NEWSLETTER

August 2007

Special Symposium Edition

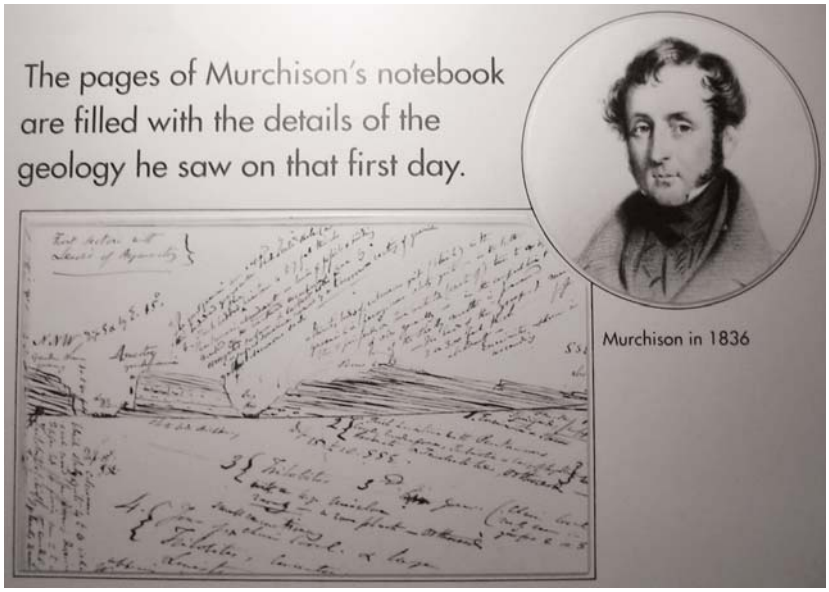
The ground beneath our feet: 200 years of geology in the Marches

A Symposium to be held on Thursday 13th September 2007 at Ludlow Assembly Rooms

Hosted by the Shropshire Geological Society in association with the West Midlands Regional Group of the Geological Society of London

To celebrate a number of anniversaries of significance to the geology of the Marches:

- the **200th anniversary** of the Geological Society of London
- the **175th anniversary** of Murchison's epic visit to the area that led to publication of The Silurian System.
- the **150th anniversary** of the Geologists' Association



The Norton Gallery in Ludlow Museum, Castle Square, includes a display of material relating to Murchison's visits to the area in the 1830s.

Other Shropshire Geological Society news on pages 22-24

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Some words of welcome by the organising societies

Chris Rayner, Chair of the Shropshire Geological Society:

It is humbling and yet a great delight that a mere 28 year old will be hosting this symposium celebrating the 200th anniversary of the Geological Society of London and also the 150th of the Geologists' Association. I refer, of course, not to the age of the Chair but to the Shropshire Geological Society which was formed in 1979, growing out of an evening class in Shrewsbury led by Dr. Peter Toghill. The Society, with Dr Toghill as its first chairman, one of the contributors to the symposium today, was established to bring together people with a common interest in geology, with particular reference to the varied and stimulating rocks and landscapes of our beautiful county. Throughout the 28 years, we have enjoyed lectures and field excursions as well as being involved in a range of specific projects, appealing to both amateur and professional geologists alike.

Today we have about 75 members and, since moving into the new century, we have undergone an evolutionary leap forward!

The Society's first major undertaking was to identify, designate and record our Regionally Important Geological Sites (RIGS), an exciting yet lengthy task in Shropshire where there were so many potentially important sites. This is an ongoing process; over 300 RIGS are currently designated. Next came a joint project with the Shropshire Wildlife Trust called 'the Shaping of Shropshire'. Since then successful bidding for grants has enabled us to carry out a variety of projects including a South Shropshire stone roofs survey in partnership with English Heritage, and Geodiversity Management Plans for four key sites supported by the Aggregates Levy Sustainability Fund, providing the basis for a new series of Geological Trails specifically to increase awareness of how rocks make the landscape; 8 have been prepared to date, some of which are supported by detailed field guides published in the Society's Proceedings. All this and more has been master-minded by our Projects Officer, Andrew Jenkinson, with the help of a group of hard-working member volunteers.

The year 2007 has seen our website flourish and even greater efforts to promote wider interest in geology amongst the general public. Conscious that our subject, although fascinating to 'insiders' can be perceived as specialised, difficult and even boring to those who don't speak the language, we are trying at events throughout the county to increase awareness and improve appreciation with display material and user-friendly activities for adults as well as children. In partnership with the Geology Trusts, the Geologists' Association and UK RIGS, the Society has been actively involved with the geodiversity agenda regionally within the West Midlands and the Welsh Marches.

The Shropshire Geological Society in co-operation with the County Council, Museums Service, and the Wildlife Trust has recently compiled a Geodiversity Action Plan to help protect, promote, enhance and explain Shropshire's wonderful geological heritage. We hope this will further enlarge our vision as a Society, make us more aware of the treasures of the past and shape our future efforts to conserve, to encourage research, and also to enlighten, to educate and to excite.

There is another important geological anniversary this year! It is 175 years since Murchison visited our area and subsequently published his classic work, '*The Silurian System*,' thereby laying the foundations for our current understanding of Lower Palaeozoic earth history. So, it is appropriate that the various geological organisations within the region have come together to promote the Marches Festival of Geology and that the Symposium is taking place in Ludlow.

On behalf of all those involved in the planning and organising of the Symposium and Festival as a whole, I should like to welcome all who will be attending. May it be a memorable and enjoyable day, and of lasting benefit to those who are here, the local community, and those who will visit in the future.

Adrian Collings, Chair of the West Midlands Regional Group of the Geological Society of London:

The Geological Society of London (established in 1807) is the national society for geoscience in the United Kingdom.

The West Midlands Regional Group (WMRG) is one of thirteen Regional Groups inherited from the former Institution of Geologists, each of which represents the Society in their respective region, organises meetings of geoscientific and professional interest, and deals with matters related to professional training for Geologists. The first meeting of the WMRG took place on the 24th March 1977.

The Group continues to provide a local forum where professional geologists, academics and interested amateurs, can consider and discuss scientific and technical issues, and also meet outside the workplace. This currently focuses on a programme of evening talks between September and April, covering a broad spread of subjects ranging from the local, such as Landslips in Telford, through policy, such as the Landfill Directive, to global, such as a review of the geohazards related to the Asian Tsunami.

Symposium Programme

All information is given in good faith. However, we reserve the right to amend or cancel events in the published programme at any time due to circumstances outside our control.

9.00-9.15am (setting up from 8.30am)
Registration and setting up
Tea/Coffee available
Venue: Level 2, above Entrance Foyer, Ludlow Assembly Rooms, Mill Street

9.15-9.45am
Opening Session and Welcome Address
Chair: Prof Michael Rosenbaum, Chair of the Steering Group for the Marches Festival of Geology 2007
Venue: Main Auditorium

Marches Geology for All - an introduction to 700 million years of earth history in Shropshire and Herefordshire
Dr Peter Toghill, Vice Chair of the Shropshire Geological Society
Time: 9.20-9.45am

9.45-10.45am
Session 1: The mark of distinction: local character shaped by landscapes and building stones
Chair: Colin Richards MBE, Conservation Officer, South Shropshire District Council
Venue: Main Auditorium

Local character shaped by landscapes
Dr David Lloyd MBE, past Chair of the Ludlow Historical Research Group
Time: 9.50-10.15am

From the Ground, Up: vernacular building stones in a border landscape
Andrew Jenkinson, Countryside Interpreter and Projects Officer for the Shropshire Geological Society
Time: 10.15-10.40am

10.45-11.15am
Exhibition and Refreshment break
Tea/Coffee available
Venues: Level 2 Bar (drinks), Museum (exhibition) - see note on oppostite page for access details

11.15-12.30am
Session 2: The Marches in the past: on the edge of a lost ocean
Chair: Chris Rayner, Chair of the Shropshire Geological Society
Venue: Main Auditorium

Palaeogeography of the Lower Palaeozoic
Dr Robin Cocks OBE, recently Keeper of Palaeontology and President of the Geologists' Association
Time: 11.20-11.45am

The Silurian Herefordshire Lagerstatte: a unique window on the evolution of life
Prof David Siveter, Head of Palaeontology, University of Leicester
Time: 11.50-12.15am

12.30-1.30pm
Exhibition and Lunch break
Light buffet lunch
Venues: Oscars (lunch, tea/coffee), Level 2 Bar (other drinks), Museum (exhibition) - see note on opposite page for access details

1.30-2.45pm
Session 3: Geology in the community: evolving perceptions and realities
Chair: Dr Paul Olver, Vice-President of the Woolhope Naturalists' Field Club
Venue: Main Auditorium

Geology in the community: evolving perceptions and realities
Harriett Baldwin, Parliamentary Candidate for West Worcestershire, and Philip Dunne MP (in absentia), Member of Parliament for Ludlow
Time: 1.35-1.45pm

Geological pioneers in the Marches: from Robert Townson (1799) to Roderick Murchison (1839)
Prof Hugh Torrens, Emeritus Professor of Historical Geology, Keele University
Time: 1.45-2.10pm

Challenges for the geoscientist: an international perspective
Prof Rod Stevens, Head of Sedimentology and Quaternary Science, University of Gothenburg, Sweden
Time: 2.15-2.40pm

2.45-3.15pm
Exhibition and Refreshment break
Tea/Coffee available
Venues: Level 2 Bar (drinks), Museum (exhibition) - see note on opposite page for access details

3.15-4.00pm
Session 4: The Ice Age: on the edge of a glacier
A moment to reflect on the life of Dr Peter Cross who passed away on Monday 9th July 2007. Peter revolutionised our understanding of the landscape in the Teme Valley and the Devensian history of the North Herefordshire area.
Chair: Adrian Collings, Chair of the West Midlands Regional Group of the Geological Society
Venue: Main Auditorium

The Ice Age Legacy in North Shropshire
David Pannett, Field Meetings Officer for the Shropshire Geological Society
Time: 3.15-3.35pm

The Ice Age in the Marches: Herefordshire
Dr Andrew Richards, Herefordshire and Worcestershire Earth Heritage Trust
Time: 3.35-3.55pm

4.00-5.00pm
Session 5: The future for geology in the Marches
Chair: Prof Michael Rosenbaum, Chair of the Steering Group for the Marches Festival of Geology 2007
Venue: Main Auditorium

Future avenues of research in the Welsh Borderland
Prof John Dewey FRS, UC Distinguished Professor of Geology, University of California Davis
Time: 4.05-4.30pm

The future for geology in the Marches: a BGS perspective
Dr David Schofield, British Geological Survey Regional Geologist for the West Midlands and the Marches
Time: 4.30-4.55pm

5.00-5.15pm
Closing Session: 200 years of geology in the Marches
Chair: Dr Paul Olver, Vice-President of the Woolhope Naturalists' Field Club
Venue: Main Auditorium

Closing Address
Lawrence Banks CBE, Great Grandson of Richard William Banks who hosted Murchison at Hergest Croft on his epic visits to the Marches
Time: 5.00-5.15pm

5.30-6.30pm
Reception:
Hosts: The Friends of Ludlow Museum
Venue: John Norton Gallery of Ludlow Museum

Exhibition

10.30-17.00 and during the Reception

The Norton Gallery in Ludlow Museum will also be hosting a display of items of local geological interest, including the cross sections prepared by Murchison for his lecture to the Ludlow Natural History Society in 1854, delivered at the Mechanics Institute that used to be located nearby. The Museum is located beneath the lecture hall but the entrance is outside, accessed from Castle Square.
Today (13th September only) the Norton Gallery is open 10.30-17.00 throughout. Otherwise in September the opening times are Monday to Saturday (closed Sunday) 10.30-13.00 and 14.00-17.00, closed for lunch 1-2 pm.

John Norton.
copyright LLMRC

Abstracts and Biographical Details

Opening Session:
Welcome Address

Prof Michael Rosenbaum: *It was the then curator of Ludlow Museum (which had grown out of the Ludlow Natural History Society) John Norton who, with Brian Young (then Youth Hostel warden) inspired a young Rosenbaum to pursue his enthusiasm for geology when he participated in their first YHA geological break, in April 1967. Now he is Chair of the Steering Group for the Marches Festival of Geology, having developed a career out of his hobby, which still continues unabated.*

Rocks represent our main source of evidence for interpreting the past, and the Marches include representatives from all twelve internationally recognised periods of geological history, from the Precambrian to the Holocene, spanning 700 million years of earth history. Included within these are four which were defined on the basis of the evidence discovered here: Cambrian, Ordovician, Silurian, Devonian, and a fifth, the Permian, was subsequently defined on the basis of techniques first worked out in the region.

One of the reasons that the area is so interesting and varied is that it is a geological "frontier zone". For instance:

- The Malvern Fault, running North South, represents an ancient and fundamental division that has asserted considerable influence through time, at the join between two small Precambrian continents.
- The Church Stretton Fault/Neath Valley Disturbance and the parallel Pontesford/Linley Fault, both running North East to South West, form the boundary between areas of Caledonian folding to the west and relatively undisturbed, older continental crust to the east. It was a major plate boundary during the Silurian.
- The region was uplifted as a huge dome towards the end of the Cretaceous as crustal tensions developed, eventually ripping North America apart from Europe to create the North Atlantic Ocean. One of the associated "hot spots" developed in the eastern Irish Sea basin, raising the elevation of Wales and the Marches. Much of the drainage system recognizable today developed on this uplifted area.
- The Pleistocene Ice Sheets encroached the lower ground, but probably left the hill tops ice-free, creating a complex local topography that includes hummocky terrain as moraine accumulated beneath the ice or was dumped as the ice melted, along with considerable disruption to the drainage system, diverting rivers, flooding valleys and eroding new landscapes.

Our current level of understanding of the 700 Ma evolution of the Marches is based upon detailed evidence acquired through diligent collecting and recording by generations of enquirers. Its interpretation is due to the skills that geologists are able to employ to read it. However, many questions remain unanswered, awaiting discovery of new facts and interpretation, or re-interpretation, as new ideas emerge.

The Ludlow Research Group has been particularly effective at encouraging geological research in the region since its inception in 1951, essentially through establishing a network of contacts fostered by annual meetings in the field. The LRG grew from a small team of young researchers at Manchester University (notably Jim Lawson, Charles Holland and John 'Mac' Whitaker and, later, Vic Walmsley). Their aim (guided by Dr Stephen Straw, 35 years a lecturer at Manchester and himself a Ludlovian researcher, first on fish remains in Ludlow and then conducting geological mapping of the Builth area) was to further research into the detailed geology of the Ludlow area with particular reference to rocks of Upper Silurian age, their importance having been recognized over a century earlier by local naturalists (notably the Rev Thomas Lewis and Dr Thomas Lloyd) and publicised by Roderick Murchison.

It is, incidentally, nearly 175 years since Roderick Murchison first publicly described his interpretation of what had previously been called the "Grauwacke Series" within the "Transition Rocks", in a paper read to the Geological Society of London on April 17th 1833 and published in the Proceedings for that year. This led in 1839 to publication of his milestone book: *The Silurian System*. Arguments ensued regarding the exact terminology appropriate to each bed, notoriously the overlap between Murchison's Silurian and Sedgwick's Cambrian. Resolving the disputes required more detailed studies, particularly of the graptolites, which followed at the turn of that century under the direction of Charles Lapworth at what was to become Birmingham University, notably by his two students Gertrude Elles and Ethel Wood.

The need to agree time zones internationally led to renewed interest and a new sense of purpose for the LRG during the late 1960's into the 1970's, notably by Robin Cocks and Mike Bassett, working mostly in the UK on Silurian rocks. Agreement was reached in the 1980's through the Subcommission on Silurian Stratigraphy under the auspices of the International Commission on Stratigraphy within the International Union of Geological Sciences. Emanating from the work of this Group came the basis for global definition and correlation of chronostratigraphical units and their boundaries, which were to lead eventually to those principles being applied by the IUGS to the whole of the geological column.

The LRG has been, and still is, an amazingly influential body whose informal status and loosely knit membership belies the

huge influence that it has had on Palaeozoic stratigraphy throughout the world. Membership of the LRG remains buoyant as a new generation of researchers are becoming excited by the wealth of information still to be discovered, the fantastic fossils of the Herefordshire Konservat-Lagerstätte (David Siveter) and the re-interpretation of the Ludlow Bone Bed as containing charcoal of primitive plants destroyed by the world's earliest wildfire (Dianne Edwards) are but two examples. Others must surely be discovered in the course of time.

The impact of our understanding of the ground on the lives of those who live in the area is considerable. The industrial revolution began here, with ironstone nodules brought down from Clee Hill to be smelted at Burrington using charcoal. This was followed in Broseley and Coalbrookdale by ironstone and limestone being fired with coal and an upsurge in industrial output along the banks of the River Severn in Ironbridge Gorge. Mineral extraction is still active, nowadays primarily for construction and roadstone; the groundwater is a major concern both to domestic consumption and agriculture; the landscape attracts tourism, arguably now the most important source of income, and its configuration determines the potential for sustainable development of the region.

On a local level, the public understanding of geological science has been developed most notably by the work of the late John Norton, who had a remarkable gift for encouraging youngsters to take an interest in the ground around them. This has been one of the reasons that the area has been portrayed as "The Geological Capital of the UK" (quoting the Wikipedia entry for Shropshire) and many have felt this should be reflected in the Bicentennial Celebrations of the Geological Society of London. A number of organisations in the Marches have therefore agreed to collaborate to run a festival to celebrate the Society's 200th anniversary.

The one-day symposium in Ludlow is at the centre of this Festival, on the theme of "The ground beneath our feet: 200 years of geology in the Marches". This focuses on five themes of general as well as regionally significant interest.

Marches Geology for All - an introduction to 700 million years of earth history in Shropshire and Herefordshire

Dr Peter Toghill: *Until his retirement last year, Peter was a senior lecturer in geology at the School of Continuing Studies in Shrewsbury, part of the University of Birmingham. He is a Fellow of the Geological Society of London and was awarded the prestigious R.H. Worth Prize by the Society for promoting an understanding of geology to a wider public. He is now Vice Chair of the Shropshire Geological Society.*

The beautiful landscape of the Welsh Marches is underlain by a rock sequence representing 10 of the 12 recognised periods of geological time (10 out of 13 if the Tertiary is subdivided into two periods). This remarkable variety, covering 700 million years of Earth history, has resulted from the interplay of three main factors: (1) erosion and faulting which have produced a very complex outcrop pattern; (2) southern Britain's position near to plate boundaries through most of late Precambrian and Phanerozoic time; and, most importantly, (3) the incredible 12000 km, 500 million year, journey of southern Britain across the Earth's surface from the southern hemisphere to the northern, caused by plate tectonic processes.

The story begins on the northern margins of Gondwana, around 60 degrees south of the equator ca. 600 million years ago. A late Precambrian basement of metamorphic rocks and igneous complexes, now exposed as the Rushton Schists of Shropshire and the igneous rocks of Hanter and Stanner Hills in Herefordshire, was split apart around 600 million years ago (Ma) to form a marginal basin bounded by faults now called the Welsh Borderland Fault System. The most famous of these faults, the Church Stretton Fault, together with its partner further west, the Pontesford-Linley fault, would have a profound affect on Shropshire geology for nearly 500 million years.

A volcanic arc near to the margins of the basin formed the Uriconian Volcanics of Shropshire between 570 and 560 Ma, and around the same time a nearby shallow marine basin received sediments from the eroding volcanic arc and adjacent areas to form the unique Longmyndian Supergroup of sedimentary rocks, up to 7000 m thick. The marine basin rapidly shallowed so that the early Longmyndian fine grained marine and deltaic/fluvial sequence, the Stretton Group, is followed, without an unconformity, by the coarse grained fluvial Wentnor Group. Major earth movements around 550 Ma (latest Precambrian) formed the remarkable overturned Longmynd Syncline, exposed around Church Stretton between the Church Stretton and Pontesford-Linley Faults, with small exposures further south around Old Radnor.

A major marine transgression following further widening of the Iapetus Ocean marked the start of the Cambrian period (545 Ma to 495 Ma) with a major unconformity below shallow water quartzites and sandstones which formed over the Welsh Marches, now exposed around the Wrekin and Church Stretton. These Cambrian rocks yielded Britain's oldest trilobites in the late 1800s.

During the Ordovician (495 - 443 Ma) the Iapetus Ocean started to close as the Avalonian microcontinent split away from Gondwana and moved northward, "pushed" by the spreading Rheic ocean to the south. By the end of the Ordovician southern

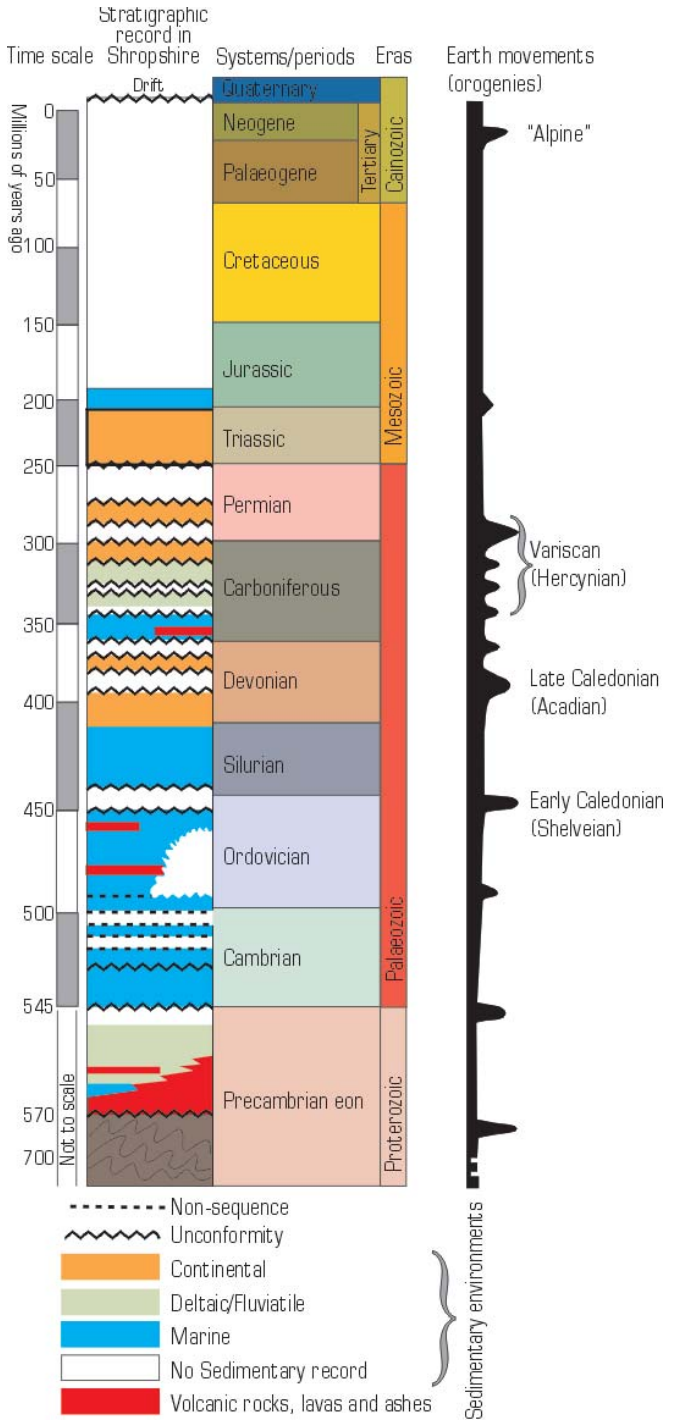
Britain had moved from 60 degrees south to 30 degrees south of the equator. The Welsh Marches were right astride the Iapetus southern shoreline, which fluctuated west to east to form very different sequences either side of the Pontesford-Linley fault. An early Ordovician (Tremadoc) mud blanket encroached over the whole area followed by a rapid regression of the sea west of the Pontesford-Linley fault, so that Arenig to Llanvirn epoch sequences, amounting to 4000 m including the famous Stiperstones Quarztite and volcanic lavas and ashes, only occur west of the fault. The well known Caradoc epoch transgression spread shallow water sequences east of the Pontesford-Linley fault in the type area around Church Stretton. A major regression in the Ashgill epoch caused by tectonic uplift, the Shelveian event, and amplified by falls in sea level caused by a northern Gondwana glaciation, meant that the sea retreated west into Wales during the late Ordovician. Major folding and faulting during the Ashgill Shelveian event affected the Shelve area in particular.

The Silurian period (443 to 418 Ma) made famous by Murchison saw the Welsh Marches in the southern tropics, around 25 to 20 degrees south. An early Silurian Llandovery transgression from the west (mapped by Ziegler, Cocks and McKerrow using brachiopod communities as depth indicators) produced shallow water sequences. This was followed by shallow water subtropical limestones with reefs (including the Much Wenlock Limestone), and shales, of the Wenlock and Ludlow epochs, e.g. around the southern end of the Long Mynd. At the top of the Silurian it is deep-water graptolite faunas that have changed the international stratigraphic picture in recent decades. Murchison's neat Ludlow Bone Bed marker horizon did not fit with the graptolite-bearing type sections in the Po□áry Section of the Daleje Valley near Prague (Czech Republic), with the result that a new Prídolí Series now extends the Silurian upwards into our Old Red Sandstone lithologies, finishing at the *Psammosteus* Limestone (now the Bishops Frome Limestone Formation).

At the end of the Silurian the Iapetus Ocean had almost closed, with southern and northern Britain finally joined by the time of the mid Devonian. The Acadian (Late Caledonian) orogeny, represented by the unconformity between the Lower and Upper Old Red Sandstone, was responsible for the folding that gave us the Ludlow Anticline and the dip of the Wenlock Limestone, giving rise to our most conspicuous topographical feature: Wenlock Edge. During the Devonian period (418 - 362 Ma) non-marine Old Red Sandstone sediments formed over the Welsh Marches. During the Carboniferous (362 - 290 Ma) periodic episodes of the Variscan Orogeny left their mark on a landscape which was now more subdued, and divided into a number of basins of deposition, but again with Shropshire in a crucial marginal position astride St George's Land, and right on the Equator. The result is a series of minor unconformities at the base of the Carboniferous Limestone, the Namurian and the Coal Measures. This is well seen in the Clee Hills, where Titterstone Clee shows each of these Carboniferous Series, but in Brown Clee the Coal Measures rest directly on Old Red Sandstone. In the East Shropshire Coalfield the Upper Coal Measures spread unconformably over an earlier Variscan landscape with a break that earlier geologists referred to as the Symon Fault.

Arid conditions set in during the late Carboniferous as Britain found itself in the arid heart of Pangaea, just north of the Equator. Desert sandstones covered the area during the Permian and Triassic periods (290 - 206 Ma). During the late Triassic and the beginning of the Jurassic period marine conditions, with Britain around 35 degrees north, spread from the east to deposit clays and thin limestones. The early Jurassic Lias (ca. 200 Ma) is the youngest bedrock deposit now preserved in the Welsh Marches, around Prees in north Shropshire. We have no record of younger Jurassic or Cretaceous rocks but it is likely that Middle Jurassic rocks and the Chalk were deposited but have since been removed by erosion.

During the Tertiary period (65 - 2 Ma) the Welsh Marches, now close to their present latitude, experienced uplift and erosion of great thicknesses of Mesozoic rocks, to expose a landscape not too dissimilar to today, but which was extensively modified during the Quaternary Ice Ages and post glacial periods (2Ma to present day).



From Geology of Shropshire, 2nd edition.
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Session 1: The mark of distinction: Local character shaped by landscapes and building stones.

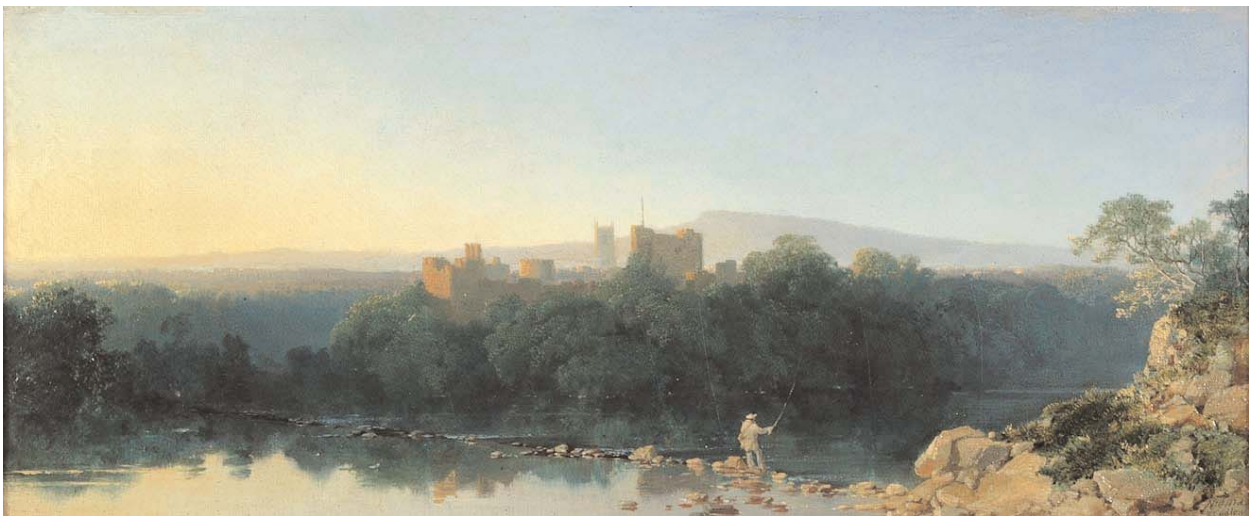
Local character shaped by landscapes

Dr David Lloyd MBE: *David was born and brought up in Ludlow and later became an Exhibitioner of Balliol College, Oxford. After a career as a schoolmaster and college lecturer, he returned to Ludlow, where he became active in local affairs, serving variously as Mayor, County Councilor and Church Warden. He has written a number of books on local history runs courses and has lectured both in Britain and abroad. David is a past Chair of the Ludlow Historical Research Group and is now an honorary life member, having been involved since its formation in 1976, and is currently Research Adviser.*

In 1770 the English landscape painter Paul Sandby, with his patron Sir Watkin Williams-Wynne of Wynnstay near Ruabon, and accompanied by his nine servants, fifteen horses and a large cart, visited Llangollen, Bala, Dolgellau and Caernarfon.

This provides a flavour of the portrayal of the landscapes of The Marches seen through the works of great artists, providing an insight of the region as seen by the pioneer geologists and often revealing details of the ground that have since been lost, or features whose importance might otherwise be overlooked.

The mid 19th Century sketch of Ludlow and the River Teme drawn by Charlotte Murchison, wife of Roderick Murchison (later Sir), probably drawn during her first visit to Ludlow, in 1831, and used on page 195 of The Silurian System (published 1839) to introduce Chapter 16 of the same name. This was reproduced as the frontispiece of the 1974 (No.21) Bulletin of the Ludlow Research Group. However, field evidence actually shows the beds to be dipping in the opposite direction at this point! Perhaps Charlotte merged two separate views to enhance the aesthetics, one of the church and castle looking east towards Titterstone Clee (the prominent hill in the distance), and another of the rocks exposed along the Bread Walk near the last major building stone quarry to have exploited the calcareous siltstone of the Whitcliffe Beds, some 300-400 m to the south (right) where their inclination is indeed to the right, as depicted here. In between lies the core of the Ludlow Anticline



Ludlow oil painting by E.J. Niemann in the mid 19th Century. A somewhat more realistic depiction of the scene than the previous painting. Copyright Shrewsbury Museums Service (SHYMS:FA/1991/032).

From the Ground, Up: vernacular building stones in a border landscape

Andrew Jenkinson MA: *After a brief spell of biology teaching at Lancaster Royal Grammar School (1966-69), Andrew returned to his main outdoor interest as an adult education tutor in geology, in Shropshire. He has moved gradually into publishing and tourism through publication of visitor information papers, local interest (Shropshire) books, booklets and trail guides. He is now a countryside interpreter, trading as Scenesetters, and Projects Officer for the Shropshire Geological Society.*

Many parts of Britain are characterised by their building stones: the Jurassic Limestone of the Cotswolds, flint of the chalklands of the south east, gritstone of "the north". But look at a vernacular architecture map of Britain and the chances are it will show Shropshire, along with Cheshire to the north and Herefordshire to the south, as "black and white" or timber-framed country. In practice stone buildings are more common than timber-framed ones in most parts of the county prior to the mid-nineteenth century, but this is not recognised as the general perception because there is no single characteristic stone.

Instead we see extensive use of local stone which mirrors the huge variety of different rock types across the county. A few Shropshire stones had structural qualities which made them very suitable for building, notably the freestones of the north Shropshire hills, and in particular Grinshill. Their reputation ensured a wide market. But the most interesting are those of very restricted outcrop, used of necessity, but only in the immediate vicinity of the quarries. Examples include Alberbury Breccia, Acton Scott Limestone, the Pentamerus Sandstone or Bog Quartzite of Norbury and Wentnor amongst others. These are the stones which give local distinctiveness to individual villages or estates. But others equally reflect the local geology from the almost Cotswold-looking calcareous siltstones of Corvedale to the Carboniferous Limestone of Llanymynech.

This talk will range across the county, looking at the way in which the vernacular buildings can be read as a geological map, and considering the importance of recognising and conserving this degree of distinctiveness in restoration of stone buildings.

Session 2: The Marches in the past: On the edge of a lost ocean

Palaeogeography of the Lower Palaeozoic

Dr Robin Cocks OBE: *Robin was head of the Department of Palaeontology within The Natural History Museum, London, which was formerly termed The British Museum (Natural History). He has a BA degree in geology and a MA, DPhil and DSc, all from Oxford University. He is a Titular Member of the Silurian Subcommission of the International Union of Geological Sciences, a recognised global expert on Lower Palaeozoic stratigraphy, palaeontology and terrane positioning and the author of over 150 scientific publications, including subsidiary work on both petroleum and engineering geology. He is a Chartered Geologist and has been awarded four medals, both nationally and by the geological community. He has been President of the Geological Society of London, the Palaeontological Association and the Palaeontographical Society, as well as serving on many other national and international committees. He was recently President of the Geologists' Association.*

Based on his address to the Geologists' Association (*Proceedings of the Geologists' Association, vol. 116*) Robin Cocks writes that it is natural for us all to assume that Britain has always been the sea-girt isle beloved of Shakespeare. However, as soon as one starts to look at British rocks and to understand her geology it becomes progressively obvious that, since the rocks contain numerous and varied fossils of marine origin, these islands have been under the sea for a very large part of geological time. For these reasons, Britain is one of the best places in the whole world in which to study geology, since the rocks represent a large proportion of the Earth's history, with every period from the Precambrian to the Holocene represented by sediments and fossils. Shropshire emulates much of this within the compass of a single county.

However, it is also natural to assume that the area now occupied by the British Isles has always been together as a single unit, if not always at today's latitude and longitude. Once again, a fallacy, and it is the chief purpose of this relatively brief review to describe how the disparate parts of these islands have come together, with particular reference to their amalgamation in the Palaeozoic. For, since the Palaeozoic, all the area of these islands has been joined together as a single unit and, thus, although the seas have advanced and retreated many times in the Mesozoic to Recent, the changes in palaeogeography during the last 250 million years have been much less fundamental than in the previous aeons.

The past forty years have been a most exciting time for geologists: despite the preceding 200 years of steady progress in geological knowledge, it has only been since the 1960s that geology has possessed the unifying theory of plate tectonics, comparable to that of evolution for the biological sciences.

The effects of that global knowledge on our understanding of the geology and history of the British Isles have been astonishing. Most dramatically, we now know that Britain was divided between two major terranes until the Caledonide Orogeny of the Silurian and has thus only been united for less than 10% of geological time.

A terrane is a discrete piece of continental crust that is moving or has moved in relation to those blocks which surround it. I will first outline the general principles and methods by which we can establish the former positions of all terranes anywhere. Then, after a glimpse at some of the relevant previous research, we will review the terrane divisions of these islands in the past and then go on to consider their history. To set the Palaeozoic scene, the Precambrian is mentioned briefly, but the ongoing events in the Lower Palaeozoic form the core of this paper, to be followed by a brief section on the Upper Palaeozoic.

Scotland and northwestern Ireland were part of Laurentia, which today also makes up the greater part of North America; and England and southeastern Ireland were parts, first of the Avalonian part of Gondwana until the earliest Ordovician and subsequently the independent Avalonia Terrane until its collision initially with Baltica in the latest Ordovician and, subsequently, with Laurentia in the Caledonide event. In addition, various much smaller terranes, which had existed in the various oceans surrounding the different parts of the British Isles, were accreted to us within the different phases of the Caledonide Orogeny, and are to be identified today along the closed Iapetus Ocean Suture Zone between Laurentia and Avalonia.

The later Variscan Orogeny, in the Carboniferous, also affected these islands, not only in the tectonic distortion of their southern parts, but also in the accretion of the microterrane which is today exposed in the Lizard Peninsula of Cornwall. However, the Variscan and much later Alpine orogenies were not nearly so significant in the development of Britain as was the Caledonide Orogeny in the Silurian.

Subsequently, the unified British Isles were first part of Laurussia, secondly Pangea and, finally today, after the Atlantic Ocean opening, at the northwestern margin of Eurasia.

*Palaeogeography of the Iapetus Ocean area in Lower Ordovician times (480 Ma), a polar projection modified from Cocks & Torsvik (2002). The curved line to the left of the figure shows the palaeoequator, which Laurentia (most of North America) straddled at the time. Scotland and northwestern Ireland is the area shown to the east of Greenland; and England, Wales and southeastern Ireland formed part of the Avalonia Terrane, then part of Gondwana. This map shows only the outlines of the various terranes present, with some modern geographical coastlines added to assist terrane recognition. [*from Proceedings of the Geologists' Association, vol. 116, p. 119*]*

The Silurian "Herefordshire Konservat-Lagerstätte": a unique window on the evolution of life

David Siveter: *is Professor of Palaeontology and leader of the Palaeobiology Research Group at the University of Leicester. This Group has an international reputation for initiatives elucidating the taphonomy and palaeobiology of globally important Palaeozoic lagerstätten, especially the Cambrian Chengjiang (China), Ordovician Soom Shale (South Africa) and Silurian Herefordshire (UK) faunas. Members of the group are leaders in the fields of the palaeobiology and evolutionary relationships of conodonts and early fish, Mesozoic vertebrates, graptolites, ostracods and other arthropods, and in determining preservational pathways for the fossilization of soft-bodied organisms.Professor Siveter's main fields of research are stratigraphy & invertebrate palaeontology, especially the palaeobiology and evolution of arthropods. He works particularly on Palaeozoic faunas from Europe, North America, China and the former Soviet Union. He is Chairman of The Micropalaeontological Society.*

David Siveter looking at one of the Herefordshire fossils

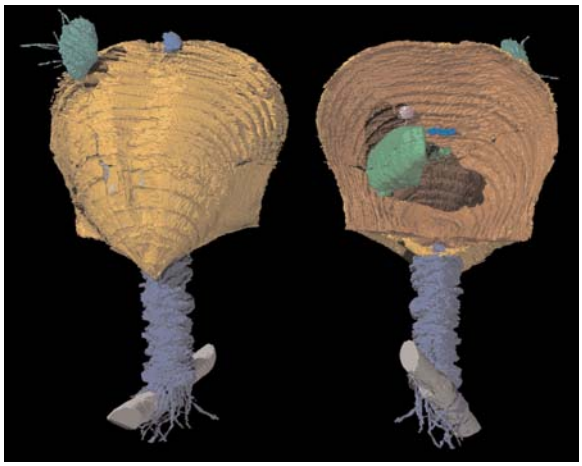
Our understanding of the history and biodiversity of life on Earth relies on the fossil record, and especially on information gained from rare cases of exceptional preservation, where the soft parts of animals and even entire soft-bodied animals are preserved. The recently discovered Silurian Herefordshire Konservat-Lagerstätte is one such deposit, and it is emerging as an exciting palaeontological discovery of global importance. It contains a variety of small marine invertebrates such as worms, molluscs, starfish, and brachiopods, together with a range of arthropods, plus many intriguing forms of yet unknown affinity.

All of the fossils are beautifully preserved in extraordinary detail and in three dimensions. They occur as calcite in-fills within nodules entombed in an ancient volcanic ash that fell onto a shallow sea floor some 425 million years ago. The soft-bodied animals that became preserved are unknown from anywhere else in the world.

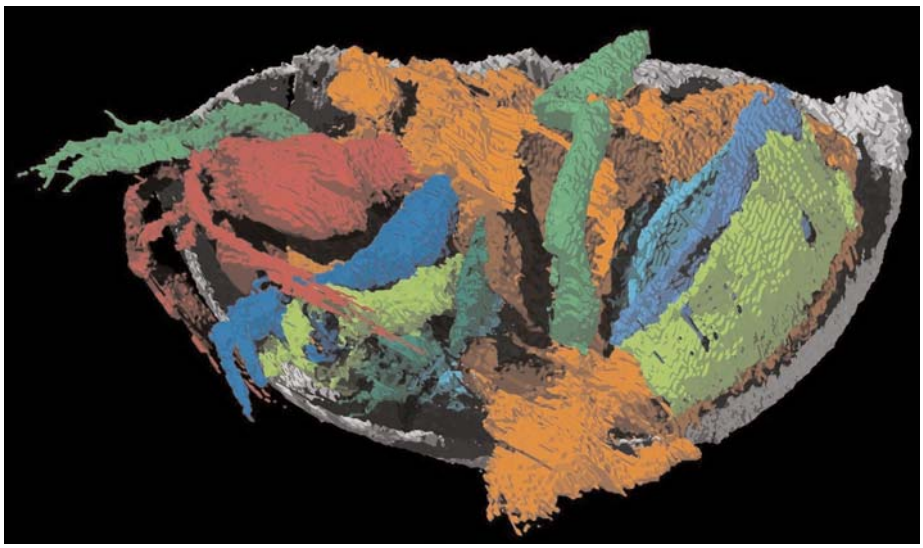
A small team from Leicester, Oxford, London and Yale universities has been working on these amazing fossils since the discovery of the biota. The Herefordshire fossils cannot be extracted from the rock nor fully studied by conventional means. Instead, they are captured digitally and reconstructed in 3-D as 'virtual fossils' using computer techniques. The computer reconstructions can even be turned into physical models of the animals through the use of rapid prototyping technologies.

The Herefordshire animals are from a period of geological time for which we have hardly any information about soft-bodied faunas. This remarkable fauna from the Welsh Borderland is therefore crucial in helping to fill a gap in our knowledge of the history of life and to resolve controversies about the relationships of animals still alive today.

Phyllocarid (a shelled arthropod, among the earliest animals with a hard shell) from the Herefordshire Konservat-Lagerstätte © copyright David Siveter 2007



Brachiopod and attachment from the Herefordshire Konservat-Lagerstätte © copyright David Siveter 2007



Internal detail of an ostracod crustacean showing remarkably detailed soft-part anatomy from the Herefordshire Konservat-Lagerstätte © copyright David Siveter 2007

Session 3: Geology in the community: evolving perceptions and realities

Harriett Baldwin: *Harriett was selected as Parliamentary Candidate for West Worcestershire in July 2006. She read Modern Languages (French and Russian) at Oxford, receiving First Class Honours, and then obtained an MBA from McGill University in Canada.As an enthusiast for all aspects of country life, Harriett is helping campaign on behalf of local farmers, and welcomes Parliament's increased focus on the environment, so important in this area of natural beauty with its low-lying flood plains. She recognises the importance of partnership between government and the scientific community in addressing the challenge of flooding, which had such a severe impact on Ludlow and South Shropshire both in late June and mid July.*

Philip Dunne MP: *As the Member of Parliament for Ludlow, Philip has been able to influence national policy concerning environmental issues. Prior to election in 2005 he had represented Ludlow town centre on South Shropshire District Council. Before entering politics he was an investment banker, and since 1987 has been a partner in his family's farm. Philip was unfortunately unable to attend in person due to Parliamentary commitments in the Middle East.*

Earlier this year (2007) the Government missed an opportunity to protect the 57 Sites of Special Scientific Interest in the Ludlow constituency; there are a further 55 elsewhere in Shropshire. New rules, required under the Environmental Liability Directive (ELD), provide a minimum standard of protection by holding companies liable for polluting the environment.

The ELD covers environmental harm that may arise from certain hazardous activities including the use of genetically modified organisms (GMOs), waste disposal and the discharge of pollutants to water. The Government's plans for England exclude most wildlife species recognised as requiring protection, 375 in total, and over 3,000 SSSIs.

The intention of the ELD is to introduce the 'polluter pays' principle. By making businesses financially and legally accountable for any environmental damage they cause, they will be more cautious about what they do. It should prevent environmental harm and, if that does not work, the costs of putting things right should be borne by those causing the damage.

The proposed legislation has two loopholes which could enable companies to avoid financial liability for damaging the environment. The 'permit defence' would allow companies to avoid liability if they had been granted a licence for what turned out to be damaging activity, and the 'state of the art defence' excuses pollution if scientific knowledge at the time did not predict the potential harm. This may lead to inadequate research into side-effects, and allow polluters to continue to pollute. It will be the taxpayer who will have to pick up the bill.

The second half of June and the middle of July, 2007, saw exceptionally prolonged rainfall across South Shropshire, saturating the drainage system and causing widespread flooding. The floods brought out the best in people: emergency services, utilities, local councils and their contractors reacted with great speed and efficiency to help get people to safety and begin the clean-up; neighbour has supported neighbour.

The collapsed Burway Bridge; until Monday 25th June 2007 this carried the former A49 (Coronation Avenue) over the River Corve south into the centre of Ludlow.

Many have had their homes flooded - 62 houses in Much Wenlock alone. In some cases repairs will take months to complete. The saddest sight in the constituency was that which faced the couple in Ludlow whose house collapsed into the river Corve.

Is anyone to blame? The Environment Agency has responsibility for flood risk management and the River Severn basin is one of the few areas in the country where it has completed its plan. But it could not cope with the volume of water and had not foreseen all the places where problems would occur.

With climate change likely to increase incidence of extreme weather, the Government does have a responsibility to pay more attention to flood risk management. Last year the Environment Agency spent some £70m less on inland flood defences than the year before.

Record rainfall should add one more item on to Gordon Brown's 'to do' list: the Government should protect the people from climate change.

This means recognising flood plains serve a purpose and stop building on them; stop cutting back DEFRA's budget to pay for its own mistakes in farm payments; and start giving greater priority to managing water resources and flood defences.

A broader role of national government concerns its lead on combating climate change. Here there is opportunity for technical innovation, leadership and pump-priming for technological solutions. There are various examples of Government putting their toe in the water and trying to introduce market solutions by means of pump-priming, but the results have been disappointing.

Science has a big part to play in these matters. British companies are innovative and keen to take advantage of whatever pump-priming the Government are prepared to put in place. They are willing to meet the regulatory burdens placed on them in the search for alternative solutions, and a regime is needed to encourage the practical implementation of ideas arising from the scientists' imagination, an essential aspect of enabling enterprises to get going.

Geological pioneers in the Marches: from Robert Townson (1799) to Roderick Murchison (1839)

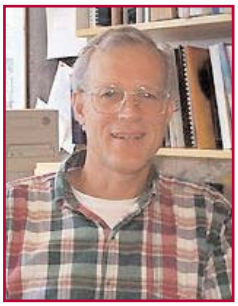
Prof Hugh Torrens: *After completing his B.A. at Oxford and Ph.D. at Leicester, Hugh moved to the Department of Geology at Keele in 1967, where he attained his professorship in May 1998. During his career, Hugh has produced more than 200 books, papers and articles on subjects ranging from palaeontology (especially the study of ammonites) to work concerning the life history of numerous scientists whose achievements had previously not been deservedly recognised for their true worth. In recent years Hugh has focussed his attentions primarily on the history of geology and it is in part thanks to his detective work that the Geoschool building at the University of Keele was renamed in May 2001 after local geologist William Smith.*
Hugh remains passionate about his research and in 2000 was slightly involved in three books that have each received widespread acclaim: Simon Knell's Culture of English Geology, *Cherry Lewis'* The Dating Game: One Man's search for the Age of the Earth, *and Debbie Cadbury's* Dinosaur Hunters.
Hugh retired in September 2000, the year he was the winner of the prestigious Geological Society of America History of Geology Division Award. Despite retirement he is still highly committed to his work and remains a regular and welcome face around the department at Keele.

Shropshire provides a birthplace for the worlds Industrial "Revolution", from the early 1700s. This had used Shropshire's abundant, and varied, geological materials; like coal, iron ore, pitch/oil, and its various limestones and clays. Most commentators have however seen the rise of geology in Shropshire as much later, dating only from 1839, when Roderick Murchison, the "King of Siluria", ordered the county's rocks in print in his *The Silurian System* and described its wondrous geology.

The truth is more complex. There was much geological activity here before Murchison, much of it inspired by its early industrialisation, with a number of often fascinating figures. These include the sadly forgotten, and Cardington-based, Robert Townson and two Darwins. Residents and visitors have included James Hutton, the supposed "father of modern geology", and two important members-to-be of the worlds oldest Geological Society, that of London, founded in 1807. One was soon to guide William Buckland on his first ever field trip and the other produced the first properly geological publication (and on Shropshire) which that Society ever produced, both in 1810.

Challenges for the geoscientist: an international perspective

Prof Rod Stevens: *Professor of Quaternary Geology, University of Gothenburg, Sweden. This is the largest university in Sweden on the basis of undergraduate enrolments, and this profile is also reflected at the Department of Earth Sciences. Applied geology is emphasised within both research and teaching, and roughly 50% of the students are today taking careers within environmental geology.Professor Stevens has led national and international projects dealing primarily with the applications of sedimentology to environmental problems, including local, site-specific issues such as landslide risks and harbour sedimentation, as well as large-scale processes in the Skagerrak and Baltic Seas. Sediment mineralogy and quantitative provenance (source budgeting) have been of special interest in recent projects.*



Both dead-ends and turning points can be described as essentially two perspectives on the same situation, just as strengths, weaknesses, opportunities and threats are all closely related. Perhaps it is not so ironic as it would first seem that now, when we have such an obvious, even desperate awareness of the need for understanding the Earth, the real impact of geoscientists is marginalised in all too many cases.

Science communication is a challenge at all levels of society, and essential if we are to maintain or increase our impact concerning important issues. Science communication is, I suggest, seldom effective if kept at the beginning of the continuum: "information - interaction - integration", which can be used to describe the interface alternatives between science and society. A few diverse examples will be used of some successful and some questionable applications of geoscience knowledge. Also, the role that community contact has had in these examples is of interest.

Climate change induces continental-scale changes in large-scale systems, such as the Paraná/La Plata river basin in South America, bit also very local effects, such as flooding and landslides along the Göta älv River in Sweden. Technology allows us to propose larger and bolder schemes to "remedy" threats. Pumping oxygen to the deeper parts of the Baltic Sea to raise oxygen contents may counteract recent algal blooms, but is probably not consistent with the natural variability within this system as a whole.

Another questionable "solution" to a common problem is "dig-and-dump" in connection with polluted ground and sediments, where economy is mainly equated with time, that is to say, the time scale of the building project rather than a historical or geological scale. Integrating research, education and practical science is sometimes very easy. A small-boat harbour in California and an abandoned waste depository in Göteborg are case-studies that have brought secondary and university students into direct contact with Earth science theory and application.

One of the most alarming facts today is that the dependent relationship between science and society is often not apparent to those that are most important for our future: decision-makers and youth.

Session 4: The Ice Age: on the edge of a glacier
Reflection on the life of Dr Peter Cross

*A moment to reflect on the life of **Dr Peter Cross** who died peacefully at his home on Bircher Common, Leominster, on Monday 9th July 2007 at the age of 85.*

He was hoping to be able to come to the Marches Festival of Geology Symposium and his daughter, Stella, tells us that he was actually browsing through the programme for the day when he collapsed in his chair.

Photograph of Peter Cross ca. 1954

Peter revolutionised our understanding of the landscape in the Teme Valley and the Devensian history of the North Herefordshire area. His lasting legacy will be the work he did with Mike Hodgson arising from their collaboration during the mapping by the Soil Survey in the 1960s, culminating in 1975 with publication in the *Proceedings of the Geologists' Association* (vol.86, 313-331, "New evidence for the glacial diversion of the River Teme near Ludlow, Salop").

Mike Hodgson writes: "In the early sixties I was posted by the Soil Survey of England Wales to their Wolverhampton office and as part of their regional programme was assigned to a survey of the Ludlow area. On arrival in the office there was a note on

my desk briefing me about various aspects of the proposed project from the colleague that I was replacing. The main text of the note included much good advice. At the end, however, in a hurried postscript, he had scribbled "There are extensive gravels at Woofferton, P. Cross of Spout House knows all about these."

"It was some months before we started to work in the Woofferton area and from time to time I wondered who was P Cross and where was Spout House? Of all my colleague's advice his afterthought proved the most valuable.

"Peter did indeed know a lot about the drift of the area as he had been working on it for some years. On first meeting this modest man we joked about "knowing all about" and this was the start of our co-operation on the glacial diversion of the River Teme.

"Peter spent many of his spare evenings and weekends in the field recording numerous temporary sections that came available at that time. He combined this with his job as Head of Geography and Head of Maths at the local secondary school, his garden and his family life. He was a clear thinker and an assiduous, painstaking field worker. His work resulted in the award first of an MSc (1966) and later a PhD (1971) from the University of London. Not an easy thing to do part-time in those days. He also contributed much to the Woolhope Naturalists' Field Club (for instance, he was the Geology Recorder for some years, and published several papers).

"It was clear on our first contact that there was almost complete overlap between our activities and we agreed from the start to combine our knowledge. Peter was the most delightful colleague and friend and couldn't have been easier to work with. Peter continued to maintain his interest in the local Quaternary geology long after I left the region.

"I have fond memories of a kind and generous man. He will be greatly missed.
[There is an online memorial web site for Peter at www.gonetosoon.co.uk (type in Peter Cross, Bircher) where you can read tributes to Peter, and add your own if you wish.]

The Ice Age Legacy in North Shropshire

David Pannett: *A longstanding proponent of adult learning, and formerly on the staff at Preston Montford Field Study Centre, David is now Field Meetings Officer for the Shropshire Geological Society.*

Hidden beneath the 'green and pleasant' land of North Shropshire there lies an 'arctic' landscape born of harsher conditions now only seen in mountains and higher latitudes. After initial disbelief in the early nineteenth century, geologists have since been slowly discovering and interpreting its complex features, while farmers and builders have had to wrestle with various practical problems posed by the deposits.

Local river systems, like so many in the country, are also still dominated by their Pleistocene inheritance. One example of this, which captured the popular imagination, was recognition of the unusual course of the River Severn. Based on evidence confined to the Newport area, Dixon of the Geological Survey suggested a vast ice-dammed lake filling up and overflowing to form the Ironbridge Gorge and thereby establishing a new route for the river. Although this 'Lake Lapworth' model is associated with Wills, it was really the Geological Survey which promoted it, following contemporary fashion influenced by examples in North America. Fashions change, and ideas on glacial lakes are currently being revised.

The classification of glacial deposits on published geological maps both helped and hindered subsequent research. Progress has been made recently with the appreciation of glacial deposits as three dimensional packages revealing varied depositional environments. Boreholes for mineral assessment, construction and groundwater studies have enlarged a picture once restricted to small exposures in gravel pits and small river, road or rail cuts. Patterns within the hidden layers of lower parts of the Pleistocene deposits (formerly called 'Drift' but now known as 'Superficial Deposits') are also being revealed.

'Anglian' ice must have passed this way but the 'Wolstonian' cold period no doubt helped to remove much of the evidence, although small fragments remain to the south, in North Herefordshire. Subsequently 'Devensian' ice encroached, both from Wales and the Irish Sea, and it is these ice sheets that were responsible for developing much of Shropshire's glacial landscape as seen today.

This last glacial period takes its name from the Roman name for Chester, in recognition of the clear evidence across the North Shropshire-Cheshire Plain. The landscape of the Ellesmere area is one well known example. Lesser known is the Severn Valley itself, where a Welsh glacier has left a 'textbook' pattern of lake basins, moraines, outwash plains and river terraces, and even buried sub-glacial channels. The latter have particular implications for the development of Ironbridge Gorge. The area can thus demonstrate to the public the scale of our Ice Age legacy and contribute to the on-going debate concerning climate change.

The Ice Age in the Marches: Herefordshire

Dr Andrew Richards: *submitted his Ph.D. thesis on the Pleistocene stratigraphy of Herefordshire. He has lectured at the Universities of Kingston, Limerick and at University College Worcester, where he is now Quaternary Consultant to the Herefordshire and Worcestershire Earth Heritage Trust.*

The Welsh Borderland has been subject to at least two phases of widespread glaciation and significant river system development over the last half million years. The latter has received very little attention over the past few decades. This talk aims to look at the response of river systems in Herefordshire and the surrounding area to environmental change during the Quaternary. It will provide an introduction to the complex causes of change in river behaviour, looking particularly at the longer term development of fluvial landscapes in the region. The overall aim is to draw attention to the need for more research in this aspect of the landscape, necessary for a full appreciation of the recent geological history of this fascinating region.

Five hundred thousand years ago the British landscape was very different from today. The earlier up doming of the Irish Sea Basin and NW Britain prior to plate divergence and the opening of the North Atlantic had controlled river evolution across the British Isles throughout the Tertiary. This is essentially the reason why so much of the high ground of central Wales seems to be a plateau dissected by deep valleys. To the east, across England, the general flow of the rivers, as with the dip of the rock beds beneath, was consequently towards the ESE, away form the up domed region. However, in detail many of the major rivers we know today either did not exist, as for example the River Avon in Warwickshire, or flowed along a different course, as for example the Severn. There were also rivers that have since disappeared. The painstaking work of reconstructing this lost landscape has been carried out by several geologists and other specialists, notably the research of Professor Fred Shotton, Head of the Geology Department at Birmingham University for many years, and John C.W. Cope, formerly at Cardiff University and now Honorary Research Fellow at the National Museums & Galleries of Wales.

These ancient river systems were either obliterated or fundamentally altered by the severest glaciation known in British geological history, the Anglian glaciation. Around 478,000 years ago the ice sheets flowed down from the northwest covering most of Britain as far south as London. This cold period or glaciation lasted for almost fifty thousand years. The Anglian glaciation is just one - if a very severe example - of a number of fluctuating climatic events that are known collectively as the Pleistocene (Ice Age). The Pleistocene in fact comprises a series of cold stages, known as glacials, and warm stages, known as interglacials, with many more minor climatic variations in between. Since the Anglian glaciation there have been eleven glacial and interglacial cycles.

The effects of the glacial/interglacial cycles on Britain's rivers formed the landscape of the river valleys we know today. Fast-flowing rivers transported sands and gravels, which were deposited to a depth of metres in the valley bottoms. During the glacial/interglacial cycles the rivers cut down through earlier deposits and laid down fresh deposits of sands and gravels. This process has resulted in the creation of a series of terraces in our river valleys, with the highest terrace being the most ancient and the lowest the most recent. Much geological research and controversy surrounds the interpretation of these terraces and their correlation with specific glacial events.

These deposits now form a valuable resource extensively exploited, in the Midlands as elsewhere, by the construction industry. The deposits also contain valuable evidence of past environments in the form of the fossilised remains of plants and animals as well as evidence of human activity in the form of stone tools. The majority of British handaxes have been found in these sand and gravel deposits.

The most recent major cold event, which peaked around 18,000 years ago, saw the last major advance of the ice sheets of the Devensian glaciation, which came as far south as Birmingham and covered much of Herefordshire. The current warm phase (the Holocene) began about ten thousand years ago.

Session 5: The future for geology in the Marches

Future avenues of research in the Welsh Borderland

Prof John Dewey FRS: *is a British structural geologist and a strong proponent of the theory of Plate Tectonics, building upon the early work undertaken in the 1960s and 1970s. He is widely regarded as an authority on the development and evolution of mountain ranges.*
Dewey was educated at Bancroft's School and then at Queen Mary and Imperial Colleges, both within the University of London where he was awarded a BSc and PhD in geology respectively. Following a period as lecturer at the University of Manchester (1960-64), the University of Cambridge (1964-70) and Memorial University of Newfoundland (1971), Dewey was appointed Professor of Geology at the University at Albany, The State University of New York. During this period he produced a series of classic papers centered around the history of the Appalachians in Newfoundland as well as the Scottish and Irish Caledonides. In later years, his research has concentrated upon producing a model to describe the development and orogenic history of the Himalayan mountain range.
Dewey returned to the UK in 1982 as Professor of Geology at the University of Durham, a position he held for four years. As with several Durham geologists before him, notably L. R. Wager, Dewey was appointed Professor of Geology at the University of Oxford (and Fellow of University College) in 1986, a position he held until retirement in 2001. Since then he has returned to the US as Professor of Geology at the University of California at Davis, although he maintains a position as Senior Research Fellow at University College, Oxford.
John Dewey was elected a Fellow of the Royal Society of London (FRS) in 1985 and has received numerous medals and awards, notably the Wollaston Medal of the Geological Society of London (that society's highest award) in 1999 and the Penrose Medal of the Geological Society of America (1992).

John Dewey has spent forty four years doing research in structural geology and tectonics mainly in the field in Ireland, Scotland, Norway, Newfoundland, Switzerland, Tibet, New Zealand, Peru, Bolivia, South Africa, Vermont, and California. He's studied what happens at plate boundaries where tectonics plates diverge, converge and slide past each other, especially how the Earth's crust is squashed, sheared and is pulled apart to form mountain belts and their collapsed remnants.

John's goal is to relate the detailed structure of extant and extinct plate boundary zones to present and past relative plate motion. He is especially interested in rock fabric evolution and block rotation and deformation in transtension (oblique extension) and transpression (oblique shortening).

Why should the general public be interested in what he does? This work concerns fundamental questions of rock behaviour under varying pressures and temperature conditions; this basic research contributes to an understanding of geohazards, such as earthquakes and landslides.

Forty years of research has led to more and more excitement about finding out how the Earth works. For each question answered, five new problems emerge! Research is the most interesting thing that a scholar can do. Also research makes one a better teacher. In terms of personal achievement, John has worked out a scheme for understanding sea level changes over long and short periods of time. He discovered how oblique convergence 420 million years ago in western Ireland and oblique divergence 400 million years ago in Norway explain rock structures and fabrics.

Within the Marches there are ancient plate boundaries and hidden within these are new facts to be discovered and theories to be evolved to help explain "the ground beneath our feet".

"Geology is not for the cautious and faint-hearted. It demands a blend of physical and intellectual stamina, keen powers of observation, the use of data, ideas and methods from all the other sciences and mathematics, and the lateral-thinking ability to evaluate and synthesize a mass of disparate data."

- John Dewey

The future for geology in the Marches: a BGS perspective

Dr David Schofield: *David is a field geologist with extensive experience of the early Palaeozoic strata of the Welsh Basin. He is currently British Geological Survey Regional Geologist for the West Midlands and the Marches.*

The Marches comprise a diverse geological collage spanning at least 700 million years of earth history that underlies a varied scenery extending between the Cotswolds to the south and the margins of Snowdonia to the north. It includes the upland regions of Wyre Forest and Clun Forest, the Clee Hills, the Wrekin, the Longmynd, Caer Caradoc, Corndon, the Black Mountains, Mynydd Eppynt and Radnor Forest and includes the North Shropshire Plain, the valleys of the Severn and Wye, and the Wigmore and Leominster basins.

Our understanding of geology has a considerable impact on the lives of those who live in the area. Mineral extraction is still important to local development, groundwater is a major concern for both domestic consumption and commercial use, the landscape attracts tourism and its configuration determines the potential for sustainable development of the region. It is the responsibility of the British Geological Survey to maintain and develop the nation's understanding of its geology to improve policymaking, enhance national wealth and reduce risk.

In order to fulfill this role, our programme seeks to supply relevant geological data to enable local and regional planning authorities, and other public and private sector organizations, to make evidence-based decisions and to carry out research directed towards the central themes of our parent body, the Natural Environment Research Council. These include the sustainable use of resources and the understanding of natural hazards which we attempt to deliver through our systematic mapping programme, specialist studies and collaborative work.

The BGS has a long history of geological study in the Marches starting in the 1830's with the work of Sir Henry de la Beche and Sir Roderick Murchison who oversaw the original one-inch geological survey of the area. The current phase of work by the BGS started in the mid 1980's and has largely been driven by the requirement to complete 1:50 000 scale geological map coverage of Wales and the Borders. This phase commenced with a transect across the central part of the Welsh Basin in the Rhayader and Llanilar districts, and aimed to establish a workable stratigraphy within the basin informed by new concepts on deep marine sedimentology, sequence stratigraphy and the relationship between depositional facies, eustacy and tectonics. Careful surveying at the 1:10 000 scale combined with detailed graptolite biostratigraphy illustrated the importance of major eustatic cycles, in particular glacioeustatic recession during the Ashgill followed by early Silurian, post glacial transgression, and the superimposition of more localized tectonic events.

This theme was developed during subsequent work in the Builth Wells, Brecon and Llandovery districts where important relationships between depositional processes in the basin and those of the adjacent shelf succession in the borderlands were investigated. This has led to substantial revision of the stratigraphy in the type area of the Llandovery series and the Wenlock to Ludlow succession of Mynydd Eppynt and the Myddfai Steep Belt, the new stratigraphy of which will be presented by Drs. R A Waters and J R Davies at this years' field meeting of the Ludlow Research Group.

Current work in the Dinas Mawddwy district aims to produce the first 1:50 000 scale geological map of this area and develop scientific collaboration with university researchers interested in palaeoenvironmental controls on Llandovery-Wenlock sedimentation. Parts of this district were originally surveyed by W J Pugh and D A Bassett and include the northern margin of the southern Welsh Basin. During the next financial year we hope to build on the earlier work while carrying out surveying of the Knighton district, and to use this as a basis for reappraising the geology of the adjacent Ludlow Anticline itself. We will also be commencing a programme of collaborative studies in the Wem district, part of the North Shropshire Plain, focusing on developing sediment/landform assemblage models aimed at elucidating ice marginal processes and the history of deglaciation after the last, Late Devensian glacial maximum.

Closing Address

Lawrence Banks CBE: *is great grandson of Richard William Banks who hosted Murchison at Hergest Croft on his epic visits to the Marches.He is a former Governor of the Imperial College of Science, Technology and Medicine, former Deputy Chairman of merchant bank Robert Fleming Holdings Ltd. and former Chairman of the Council of the Royal Post Graduate Medical School, but now dedicated to the upkeep of the family estate in Herefordshire.*

It was Richard Banks (1791-1871) who was one of the guests at a seminal meeting in July 1831 at the home of Thomas Frankland Lewis MP, Harpton Court. Present were the "Border Squires", families of some social standing in Radnorshire, with whom Banks had become linked by marriage in 1817. This was the occasion which fired Murchison's enthusiasm for geology, inspired by their recollections based on personal collections of fossils and the character of the strata from whence they had come. It was also on this occasion that Lewis' son, George Cornewall Lewis (1806-1863), Murchison later acknowledged as being the first to urge him to compile the geological records of the region, the work that was to become The Silurian System.

RB's son, Richard William Banks (1819-1891), inherited Ridgebourne in 1858 and the land on which Hergest Croft now stands. He was a keen amateur geologist, self-taught (it is said) by reading the copy of *The Silurian System* found in his father's study, but perhaps better known for planting some of the earliest exotic trees. With encouragement from his friend in the Woolhope Club, and notable local geologist, the Reverend William Samuel Symonds, RWB was to submit news of his discoveries for publication by the Geological Society, *via* Murchison who was a Past President. Murchison agreed to read the paper before the Society, and the high quality of RWB's study helped establish his (Murchison's) reputation as "an assiduous researcher"!

It was his son, William Hartland Banks (1867-1930), a banker, traveller, photographer, gardener and passionate plant collector who, in 1895 with his wife Dorothy Alford, whom he met at Cambridge, began Hergest Croft house and garden.

The Banks family lived in the house until 1940 when the government requisitioned it for World War II refugees. In 1974 the family converted it into flats and the tearoom and shop.

His son Richard Alford Banks (Dick) (1902-1997) came back to live at Ridgeboume in 1953 with his first wife, Jane. He was an industrialist and Director of lCI. He planted a huge number of trees and shrubs. His interest in maples and birches is reflected in the range of these genera, which now form National Collections. His widow, Rosamund continues to care for Park Wood.

Lawrence Banks (b 1938) and his wife Elizabeth (b 1941) took over full responsibility in 1988. He is a former Treasurer of the Royal Horticultural Society and she is a noted landscape architect. The tradition of planting continues and the new introductions of Chinese plants in the Maple Grove rival those of W.H. Banks in the first decade of the century.

The role of the local clergy and gentry in supporting the scientific forays of visitors such as Sir Roderick Murchison, in turn advancing our knowledge of natural science, is perhaps far greater than generally acknowledged. Research for the paper by Sinclair & Fenn in the 1999 *Radnorshire Society Transactions* (pages 143-172) Geology and the Border Squires, was based largely on papers in the private library of the Banks family, lodged at Hergest Croft. This reveals the significant assistance that was afforded, scientifically, financially, and socially. Indeed, this research indicates that it was an ancestor of Thomas Frankland Lewis MP of Harpton Court, Thomas Lewis MP (1690-1777), also of Harpton, that had leased a farm constructed using the local (Silurian) limestone. The farm was, and is still, called *Siluria*. Their thesis is that here lies the true origin of the world-famous period of geological time, named in deference to Murchison's sponsors rather than a long-lost Celtic tribe.

Long may the spirit of the local amateur live on in organisations such as the Shropshire Geological Society and the Woolhope Naturalists' Field Club, encouraged by the Geological Society, now entering its third century.

Reception

The day ends with a reception in the John Norton Gallery kindly hosted by the Friends of Ludlow Museum.
To include the official launch of the Shropshire Geological Society's Geotrails project which was supported by DEFRA's Aggregate Levy Sustainability Fund grant scheme administered by Natural England.

MSR
17 July 2007

The one-day symposium on Thursday 13th September 2007 is the core event of the **Marches Festival of Geology**, in celebration of a number of geological anniversaries. The Festival has been brought together by aall the geological organisations in the region, including:

- Herefordshire Heritage Service
- Hereford & Worcester Earth Heritage Trust
- Ludlow Museum Resource Centre
- Ludlow Research Group
- Shropshire Geological Society
- West Midlands Regional Group of the Geological Society
- Woolhope Naturalists' Field Club Geology Section

Registration

Registration (£20 pounds in advance, before 31st August, including a light buffet lunch; £25 after 1st September or on the door excluding lunch) includes attendance at all the lectures and the exhibition in the Ludlow Assembly Rooms on 13th September, and tea/coffee in the morning and afternoon breaks.

Advance registration for this event should be made with the Treasurer:
David HT Smith:
25 Grange Road
Shrewsbury
SY3 9DG

Cheques should be made payable to "The Shropshire Geological Society".

Registration enquiries may be made by email to: david@thursfieldsmith.co.uk

Trail Guides

A series of GeoTrails has been prepared, in part to support workshops and fieldtrips, and in part as self discovery guides. These are available in digital form on-line (details below) and include:

- in front of the last glacier in South Shropshire
- the landslides of Ironbridge Gorge
- a revision to the Teme Bank Trail
  (the first edition is still available as a printed leaflet from the Ludlow Museum Resource Centre)
- a reprinting of the Mortimer Forest Trail, originally prepared by Jim Lawson
- the building stones of Ludlow

Details are on the Society web site:

http://www.shropshiregeology.org.uk/SGSpublications

The Big Chill: Britain in the Ice Age - talk given by Dr. Jenni Chambers: Wednesday January 10th.

Jenni works for the ALSF funded National Ice Age Network of Birmingham University for Geological and Archaeological researching Pleistocene remains in the W. Midlands. Her work is with people who have an interest in ice age sediments, and especially with quarry workers which helps monitoring of sand and gravel deposits. Much evidence relating to human life is from river terrace deposits of sand and gravel, where the river channels served as Ice Age motorways.

Climatic oscillations were considered with times when it was perhaps as much as 3 warmer than at present. The Ice Age Network is mainly confined in its work to the interglacials and the two ice ages, the Devonian of 20,000BP and the more southerly reaching Anglian glaciation of 478-423,000years BP.

Jenni commented that the build up of glaciers is fairly rapid but many areas were not ice bound and had open grassland with low grade vegetation exploited by Woolly Mammoths, Musk Oxen and Woolly Rhinoceros.

Jenni spent much of her talk considering human development, noting that findings continue apace and evidence found only in the last two years has extended our knowledge a further 200,000 years to 700,000BC. Jenni traced through human characteristics of development from Homo heidelbergensis to Homo neanderthelensis to Homo sapiens.

Jenni's speciality is the study of Palaeolithic artefacts. Flint was the main stone used but near Coventry andesitic ash had been used to make an axe. Further north, quartzite hand axes had been found. Techniques, measuring the fading of the grains when exposed to daylight, gave an accuracy of 10-25,000 years on a 400,000 year old tool. Jenni jested that quartzite had been fundamental in language development - anybody attempting to make a sharp edged tool from quartzite would have been so sorely tested that "foul language" would have been a natural consequence!

Jenni concluded with reference to Shropshire and said that H. heidelbergensis could well have come to the County - a handaxe had been found near Kidderminster. She also referred to the meltwater lakes, Ironbridge Gorge, and the 12,800 years old fossils of the Condover Mammoths from the Windermere interstadial. The excellently preserved juveniles of Mammuthus primigensis were important in demonstrating that these creatures had greater climatic tolerance than once thought.

Dates for your diary

In the Field 2007

12th May: Llanymynech Hills Geotrail Launch at the canal wharf during the Llanymynech Heritage Area open-day, 2-5pm.

19th May: The Ercall. Members are welcome to join in this meeting with the North Staffs GA Group, led by Christine Rayner. Details of arrangements from Christine on 01952 510463.

26th May: Trail launching day - an event for International Geopark week. 10.30 , jointly with Herefordshire and Worcestershire Earth Heritage Trust.

June 17th: Members might like to attend the garden party at The Lodge, Richards Castle (2-4.30) in aid of St Laurence's, Ludlow at which Mike Rosenbaum will be leading a short local geology walk and there will be a SGS stand.

June 20th Wednesday evening: 6.30 at Bull Farm near Harnage to look at the Harnage 'Slate' and Kenley Grit, both distinctive building materials. Park in the farm yard at grid ref. 558011, approached from Cound, Kenley or Acton Round.

July 8th: "Mini Extravaganza" at Church Stretton Food Fayre - volunteers required.

September 13th: The ground Beneath our Feet - 200 years of geology in the Marches; symposium at Ludlow *(see advert to right) . Full details of other Festival events in next newsletter and on previously circulated listing.*

Volunteers please

The Society is trying ever harder to increase its public presence and promote the case for geoconservation by attending a variety of shows. To be successful these require your support to staff the stand. Forthcoming dates are:

Llanymynech Heritage Area open day - 12th May
Stretton Food and Country Fayre - 8th July
Burwarton Show - 2nd August
Minsterley Show - 18th August
Dudley Rock and Fossil Festival - Sept. 22nd-23rd

If you are willing and able to help, particularly on the day, but also in preparation of material, please contact
Keith Hotchkiss on 01694 723130 or
e-mail: keithhotchkiss@onetel.com

If you know of other local shows, garden parties, special events or shop windows where we can show off our wares, please tell Keith. The Society will pay travel expenses for these occasions and of course you get free entry to the event.

The next project for which the Society is hoping to get grant from the Aggregate Levy Sustainability fund is devoted to Promoting Geo-awareness through Aggregate Sites, and again we will be looking to volunteers to assist.

The Society's 'office' has now moved to Ludlow Museum Resource Centre, and volunteers are sought there to call in and collect messages, post etc.

The Marches Festival of Geology 2007

a part of the Bicentennial Celebrations
of the Geological Society of London

Enclosed with this Newsletter are further details of

The ground beneath our feet:
200 years of geology in the Marches
symposium in Ludlow on 13th September

and on the reverse, a note about the Silurian System and other events and activities during the festival.

For more details and information check out
www.shropshiregeology.org.uk/festival

Geology, Landscape and the Picturesque

July 12-15: Third Lucton Summer School

Excursions to Church Stretton (Little Switzerland), Downton Gorge (home of Richard Payne Knight, author of *The Landscape*), Hergest Croft (the Banks' archive) and other "Picturesque" geological sites.

Contact Andrew Jenkinson on 01547 530660 or
scenesetters@btinternet.com
for full programme / booking form.

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