probably because they were intruded into cold crust, and they are virtually featureless. Generally with gabbros homogeneity is not the rule; they exhibit many details that record the magma's crystallisation history.

Fig. 3

The magma for these basic rocks is likely to have originated in the mantle. It is common for such ultramafic magmas to leave ultramafic material either underplating the lower crust or within the lower crust. As no ultramafic rocks are seen in the complex it is assumed that this has probably occurred. The now-changed (evolved) magma ascended through the lower crust, assimilating crustal material as shown by the published isotopic data. Magma may also have crystallised in place and been left there. These processes would have continued during the magma's ascent through the crust. Most of the currently exposed gabbro was not intruded in a single episode but rather as a series of sills from separate pulses of magma, each of which may have been geochemically slightly different.

Whilst some of the gabbro on Hanter Hill looks fairly uniform, other areas exhibit a wide range of crystal sizes (Figures 2 and 3). These crystals cannot have developed together but probably crystallised in different parts of the

Fig. 4. Igneous layering in gabbro.

feeder system or possibly different parts of the same magma chamber. Ascending magma then entrained blocks of these. Sometimes these blocks appear to have been relatively undisturbed, as in Figure 2 (below and to the right of the notebook). Other entrained material has much more indistinct boundaries where interaction with the magma has occurred (Figure 3). Occasionally veins of gabbroic material that have clearly intruded the main gabbro are seen.

On the southern side of Hanter Hill igneous layering is seen in the gabbro (Figure 4). This takes the form of alternating layers of feldspar-rich (light coloured) and pyroxene-rich (darker coloured) material. Debate still goes on as to what sort of crystal sorting process has occurred, crystal settling or in situ crystallisation. It seems likely that both processes could occur at different times and places within the same intrusion. Either way, the removal of these crystals from the magma alters the overall composition of the remaining magma, i.e. it evolves.

On the summit of Hanter Hill, at the contact between the dolerite and gabbro, a porphyritic dolerite (Figure 5) has intruded the gabbro. Porphyries are characterised by a fine groundmass containing comparatively large crystals, plagioclase feldspars in this case. The size difference indicates that the groundmass and the feldspars must

Fig. 5. Porphyritic dolerite

have slightly different histories before being brought together. The large crystals would have needed time to grow uninhibitedly, probably in a magma chamber lower down in the crust. It is likely that they were 'picked up' from this chamber by a pulse of ascending mafic magma, carried by it to their current location and then crystallised rapidly.

A similar thing appears to have happened in a granophyre found on Stanner Hill. A granophyre is an acid rock composed of an intergrowth of quartz and feldspar, often having the chemistry of a first melt from crustal material. This contains small quartz crystals that must have grown uninhibitedly. Although acid rocks can be produced by extreme fractionation of a mafic magma, the isotopic data suggests these originated from melting of the lower crust caused by the intrusion of large amounts of mafic magma. The granophyre's composition is further evidence that this has occurred.

Finally we turn to the tourmaline that we discussed in the previous article. Since then we have found a possible feeder (Figure 6). Here a large tourmaline-rich stringer can be seen beside the hammer at the top of the picture. This can be traced downward in the crack below the white scale marker. The acid rock thought to be the source of the fluorine-rich and boron-rich volatiles is seen to the right of the rucksack. Samples have now been examined for their chemistry using an electron microprobe. This has shown that the tourmalines are slightly zoned. So the composition of the volatiles associated with the acid magma that formed the tourmaline clusters was also evolving during their formation.

Fig. 6. The possible feeder vein.

All these variations within this proposed volcanic feeder zone show just how complicated the situation really is, with magmas constantly interacting with and/or absorbing material from both their surrounding crustal material and the other magmas in the system. The result is that the rocks we see today have geochemical signatures which will be different from each other and from their original mantle source magma.

Section Excursion to Pembrokeshire

by John Stocks

THE VISIT by members of the WNFC geological section comprised thirteen persons including the joint leaders Prof Bill Fitches and Dr John Payne hereinafter referred to as Bill and John.

Members assembled at The Hotel Mariners, Haverfordwest for the weekend and on Friday evening John launched the programme with a slide presentation outlining the scope of the geological excursion. Pembrokeshire geology is both complex and fascinating but with the benefit of Bill and John's enthusiasm plus their knowledge of the subject, members retired for the night impatient to get to grips with the challenge.

Study of the geological map of Pembrokeshire (Fig. 1) reveals the unique features of this region. In an area roughly 40km wide and 45km deep there were two major orogenic events; the Caledonian (Silurian/Devonian) in the north and the Variscan (late Carboniferous/early Permian) in the south, (plus three

Fig. 1 : Geology map of Pembrokeshire
(reproduced here by the courtesy of Nick Chidlaw)

periods of volcanic activity). Both were in the respective foreland basins on the edge of the main orogenic activity. Even so, both events had a profound effect on the regional structural development resulting from the compression of the crust and the consequent thrust faulting and folding. Generally any metamorphic impact was low level, being mainly confined to the development of slates in the north.

Geologically, therefore, two provinces developed; north and south. In the north the rocks range from late Precambrian to Ordovician, while in the south from Ordovician to Carboniferous. The weekend excursions provided insight into both provinces.

Saturday 29th September

Broadhaven: SM860140

The Carboniferous rocks here form the western limit of the South Wales coalfield and were disturbed by multiple faulting and thrusting. Mining conditions were difficult. However the 'high rank' anthracite was extensively mined and loaded conveniently from the beach.

The tides limited the walk to the first northern cove beyond Emmets Rock. Fig. 2 shows an example of asymmetric thrust and fold geology induced by the northerly thrusting Variscan orogeny. Well defined sandstone beds are separated by weaker mudstones and shales. This sequence is often repeated along this coastline.

Fig. 2 : Variscan folds in Lower Coal Measures at Broadhaven

Little Haven: SM857130

Walking north, the Fox Hole headland is formed from a thick sandstone anticline with an eroded cave at its core. Next at Settlands there are further examples of major reverse thrust faulting. This excursion stopped south of The Rain, built across a large inverted anticline.

Whitesands Bay: SM734272

Whitesands Bay lies 3km north-west of St David's and is dominated by Carn Llidi, formed of hard Ordovician gabbro (Fig. 3). Several prominent headlands stand out from inlets eroded into the less resistant Ordovician

Fig. 3 : Carn Llidi - 180 metres high and formed of hard coarse gabbro

shales. This excursion, at low tide and in warm sunshine, was ideal for enjoyable geology. The group walked directly from the car park to the southern end of the beach to Ogofgolchfa, which forms a small cove. Here is a fine example of the basal conglomerate of the Cambrian overlying Pebidian tuffs. The pebbles are well rounded and set in a sandstone matrix, and it is claimed that some beds exhibit imbrications. An E-W fault penetrates the cave and a large dolerite dyke intrudes the tuffs. These features generated much discussion on the correct identification of chilled margins (Fig. 4).

Fig. 4 : Multiple features at Ogofgolchfa attract much attention.

The route back included trace fossils, pyrites, quartz veins, cleavage structures, and the ten metre raised beach. Part of the group then explored the gabbro/shale boundary at Penlledwen.

Sunday 30th September

We began the day with a short halt at St. Ann's Head for a view of Cobbler's Hole, with Variscan folding, observed from the security of the cliff top.

Marloes Sands: SM781077

Marloes Sands lies to the south of the Wooltack - Skomer peninsula and consists of Silurian rock formations. The Sandstone series (Ludlow/Wenlock) overlays the Coralliferous group (Wenlock) which sits unconformably above the Skomer Volcanic Group (SVG). From the cliff top path there are good views of Skomer and Gateholm Islands. The Pembrokeshire 60m wave cut platform is also evident.

These formations are well exposed in the sea cliffs below, with the strike lying on an axis approximately W-E. This forms the southern limb of the Marloes anticline. These formations are stacked in a steep repetitive series created by generally well defined faults in subvertical strata - this being especially prominent at the site of The Three Chimneys.

The visit coincided with wet stormy weather for which the party was well prepared and the low tide ensured a safe passage along the beach.

The route started from the Gateholm Island end in the

Fig. 5 : Quartz-filled tension gashes at Marloes Sands

Milford Haven Group (with the distinctive colouring of the Old Red Sandstone facies). Inspection of heaped boulders revealed conglomerate pebbles with mudstone and sandstone. Near the Horse Neck the rock is penetrated by multiple quartz veins with tension gash arrays demonstrating both ductile and brittle extension in the same rock (Fig. 5). This may indicate closeness to a critical transition point in the crust when the events occurred. Three hundred metres east of this point there are large bedding surfaces exposed in steep southerly dipping sandstones.

To the east of Mathew's Slade are two basalt flows of the Skomer Volcanic Group, cut by numerous faults, the lower flow with a vesicular base and epidote partings (Fig. 6). The end of the excursion was The Three Chimneys in the SVG, a most dramatic formation consisting of three sub-vertical beds of sandstone with intermediate siltstones. In this last 300m there is evidence of wave ripple marks on bedding planes and various fossils including brachiopods, coral fragments, crinoid stems and trace fossils.

Conclusion

Thanks to Bill and John for a most enjoyable excursion and the excellent supporting data.

Fig. 6 : Basalt flows in the Skomer Volcanic Group at Marloes Sands.

A Day at Stromboli

by Dr Paul Olver

SATURDAY, 21ST APRIL 2012, dawned bright with blue skies and calm seas, ideal conditions for a visit to Stromboli, the northernmost outpost of the volcanic Aeolian island arc. Stromboli, unusually amongst the world's volcanoes, shows continuous moderate activity. If you want to see 'live lava' Stromboli is the place to go!

It was first recorded as a volcano by Timaeus back in the 4th Century BC. Radiocarbon dates on charred vegetation drawn from within the pyroclastic layers suggest that Stromboli continued to be active right up to the 1st Century AD. This is confirmed by several historical accounts although the nature of the eruptions seems to have been different from the current persistent activity. After a hiatus in major activity, eruptions similar to today's Strombolian lava fountains seem to have resumed in the 3rd Century AD and were confirmed by the Arabian geographer, Ibn Hawqal, in the 10th Century AD when he described Stromboli as "an island with a mountain in which fires burn all night long and by day smoke never ceases".

Our small cabin cruiser approached the 'Lighthouse of the Mediterranean' from the south-east, passing the isolated village of Ginostra which was severely damaged on 11 September 1930 by a major explosive event which sent blocks of up to ten cubic metres in size raining down on the village. Such events are fortunately very rare but important in the evolution of this most famous of all volcanoes.

We landed at Stromboli village on the north-east of the island. Neat rows of whitewashed houses and cafe-bars greeted us as we wound our way through narrow lanes up to the prominent church. Its terrace provides stunning views across towards the isolated eroded volcanic neck of Strombolicchio, now a separate islet to the north-east, and a remnant of former activity along the same major fracture running SW-NE through this region of the Tyrrhenian Sea.

Fig. 1 : A view of the terrace at the top of the Sciarra with the three eruptive craters.

Fig. 2 : Lava fountaining beginning at the right-hand crater.

Beyond the church the road passes through small vineyards on the northern side of the island gradually becoming narrower and cobbled with lava setts. A final cafe bar, with good views towards the summit at Vancori (924m), marks the beginning of an easy ascent to 300m by a zigzag cobbled path. From here on the path steepens, becomes more gullied and rises up along the eastern edge of the famous Sciarra del Fuoco.

This steep-sided scree slope, on the north-west side of the volcano, is currently surmounted by a terrace at 750m and a line of eruptive craters. Looking further up, this terrace is backed by a steep cliff, a landslip scar, originating from the catastrophic collapse of this sector of the volcano, one of eight such events in the last 13,000 years. These major events are generated by four main factors namely:

(a) The continuous activity of the volcano which eventually leads to a critical mass and inherent instability;

(b) The Tyrrhenian sea floor is higher to the south-east than to the north-west of the island leading to gravitational collapse over the edge

Fig. 3 : Lava fountaining in action at the right-hand crater.

into deeper water;

(c) Continuous dyke emplacement along the SW-NE fissure displaces the unstable NW sector seawards and thus increases its overall instability;

(d) The last 1300 years has seen an increase in pyroclastic deposits over lava flows, which are inherently less stable on steep slopes.

As we approached the edge of the Sciarra, intermittent explosions could be heard rumbling ominously above us every 10 to 15 minutes. Suddenly the scrub vegetation disappeared and we were walking straight towards the barren slopes of the Sciarra. Above us, the clearing smoke of the last eruption was clearly seen.

We waited for five minutes; suddenly a fountain of lava spewed out to the right, its incandescent fragments tumbling down the Sciarra. There was then silence except for the chattering of small mountain birds before a small but loud explosive ash eruption took place to the left on the volcanic terrace above us.

This is typical of current activity at Stromboli with Type 1 lava fountaining (Strombolian activity) being interspersed with Type 2 ash-rich explosive events (Vulcanian activity). Occasionally, fortunately not while we were there, there are periods such as in 2002-2003 when there was a major explosive event and lava effusions down the Sciarra del Fuoco. These recent eruptions propelled volcanic bombs as far as Ginostra village and generated a major landslide down the Sciarra. This in turn caused a metre-high tsunami which affected low-lying parts of the island and was recorded on the neighbouring islands of Panarea and Basiluzzo.

The main eruptive product, a dark basaltic scoria, litters the slopes of the volcano with loose, rubbly material mainly of the larger size grades. It accumulates at an angle of 33 degrees, a constant for all modern scoria cones. This coats the older deposits of calc-alkaline basaltic and andesitic lavas and tuffs of the eastern side of the island and can be seen throughout the climb up to the Sciarra del Fuoco. Small euhedral crystals of augite are common in these pyroclastic deposits. Augite is one of the earliest minerals to crystallise out of a basic magma and exists as intratelluric crystals within the magma chamber prior to eruption. The basalts, containing 50-51% silica, are rich in potassium and of slightly greater viscosity than those on Hawaii. This change in composition is thought to be due to a segment of foundered continental crust beneath the Tyrrhenian Sea contaminating the otherwise parental basalts of the upper mantle.

The sun was beginning to set and we carefully made our way down using torches on the rough zigzag path. A stop for tea and coffee at the nearest cafe-bar recorded some grandstand views of the intermittent lava fountains up to 40m high and ash explosions (see photos). As the night descended, activity seemed to increase at the vents; a feature that seems to occur every day and which may be due to thermal contraction effects within the conduits.

Fig. 4 : The fountaining is dying down and a new more explosive eruption has just taken place at the nearest crater.

Stromboli is currently in a phase of strong activity, starting in 2007 with a major eruption and continuing into 2011 with explosive activity sending incandescent materials 500m into the air and lava fountaining up to 80m in height. We saw more moderate activity but it is clear that magma levels are still relatively high within the conduit. Past activity suggests that major flank eruptions can occur in such phases - like all volcanoes Stromboli is unpredictable and needs to be closely monitored.

(All photographs were taken by Alan Wood.)

Meeting Reports, 2011-12

by Dr Geoff Steel

Friday 18th and Saturday 19th November 2011 : Underground - Overground

Dr Mike Simms is a palaeontologist at the Ulster Museum in Belfast. He has a special interest in the limestone of South Wales with its caves and karst formations. For this talk he concentrated on just one cave: Ogof Draenan (cave of the thorns) which is close to Blaenavon. With over 70km of passages it is the second longest in Britain, yet was only discovered in 1994.

The upper parts of Ogof Draenan are now inactive. They were formed by streams draining southwards but their course was interrupted by erosion of Cwm Ifor which lowered the water table and changed the flow to northward - an underground example of river capture. This left truncated passages on either side of the valley. Continued erosion exposed limestone to the south and lowered the water table still further so now the active streamways, which are the lowest, are again draining southwards. Hence Mike showed how the cave can be used to reconstruct the changes in the earlier landscape.

On Saturday we met at Keepers Pond on the road from Abergavenny to Blaenavon. Thick fog obscured the view. We walked past the Lamb and Fox, a pub popular with cavers, to Gilwern Hill where we visited three limestone quarries. Here we could see the Gilwern Oolite, which contains the older parts of Ogof Draenan. On the wall of a small cave Mike showed us how the scallops (dissolved hollows) indicate flow direction and speed. And we stopped for lunch by the collapsed remains of an early truncated passage.

In the afternoon we descended a steep path below the Lamb and Fox to see the Coed Ffyddlwyn Formation in a small quarry. This lower limestone contains the active parts of Ogof Draenan. Crossing Cwm Ifor we arrived at the remains of Garn Ddyrys Iron Works. It dates from the eighteenth century. We stopped by some huge boulders of iron slag which look rather like basalt. Finally, and still foggy, we returned up an old tramway past exposures of dolomite with joints containing barytes crystals.

Friday 9th December 2011 : Members' Evening

We began the evening by looking at samples brought in by members. Rosamund Skelton showed a conglomerate pebble from the Herefordshire glacial gravel, inclusions of quartz and rhyolite suggested a Mid-Wales origin. Geoff Steel showed pegmatites from Harris, and a visitor, Valerie, showed bones and antlers from Norfolk, deposited there during the ice age by a river from Holland. Chris Fletcher brought a set of samples used by stonemasons. He described the bizarre rules applied by churches which make some types of stone ‘unsuitable’ as grave stones. We also looked at samples of pumice, marble and sandstone, from the Woolhope Dome a fossil coral, and from Devon a sample of Upper Greensand. Paul Olver recently visited Roshuart in France, the site of a Triassic meteorite impact. From there he showed samples which look like lava. They are rich in iridium and have inclusions with a glassy texture - the result of total melting.

Friday 20th January 2012 : Catastrophe!

Richard Edwards worked as a geologist in Africa then taught at the Camborne School of Mines. Since retirement he has taken an interest in the lives and ideas of the early geologists and the way in which they founded the subject.

Richard began his story in France with Georges Cuvier. He trained in the late 18th century as a civil servant but ended up studying fossils. Today we would call him a vertebrate palaeontologist, the first of his kind. Cuvier recognised that the land has risen and fallen many times compared with sea level, and that animals like mammoths once existed but are no longer here. He explained these observations by a 'Catastrophe' theory in which huge events happened in the Earth's history which do not occur today.

Crossing the channel, Richard described Cuvier's English contemporaries: Buckland, Conybeare and Sedgwick. All three were clergymen. Not surprisingly they looked to the bible for guidance and developed the alternative 'Diluvial' theory, in which the biblical flood explained features of the rocks and landscape.

It was Charles Lyell who put geology into its modern setting. He spoke several languages and travelled widely through Britain and Europe. Combining all his observations led in the 1830s to his 'Uniformitarian' principle: "The present is the key to the past". No catastrophes, no biblical floods, just slow processes and vast amounts of time.

Moving to the present day Richard described the mass extinctions which feature prominently in the geological record. He likened our fascination with them to a modern form of catastrophism. In particular, he considered the meteorite impact at the Cretaceous/Tertiary boundary. Studies of ammonites, dinosaurs and foraminifera show that all were in decline for several million years before the impact, so maybe slower processes like the eruption of the Deccan Traps were more important than meteorites.

Friday 24th February 2012 : AGM and Dinner

Gerry Calderbank, the Chairman, welcomed a full house for this, the ninth AGM of the Geology Section. In his annual review he drew attention to the diversity of the year's activities due to the wide range of speakers and field leaders, and in particular he thanked Sue Hay, the Programme Secretary, for bringing them together. Paul Olver gave an update on progress towards publication of

our book on Herefordshire geology, some sections of which are still not finished. Also he has raised our profile within the Geologists' Association (to which we are affiliated) by organising local meetings outside London. Sue Hay reported a difficult year at the Earth Heritage Trust due to poor funding; it has now converted to a company with limited liability, which is a welcome development. Beryl Harding, the Treasurer, showed that we continue to have a good bank balance with no need to raise the cost of membership. John Payne thanked all the authors who contributed to the recent issue of 'Earth Matters', which was larger than usual because he received so much good material. Finally the existing committee members were re-elected, and Gerry Calderbank announced that he will step down as Chairman next time so we have one year to find a replacement!

Following the AGM by an annual dinner has proved a successful formula and no doubt explains the good attendance. This year, by popular request, we again went to the upstairs restaurant at Ascari's for a relaxing and enjoyable meal.

Ridge of ORS material north of Llangorse

Friday 26th March 2012 :
Nickel Sulphide Deposits in Australia

Chris Fletcher worked in Western Australia during the 'nickel boom' of the late 1960s to 1970s. He described it as being very similar to the 'gold rush' a century earlier, with speculators driving wild prices and fortunes made and lost.

The largest nickel deposit then known was at Sudbury in Canada. It occurs in Archaean rocks where an intrusion of norite gabbro forms part of a greenstone belt. The geology of Australia was not known in detail so the prospectors just searched for anything that looked like Sudbury. Chris described the work as very challenging because there have been no ice ages there; the soil surface is so old that many different rocks have weathered to look much the same. The secret was to try and find gossan, which is a hard, mineral-rich soil formed by leaching by ground water. It was identified by taking chemical samples.

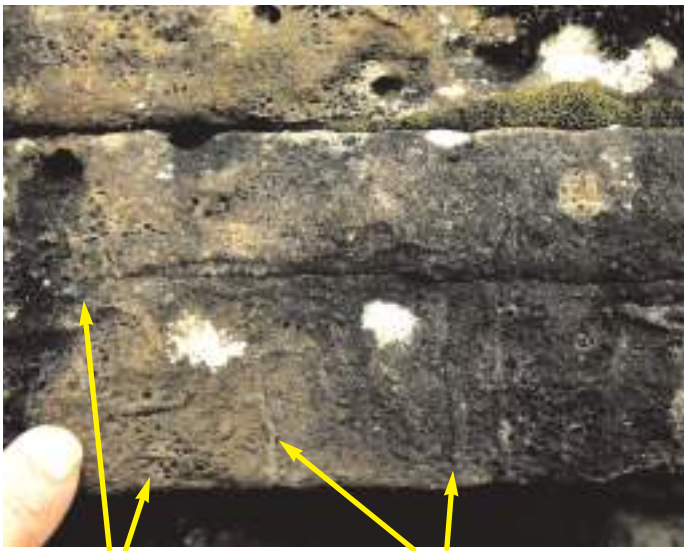
Nothing the same as Sudbury was found but one small company focussed on an area of komatiite. It is an extrusive ultrabasic rock, which is unusual because ultrabasics formed today are only intrusive. Nearby pillow lavas show that the greenstone belt in which it occurs was an Archaean version of a deep ocean trench, and the early Earth's crust was thinner so mantle-derived ultrabasic magma could reach the surface. The company employed two students to map the area in their summer holiday. They found mineral traces, recommended drilling, which started in January 1966, and in July at a depth of 148m they hit a huge deposit of 8.3% nickel.

Development of plate tectonics has now given a much better understanding of mineralisation. Chris described the importance of tracing linear features like the Malvern Hills which are now known to mark boundaries between underlying plates not visible on the surface. By this method the giant Olympic Dam deposit (copper, gold and uranium) was recently discovered in South Australia.

Sunday 22nd April 2012 : The Llangorse Basin

On a heavily overcast day, fourteen members were led by Duncan Hawley in an exploration of the glacial evolution of the area around Llangorse Lake. The Quaternary evolution of the area is still not fully understood and it now appears that, at different times, ice entered the area from both the Wye valley to the north and the Usk valley to the south.

Duncan led us to a number of the key locations. First was a moraine at Tregunter, south of Talgarth, where we found Silurian fossils, proving that the ice flow here was from the north. Six hundred metres to the south-west we were shown a ridge of gravel which was mostly Old Red Sandstone material and so was brought in from the south. The ridge is thought to be a deposit in a proglacial lake. We drove south, viewing other moraine deposits on



'Pepper pot' structures and skolithos burrows on Cockit Hill. (The picture has been adjusted to enhance the visibility of the structures.)

The Llangorse basin from Cockit Hill.

the way, to Pennorth, east of the lake. Here Duncan described the history of the lake and how, when it was about 35m deeper than at present, it had overflowed into the Usk valley here and at Bwlch, about 5km to the south-east. He discussed recent work on cores taken from the deposits in the lake. These show laminated structures (varves) covering a period of nearly 600 years. From this sequence it has been possible to reconstruct the phases of retreat of the ice which fed the lake from the north.

For a complete change, Duncan led us up Cockit Hill to see both the magnificent panorama of the Llangorse basin and the crags of sandstones of the Senni Formation. The sandstones revealed a variety of trace fossils, including *Skolithos*, *Beaconites* and the 'pepper pot' structures of unknown origin.

Monday 7th May 2012 :

Excursion to the Ledbury Area

Our leaders, John Payne and Andy Sims, met us at Wellington Heath and took us on a short walk up the road to Loxter's Ashbed Quarry. Here the Aymestry Limestone was worked in the nineteenth century. The quarry is about 5m deep and displays a plunging anti-cline, with a layer of brown bentonite clay forming a prominent notch about half way up. (*The term 'ashbed' appears to refer to the earlier use of the woodland and not to the presence of bentonite volcanic ash. - Editor*) This EHT Champions site has recently been cleared of vegetation by a group of local volunteers. The intention was to continue up Oyster Hill to enjoy its fine view of the surrounding landscape, but low cloud and heavy rain made The Farmers Arms a more attractive proposition.

.A chemistry lesson in Lime Kiln Quarry, Croft Castle

After lunch we drove through Ledbury, past the railway cutting which is famous for its fish fossils but now over-grown. We parked at Upper Hall Farm and walked into the adjacent quarry. The main face is vertical and exposes bedded nodular limestone in the lower part with grey calcareous mudstone at the top. This is the transition from Much Wenlock Limestone to the Lower Ludlow Formation. Both the railway cutting and the quarry are SSSIs.

Upper Hall Farm Quarry, an SSSI near Ledbury

Finally we drove a few miles south to Haffield House to see the Haffield Breccia. It lies at the base of the Permo-Triassic succession and was derived from the east, the area of the Severn valley being high ground at that time. The breccia contains hematite-coated clasts of Malvern Gneiss and May Hill Sandstone in a dark brown sandy matrix. Some of the best examples were dressed stone blocks in the garden wall.

Saturday 21st July 2012 :

Croft Castle Champion Sites

Sixteen members spent a day with the Earth Heritage Champions at their two quarry sites within the Fishpool

Valley at Croft Castle. Robert Williams started by discussing the historical context of these sites and the early geologists who researched in this area, together with the Picturesque movement, which influenced many local landowners. He also explained how the Champions group has developed ways of presenting these quarries to the general public, of which over fifty visited on one 'open' day last year.

Lime Kiln Quarry, which as its name suggests also has an old lime kiln on the quarry floor, displays the bedded nodular clay-rich limestone and calcareous siltstone that are typical of the Aymestry Limestone Formation. Here John Charles, a retired chemistry teacher, gave a demonstration of the chemistry behind limestone formation and its subsequent roasting in the lime kiln.

We then visited Highwood Bank Quarry, which is also in the Aymestry Limestone Formation. Here the nodules are much more prominent and their true dip can be seen. Andrew Jenkinson demonstrated how to measure true dip using a beautiful vintage instrument. Time was also spent looking for the type fossil *Kirkidium knighti* amongst others in the rock.

The Geology Section in Lime Kiln Quarry.

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An Overview of the Geology of Loxter Quarry, Wellington Heath

by A. P. Sims, R. Hurley, F. Rozelaar, A. J. Sims and A. Wood

LOXTER QUARRY (Grid Ref. SO 7179 4094) is a small, disused quarry on private land to the north of the village of Wellington Heath. In the period from March to October 2010, local volunteers opened up the quarry and cleared the faces as part of the Lottery Funded 'Community Earth Heritage Champions Project', an initiative of the Herefordshire and Worcestershire Earth Heritage Trust (http://champions-earthheritagetrust.org). The quarry is now maintained as a community and educational resource, with public open days arranged throughout the year. Alternatively, the site can be visited by appointment (e-mail loxterashbedquarry@yahoo.co.uk).

Although relatively small, Loxter Quarry contains much of geological interest, both from the sedimentological and the structural perspective. The beds exposed in the quarry lie on the southern limb of the Oyster Hill anticline (Brandon, 1998) and dip at approximately 45 degrees SSE. Due to the perspective given by the faces, the quarry appears to show a steeply plunging periclinal feature (Figure 1) but, in fact, there is only a minor variation of dip and strike across the quarry. Many minor faults cut the walls and the dipping floor of the quarry and display complex cross-cutting relationships. The eastern wall of the quarry may include a section repeated by a much larger reverse fault, although this remains to be proven. The orientations of the structural features in the quarry can be easily measured and, therefore, the site is ideal for training students in measurement techniques and in the subsequent interpretation of the measurements.

The face of the quarry also provides a good opportunity to observe, document and interpret numerous facets of sedimentary geology, with something of interest for all levels of geological experience. The section exposed in the quarry comprises approximately 5m of calcareous siltstones with common limestone nodules, the latter sometimes merging to form bands of nodular limestone. These beds are assigned to the Aymestry Limestone Formation and are thus of Silurian age (Late Gorstian, c. 422Ma based on time scale of Gradstein et al. 2004). BGS note that this formation was mapped on the basis that the unit "formed a feature and generally contained at least 50 percent limestone" (Brandon, op. cit.); however, although lime-rich in parts, the section at Loxter is very different from the Aymestry Limestone in its type area, lacking the well preserved, complete brachiopod faunas described there. Indeed, the beds in the quarry are generally poorly fossiliferous, except for certain horizons where a diverse fauna of strophomenid brachiopods, bryozoa, gastropods and corals (both solitary and compound) are preserved on bedding planes. To date, only epifauna has been seen, with no evidence for fossil infaunas or for any obvious bioturbation. One dalmanitid trilobite pygidium was found by a member of the Woolhope Club during a recent visit, and has now been cast to preserve the occurrence.

The bedding planes on which the epifaunas have been observed appear to lie directly under thin (2 to 5cm) claystone beds that are continuous across the quarry faces (Figure 1). These claystone beds have previously been

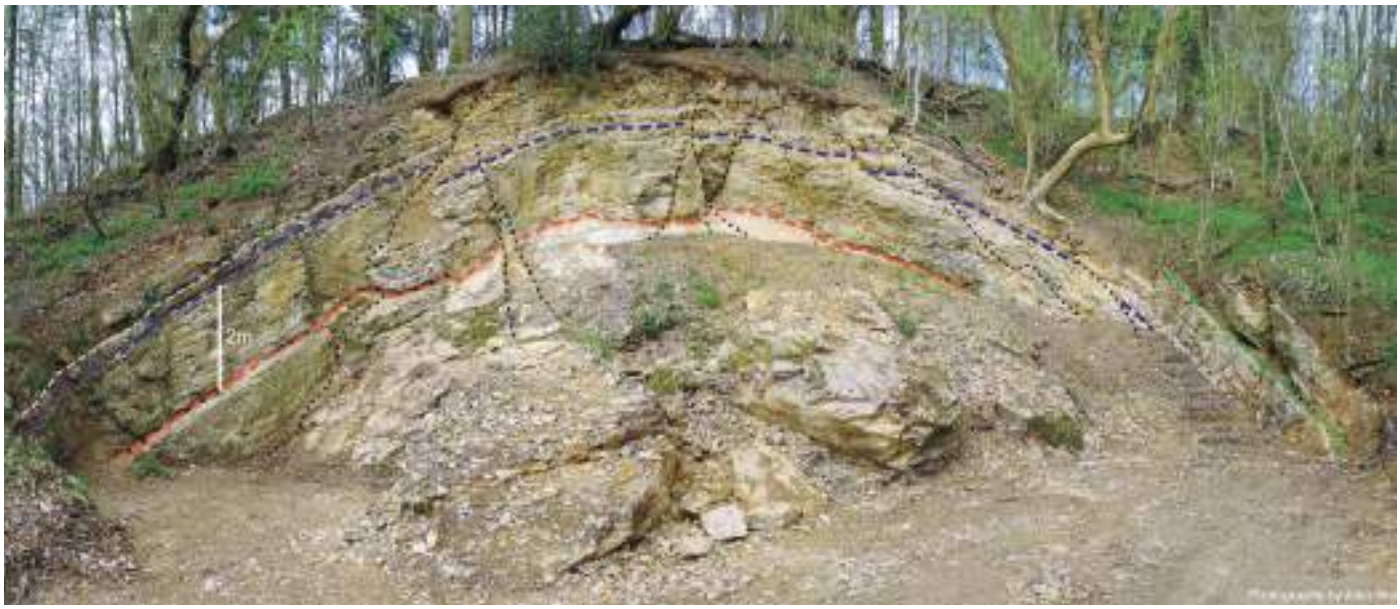

Figure 1. A panoramic view of Loxter Quarry from late 2011 (west to left, east to right). Some regrowth has occurred, but all the main features of the quarry remain exposed as of writing. The bentonitic claystone beds are highlighted with dashed coloured lines and some of the numerous minor faults with black dashed lines. The blocks in the foreground have slid down on the oldest bentonite (red). The uppermost bedding plane of the rightmost block initially underlay a higher bentonite (blue) and this surface, together with the bedding plane beneath the oldest bentonite, are the most fossiliferous surfaces in the quarry.

interpreted as bentonites, resulting from the accumulation of volcanic ash falling through the water column and blanketing the seafloor. The diverse epifaunal assemblage seen immediately beneath these beds may, therefore, be a death assemblage resulting from the rapid deposition of volcanic material. The reason why these epifaunas are only seen close to these claystones rather than on all bedding planes does, however, still need to be addressed. It is possible that the claystones acted as fluid barriers during subsequent diagenesis, preventing total remobilisation of the carbonate skeletal material. Also, the bentonitic clays may have enhanced the preservation of delicate fossil moulds. However, unless such arguments can be shown to be realistic, or further bedding planes with associated epifauna are observed in the main section, the interpretation of the claystones as volcanic bentonites may need to be reconsidered. It seems unlikely that seabeds stable enough to attract epifauna would develop always, and only, before an essentially random volcanic event.

Further sedimentological logging of the quarry is being carried out at present, partially to investigate the potential concerns over the origin of the claystone beds. Initial work indicates that the depositional environment was of very low energy although some thinner beds have internal lamination and erosional bases that suggest periods of marginally higher energy. Together with the lack of infauna and bioturbation, the facies of the siltstones are suggestive of deposition in sub-storm wave base conditions, perhaps in a slope setting where rates of sedimentation were sufficient to preclude colonisation. Alternatively, the bottom waters may have been oxygen depleted, perhaps due to the seafloor lying within the depth range of the oxygen minimum zone. The rare levels of well-developed epifauna suggest occasional periods during which the seabed was both stable and with bottom waters sufficiently oxygenated to support colonisation. However, the immediate sub-seabed sediment appears to have remained anoxic judging by the lack of any apparent bioturbation in beds beneath the colonised bedding planes.

The numerous nodules within the calcareous siltstones range from almost spherical to highly elliptical in form, with the long axes aligned with bedding. Nodule sizes also vary widely, from centimetres to decimetres. The boundaries of the nodules with the enclosing siltstones are generally sharp to very sharp and there is no evidence for significant deformation around the nodules during burial and compaction. Petrographic work shows that the nodules comprise mostly calcite, but with a significant proportion of iron-rich dolomite or ankerite. It appears that the carbonates are replacive of quartz. The nodules are, therefore, currently interpreted as diagenetic features created after compaction of the initial sediment by remobilisation of existing detrital carbonate within the calcareous siltstones.

The Loxter Quarry Champions group intends to continue the geological evaluation of the site and to maintain the site in as safe a condition as possible for educational visits. We would welcome contributions to the geological debate over features of the site and, in particular, would request help from any reader who could aid with preparing a faunal list for the site.

We are immensely grateful to Mr and Mrs R. Allsop for allowing access to this quarry, and for their enthusiastic support of the Champions project.

***Reference**: Brandon, A., 1989, Geology of the Coddington District. British Geological Survey Technical Report WA/89/3*

Geology Section Programme for Early 2013

LECTURES and the Annual General Meeting are held in the Woolhope Room, Hereford Library, Broad Street commencing at 6:00pm unless otherwise stated.

Friday 18th January.

'The Road from Damascus to the Seven Pillars of Wisdom'

Talk given by Dr Sue Hay.

This seems a very appropriate time to look at geology of the Levant, in particularly Syria and Jordan. Geologically this is a very active part of the world. It sits at the boundary between the African, Eurasian, Sinai and Arabian plates with the Dead Sea Fault aligned almost north to south through both countries. The fairly sparse vegetation leads to good geological exposure and there is a very long and interesting history of stone usage in both countries which we can explore along the way.

Friday 22nd February. Section AGM and Dinner. Booking forms for the dinner will be sent out electronically in January

Thursday 7th March. 'Snowball Earth'.

Talk given by Dr Gawan Jenkin.

Joint meeting with Hereford Astronomical Society.. 7:00pm at the Kindle Centre, Hereford.

'Snowball Earth' is a somewhat controversial theory first put forward in the late 1980s. It proposes that the Earth's surface became entirely or nearly entirely frozen at least once, some time earlier than 650 million years ago. There are still a number of unanswered questions, including whether the Earth was a full snowball, or a 'slushball' with a thin equatorial band of open (or seasonally open) water.

Dr Jenkin is one of the country's foremost researchers on this concept, which has found evidence that at the end of the Precambrian a massive glacial episode nearly covered the Earth with ice except for a narrow seaway at the Equator. This event saw the end of the Ediacaran faunas and its eventual melting generated the transgression of the Cambrian seas and a new start for life on this planet.

Herefordshire Astronomical Society members pay £2.00 to attend meetings and Woolhope visitors will be charged the same. It covers the tea, coffee and biscuits provided as well as a small element towards the room hire.

Friday 22nd March. 'The East African Rift'.

Talk given by Prof. Bill Fitches.

The East African Rift is an active continental rift zone in East Africa which appears to be developing a divergent tectonic plate boundary. It runs from the Afar Depression in Ethiopia southwards through eastern Africa. The Rift Zone includes a number of active as well as dormant volcanoes. It is also a very important source of fossils that have allowed the study of human evolution. Over the past few years Bill has paid several visits to the East African Rift, on which this talk is based.

Sunday 21st April. 'Para-?, peri-?, or just plain glacial? a geological puzzle near Crickhowell'.

Excursion led by Duncan Hawley.

Further information for all events, unless otherwise stated, from: Sue Hay, 01432-357138 or e-mail svh.gabbros@btinternet.com.

Annual General Meeting

MEMBERS are asked to accept this as notification of the Geology Section AGM to be held on **Friday 22nd February 2013** starting at 6:00pm in the Woolhope Room. After the AGM we will retire for dinner to a local restaurant. Booking forms for the dinner will be e-mailed to members in January.

The officials and committee for the coming year will be elected. All of the present committee members (see the back page of this issue) will stand for re-election. There is a vacancy on the committee for an additional, ordinary member. Section members are invited to submit nominations for election to the committee. Nominations, with the names of the proposer and a seconder, must be received by the Section Secretary in writing (letter or e-mail) before 22nd January 2013.

Subscriptions

THE ANNUAL SUBSCRIPTION to the Geology Section is currently £7.00. This is due on 1st January (as for all other WNFC subscriptions). Please pay this directly, and on time, to the Section Treasurer, Beryl Harding, 'Bramley', Lugwardine, Hereford HR1 4AE. **Do not** send it to the WNFC Secretary with your WNFC subscription. Cheques should be made payable to 'Geology Section / WNFC'. Members are encouraged alternatively to pay by Standing Order; forms are available from Beryl.

Editor's Note

WELCOME to the ninth issue of Earth Matters. After expanding to twenty pages last year, we have reverted to the normal size because the contributors have all sent me just the size of articles that I requested from them. For this I am very grateful since it is always an unpleasant task to have to remove good material from their submissions simply because of space limitations. I remain very appreciative of their work and the continuing support of the WGS committee.

The contents this year reflect the general interests of the Section, lectures, excursions and, for some members, their own research. Geoff Steel has produced his usual thorough reports on most of our meetings and the remainder are covered by full articles. Three areas of local research activity are described or mentioned, at Hanter Hill, Loxters Ashbed Quarry and Martley Rock. We follow these developments with great interest and look forward to further reports on these and other researches in future years.

John Payne, *Editor*

Members of the WGS Committee

(December 2012)

Gerry Calderbank ***Chairman***

Dr Geoff Steel ***Vice-Chairman***

Dr Paul Olver ***Secretary***

Beryl Harding ***Treasurer***

Dr Sue Hay ***Programme Secretary***

Moira Jenkins ***Section Recorder***

Dr John Payne ***'Earth Matters' Editor***

Charles Hopkinson ***Minutes Secretary***

H&W Earth Heritage Trust and Abberley & Malvern Hills GeoPark

THE EARTH HERITAGE TRUST finally became a charitable company on 1st January this year. Finance has again been an overriding issue during the past year. Over £1000 was raised by a few members undertaking a sponsored walk in March. The Trust was also very grateful to receive a generous legacy from the estate of Stephanie and Peter Thomson, who were both well known to many of you.

Last autumn the Trust obtained funding from the Heritage Lottery Fund to develop a bid for a large project spread over 3.5 years, working with local communities to increase public understanding and appreciation of local building stone in the counties of Herefordshire and Worcestershire and to identify the quarries from which they were sourced. We were all delighted to hear in September that our full bid had been successful. By the time you read this article the main phase of this project should be underway.

Work started last autumn to develop earthquake observatories at the Wyre Forest Discovery Centre and in the centre of Worcester at the Hive. Whilst some funding had already been obtained, more was and still is being sought to enable the project's completion. These centres are primarily aimed at children but it is hoped that they will also be of interest to adults. Not only will they show current global earthquake activity via a live seismic feed from the British Geological Survey (BGS) but BGS have also provided geophones for the 'Make your own Earthquake' activity. There is also a 3D plate tectonic model and an archive of photos and video footage of famous earth- quakes and other related tectonic events, e.g. volcanoes, tsunamis. These will tie in with the case studies used by school children within the geography and science curricu- lums. In the future, if funding can be found, the Trust would like to place more of these centres at other sites, including at least one in Herefordshire.

The Abberley and Malvern Hills Geopark now has fifteen partner organisations including the Geology Section of the Woolhope Club. In early June Chris Darmon, the Geopark President, opened this year's Geofest in the pouring rain at Martley Rock. Despite the poor weather this summer, which included over two inches of water running through the marquee at the Three Counties Show in June, there have been over 100 days of events and 16 weeks of exhi- bitions. Over 11,000 people attended these events, includ- ing 4000 people who used the Carboniferous self-guided trail in the Wyre Forest and some 5000 people who visited the Building Stones Exhibition at Bewdley Museum. All in all something of a record for the Geopark!

Dr Sue Hay, *EHT Chairman*

Herefordshire Heritage Services

GEOLOGICALACTIVITY this year has seen the completion of the chapter on the history of geology in Herefordshire, ready for the forthcoming Geology of Herefordshire book due to be published by WNFC, and a major step forward with the computerisation of the geology collection catalogue. Russell Dornan, the curatorial trainee based with the service in 2011-2012 took on the task of transcribing the hand-written catalogue, prepared by Tess Ormrod and creating the necessary hierarchies and thesauri on Micro Musee to allow records to be entered. He didn't quite manage to finish before securing a job at the Horniman Museum, leaving a task that a volunteer might like to address. Russell also created a very impressive WordPress-based web site of museums in the West Midlands with Natural History collections, well worth a look (http://naturalsciencewm.wordpress.com/).

Herefordshire Heritage Service delivered another successful geologically themed activity day in the Easter 2012 holidays in partnership with EHT. Around 120 people visited during the day and, as ever, many stayed all day. This year's theme was the Pleistocene and, in addition to the usual rock and fossil roadshows and the by now familiar 'geological theme in a box' construction, participants were able to enter and paint the walls of a cave with ochre, make a hand print pattern using the techniques developed by the people of the Stone Age, paint an Ice Age animal on a peb- ble and follow an ice age trail. It was one of the first events that Ben Moule, our 2012/13 curatorial trainee participated in with the cave idea coming from him.

Over the last four years, the themes of the activity days have moved through the geological periods of the rocks of Herefordshire and in 2013 should return to the Silurian again. However, a major re-structuring of Cultural Services has resulted in the loss of two full time posts with- in Heritage Services by redundancy, leaving the service without any geological expertise.

Katherine Andrew, *Principal Heritage Officer*

(One of the redundant posts is that held by Kate Andrew. She therefore no longer works for the Service. Her job is now shared between two other employees. Kate has been a good friend and member of WGS since its beginning and has represented the Heritage Services on the committee for a long time. She will be missed and we wish her well for the future. - Editor)