Earth Matters

The Newsletter of the Geology Section

of the Woolhope Naturalists' Field Club

No. 3 December 2006

The Geology Section is an Affiliate Member of the Geologists' Association.
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Contents

Message from the Chairman

Our June visit to Ridgebourne near Kington at the invitation of Lawrence Banks was a major highlight in a very successful third year for the Geology Section. The event allowed us to touch base with the first stirrings of geological investigation in the 1830s and with the Section's past through the formation of the Woolhope Club in 1851. The guiding light in both these key events was Sir Roderick Murchison, one of the first Honorary members of the Woolhope Club, for whom Lawrence Banks's great grandfather, RW Banks, a self-taught geologist, was a constant companion in the field during the 1850s.

This important link with our roots is particularly appropriate as we enter 2007, the 200th birthday of the Geological Society of London. Through the 'Local Heroes' initiative with the Geologists' Association, who celebrate their own 150th anniversary in 2008, a series of events is planned in the Welsh Marches in August/September 2007. Our own Section will be involved in a full re-enactment of one of our earliest field excursions led by Sir Roderick and attended by stalwarts such as the Rev Thomas Taylor Lewis and RW Banks.

Several field excursions, although not in period costume, have been enjoyed by the Section this year. The Jurassic strata of Bredon Hill and the Ordovician volcanics and fossiliferous sediments of Llandrindod Wells have been visited together with a longer trip to Cornwall where granites, mineralisation, china clay and intensely folded Devonian and Carboniferous strata have provided a strong contrast to our own Welsh Marches.

Our annual Murchison lecture in February, excellently presented by Dr Derek Siveter on the newly discovered soft-bodied faunas of the Silurian, gave a chance to update on new developments. Murchison's 'Silurian System' was an important milestone in geology but the detailed work on its rocks still continues to this day. (*Continued on page 2*)

Geology Section Programme for Early 2007

Lectures and the AGM are held in the Woolhope Room, Hereford Library, Broad Street commencing at 6:00pm unless otherwise stated.

Saturday January 20th. Field excursion to the Whitman's Hill and Ledbury areas. Leaders: Abigail Brown and Paul Olver. Meet at Storridge village hall, SO750486, at 10am. Pub lunch.

Friday January 26th. AGM followed by dinner at the Green Dragon. Book your place(s) with Sue Hay by Thursday 18th January (see AGM note on this page)

Saturday February 24th. Visit to the Museum of Natural History in Oxford, including a talk on 'Minerals of Zimbabwe - ancient and modern' by Kevin Walsh

Friday March 16th. Talk on 'Geohazards in the Built Environment' by Professor Mike Rosenbaum, Emeritus Professor of Engineering Geology

Last week of April / First week of May. Trip to the Rhône/Rhine area.. Leader: Paul Olver. Please send expressions of interest in this excursion to Paul. He will supply more details later.

Sunday June 3rd. Field trip around Raggedstone Hill. Leader: John Payne

Further information for all events unless otherwise stated from: Sue Hay, 01432-357138 (evenings and weekends) or e-mail susan.hay@ hhtr.nhs.uk. If you would like to join our email circulation please send me an email so that I can pick up your correct email address.

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Editor's Comments

Welcome to the third issue of Earth Matters. Most of the articles are accounts of Section events during the past fourteen or so months. Gerry Calderbank has written an extensive description of our Spring trip to Cornwall. I have unfortunately had the space to print only about half of it. Moira Jenkins relives for us the excitement of hearing, and seeing, David Siveter show the results of his team's work on the fossils from Herefordshire's unique and world-class *Lagerstätte* geological site. A further article on this work will appear in the Transactions. Paul Olver describes the Section's visit to Ridgebourne, with its strong historical associations with RI Murchison. Lastly, but far from least, Geoff Steel has provided his usual comprehensive account of the remainder of our excursions and lectures, so that a full record of our activities is maintained.

In addition, Geoff gives an account of his visit to see a local exposure of the Townsend Tuff Bed. Such articles are of great interest and I encourage all readers to supply similar texts for future issues of Earth Matters. Lastly, we have reports of their recent work from our three other local geological bodies.

I would like to thank all the members of the Section committee for their continuing help and support.

John Payne, *Editor*

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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.

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Annual General Meeting

Members are asked to accept this as a reminder of the Geology Section AGM to be held on Friday 26th January 2007 starting at 6:00pm in the Woolhope Room. After the AGM we will retire for dinner to the Green Dragon Hotel, along the road from the Library. Seating for dinner must be booked in advance. Please book with Sue Hay by Thursday 18th January.

All of the present Committee members will stand for re-election to the Committee. Our present Chairman and Secretary will resign these roles at the AGM but have been nominated to exchange them. Any other nominations for election to the Committee must be received by the Secretary by 10th January 2007, in writing (letter or e-mail) and with the name of a seconder.

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Chairman's Message (contd.)

I hope that members will be able to support the various events of the Bicentenary celebrations during this coming year. Finally I would like to thank John Payne for his close attention to detail in bringing this Newsletter together. The Section needs to publicise its activities especially in this coming year of high public exposure and our Newsletter is already succeeding in this important role.

Paul Olver, *Chairman of the Woolhope Club Geology Section*

N.B. 2008 is the International Year of Planet Earth - any ideas on what the Section might do then?

CORNWALL DIARY : 2006

Gerry Calderbank

Geology section, Woolhope Naturalists' Field Club

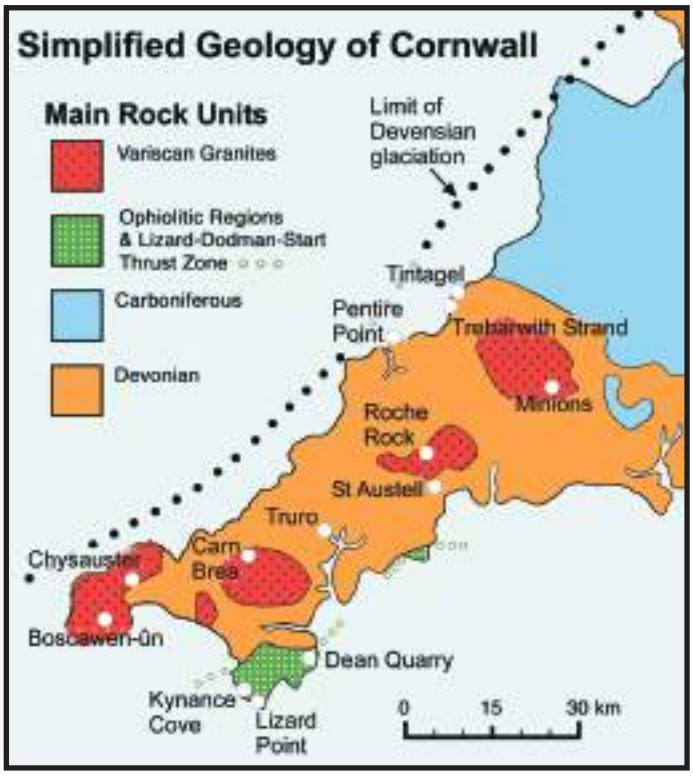
This excursion was joint with the Farnham Geological Society and was excellently organised and led by our Chairman, Paul Olver. There were twenty participants. The tour was organised so as to present an overall view of Cornwall geology according to recent research findings.

Cornwall exhibits mostly Devonian and some Carboniferous sedimentary rocks. Ophiolites were imposed from the south during the Devonian. The sedimentary rocks were greatly distorted and altered in the Variscan Orogeny. Later, a granite batholith was intruded into the suture associated with the Variscan thrusting.

Day 1 - Carn Brea and the Lands End peninsula. Our first day in Cornwall took us from our Truro hotel via Redruth and Camborne to Carn Brae, which was accessed by a tortuously narrow track and then a short walk to the summit. There, a denuded granite tor exhibited exposed jointing that was heavily weathered so as to form spectacular blocks. Many blocks have become entirely detached and tumbled. The site also contained Iron Age stone hut circles, a mediaeval castle (once a hunting lodge and now a restaurant) and a more recent granite monument to a local dignitary.

A lengthy drive then brought us to Chysauster in the Penzance hinterland. This is the site of a classic Cornish Iron Age 'courtyard house village' constructed from granite blocks with turf infilling of the interstices. There was also a (roofless) Celtic fogou (a built, underground cave of unknown use). Next, we drove to the disused china-clay pit at Lower Bostraze. This is now flooded. Although no longer permitted access to the kaolinised granite, we found plenty of interesting mineral specimens amongst the waste make-up of the track.

At Boscawen-ûn stone circle



Continuing the mainly archaeological flavour of the day, we next visited a remarkably well-preserved stone circle near Boscawen-ûn, the presumed astro-calendrical purpose of which was explained by Paul. Our final visit was to Sancreed church and churchyard where we viewed the interior with its beautiful wood carvings, its exterior building stones and, in the graveyard, two Celtic crosses that were recycled, 'Christianised' megaliths - a fate resembling that of some dolmens we had seen last year in Brittany, but on a much more modest scale!

Day 2 - The Minions district of Bodmin Moor. Initially ignoring several abandoned engine houses near Minions, hub of a former mining community, the party walked to the Cheesewring quarry. This once yielded high quality building-stone granite that was shipped by a purpose-built railway for export from Looe. Locally, there is also evidence of early tin mining. The actual Cheesewring is a fantastically weathered and much photographed granite tor. When such tors weather completely away, leaving just the 'core-stones', they sometimes reach a rocking-stone phase and are then locally termed 'logans'. The location is also noteworthy for an Iron Age hill-fort with ramparts built from the granite blocks.

Lunch was taken at the highest pub in Cornwall (over 270m OD) before the party proceeded to prospect the spoil heaps of one of the nearby abandoned mines, the United Phoenix Mine. Many of the party returned to the coach with a variety of hand specimens collected from the waste, including the primary ores chalcopyrite and

Finding minerals at the Phoenix United Mine spoil heap

chalcocite as well as secondary chrysocolla and malachite/azurite. Lead and tin have also been extracted hereabouts and we were warned that some specimens contained traces of arsenic - so much hand washing ensued!

A short drive through the village took us to three stone circles, known as The Hurlers. Paul explained their astro-calendrical significance. It is thought that the south circle is the earliest but that this was later robbed in order to build its more northerly successor as the sky pattern shifted over a considerable period of time, thus requiring the new 'calendar'. Upon returning to Truro, we were briefed after dinner on Cornish 'Mineralisation and Metamorphism'.

Preparing to visit Kynance Cove

Day 3 - Pentire Point and St. Austell. Arriving at the National Trust property around Portquin Bay, our view from the cliff tops was partially obscured by sea mist. During early Upper Devonian times this area was a shallow sea with considerable volcanicity and during the course of our walk to The Rumps we were able to examine the folded Pentire Slate Formation with, in places, evidence of the volcanic activity including pillow lavas. En route to the headland I found a worked flint that probably dates from prehistoric times. At the headland cliff-top there were good exposures of glacial head, evidence of periglacial conditions during and immediately following the Devensian glaciation that so nearly enveloped the South West Peninsula.

We next drove across country to the Wheal Martyn China Clay Museum where Paul had arranged a guided tour of the industrial site. This tour, and our freedom afterwards to wander at will, took the remainder of the day. The earliest china clay workings were hillside sites, with the clay washed out by water diverted from natural streams. By the late nineteenth century, as the workings deepened, it became necessary to use high-pressure hoses to wash the china clay from the kaolinised granite and to pump the slurry. The end effect on the landscape has been enormous pits and huge heaps of gleaming white spoil, the latter comprised mostly of undesirable clays, waste quartz and mica. Most of our party zigzagged up through the beautiful woodland to the visitors' viewpoint overlooking an enormous pit that, although not actually working at the time, held a scattering of heavy-duty plant and machinery. It was a most impressive sight!

Day 4 - The Lizard 'Ophiolite assemblage'. As we drove south from Helston I was struck by the peneplanation effects throughout the Goonhilly Downs/Lizard Downs plateau. This is the result of prolonged chemical weathering that formerly produced as much as 60 to 80m of detrital over-burden, virtually all of which has been eroded in the past 65 million years. There are few inland exposures on the Lizard peninsula but the sea cliffs give excellent geological opportunities.

Our first stop was the well-known beauty spot of Kynance Cove, where bastitic and tremolitic serpentinites occur. These colourful hydrated phyllosilicates are famous because of the ornaments fashioned from them locally. Their outcrops are separated by a fault which we presumably crossed en route from the car park. Each has been altered by serpentinisation from the original peridotites emplaced by Devonian-age obduction from the south. They have, furthermore, been intruded by basaltic (epidiorite) dykes and also contain small bodies of granite and gneiss. We took the cliff-top (high-water) route to the cove and were able to collect serpentine specimens as we picked our way along the track. Upon reach-

Posing for a photograph at Kynance Cove

Leaving Kynance Cove

ing the main access road, we came across roadside exposures of other ultra-basic rocks that Paul identified as remnants of ocean crust and even the (rarely observed) mantle itself. The cove is breathtakingly beautiful and, favoured by the low tide, we were able to examine the sea caves and the complex rock structures exposed both in the cliffs and in the tumbled boulders on the beach.

Next to the lifeboat station at Polpeor Cove at the southern tip of the Lizard, in the vertical road cutting adjacent to the launching slipway, we saw one of the best local exposures of the 'Old Lizard Head Series'. These metamorphic rocks are predominantly mica-schists that are interbedded with quartzites and hornblende schists. In detail, the mineral content includes muscovite, chlorite, epidote and hornblende, with the quartzites being somewhat impure. The bedding was well marked although intensely distorted. It is thought that, prior to metamorphism, some of the greenschists were volcanic in origin whereas the more massive hornblende varieties may originally have been lava flows and/or sills. Just off shore, the Man of War Rock and other reefs are of at least Ordovician age but they may be much older since further dating is required.

At Dean Quarry near St Keverne gabbro is quarried for use both as aggregate and in sea defences. This Crousa Gabbro, of Lower Devonian age, is a schistose gabbro that varies from fine-grained to 'pegmatitic'. It has been penetrated by a swarm of epidiorite dykes (Lower Devonian). The gabbro was profusely mineralised in Triassic times. Paul's handout lists no fewer than eight different 'tektozeolitic' varieties, all containing true water of crystallisation and therefore thought to be the product of hydrothermal activity. This indicates a relatively late stage of low-grade metamorphism in the Lizard. However, certain (mainly tectonic) effects recurred in the late Palaeogene when north-south thrusting, associated with the Alpine orogeny, probably re-activated the boundary faults in an area just to the north of the quarry.

The party at Roche Rock

Colin Bristow (2004), summarising the development of the Lizard peninsula, emphatically states that much more dating evidence is required for the presumed early stages. Nevertheless, he postulates twelve stages in the history of the Lizard Peninsula, ranging over about 500 million years, from the Ordovician to the Tertiary.

Day 5 - Roche Rock, then Trebarwith & Tintagel. Our journey to the north Cornwall coast was punctuated by a quick diversion to look at the Roche Rock. This remarkable 'schorl' crag is capped with a mediaeval chapel to which some of us clambered by means of iron ladders anchored in the rock-face. Viewed from aloft, the landscape is normal granite moorland, dotted close by with China clay workings. So why this isolated, non-granitic crag? The schorl occupies a peripheral cusp in the St. Austell pluton where the original overlying granite cap has weathered away. Prior to this, as the cap had cooled the granite crystallised from the roof of the magma chamber downwards, thus trapping and sealing the still molten magma below. As the solid crystals formed around the cooler periphery, the vapour pressure within the magma chamber increased considerably, temporarily inducing a highly pressurised semi-fluid 'mushy' condition. Overall, the cooling led to gradual shrinking and cracking of the whole body. The cracks developed radially (mostly upward) whereupon 'late-stage' magmatic fluids - containing carbon dioxide, sulphur dioxide, fluorine and boron - next started to migrate. This 'tourmalinisation' phenomenon is commonplace throughout the granite regions. However, at Roche Rock these hydrothermal fluids were unusually rich in boric acid and the fluids became trapped and concentrated around the roof of the chamber, with the resultant 'borosilicate' condensing, into a mass of mainly quartz and tourmaline - the non-felspathic schorl rock. The schorl is extremely tough. It is clearly not subject to the kaolinisation processes affecting the normal granite that once surrounded it before differential weathering took effect, thus leaving exposed the core of hard rock.

Paul points out a boudin at Tintagel castle

We at last reached the coast at Trebarwith Strand. Walking to the beach, we were again favoured by a low tide - Paul must have planned these trips very carefully! Once again the Variscan orogeny was seen to have wreaked havoc because, although the sea cliff revealed a succession of Devonian and Carboniferous rocks, in this case the succession was inverted. This results from one of several extremely low-angle normal faults, although it could possibly be a more general large-scale thrust effect; opinions are divided amongst the experts, since both causes are postulated in the literature. However, it is certainly a Variscan effect; a fault slice or nappe, the Tredorn Nappe, contains the Devonian slates. At beach level and in the base of the cliff were the Tintagel Volcanic Beds, topped by more Carboniferous strata, the Trambley Cove Beds consisting, at the junction, of boudinated layers of black and grey slates. 'Boudins' are formed when structures composed of alternating 'competent' and 'non-competent' beds are deformed by stretching. The competent beds become detached into long, discrete, sausage-shaped features surrounded by the plastically-deformed non-competent material. Above these Carboniferous beds was the faulted junction with the Devonian slates.

A short drive after lunch took us to Tintagel village. 'Tintagel Island' is not quite such but comprises a highly defensible headland. The present picturesque ruins were built by a 19th century industrialist. It is now in the custody of English Heritage who have provided excellent access. Once inside the Island fortifications, the party split up. Some visited the grassy summit plateau whilst others were attracted to the 'Iron Gate' that was once a 'water-gate' giving access on the seaward side to a defended landing wharf at the base of the cliffs in Tintagel Haven. We reassembled in the Island Courtyard before retracing our steps steeply down to the modern high-level bridge that has replaced the hazardous steps and rickety planks I remembered from a boyhood cycling holiday.

Upon crossing the bridge, most of us made the short, even steeper ascent to the Mainland Courtyards area where interesting exposures of the distorted slates showed fine examples of boudins - and a much more favourable perspective of the Island's geology than we had seen hitherto. Hereabout, the same inverted sequence pertains as was seen at Trebarwith, but here some of the low-angle faulted zone has been uptilted by later, very steep normal-faulting. The whole effect is readily visible from this headland viewpoint. We returned to the village via the cliff path, with a brief diversion to the parish church of St Materiana, part of which dates from 1150 AD although there is archaeological evidence of its Dark Age predecessor.

On our final morning we bid farewell to our Farnham friends and returned to Herefordshire via a leisurely lunch-stop at Buckfast Abbey. We disembarked into heavy rain, a wet but geologically well-satisfied party.

The group owes a debt of thanks to our knowledgable leader, Paul Olver. In addition to guiding us in the field, he gave most instructive after-dinner lectures on on what we had seen and would see on the following day. This gave us a much-needed overall view of Cornwall geology. I acknowledge the input of my wife, Iris, to this article, in providing information for a day when I was indisposed.

On the point of departure for home

Reference

Colin M. Bristow (2004). Cornwall's Geology and Scenery (2nd edition). Cornish Hillside Publications, St Austell. 167pp (£14.99)

CLUB INSURANCE Each person attending a meeting does so on the understanding that he/she attends at his/her own risk. The Woolhope Naturalists' Field Club has Public Liability Insurance Cover for field and indoor meetings, but Personal Accident cover and Personal Liability cover remain the responsibility of the participant. Members with house insurance will probably find this included. Members should also note that they will be required to take out appropriate travel insurance for any overseas event.

Soft-Bodied Sensations from the Silurian of the Welsh Borderland

The third Murchison Lecture

Delivered at the Section meeting of 17th February 2006 by

Dr Derek Siveter, Oxford University Museum of Natural History

In Herefordshire there is a recently discovered geological site of global significance. Hard parts of animals, such as the shells or bony parts are resistant to decomposition but soft parts usually decay. In animals such as shrimps or arthropods, the hard carapace may be fossilised. There is very little chance of soft-bodied creatures such as jellyfish, or a rudibranch gastropod with no shell, becoming a fossil. However 60% to 70% of ocean communities are soft-bodied and, with such a small proportion being fossilised, a huge part of the evidence of ancient communities is missing from the fossil record. A *Lagerstätte* is a very rich layer with exceptional preservation. Such sites, where fossils of soft-bodied creatures are found, provide a unique window on ancient environments. Their occurrence is exceedingly rare.

One example of a Lagerstätte is at Chengjiang in south west China, where there are soft-bodied fossils from the base of the Cambrian, about 525 million years old. They are preserved by replacement with pyrite. Another site is the Burgess Shales in British Columbia, Canada, which is mid-Cambrian. These shales were first discovered by Charles Walcott in 1910 and brought to public notice by Steve Gould's book, 'Wonderful Life'. Clay minerals stopped bacterial life biodegrading the remains. There are two-dimensional forms preserved as carbon films showing antennae, eyes and gills. Another of the fourteen Cambrian Lagerstätten is at Orsten in Sweden where there are soft-bodied fossils from the Upper Cambrian, 510 million years old, which are preserved by the mineral apatite, calcium phosphate. There are more Cambrian sites than Ordovician, Silurian and Devonian put together. Only three Lagerstätten represent the Silurian worldwide and these are at Waukesha in Wisconsin USA, at Lesmahagow in Scotland and the site in Herefordshire. The Herefordshire site has been dated as 425 million years old, with marvellously preserved fossils showing incredible detail in three dimensions including leg hairs, eyes and gills. One other British site is at Rhynie in Scotland, the Devonian Rhynie Chert.

The Herefordshire Lagerstätte was discovered by the curator of mineralogy at Leicester University, Dr Bob King. While looking for minerals, he found nodules, some of which were 10 to 20cm across, others 3 or 4cm, in a bentonite band, a product of volcanic ash, about 1m thick. He cracked open a nodule and found calcite in an organic form. This specimen was stored in a drawer at the museum in Leicester. Sometime later someone showed it to Professor David Siveter, who, because he could see arthropod appendages, contacted his brother Dr Derek Siveter at Oxford University. The site was investigated further by them with Dr Mark Sutton also of Oxford University and Dr Derek Briggs of Bristol University. One in three or four of the nodules was found to contain fossils in the central, unweathered part of nodules or perhaps to one side, sometimes more than one in a nodule. The nodules have grown and captured fossils such as arthropods with appendages preserved in calcite, fibrous at the edge and sparry in the centre. There are clay minerals round the edge and apatite and pyrite. There is calcite in the background sediment and enrichment of elements in the body. Some arthropods have been shown to have their guts preserved as calcium phosphate, which probably originated due to the action of bacteria.

During the Silurian Period, Avalonia, including the area which is now Herefordshire, split off from the Southern Hemisphere continent of Gondwana and moved northwards, later colliding with North America. The area where the Lagerstätte formed was on the slope of the outer continental shelf and upper continental slope in about 150 to 200m of water with deep water to the west (the Welsh trough) and shallow water to the east. At this time there was an Irish landmass. About 425 million years ago, in late Wenlock times, a volcano erupted and a layer of ash covered the area.

Animals were washed onto the seabed. Quickly-forming nodules encapsulated the creatures before the body parts decayed. As decay products leaked into the matrix an external mould was created. The surrounding clay was thixotropic, sticky, and the build up of gases as the creatures decayed may also have helped to maintain the shape of the void. The decaying body parts were replaced by $CaCO_3$, fibrous or sparry calcite. This occurred very, very quickly or the three-dimensional shapes would not have been preserved. The nodule was strong enough to prevent squashing by the weight of overlying sediments. The fossils are only found in nodules preserved as calcite, quartz, dolomite or clay minerals. As well as the remains of soft-bodied forms, the deposit contains animal groups that are frequently found as fossils, such as gastropods, sponges and brachiopods. There are trilobite appendages with cetae. There is no other locality in the world with trilobite appendages. Other fossils found include a starfish with

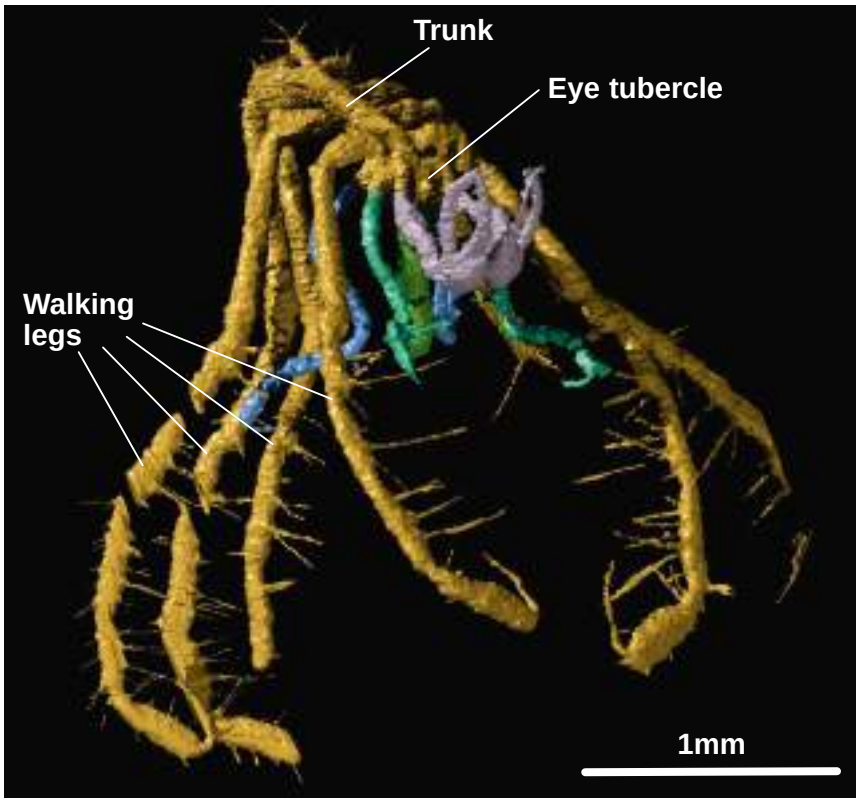


Figure 1. Silurian sea spider, Haliestes

tube feet preserved. There is a brachiopod with pedicle to tether it to the substrate and a crinoid with epifauna on it. 2mm radiolarians are known from only about six localities. These are the first radiolarians found in the Silurian in Britain and they are wonderfully preserved.

Splitting a nodule revealed only a two-dimensional cross-section through a creature. Identification was impossible. At first they were given nicknames - Hairy Worm, Spiny Worm, Wispy Worm, Humpty, Hairy Ball and Flying Fortress. How could they be investigated further?

Radiolarians are formed of silica and so can be put in an acid bath to dissolve the surrounding sediment. Most of the present fossils are preserved as calcium carbonate with the same mineral in the sediment around them so this method was not feasible. A dentist's drill with a fine needle was tried but was too slow and was not suitable for dealing with fragile features. A novel technique has been invented using serial sectioning, grinding and the power of the modern computer. A specimen is cut square and put in resin in a slide holder in wax, raised above the rim by 20 microns (twenty thousandths of a millimetre). Carborundum is used to grind it down 20 microns. Digital photos are taken and the sequence is repeated to produce 200 to 500 images. A computer programme has been developed to stitch the photographs together and make a three-dimensional computer model of the actual fossil which has been destroyed. It takes one to two weeks to grind and photograph, then a few months to edit the digital photos and a couple of months with the computer.

The results of further research on the fossils were in some cases surprising and the detail of the soft parts found was astounding. Hairy Worm has gills and is a polychaete worm. It has a gut filled with sediment and a ventral grove. Spiny Worm was found to be a mollusc with valves. This had been found previously but it was not known what it was. Wispy Worm is an arthropod with fine appendages, sixty eight body segments, horns on the head, side plates and a food groove. Humpty has a bifurcate tail, huge eyes and antennae and turned out to be a shrimp-like creature. Hairy Ball is a 4.5mm arthropod with many appendages and is related to the king crab. Flying Fortress (Figure 1) is a sea spider, with pincers and spindly appendages with setae. This has been identified as a male, because it is carrying eggs, which the females do not usually do. This is the oldest known adult sea spider and the most completely known fossil species. There are only four other sites known in the world with fossil sea spiders and the Herefordshire specimen is the best

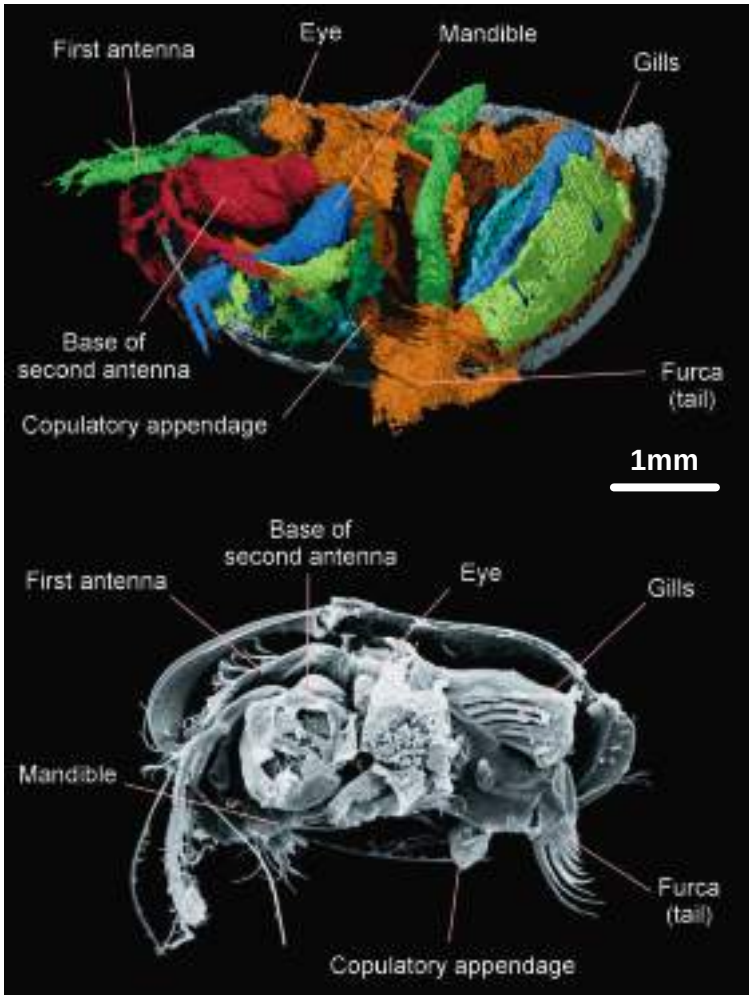


Figure 2. Computer generated 3-D image of a Silurian fossil ostracode (above) and a modern day ostracode (below). Further details can be found in the papers listed at the end of this report, especially Siveter, 2003.

preserved.

There was a 2mm fossil similar to specimens which had been found before. It was thought to be an ostracode, but the soft parts of this had previously not been known. This fossil can be seen to be bivalved and the eye, mandibles, gills, internal organs and antennae can be seen (Figure 2). Even valves are preserved. It can be related to modern-day ostracodes. In the Sun newspaper on 5th December 2003 this was reported under the headline, "Old Todger". The specimen is male as can be seen from the oldest copulatory organ known, 425 million years old.

Where were the volcanoes which laid down the ash? In the Prague area are thick volcanics but this is not close to the site. It could be the Dingle Peninsula where there are trace fossils and volcanics. Moons Hill Quarry in the Mendips has volcanic rocks but these are of mid-Wenlock age so there is a discrepancy in age. More work is needed.

There are hundreds more nodules but the exposure is small. Its location has not been divulged. This is a treasure trove with many fossils showing details that have not been seen elsewhere and with species which are known only from this site.

Thanks are due to Dr Derek Siveter for considerable help in the preparation of this paper and, in particular, his permission to reproduce the two pictures.

Some References

Derek Siveter et al. 2004. A Silurian sea spider. *Nature*, **431**, 978-980

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Derek EG Briggs. 2004. A new *phyllocarid* (Crustacea : *Malacostraca*) from the Silurian Fossil-Lagerstatte of Herefordshire, UK. *Proc Roy Soc Lond B*, **271**, 131-138

David Siveter. 2003. An Ostracode Crustacean with soft parts from the Lower Silurian. *Science*, **302**, 203

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Reported by Moira Jenkins

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A Visit to the Townsend Tuff

By Geoff Steel

Having been surveyed in 1845, the long-awaited Hay-on-Wye 1:50000 geological map was published recently, along with a booklet describing its main features. My attention was drawn to the Townsend Tuff, said to be exposed in the Merbach Brook. And the chance for exploration came when Mike Simms, a geologist friend from Belfast, stayed for a weekend. He explained that the tuff is a volcanic ash, probably originating from North Devon, and has been mapped throughout Herefordshire and South Wales. It is an important time marker in the Raglan Marl.

With our 1:25000 Explorer map we parked at Merbach and walked up a steep drive to New House, then eastwards on a footpath through thick dark woods. Being Raglan Marl, and being a wet weekend, this was definitely a trip for wellies. At the end was a gate into a field, a surprise as the map shows woodland. An old man walking his dog said it was OK to go into the field (it's not on the footpath) and he also said he remembered people living in the house by the gate, which is now a ruin. It is shown on the map at SO306451, on the boundary between two wooded enclosures. They are the field now. We walked downhill to the far corner, due north of the ruin, where he told us there was a waterfall. Barbed wire blocked the way, and after that some thick brambles, but we managed to climb over and through them.

Success! We found a 3.61m high waterfall consisting of two green, well-jointed porcellanites separated by a purple and cream crystal dust tuff. We knew that because the book says so. Reading on further it also says that the lower porcellanite has a surface crowded with faecal pellets. And, yes, we found them as well. The tuff forms a waterfall because it is harder than the Raglan Marl. This was a surprise to Mike who had previously seen it near Pembroke, where it is softer than the surrounding rocks and forms a gap in the cliff. Here at Merbach it has a thin covering of tufa derived from the Bishop's Frome Limestone. We followed the stream upwards through a narrow muddy gorge, scrambling over boulders and fallen trees. But we couldn't find the limestone. So that is the project for next time.

(*Editor's note* : An excellent account of this interesting stratum is given in the following paper, which may be referred to in the Club library.

JRL Allen and BPJ Williams. 1981. Sedimentology and stratigraphy of the Townsend Tuff Bed (Lower Old Red Sandstone) in South Wales and the Welsh Borders, *J Geol Soc London*, **138**, 15-29)

MEETING REPORTS

by Geoff Steel

Friday 21st October 2005 : Members' Evening

We started the evening by looking at geological maps and samples. Derek South showed a map of the North Sea oil fields. He described the three essential components of an oil field as source, reservoir and structure. In the northern area the Kimmeridge Clay forms the source while in the south it is Carboniferous rocks. Typical reservoirs are porous strata such as sandstones, and suitable structures may be anticlines or regions bounded by faults.

Then Martin Allbutt showed a sequence of rocks collected from the Precambrian 'Batch Volcanics' of the Longmynd. These are interbedded with the local purple shales, the layers being steeply dipping to vertical. At the base of the volcanic sequence there are ignimbrites, which were formed by pyroclastic flows in which pumice has been melted into glass and flattened by the weight above. They are followed by a fining-upwards series of ash falls.

Sue Hay showed samples of Irish marble from Connemara, a region tectonically displaced from the main outcrops which are further to the north, on the opposite side of the Iapetus suture.

The evening finished with a slide show. Gerry Calderbank showed pictures of the recent Brittany trip and John Payne described part of the western USA, including Jurassic sandstones in Zion Canyon and opencast Palaeocene coal in Wyoming.

Saturday 5th November 2005 : Upper Swansea Valley

Dr Geraint Owen of Swansea University met us at the Craig y Nos Country Park on this very wet and windy day. Here the A4067 follows a valley along the weakness of the Swansea valley disturbance, a complicated fault with a NE to SW trend hinting at a deep underlying Caledonian structure. He led us up the Cribarth ridge. Many small quarries reveal that this is an anticline of millstone grit with Carboniferous limestone at the base. Through the clouds he showed us a view of the limestones to the north, with sinkholes leading to the nearby Dan yr Ogof show caves. Most of the rocks have a gentle southerly dip towards the coalfield, but in this region the structure is interrupted by the fault.

At lunch time the inn at Abercraf provided a welcome refuge from the weather. Then in the afternoon we drove to the small car park at Craig y Ddinas and walked up the spectacular gorge to the lowest of the waterfalls on the Afon Mellte. Finally we parked at Porth yr Ogof to investigate the caves and limestone formations, finishing in darkness as the evening approached.

Friday 9th December 2005 :
Gabbros - Where and When?

In this lecture Dr Sue Hay described the gabbros of eastern Scotland which she studied for her PhD. They include the large intrusions at Insch and Huntley, along with several smaller ones in the same area. The rocks are difficult to study because gabbro erodes into fertile soil and the resulting vegetation leaves few good exposures. All the margins of the intrusions are faulted, and the Huntley intrusion has also been metamorphosed by shearing.

Some exposed sections reveal a layered structure, similar in appearance to sedimentary rocks, in which gabbros of slightly different compositions form a vertical sequence. The full range includes dunite and peridotite at the basic end (they are almost pure olivine) through troctolite, olivine gabbro and ferro-gabbro to syenite (about 10% quartz).

Sue's particular speciality is geochemical analysis which provides suitable samples for dating. She showed how the separation of crystals from molten gabbro could lead to incorrect dating by not including the full composition. The gabbros of this area have a low concentration of niobium. This indicates that they were formed during subduction. Their Ordovician age agrees with closure of the Iapetus Ocean and correlates with dates from Ireland and North America.

Saturday 25th February 2006 :
The Lapworth Museum

The Lapworth Museum is part of Birmingham University. It commemorates Charles Lapworth, who named the Ordovician Period and was the first Professor of Geology at Mason College (from which the University developed). The museum is housed in the Aston Webb Building, with its well-known red-brick architecture, and still retains its original Edwardian interior.

John Clatworthy, the museum curator, began by giving

Waterfall on the Afon Mellte, with damp geologists

us a general introductory talk. He then guided us on a tour of the current research facilities, which include grinding and polishing equipment for preparation of geological samples and thin sections. We were shown part of the vast collection of samples from sites around the world, including a set of rare and precious gemstones and minerals. He then showed us a selection of material from Herefordshire, specially laid out in preparation for our visit.

In the afternoon we had a tour of the archive. The lower part contains a full set of original one-inch series geological maps of Britain. In the upper part are preserved the diaries, maps, surveys and drawings of Charles Lapworth. It is one of the most complete records of the work of any scientist of that period.

Inspection of mud flows on Bredon Hill

Friday 3rd and Sunday 5th March 2006 : Leominster Canal

"Every canal should have coal at its head." With these words, quoted from the Duke of Bridgwater, Gerry Calderbank introduced his talk at the Bunch of Carrots in Hampton Bishop. In 1777 Robert Whitworth proposed the Leominster Canal, with the aim of linking to the coalfield at Mamble and continuing to the River Severn at Stourport. But construction did not begin until 1791 when England was gripped by 'canal mania'. The scheme was never completed. A section from Leominster to the Teme valley operated until 1850 when the route was sold to a railway company.

On Sunday Gerry led us around some of the surviving canal features. The trip began at Watery Lane, off the Bromyard road, to see the feeder weir on the Stretford Brook. This formerly supplied the south end of the canal, but was dismantled last century as a flood alleviation measure. From there we drove to the Putnal Tunnel near Orleton. It was dug with great difficulty through the gravel of a glacial moraine. We saw a collapsed construction shaft and the North Portal of the tunnel. Gerry pointed out the diverted Ashton Brook which supplied the north end of the canal, and also a pilot channel which provided water for ongoing construction in the Teme direction. After completion it became part of the main canal. It is a considerable rarity for such a pilot channel to be preserved.

After lunch at Burford House Gardens we met with 'Friends of the Leominster Canal' for a joint visit to the Rea Aqueduct which is hopefully soon to be restored by a charitable trust.

Friday 21st & Saturday 22nd April 2006 : Bredon Hill

Les Morris gave us a Friday evening lecture on the geology and geomorphology of Bredon Hill, an outlier of the Cotswold escarpment. It is formed from alternate layers of clay and limestone of lower to middle Jurassic age. Les drew attention to the unusual properties of clay. It has very small particles (about 3mm) so it traps a large amount of water, but the water has difficulty moving between the particles. After heavy rainfall this can lead to a build-up of pressure until a critical point at which the clay begins to flow like a liquid. Photographs taken on Bredon Hill over a period of more than twenty years show repeated movements on a spectacular series of landslips.

On Saturday we parked close to Bredon's Norton and Les took us up the north side of the hill. Landslips in this area merge with head deposits at the bottom which were left after periglacial conditions. Ridge-and-furrow ploughing has been disturbed by the landslips, indicating significant movement since

The Bambury Stone on Bredon Hill

medieval times. Midway up the hill the Marlstone Rock forms a prominent bench with small quarries along its outcrop. A cap of Inferior Oolite forms the summit of Bredon Hill, which has a cambered (i.e. tilted) surface due to instability of the underlying rocks.

Sunday 23rd July 2006 :
Ordovician Volcanic Exposures

This was a joint field trip with the Mid-Wales Geology Club led by Tony Thorp. We met in Llandrindod Wells at Llanfawr Quarry. Here there are black shales of middle Ordovician age which dip towards the NW. The shales are intruded by dolerite sills and a strange set of dome-like laccoliths with feeders. They have been quarried at several places, revealing good examples of contact metamorphism. In the largest of the quarries we found many trilobites (*Trinucleus fimbriatus*) for which the site is well known, along with a smaller number of graptolites (*Nemagraptus gracilis*).

The search for fossils at Llanfawr Quarry.

After a picnic lunch in hot sunshine we drove to the car park at Shaky Bridge next to Cefnllys Castle. From the bridge we followed a newly cut track around the west of the hill in which there are fresh exposures of rhyolitic tuffs and keratophyre lavas. Returning over the castle we collected samples of finely laminated tuffs and at the southern end we could see coarser tuffs which contained volcanic bombs up to half a metre in diameter.

King Arthur's Cave on Great Doward

Saturday 9th September 2006 :
Forest of Dean

The President, Dr Paul Olver, led this Club tour in the Forest of Dean. We took a coach from Hereford, with a pick-up point at Ross, and with some skilful coach driving went up the Great Doward. It has a cliff of Carboniferous Crease Limestone on top, in which King Arthur's Cave is the largest of several. The cliff was carved by the River Wye about two million years ago when its level was 100 metres higher than today. Finds of worked flints indicate palaeolithic occupation starting about 130000 years ago.

From there we drove to the Clearwell Caves. They are iron ore mines open to the public. Our guide was himself involved in working the ore as a free miner, one of the few left in the Forest. All the others mine coal and he described the traditional rivalry between the professions. The ore fills gaps and fissures in the Crease Limestone, the same rock seen at the Doward, so the iron miners are re-excavating caves which originally formed in the Permian period.

A scowle in the Forest of Dean

The same limestone is exposed at the surface near Bream. Here the miners have worked since before Roman times, leaving a maze of pinnacles and chasms called 'scowles'. Bright light and deep shade gave great photo opportunities in the afternoon sunshine. And that was followed by great cholesterol opportunities at the Speech House cream teas. Finally we drove back via Drybrook where the Devonian quartz conglomerate is well exposed at the roadside.

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Herefordshire's Geology

The Committee is considering the publication of a brief guide to the geology of the county. The form this could take, how it would be written, financed and marketed, are all subject to discussion. Anyone interested in taking part in this project should contact Charles Hopkinson (01885 400203 or e-mail candjhopkinson@onetel.com).

The Hereford Museum Resource and Learning Centre

Katherine Andrew

Herefordshire Heritage Services Representative

Since the last update, in 2005, the full funding package for the centre has been achieved, a mixture of a substantial award from the Heritage Lottery Fund and matched funding from Herefordshire Council. A lot of behind the scenes work has been underway by the team to achieve this and put the project out to tender, but nothing was really visible until early June, when the contractor, J Harper of Leominster, arrived on site.

Geologically speaking, the piling activity around the lift shaft was an exciting time in the early summer, with a series of eight to ten metre deep piles drilled into the ground with a huge auger on a piling rig. As the drill is retracted, concrete is pumped down the centre of the auger to fill the hole and then a cage of steel re-inforcing rods pushed down into the wet concrete. Watching for geological information of the section requires an inspection of the material sticking onto the auger, in this case, 10m of undifferentiated sandy red marl. It reminded me of my undergraduate mapping - I used a six inch long auger bit that with a lot of pushing would just about get down to 18 inches.

Once the piles were in place, the rig left the site and the foundation trenches could be dug. During this process, an archaeologist was on-site to undertake a watching brief; a post hole and a few pottery fragments were recovered, but nothing exciting enough to hold up work.

In the last few weeks, most of the steel frame has been delivered and erected, so it is now easy to see exactly where the building extends and its layout on what is a very tight site. We have a good view from our offices of the first floor lecture/meeting room which looks like it will be a good working space. We can also look down into the basement extension where the lift shaft, that will serve all three levels, is currently being built. The building work should be finished by July 2007 and we are intending to start operating our public programmes from early September.

In the mean time, staff and volunteers are hard at work. For the educational programmes we have created a new art session for the centre and another one has been modified to be delivered on site. We are already getting interest in all-day school visits with a lunch break, something we will have space for. We are currently sorting and cross checking the geology collection against pre-existing indexes and registers and work is going well on computer cataloguing of other collections with over 20000 records now on our database. We are also refining storage in our small to medium-sized object store with monthly deliveries of extra drawers that require several bays to be emptied, new drawers installed, then objects put back in drawers before moving onto the next batch - work that will be finished in February 2007. We are also now starting to plan the final collection moves (art and education from off-site; geology, natural history and decorative art within the site) and the displays for the atrium area.

We are really excited about the possibilities that the centre offers both to our service but also to groups and organisations that want to use the centre for meetings, workshops and projects. After a long wait, the vision is now really beginning to take shape before our eyes, we look forward to your proposals for using the completed product.

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The Marches Festival of Geology, 2007

To celebrate the Geological Society of London's 200th anniversary in 2007 and the Geologists' Association's 150th in 2008, a range of national and local events is being arranged in 2007/08. Locally the main focus will be the Marches Festival of Geology, a series of events, exhibitions, etc. based around a one-day symposium in Ludlow on September 13th. On the following day, the Woolhope Club will be staging a re-enactment of an early Club excursion to Aymestrey, with our leaders, in appropriate dress, taking the roles of RI Murchison and TT Lewis. Lawrence Banks, of Hergest Croft, will assume the role of his great grandfather, RW Banks. The excursion, like the original, will start on the train at Titley station, near Eardisley, now operated privately. In addition, the Club will join with the Earth Heritage Trust in mounting a Rock & Fossil Roadshow in Leominster on 4th August.

More information on the Marches Festival of Geology can be found on the following web site : www.shropshiregeology.org.uk/festival.

In Murchison's Footsteps

Dr Paul Olver

Chairman, Woolhope Club Geology Section

Clear skies and bright sunshine greeted members of the Section when they visited Ridgebourne, close to Kington, and the ancestral seat of the Banks family whose four generations have made major contributions to both geology and botany. Lawrence Banks welcomed us all at the Hergest Croft car park and gave us a brief introduction to the estate and the involvement of his great grandfather, RW Banks, with the early geological investigation of the Welsh Borders in the late 1850s. Armed with Murchison's 'Silurian System' (published in 1839), which he had found in his father's library, RW Banks had paid particular attention to the sequences of late Silurian rocks in the Kington area. A discovery on Bradnor Hill north of Kington in 1853/4 of the giant eurypterid Pterygotus had impressed Murchison, by then Director of the Geological Survey, and eventually led to a Banks paper being read by Murchison to the Geological Society in December 1855.

Lawrence Banks then led us through the estate to a small quarry at the northern end of Park Wood, close to Haywood Common. Here Upper Ludlow siltstones dipped at low angles to the south-east and yielded a good fauna of brachiopods such as *Shaleria ornatelia*, *Leptaena depressa* and a variety of rhynchonellids. The quarry was largely worked for walling materials in the late 19th century and Lawrence had kindly arranged that our access was made relatively painless by cutting back rampant vegetation, removing piles of dead leaves and cutting steps across the Park Wood boundary, a former deer enclosure.

Enjoying the newly refurbished paths and steps

Lawrence Banks and Paul Olver

We then proceeded further south into the lower parts of Park Wood where older quarries exploiting Upper Ludlow cross-bedded sandstones had been opened in the late 18th and early 19th centuries for farm building materials on the Ridgebourne estate. These competent Ludlow strata were noticeably less fossiliferous but yielded occasional gastropods, some brachiopod survivors from the strata examined earlier and evidence of some bioturbation. The two exposures examined provided the party with evidence of a rapidly shallowing sea as the Iapetus Ocean closed at the very end of the Silurian period. The restricted nature of the fauna reflects these major environmental changes.

RW Banks was an avid fossil collector and these two quarries would have provided his first points of call in his researches into the Ludlow strata of the Herefordshire-Radnorshire border. By happy coincidence, after an excellent lunch at Hergest Croft Gardens, we were to be introduced in the afternoon to his geological collection by its present curator, the Rev Roy Fenn.

RW Banks's collection strongly reflected local Silurian sites within the Mortimer Forest, nearby Bircher Common and of course, the Kington area together with cephalaspid fish remains from a variety of Herefordshire

Inspecting the geological collection.
The curator, Roy Fenn, is in the centre background.

Old Red Sandstone sites many of which are now no longer available for study. He collaborated not only with Murchison but also gained useful practical experience by working with Rev Adam Sedgwick of Cambrian System fame. He also enjoyed the friendship and mutual research interests of John William Salter (1820-1869), one of the illustrators of 'The Silurian System', and was encouraged to develop his geological expertise by Hereford's leading geologist at the time, Rev William Symonds (1818-1887), a leading light in the early Woolhope Club.

Roy Fenn also introduced the group to the RW Banks Archive collection and its extensive range of correspondence, books and photographs. Highlights included a look at a copy of 'The Silurian System' and an RW Banks school report dated 1836 signed off by Dr Thomas Arnold, the famous reforming head at Rugby School. RW Banks was elected President of the Woolhope Club in 1860, was High Sheriff of Radnorshire in 1874 and a county councillor in 1888. During this period, particularly after the death of Murchison in 1871 and Sedgwick in 1873, he embraced both history and archaeology within his varied interests. Extensive correspondence from the Cambrian Archaeological Association, seen in the archives on our visit, reflect this later half of his life.

From an earlier generation there were medical diplomas gained by the Davies family of Bronllys Castle into which Richard Banks (1791-1871) married in 1817. Richard Banks was also a partner in the highly successful Kington and Radnorshire Bank and on display was some correspondence from James Watt, Junior (1769-1848) FRS for whom he acted as both lawyer and banker. James Watt, like his eminent father, had scientific and engineering interests and was a subscriber to Murchison's 'Silurian System'.

A series of photographs taken by WH Banks, Lawrence Banks's grandfather, from about the 1880s through to the early decades of the 20th century was also on show. Field trips to Wales and the Welsh Borders, Brittany and to Cornwall all featured in this extensive collection. This was a pleasant coincidence for many of our members as the Section had recently visited all these locations on field excursions.

On behalf of the Section, I would like to thank Lawrence Banks and Roy Fenn for all the arrangements on the day and for acting as our expert guides to the Banks family through four generations. I hope very much that the Woolhope Club will continue to be able to call on their support as we approach the Bicentennial Celebrations of the Geological Society in September 2007 and its local events within the Welsh Marches.

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Earth Science Publications in Herefordshire & Worcestershire

John Payne, Earth Heritage Trust

As a part of its core activities, the Earth Heritage Trust has compiled a bibliography of publications and other documents in earth sciences for the two counties. The graph shows the rate at which these documents have been generated over the years. The few publications before 1810 dealt with agriculture, water and salt production. The huge increase following 1830 is due mainly to the influence of Murchison, who himself contributed 66 items about the area over a forty year period. The high plateau following 1850 partly reflects the initial enthusiasm of the local field clubs for geological research. The publication rate was roughly constant for the next hundred years but dips occurred during the World Wars. The vast increase during the 1970s to 1990s is mainly due to the local activity of the British Geological Survey, who produced many reports. The high rate of publication has continued in the most recent years.

Members of the WGS Committee

(December 2006)

Dr Paul Olver ***Chairman***

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

Gerry Calderbank ***Secretary***

Beryl Harding ***Treasurer***

Dr Sue Hay ***Programme Secretary***

Moira Jenkins ***Section Recorder***

Kate Andrew ***Heritage Services Representative***

Dr John Payne ***'Earth Matters' Editor and Earth Heritage Trust Representative***

Charles Hopkinson

Alan Stone

Abberley and Malvern Hills Geopark

The Abberley and Malvern Hills European Geopark Partnership has secured the area's UNESCO European and Global Geopark status for a further two years. All European Geoparks are subject to revalidation on a three-year basis to ensure that the Geopark is active- ly promoting its geological heritage for community-based initiatives and sustainable regional economic development.

The assessor was Dr Charalampos Fassoulas from the Psiloritis Natural Park in Crete. He spent three days visiting various localities within the Geopark and looking at the projects that we have been developing since the award of EGN status in 2003. He considered the work of the Geopark Partnership to be exemplary and was particularly impressed with the Community Liaison project and the educational programmes operated by members of the Geopark Partnership. However, there were some criticisms, which were largely based on a general lack of promotion of the Geopark 'on the ground'. Although there are some interpretation panels and visitor information centres located within the Geopark it was felt that there was room for significant improvement. This is clearly something that we have to address by the next revalidation. Two other Geoparks have not had their UNESCO status renewed, so there is continuing pressure on the Partnership to maintain our existing high quality activities and to develop new initiatives.

This summer also provided an opportunity for the Geopark to send a representative to the Psiloritis Geopark. The Geopark has appointed its first Artist in Residence, Sandra Masterston, thanks to the support of the University of Worcester and the Arts Council of Great Britain. Sandra plans to explore the geology and landscape of the Geopark and will link this work to the geological collection housed at Worcester Museum and Art Gallery. This collection is of national significance and has not been seen by the public for many years. One of the first tasks undertaken by Sandra as Artist in Residence was to represent the Geopark at the first Art Festival organised by the Municipality of Royvas in the Psiloritis Geopark in Crete. The festival involved the painting of public buildings and walls throughout Rouvas, drawing inspiration from the local landscape, people and environment. Artists from six European Geoparks collaborated in the festival and it is hoped that this will encourage the development of further cultural exchange programmes across the European Geopark Network.

Contact Rona Davis for further information; rona.davis@worc.ac.uk; 01905 855185

Dr Cheryl Jones,
Director, Abberley and Malvern Hills Geopark

H&W Earth Heritage Trust

The major event in the past year was the Trust's celebration of its 10th anniversary. This was held at Witley Court in beautiful weather. Eric Robinson gave the gathering a knowledgable talk on the building stones of the house, the fountain played, lunch was enjoyed and the interior of the highly-decorated parish church was described on the spot.

Later in the day, at the Trust's AGM, the present author was elected as Chairman of EHT following Les Morris who had occupied the post since the organisation was formed. At the same time, Peter Oliver, EHT's main inspiration since its foundation, retired as Director. Fortunately for the Trust, he is keeping an active, though a little less intense, role in EHT's management.

New work programmes for the Trust begun this year include the 'Geopark Way' (a long distance path between Bridgnorth and Gloucester), a Discovery Guide and RIGS designations for the Frome valley, a further trail guide in the Malverns and the gathering of baseline data on fluvial geomorphology and soils and surface deposits for Worcestershire County Council.

The Trust is fortunate to have gained two new workers this year, Tom Richards and Gemma Corby.

Dr John Payne, *H&W EHT Representative*