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Earth HERITAGE
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The geological and landscape conservation magazine

**What's in
a name?**
Geotopes or
geodiversity?

**Buried
treasure**
Conservation
through re-burial

Issue
22
Summer 2004

**Erratic
movements**



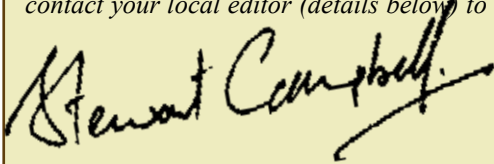
Rick pickings

This busy issue reflects the intrinsic richness and diversity of our subject. We range from global geoparks to fossil forests, from Galloway granites and enigmatic Welsh erratics to leaflets which are designed to encourage people to be more aware of the geology around them.

We also feature two pieces that we hope will provoke some thought. Anna Wetherell looks at the interaction between biodiversity and geodiversity while Peter Vincent takes a sideways look at geodiversity – asking whether we are examining geological and geomorphological features in the right way and at the right scale. I hope such articles will stimulate debate. If you feel moved to write to me with your views on either subject, please do so at the address below.

Earth Heritage has always tried to highlight cases from which others can learn. In this issue, Colin Prosser reports on the implications of the Black Rock public inquiry for geoconservation across the country. Mick Murphy updates us on English Nature's massive site enhancement programme, Face Lift, and shows how it is stimulating research and leading to fresh scientific discoveries.

If you would like to contribute an article to Earth Heritage, please contact your local editor (details below) to discuss your idea.



Earth heritage

Earth Heritage is a twice-yearly magazine produced by the Joint Nature Conservation Committee, English Nature, Scottish Natural Heritage and the Countryside Council for Wales. The UKRIGS Geoconservation Association is

a principal contributing partner. We would like to thank all those who have assisted with the preparation of the magazine. However, the opinions expressed by the contributors are not necessarily those of the above organisations. A database listing all the articles carried in issues up to issue 17 is available on CD. Contact any member of the editorial board.

Key articles from this and previous issues of *Earth Heritage* can be found on the Web at: www.seaburysalmon.com/earth.html

Offers of articles should be directed to the relevant members of the editorial board, who are:

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Cover photo

A large picrite erratic transported by the Irish Sea ice sheet, near Llanerchymedd, north-east Anglesey.

Photo by Stewart Campbell



Getting involved with the aggregates industry

In March 2004, the Environment Council published new guidance for people involved in all stages of aggregate extraction. *Good practice for stakeholder engagement in the aggregates sector* is a response to the increased need for stakeholder and community involvement in the sector.

The guidance is important to the RIGS movement and other local geological societies, where local engagement with the minerals industry is often the only way to secure access to working sites and negotiate the long-term conservation of important faces.

For each stage of aggregates working, the document suggests actions that government, industry, non-governmental organisations (NGOs), the voluntary sector and local communities can take to develop effective engagement. Of particular importance to those involved in geological conservation on a local basis, is a new



Involvement with the industry is vital to geoconservation.

Photo by Colin Prosser/English Nature

requirement for each local planning authority to produce a Statement of Community Involvement (SCI). These statements, which must be independently assessed by the Planning Inspectorate, should set out who will be consulted both formally and informally, and become a focus for community engagement.

RIGS groups and other geological societies can make sure they are included in consultations on aggregate issues by approaching their local mineral planning authorities to be listed in the relevant SCI. Failure to do so could lead to geological

conservation being forgotten in mineral planning, extraction and restoration.

The 55-page publication makes significant mention of geoconservation, SSSIs, RIGS, and Local Geodiversity Action Plans, and if used properly could be a useful tool in delivering more geological conservation in partnership with local authorities, the minerals industry and local communities.

The document is available at www.the-environment-council.org.uk/aggregates
– Colin Prosser,
Head of Geology, English Nature

'Rock On' Scottish Geology Festival inter-year event

Children invited to have their thoughts written in stone

Scottish children will have the chance to have a poem they have written, celebrating the Scottish landscape, engraved in stone outside the new Scottish Parliament building, in this year's 'Rock On' Scottish Geology Festival inter-year event. The competition, held in the autumn and publicised in schools and the press, will invite children to write 25 to 30 words, in any poetical form, including hyku, ode and prose, that says something inspirational about Scotland's landscape. The winning text will be engraved into a Caithness flagstone outside the new Scottish Parliament building.

As well as promoting the 'Rock On' themes, the competition will promote Scotland's tremendous geodiversity. It will raise awareness of the fact that the landscape is the result of 3,000 million years of

growth and development and that the story does not end there – geological processes continue to shape the landscape of Scotland. The competition will be called 'Written in Stone' and a panel of Scottish authors, celebrities and members of the Scottish Parliament will judge the entries.

The 'Rock On' festivals are a great success, with thousands of people taking part, but the lack of resources makes it impossible to run the event every year. Despite this, the Scottish Geology Festival organising committee is keen to have a 'Rock On' event of some sort every year to maintain momentum. The first 'inter-year' event was the successful 'Rock on your Mountain' poster competition for Scotland's schools held in 2002. Details of the 'Written in Stone' competition will be posted on www.scottishgeology.com

Action-packed UKRIGS programme

Dudley Museum and Art Gallery is the centre chosen for the Seventh UKRIGS Annual Conference, which runs from 2-4 September, 2004.

Early arrivals can view the museum displays on the evening of 1 September, and the conference starts in earnest the next morning.

Morning conference sessions over the following three days will deal with: RIGS and planning; museums and collections; vision, beyond planning guidelines, wildlife and geotourism; global designations like geoparks; media relations; the progress of UKRIGS; the UKRIGS database; and Local Geodiversity Action Plans (LGAPs). Three afternoon field trips are also planned.

More details on booking are available from Alan Cutler, BCGS, 21 Primrose Hill, Wordsley, Stourbridge DY8 5AG, tel: 01384 443644 (day), 07977 928493 (mobile) or e-mail: acutler@btconnect.com

Geopark becomes an official entity

Abberley and Malvern Hills Geopark, now a UNESCO Global Geopark, came of age with the opening by European Parliament Member Liz Lynne. A two-day event to mark the launch of the Abberley and Malvern Hills Geopark was held in Ledbury in mid-April. The highlight was Liz Lynne's unveiling of a plaque mounted on a piece of fossiliferous Much Wenlock Limestone from the Geopark's Silurian.

Other events were held in four public halls in the town. The Mayor of Ledbury opened an exhibition with geologically based displays from numerous organisations within the Geopark area, including University College Worcester, the Open University Geological Society and the local geological conservation groups. Capacity audiences were attracted by two lectures on aspects of local geology, the Rock and Fossil Roadshow was well attended, and old and young visitors were served by a panel of local experts able to offer an opinion on geological questions.

Three outdoor events proved popular too. Eric Robinson gave a fascinating on-the-spot account of the building stones used in Ledbury High Street, pointing out



Above: Eric Robinson explains the mysteries of larvikite to the Ledbury public and MEP Liz Lynne. Left: the Silurian Morrismen in action.

Photos by Herefordshire and Worcestershire Earth Heritage Trust

'imported' volcanic rocks and Portland stone, as well as the ubiquitous larvikite, and the local Devonian sandstones and Silurian limestones. A lighthearted feature was Morris dance performances by the Silurian Morrismen.

The final event was a public visit to two local disused quarries close to the town centre. The second of these, Gurney's Quarry, is a Geological Conservation Review site and shows the Wenlock/

Ludlow boundary. Here the 40-strong party spent time collecting fossils from the quarry rubble. Awareness of Earth science was enhanced and a large number of non-geologists attended the public events.

– John Payne, Herefordshire and Worcestershire Earth Heritage Trust

■ See also pages 10 and 27

THE GEOLOGISTS' ASSOCIATION reunion takes place on 5-7 November 2004 at the National Museums and Galleries of Wales, Cardiff. Details from Geol.Assoc@btinternet.com or tel: 02074349298.

Elspeth Reid (1942-2003): an appreciation

The geoconservation community was greatly saddened by Elspeth's sudden death in 2003. She had a lifelong passion for learning and communication, reflected particularly in her involvement in Earth science education and RIGS activities.

Following an early interest in literature and linguistics, Elspeth's enthusiasm for geology was fostered during the course of an Open University degree in Earth and Environmental Sciences and an MSc at Aberdeen University. Her experience with the Open University encouraged a strong commitment to the value of life-long learning.

Elspeth maintained her links with the Open University as a tutor between 1986 and 2003. She also taught Earth Systems Science, Environmental Geology, and Forestry and Conservation at Inverness College. Her students will remember her for the support and encouragement she gave, nurturing their talent and interest.

Elspeth later became a member of the

Scottish Qualifications Authority Geology Assessment Panel and of the emerging Scottish Earth Science Education Forum. She also contributed to the Open University textbook on Earth Heritage Conservation, edited by Chris Wilson. She had interests in the geology and geomorphology of the Namib Desert and the Dalradian of Scotland and had recently completed her PhD at Stirling University on slope evolution and Holocene climate change in the Highlands.

Many who came into contact with Elspeth will have done so through her involvement in geological conservation. She was fundamental in stimulating interest in the RIGS movement in northern Scotland. She was a founder member and chair of the Highland RIGS Group. Elspeth was a crucial link to academia, helping to provide the group with necessary expertise in a vast area of diverse geology and with few resident geologists. Elspeth also took part in the moves to establish a Scottish RIGS Association and develop a National Strategy for RIGS in Scotland.

Elspeth's was a life of fulfilment, a life overflowing with things to do. She was constantly seeking to improve her skills and to pass on her knowledge. All of us who knew Elspeth were influenced by her warm personality, her enthusiasm and enquiring mind and above all her unselfishness and willingness to share her knowledge with others. Elspeth's enthusiasm, support and commitment will be greatly missed, but we are grateful for having known her.

– John Gordon and Cynthia Burek

FOOTNOTE: The Open University has set up a commemorative fund in memory of Elspeth. The fund is to be 'used solely to provide more opportunities for Open University geology students to go on field excursions'.

Further information from David Reid at davidreid@ecosse.net. Cheques payable to The Open University Foundation (Elspeth Reid Fund), Open University, FREEPOST ANG5074, Milton Keynes,

Progress on stone supply planning

A supply of native building and roofing stone is essential if our historic built heritage is to be maintained and if new development is to be built in the local style. But quarrying and extraction has to be done within the context of the minerals planning system, and take full account of the international, national and local designations that aim to conserve our natural and archaeological heritage.

After a couple of controversial cases where applications to extract building and roofing stone coincided with sensitive wildlife sites, the Office of the Deputy Prime Minister (ODPM) commissioned an 18-month study, *Planning for the supply of natural building and roofing stone in England and Wales*. The subsequent 220-page, full-colour report provides a wealth of information and analysis. It describes the nature and significance of the building and roofing stone industry in England and Wales and its relationship to planning and development. It identifies issues of supply and demand

and reviews the extent of reserves. It identifies the planning policy required to assure the future supply of these materials. It also provides information on 491 quarries that produce, or have produced, stone.



One recommendation is for more information on good practice and on stone types and uses – especially easier access to details which show building and roofing stone sources in relation to environmental and heritage designations.

Brian Marker of ODPM said the findings would inform new government guidance on supply planning. Copies of the report are £25 and available from ODPM Publications on 0870 1226 236 or at www.odpm.gov.uk

Devon quarry reports lead the way

Sixteen geodiversity audit reports which give a unique insight into Devon's active quarries were the subject of a day seminar.

The reports document the history, current use, future plans and other operational details of each quarry. They also record the geological features revealed by extraction. As such, they can be major contributors to a geodiversity audit which, in turn, could inform any Local Geodiversity Action Plan.

The reports can furnish valuable details for planning Earth science field trips and related subjects (access permitting). Equally, they carry data for operators who want to open their quarries for educational purposes or who want to plan quarry work to conserve prime geological features.

The project, funded by the Aggregates Levy Sustainability Fund through the Mineral Industry Sustainable Technology Programme (MIST), was carried out by the British Geological Survey, Devon County Council, the Devon Stone Federation and David Roche Geoconsulting.

An attached overview report provides background information on the project and an analysis of its effectiveness. It assesses the auditing process, identifying the best

and most cost-effective methods for similar projects to follow, and it considers how to disseminate the findings widely.

The success of the reports will be seen in their usage, but their value has been recognised. A project to provide similar reports on active aggregate quarries in Somerset has now been funded by MIRO.

The Devon reports are available at: www.devon.gov.uk/index/environment/natural_environment/geology/geodiversity-2/audit_of_active_aggregate_quarries.htm
– David Evans, *English Nature*

Aerial photos on CD

Warwickshire Wildlife Trust has produced two CDs of digitised photographs showing aerial views of landscapes and geological features, mostly of Coventry and Warwickshire. More details from the Trust, tel: 02476 302912, or John Ball at Middlemarch Environmental Ltd., 01676 525880.

Photo by John Ball



ALSF grants latest

English Nature funded more than 100 projects in the first two years of the Aggregates Levy Sustainability Fund (ALSF) – and these projects have brought benefits for wildlife and geology and for people affected by aggregate extraction. Grants have gone to well-known organisations such as RIGS and geoconservation groups, Wildlife Trusts and RSPB, through to local authorities and small first-time community groups.

For 2004-05, the focus will be on high-quality projects for which funding was not available previously. It is hoped that a refreshed scheme for 2005-06 will be announced in the autumn.

English Nature received confirmation of its ALSF grants budget for 2004-05 later than expected, and the amount was disappointingly less than in previous years – £3.3m, with £600,000 of that set aside for marine projects.

The Chancellor's Pre-Budget Statement in December 2003 confirmed that English Nature would continue as a distributing body for the next three years, but – at the time of writing – there was no information about allocations for years two and three (2005-06 and 2006-07).

Because of this, English Nature is not inviting applications for land-based projects until allocations are confirmed. It is instead concentrating on existing applications and those previously approved by the independent Grants Panel and for which there was no money available in 2003-04.

Applications are invited for marine projects, though. All current projects need to be completed and the grant claimed by no later than March 2005. English Nature appreciates the difficulties that this presents and is lobbying for a more flexible way of working.

For more details, visit www.english-nature.org.uk/AboutUs/Grants or contact the Grants Management Team, tel: 01476 584821 or e-mail: alsf@english-nature.org.uk.

How to mind the LGAP

Local Geodiversity Action Plans (LGAPs) reflect their local situation and share the aim of conserving and enhancing geodiversity through conservation, education and communication.

In December 2003 English Nature brought together those active in Local Geodiversity Action Plan (LGAP) development, and led by Cynthia Burek and Jac Potter of University College, Chester. Six LGAPs were reviewed (Cheshire, Warwickshire, Staffordshire, Tees Valley, Durham and the North Pennines AONB, and Leicestershire and Rutland). Common principles emerged:

- LGAPs are broad, holistic and comprise several themes developed in parallel;
- Clearly stated aims, objectives and actions are essential to measure progress;
- Where geology is complex and the resource poorly understood, a geological audit is often a starting point;
- A strong partnership is important and the lead partner needs to guide the process. The main partners should share the work, and a range of other organisations and individuals will be consulted;
- The LGAP should be made easily available to the public.

Funding for LGAPs, which to date has come from English Nature, the Aggregates Levy Sustainability Fund and MIRO, varies widely. This can influence whether a detailed geodiversity audit is carried out, whether a full- or part-time co-ordinator is employed, or whether the time of existing staff or volunteers is used.

Importantly, the cost of establishing an LGAP is not prohibitive and can be tailored to available resources. For example, the aims and objectives of an LGAP can be established without a detailed and expensive audit. Instead, the audit can become one of the first objectives of the LGAP, for which separate funding can be sought.

It has been widely agreed that a national overview could help emerging LGAPs share their knowledge. It could also provide guidance, help establish common standards and, in the long-term, promote the sustainability of the LGAP process through gaining wider acceptance within the conservation and planning communities.

An e-mail communication network, 'Mind the LGAP', has been set up to share information on LGAP development, and the December workshop report – *Local Geodiversity Action Plan – sharing good practice* – is now available from English Nature. It is also anticipated that LGAP information will be more widely available via the web during this year.

If you would like to be kept informed as part of 'Mind the LGAP', and would like a copy of the good practice report, please e-mail your contact details to hannah.townley@english-nature.org.uk.

– Jonathan Larwood, English Nature

LGAP material: Triassic sandstones at Guy's Cliffe, Warwickshire

Photo by Mick Murphy/English Nature

Keeping history accessible

Finding somewhere which superbly illustrates the environments that existed millions of years ago and which is easily accessible to visitors is a rarity – and one well worth looking after. One such is Craigleith Quarry in Edinburgh, one of Scotland's first RIGS. It was given a much-needed spring clean this year by volunteers from the Lothian and Borders RIGS Group (LaBRIGS) and local residents.

The volunteers descended on the former quarry face to remove litter and vegetation from the rock exposures. They fought through gorse, bramble and rain showers to make the face a spike-free attraction for visitors and to spruce it up ready for a forthcoming leaflet about the site. The geological trail which is being developed at the quarry and described in the leaflet (funded jointly by SNH and a Craigleith resident) aims to introduce people to the rich historical and geological heritage of the quarry and encourage them to explore their own area.

Craigleith Quarry was the extraction site of the famous Craigleith Sandstone, the principal stone used to construct the Edinburgh New Town during the 18th and 19th centuries. The stone earned was widely exported, including to London where it was used for prestigious buildings such as Buckingham Palace. The surviving quarry face displays a fantastic succession through a variety of sedimentary rocks and structures, revealing a story of environmental change over 300 million years ago.

Today the quarry is filled in and occupied by a retail park. The best area of remaining geology lies behind Sainsbury's and the retained exposures are a credit to the negotiation skills of the first chairman of LaBRIGS, Norman Butcher. Visitors to the site should go to the information desk inside Sainsbury's superstore.

– Sarah Arkley, BGS and Lothian and Borders RIGS



Above: lithograph of Craigleith Quarry with Edinburgh beyond, c.1854 by William Leighton Leitch. Below: the quarry before and after the clear-up.

Lithograph courtesy Edinburgh City Library. Photos by Alan Ross



What's in a name?

There is much recent interest in geodiversity, and with the publication of Murray Gray's excellent textbook (Gray, 2004) the subject should eventually have a firm footing. That's the good news. The bad news is that the term geodiversity remains vague and measures of geodiversity, other than at an advanced spatial-statistical level, are poorly developed.

When soil scientists discuss pedodiversity, they think in terms of spatial autocorrelation and kriging, but there is no real analogy in geodiversity. It is not difficult to see why, since there is often no common understanding or consensus as to what the unit of measurement in geodiversity is. Analogies with biodiversity are not helpful. In what sense is an outcrop or a landform equivalent to a species? Well – in no sense, and perhaps the term geodiversity, while having a certain caché, is not particularly helpful.

The RIGS groups, for example, have shied away from a central problem: should they be concerned with identifying individual examples of rock outcrops or landforms, or should they really be concerned with identifying spatial assemblages that give rise to characteristic landscapes worthy of some sort of protection?

The notion of assemblages is well known in geomorphology. For example, glacial landform assemblages might include landscapes with moraines, drumlins, outwash plains and so on. In geology, characteristic zones of metamorphism might be regarded as an assemblage, as might outcrops of tuffs and lavas. In what sense is it useful to define a single drumlin or meltwater channel as a RIGS site? Would it not be more interesting, from an Earth heritage point of view, to identify areas containing a characteristic suite of landforms, minerals or rocks?

The central problem with the term geodiversity is that it requires rigorous measurement, and it does not correspond with fieldwork as carried out in the British Isles by those interested in Earth heritage. This was recognised by Murray Gray. His

book, in fact, has very little to say about practical geodiversity measurement methods other than hinting at a gridding method and object counting within grid squares. This in itself is fraught with difficulties. Some objects are point objects, such as quarries and some landforms. Others are spatially continuous, such as a plateau, and some are linear, such as dykes and rivers. Are these all countable by the same measure?

example of an upland limestone pavement with exceptionally deep grikes and areas of palaeokarstic, ungriked clints. But the RIGS site description would almost certainly miss the more important point regarding how the site related to the broader geological/geomorphological landscape history. A geotope would not only include pavements, and surrounding pavements, but would extend to those parts of the karst now buried by the Craven drumlin field. Why? Because the formation and distribution of the pavements is intricately linked to zones of glacial erosion and deposition in the area.

Thus the geotope description provides a more coherent description of a unique glacio-karst and doesn't deconstruct the landscape elements to the point of not being able to see the wood for the trees. The integrative nature of the geotope/biotope concept has much to recommend it, especially from an educational point of view. ■

Peter Vincent,
Lancaster University

Further reading
Gray, M. 2004. *Geodiversity. Valuing and conserving abiotic habitats*. Chichester:

Wiley

Scar Close NNR: geotope description has much in its favour.

Photo by Peter Wakely/English Nature



As an alternative, it might be better not to think of geodiversity, but to think in terms of geotopes, a concept which is widely adopted on the continent. Geotopes are spatially defined terrestrial units with outstanding geological or geomorphological qualities that are worthy of protection for future generations. Their definition specifically requires that they provide evidence of the geological history of the landscape and its development. Some scientists distinguish between passive and active geotopes, depending on whether a process that has led to its formation is still active or not.

With this definition in mind, let us contrast by way of example, a hypothetical RIGS site, with say, a geotope for the Ingleborough area of north-west Yorkshire.

One possibility for a RIGS site might be Scar Close NNR, which is an excellent



The brick bases to Sorby's wooden sheds still remained.

Buried treasure – Sheffield's lost fossil forest laid to rest

Gaynor Boon,
Sheffield Galleries &
Museums Trust

The buried stumps are tucked away in the grounds of a new housing development in Wadsley, a north-west suburb of Sheffield.

The group of *in situ* fossilised trees was discovered in 1872 during building work in the grounds of the Middlewood Hospital. Excavations into the underlying sandstone exposed the fossilised remains of approximately 10 large tree stumps – the largest around three metres in diameter.

Troubled times

That the fossils have survived *in situ* to the present day owes much to the efforts of Professor Henry Clifton Sorby, who described them in a paper to the Geological Society of London in April 1875. Unlike some of his Victorian peers, Sorby had the

good sense to realise the importance of leaving the fossils where they were found. He also had wooden sheds erected over three of the best fossils to protect them from the elements, and he published his findings in a leading scientific journal.

The site was scheduled for its scientific interest by the Nature Conservancy Council in the 1950s although it was de-scheduled a decade later, probably because of the site's limited access. At one point the fossils were to be transferred to Sheffield University's geology department but were too unstable to move. Interest gradually dwindled, the sheds fell into disrepair and the fossils became exposed not only to the elements, but to resident souvenir hunters.

In 1987, the site owners put the hospital and grounds up for sale. Although the fate

The largest fossil stump was used to create a mould. A fibre-glass outer jacket of 26 separate pieces was constructed to support the latex mould.



Further excavations in 1933 revealed more fossils.



A remarkable remnant of prehistoric fossilised forest was buried recently – to safeguard its future. The burial was the final stage in a programme of excavation and scientific study to unravel the complex ancient environment in which the giant trees of Wadsley Fossil Forest once grew.



Duncan McLean of Sheffield University explains the significance of the fossils to a group of fellow enthusiasts.

All photos courtesy of Sheffield Galleries and Museums Trust

t (again)

of the fossils appeared to lie with the bulldozer, there was also an opportunity to gain better access to the site, itself a double-edged sword. The only hope of saving the fossils was for SSSI status to be restored. Only one fossil stump could be readily found, however, providing insufficient scientific interest to warrant SSSI status. With this in mind, a team of volunteers, headed by staff of Sheffield City Museum and members of the Sorby Natural History Society, set to work on clearing dense thickets of gorse and bramble to find evidence of other stumps described by Sorby.

The brick bases to Sorby's ruined wooden sheds were fortunately still intact within the undergrowth and were obvious starting points for excavations. Several weeks later the team had discovered four *in situ* stumps. These provided clear and unique evidence of where the trees had stood in their ancient environment. The site was duly added to the SSSI schedule in 1989.

Soon after, Sheffield City Museum, Sheffield City Council planning department and English Nature established a partnership to decide how to manage the fossils. The choice was between a major scheme to develop the site as a visitor attraction, or to re-bury the site to preserve the fossil interest while carrying out some on-site interpretation to mark its presence. The latter was chosen as the most realistic option in the light of available resources.

An appendix to the planning brief ensured that the new owner signed up to fund a full

programme of scientific excavation, recording, and preservation of the fossils prior to re-burial. An added proviso was that interpretation could be increased and the fossils re-exposed if resources and expertise become available.

Gone but not forgotten

Although the fossils are buried once more, they will not be forgotten. A further phase of activities is being planned to promote their discovery in Sheffield. This will coincide with transferring the ownership of the SSSI to the local authority. This is due to happen within two years and the site will then be maintained as a landscaped public open space.

South Yorkshire RIGS Group, English Nature and Sheffield Galleries & Museums Trust will be key partners in the project, which has a number of objectives. A mould has already been made of the best fossil and it will be used to produce two replicas. One will be located on-site with accompanying information. The second will form a key exhibit in new displays of local geology at Weston Park Museum when it re-opens in autumn 2005. The project archive will be retained by Sheffield Galleries and Museums Trust. An information leaflet is also planned, with involvement from a local school, and a series of rock and fossil hands-on activity days planned both at the museum and on site. The package should increase awareness of the fossil forest – and also help nurture the next generation of that increasingly endangered species, the geologist. ■

AN EXTREMELY RARE OCCURRENCE

Whilst fossil trees and roots are common in the Upper Carboniferous, the occurrence of several fossil tree stumps in one place is rare. Wadsley is one of only two known examples in the British Isles that are likely to remain conserved. The other is some 20 million years older and located in Victoria Park, Glasgow.

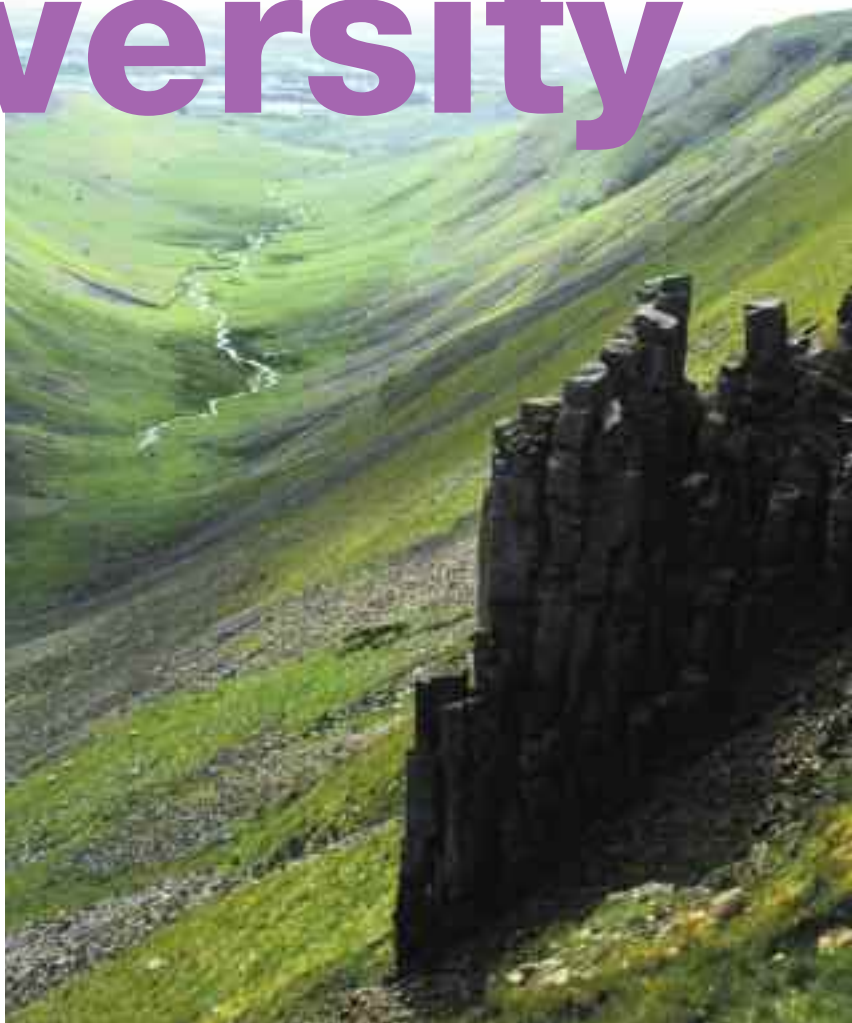
The Wadsley fossils are the best known examples of tree stumps of Westphalian (Langsettian) age, about 310 million years old. The fossils rest in an inclined bed of sandstone at or around the horizon of the Clay Coal. Recent excavations have revealed at least 13 stumps and a large number of tree and root remains of many different generations, preserved together within the same rock unit. The site also reveals previously unrecorded information on the lower rooting structures and under surfaces of the tree stumps and provides strong clues about how the rooting systems grew and interacted. Fallen stems and branches were originally preserved as 3D structures after burial in the substrate. The Coal Measures environment in the Sheffield region appears to have been very dynamic. Many generations of trees grew rapidly on an ancient riverbank which was frequently subjected to flooding and rapid accumulation of sediment. Microscopic fossil evidence is abundant, with typical Coal Measures spore assemblages but also with recycled ancient material. The fossils are mainly *Stigmaria*, whilst other plant fossils on site include *Lepidodendron*, *Lepidophlois* and *Calamites*. One as yet unidentified cone has been found.

Geodiversity

takes its rightful place

In recognition of its important geology and local efforts to conserve, interpret and revitalise the area through its Earth science, the North Pennines Area of Outstanding Natural Beauty (AONB) was the first area in mainland Britain to be awarded the UNESCO-endorsed status of European Geopark.

Here, Chris Woodley-Stewart, North Pennines AONB Officer, and Brian Young, British Geological Survey, explain the journey from audit to action plan.



In 2003, to guide understanding and management of the area's unique geological heritage and to support the development of sustainable 'geotourism', the AONB Partnership secured funding through English Nature from the Aggregates Levy Sustainability Fund to commission the British Geological Survey (BGS) to advise on the framing of a Local Geodiversity Action Plan (LGAP) for the AONB.

This is the first GAP for a protected landscape in this country. It includes a comprehensive geodiversity audit which has provided a solid, modern understanding of the area's geological features and helped guide the development of the action plan.

Key elements

The BGS project team evaluated the key elements of the area's geodiversity in their local, regional, national and, where appropriate, international context. As well as commenting on the most significant features of Ordovician, Silurian, Devonian, Carboniferous, Permo-Triassic, Quaternary and intrusive igneous rocks, mineral veins, geological structures and landforms, the audit comments on past and present economic use and the impact each has

upon the area's landscape and biodiversity. Threats to important geological features and materials are discussed and separate sections consider specific issues related to active and abandoned mines, quarries and spoil heaps.

While reviewing these mainstream subjects, the audit also highlights the important role of mineralogy, palaeontology, geophysics and geochemistry, all essential but commonly overlooked, aspects of geodiversity. Particular attention is also focused on the essential place of the built environment in geodiversity as well as the important contribution made by museum collections, documentary records and geological societies. Topics unique to the North Pennines include spar boxes, geological models and Frosterley Marble.

As a prelude to proposals for future action, the audit reviews in detail the present status of geological conservation and interpretation across the AONB. For each geological topic, all Sites of Special Scientific Interest (SSSIs) or other non-statutory sites, including RIGS, designated for their geological importance, are listed and reviewed.

Action plan

Having completed the audit, the BGS team, with input from a number of volunteer groups, presented the AONB Partnership with proposals and recommendations. The AONB Partnership Staff Unit, in collaboration with BGS, then undertook the task of compiling an action plan for the AONB/Geopark.

This includes actions on conservation, monitoring, raising awareness, developing opportunities for geotourism, education, research, collaborative working, and promoting and developing the AONB as a Geopark. The plan also includes specific proposals for on-site interpretation, self-guided walks and geological trails, together with a wide range of geological publications relevant to the AONB. It also identifies a network of North Pennine geological sites, selected to be representative of the area's geodiversity, with prioritised recommendations for specific conservation and enhancement measures at each.

The resulting document reflects a very substantial and truly collaborative effort from the BGS authors and AONB Partnership staff with contributions from



Left: Great Whin Sill at High Cup Nick on the Pennine Way above Dufton.

Below: Cottages at Blanchland built and roofed with local sandstone.

Photos and illustration courtesy of North Pennines AONB



individuals and organisations across the north of England and beyond. The North Pennines AONB Geodiversity Audit and Action Plan is a companion document to the statutory AONB Management Plan and together they provide a framework for action for the conservation, interpretation and promotion of natural beauty, for several years to come.

Geodiversity now has its rightful place in this process alongside the conservation of landscape, biodiversity, historic and cultural features. ■

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Brian Young publishes with the approval of the Executive Director, British Geological Survey (NERC).

North Pennines joins ‘family of special places’

In February 2004, UNESCO announced the launch of the new Global Geopark Network, with the 17 current European Geoparks at the forefront of this worldwide family of special places.

So why do the North Pennines deserve their place in that prestigious network?

The landscape of the North Pennines Area of Outstanding Natural Beauty (AONB) is one of wide open moorlands and remote high fells dissected by broad dales with scattered farms, villages and small market towns. From the highest fells, including Cross Fell at 893 metres the highest point in the Pennines, rise three of north-east England’s greatest rivers, the Tyne, Wear and Tees.

Extending to almost 2,000 km² in the counties of Cumbria, Northumberland and Durham, this is the second largest of the 41 AONBs in England and Wales, where the relationships between landscape, vegetation, wildlife, economic development (especially mining and quarrying), and cultural history are so inextricably interlinked.

The area is of international importance for its geology, including the

celebrated Northern Pennine orefield. Not only have centuries of mining and quarrying left an indelible mark on almost every aspect of the area’s landscape, but the North Pennines has long been at the forefront of developing ideas and concepts in the understanding of geological processes and the formation of ore deposits.

The area coincides with the upland portions of the Alston Block where a comparatively thin succession of Carboniferous sedimentary rocks, including classic Yoredale cyclothem, rest on a platform of Ordovician sedimentary and volcanic rocks in which occurs the Caledonian Weardale Granite. The Carboniferous rocks are cut by a suite of basic intrusions of Permo-Carboniferous age, collectively known as the Whin Sill, the original ‘sill’ of geological science.

Cutting all of these rocks is a conjugate series of faults which host the numerous veins and related deposits of the Northern Pennine orefield. Originally worked for their lead and iron ores, together with minor amounts of silver and copper, these deposits also carry abundant zinc ores, fluorspar, barytes and witherite, all of which have been mined on a large scale.

How to mind the LGAP:
See page 6

Face Lift improves

English Nature's Face Lift programme for enhancing geological and geomorphological Sites of Special Scientific Interest (SSSIs) has not only improved conditions at many sites but also led to new scientific understanding of geology.

The main focus of Face Lift has been vegetation and scree clearance to uncover features that have often been concealed due to long-term neglect. In the first five

Mick Murphy,
English Nature

years, since 1999, more than 220 geological SSSIs have been enhanced, with a total spend of more than £400,000.

In a number of cases, new exposures have been created, providing access to geological features which had not been exposed or examined for many years. There are now several cases where modern

concepts and new technology used in re-examinations have led to new scientific understanding. The concepts and technologies did not exist when the features were previously described.

An English Nature Research Report on the research benefits of Face Lift will be published in the coming year.

SSSI MANAGEMENT

There are currently 1,241 geological Sites of Special Scientific Interest (SSSIs) in England, covering a wide range of geological and geomorphological interest features. While naturally occurring exposures are often self-maintaining as long as natural erosion processes continue, most human-made sites – quarries, road and rail cuttings and mines – require management to maintain geological exposures.

APPLYING FOR A GRANT

English Nature welcomes suggestions from researchers, both professional and amateur, for new Face Lift projects where achieving favourable site condition can facilitate new research. Please e-mail me (michael.murphy@english-nature.org.uk) for more details.

Opening the way for sampling

Mortimer Forest SSSI, Herefordshire

Mortimer Forest forms part of the classic area of the Ludlow Anticline in the Welsh Borderland and has long been the focus of research into Silurian geology. The area has been studied more or less continuously since Murchison wrote the *Silurian System* in the early 19th century. The forest road cuttings and small quarries of Mortimer Forest contain the international stratotype boundary sections for the base of the Gorstian Stage (which is also the base of the Ludlow Series) and the Ludfordsian Stage of the Ludlow Series, as well as a number of lithostratigraphical type sections. Much of this research has related to the biostratigraphy and palaeontology, but during the late 20th century, a range of new methods became available.

Mortimer Forest SSSI embraces five Geological Conservation Review sites and two of these, Sunnyhill and Deer Park Road, had become overgrown and deeply weathered. This made them unsuitable for isotope stratigraphy, chemostratigraphy or palynology, which meant it was not possible to compare the type area for the Ludlow Series to successions in other parts of the world.

Face Lift works at these two sites during 2001 created fresh exposures where it was possible systematically to collect unweathered material for the previously impossible tests. The operation was managed by an interdisciplinary group from Oxford and Leicester universities.

Face Lift contributed towards facilitating the collection of raw stable isotope data for the type Ludlow Series successions as well as sampling for Silurian phytoplankton. The published research will contribute greatly to the understanding of the biostratigraphy of the type area as well as our understanding of oceanic change at that time.



Trackside section at Deer Park Road, Mortimer Forest, containing the Bringewood and Leintwardine formations before clearance and, below, after clearance.

Photos by Dr G. Mullins, University of Leicester



Palaeomagnetic methods put rock in a new age



Excavation works at Tideswell Dale in 2003.

Below: Columnar-jointed horizon exposed by trenching works.

Photos by Mick Murphy, English Nature



Tideswell Dale, The Wye Valley SSSI, Derbyshire

Tideswell Dale is a disused quarry in the Peak District which exposes a basaltic sill that has been intruded into limestones and volcanic rocks of Lower Carboniferous age. The base of the sill is not normally exposed in the quarry. However, some older literature had described a contact-metamorphosed, columnar-jointed, clay-rich horizon beneath the sill, which had not been exposed for several years. Although contact metamorphism associated with igneous intrusions is not unusual, columnar jointing in clay-rich rocks is very unusual.

An initial Face Lift excavation in 2002 found this horizon within a metre of the surface. In 2003, a second excavation, funded by Face Lift and English Nature's science budget and undertaken in partnership with Professor Steve Sparks of Bristol University, has revealed a surprise: the palaeomagnetic poles for both the columnar rock and the sill are those expected for a late Triassic or early Jurassic rather than Carboniferous age. Magma intrusions of this age were previously unknown in Britain. Oriented samples from this study were studied by palaeomagnetic methods and samples were also examined by microprobe and XRD to determine the nature of the very fine-grained minerals. The magnetic properties of the rock indicate that it was heated to at least 700°C by the intrusion of the sill.

The result needs to be confirmed by other dating methods and Professor Sparks is currently undertaking more research on the rocks. If the Triassic-Jurassic ages are confirmed, this will have much wider implications for

New interest in Welton sediments

Welton-le-Wold Old Gravel Pits SSSI, Lincolnshire

The disused gravel workings at Welton-le-Wold are critical for understanding the Quaternary history of the surrounding areas. The age of the glacial tills and associated sands and gravels have been the subject of much controversy. In the past, the sands and gravels have yielded various mammal remains, including elephant teeth and tusks, and human artefacts have also been recovered.

The workings were last active in the 1970s, after which they were partly back-filled, concealing important parts of the stratigraphy. More recent research elsewhere had cast serious doubt on the ages attributed to some of the deposits at Welton-le-Wold, so it had become important to re-examine the Welton sediments.

In 2001, major Face Lift clearance works exposed the lower parts of the sequence, some of which had not been seen for about 30 years. The project was proposed and overseen by John Aram, a retired local geologist with a keen interest in Quaternary geology. New dating techniques have been applied to these sediments, and research interest in the site has been re-invigorated, with an ongoing multi-disciplinary study being undertaken on the site's geological and archaeological features. John Aram is undertaking a PhD at Royal Holloway, University of London, studying the tills and gravels and there are a number of other studies being undertaken on the palaeontology and archaeology.

At present, the new research has thrown up more questions than answers, but the importance of the site for Quaternary studies has been greatly reinforced by the work initiated from Face Lift.



Clearance of face and creation of bench at Welton-le-Wold in 2001.

Photo by John Aram

Exploring the landscape

To geologists, the word ‘Assynt’ brings to mind an area of complex and fascinating geology, where the early surveyors such as Peach and Horne laboured during the 19th century to develop the concepts of thrusting, and where thousands of students cut their geological teeth.

For many people, though, Assynt is simply characterised by its spectacular landscapes: the upturned boat shape of Suilven, the green valleys and towering peaks around Inchnadamph, or the rocky coastline at Achmelvich.

Of course, geology and landscape are inextricably linked, and there are few places in Britain where these links are as clear as they are in the Assynt area. The British Geological Survey (BGS), with funding from BP, has published a new map and guide so that non-geologists can understand the geology underlying the landscape.

The geology of Assynt

The dramatic landscapes of Assynt are the product of a long and varied geological history. The geology of Assynt is controlled by the Moine Thrust, a major structure in the Earth’s crust that runs through north-western Scotland from Loch Eriboll on the north coast to the Isle of Skye. The Moine Thrust was formed about 430 million years ago, when the continents bearing Scotland, England and Scandinavia collided, forming the Caledonian mountain range.

Deep beneath these mountains, sedimentary rocks were metamorphosed and forced westwards over younger rocks. The major fracture plane along which this movement occurred is the Moine Thrust, and it is one of the most important geological structures in Scotland. Immediately beneath the Moine Thrust are a number of other smaller-scale thrusts, collectively known as the Moine Thrust Belt.

The Assynt region can be divided into three geological areas: the foreland to the west of the Moine Thrust Belt; the Moine Thrust Belt itself, and the rocks of the Moine Supergroup to the east. Each area has very different landscape characteristics, instantly recognisable even by those with no geological knowledge.



New BGS map and guide to a clas

**Kathryn Goodenough,
Elizabeth Pickett,
Maarten Krabbendam and Tom Bradwell**

The foreland is essentially the area west of the main road between Elphin and Kylesku, and it consists of three main rock types. The oldest rocks, the Lewisian gneisses, are almost 3,000 million years old – among the oldest in Europe. They form the low, rocky hills and the rough coastline around Lochinver, providing many natural harbours for fishing boats.

Around 1,000 million years ago, rivers flowing across a barren landscape laid down a blanket of red-brown sand and pebbles, many kilometres thick, known as the Torridonian Sandstone. Much of this has been eroded away, but remnants can still be seen forming isolated peaks, such as Stac Pollaidh, Suilven and Cùl Mòr, that rise above the surrounding gneisses. Some of the

peaks, including Canisp and Quinag, are capped by pale-grey layers of Cambrian quartzite, laid down as pure quartz beach sand about 500 million years ago.

Immediately east of the Elphin–Kylesku road lies the ‘Assynt Window’ – a broad outcrop of the Moine Thrust Belt that has attracted the attention of structural geologists for over a century. The geology of this area is extremely complicated, with the rock layers being highly disrupted by the thrusts. The most important landscape features here are the limestone-floored Traligill, Allt nan Uamh and Loyne valleys, stretching east from the road, and rising up into the hills of the Ben More Assynt range.

This is one of the largest limestone areas in

of Assynt and Inverpolly

Torridonian sandstone at the summit of Cùl Beag, with Stac Pollaidh in the distance.

Image provided by British Geological Survey. © NERC. All rights reserved



Classic landscape

Scotland and the calcareous soil supports a wide variety of lime-loving flowering plants, including mountain avens and saxifrages. The relative ease of dissolution of the limestone means that these valleys are riddled with caves and underground rivers. Above the heads of the valleys is a great quartzite ridge, culminating in the Munros (peaks over 3,000 feet high) of Conival and Ben More Assynt.

Beyond the high peaks of Assynt lies the Moine Thrust, east of which are the rocks of the Moine Supergroup that underlie much of the Northern Highlands of Scotland. Moine means 'peat' or 'moss' in Gaelic, and there is no doubt that this is an appropriate name for the wild, peaty expanse that stretches eastwards from the lower slopes of

A walker's guide and map to the rocks and landscape of Assynt and Inverpolly

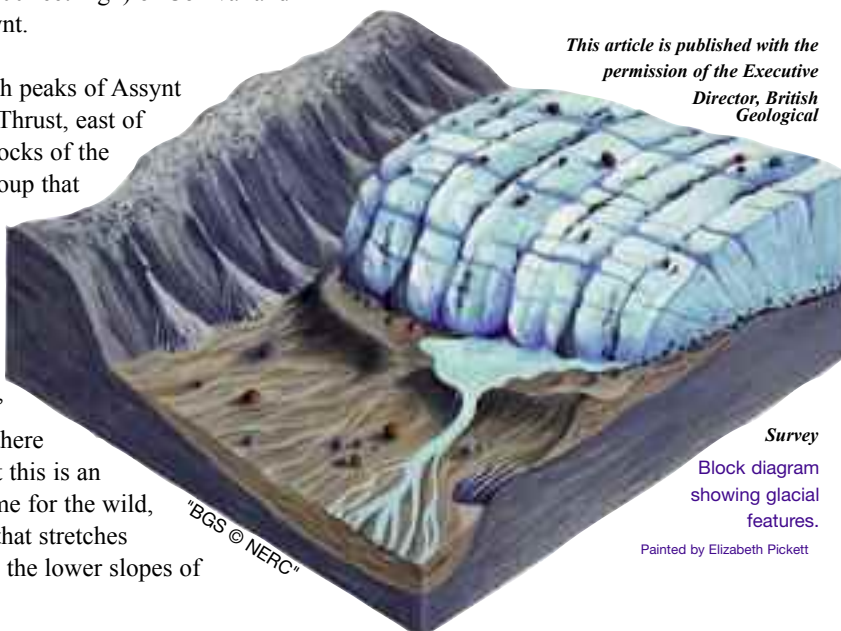


The Exploring the Landscape of Assynt map and guide.

Ben More Assynt.

The landscape of Assynt is strongly controlled by the underlying geology, but the shapes of the peaks and valleys have largely been formed by more recent processes – in particular the action of glaciers, which covered much of this area for a large part of the last two million years. Great rivers of ice streamed across the landscape, scouring and smoothing the rocks, gouging out deep valleys and leaving the peaks standing tall.

Episodes of glaciation have not only sculpted the rocks, but also left behind sediments that in places form a thick cover on the rocks below. Since the glaciers retreated, about 10,000 years ago, Assynt has gradually been colonised by plants, animals, and eventually people. Aspects of this later history have been just as important as the geology in shaping this beautiful district of Scotland. ■



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Survey

Block diagram showing glacial features.

Painted by Elizabeth Pickett

The Moine Thrust Project team at BGS has produced a new, simplified geological map of Assynt that can be more easily related to the landscape than a 'normal' geological map. The key includes explanations of what the different rock-types look like and photographs of the typical landscapes developed on these rocks, so allowing visitors to link the colours on the map to the ground beneath their feet. The map also includes cross-sections illustrated with photographs and inset maps showing the extent of the ice cover during the last glaciation.

The map is accompanied by a guide, which introduces geological processes and the geology of Assynt, together with detailed descriptions of walks. These routes are also illustrated on the map. The routes vary from easy trips to serious hill-walking routes such as the ascents of Suilven and Conival. Each route is illustrated by a range of paintings and photographs, and includes descriptions of geological and other features seen along the way.

The map and guide are available in bookshops around the Assynt area, and from the BGS shop at www.bgs.ac.uk/shop/

The map and guide were developed by the BGS as part of a ten-year project to resurvey the Moine Thrust Belt in Scotland. The main aim of this project is to produce revised versions of the 1:50 000 scale geological map sheets along the length of the Moine Thrust Belt. A revised version of the 'traditional' Assynt map will also be produced.

In association with Rob Butler at the University of Leeds, a website about the Moine Thrust Belt is being created. BGS is also working in partnership with Scottish Natural Heritage and Highland Council to put together a proposal for European Geopark status for the Northwest Highlands.



Several tracks of different size but similar form. Were they travelling together as a group or was it a common path? Scale bar = 10 cm



A sinuous tail drag and footprints on a slab at the display area. Hopeman trackways are also housed at Elgin Museum, National Museums of Scotland, Hunterian Museum and Aberdeen University. Scale bar = 10 cm



Colin MacFadyen, Scottish Natural Heritage

The display panel like reptiles that

An old quarry, new finds and a

Information on the environment and animals of late Permian Britain is sparse. The desert conditions of the time were not conducive to preserving fossils and the limited outcrops provide scant glimpses into that period. But at Clashach Quarry near Hopeman, north-east Scotland, we are getting more than our share of clues.

More than 400 trackways of fossilised reptile footprints have been discovered since 1996 as a result of an excellent working relationship with Moray Stone Cutters, the quarry operators. The Hopeman Sandstone Formation was undated, and estimated to be late Permian or early Triassic. The discovery at Clashach in 1997 of the first body fossil from Hopeman, the skull of a 250 million-year-old mammal-like reptile, dated the formation as topmost Permian.

Trackways were first recorded at Hopeman in 1852 by Captain Lambart Brickenden, and the latter part of the 19th century saw a flurry of finds. Similar tracks were also being excavated in the quarries of the Corncockle and Locharbriggs sandstones of Dumfriesshire. The trackways were mistakenly attributed to tortoises, and there are accounts of flour-besmudged professors using various reptiles to recreate the trackways in pastry. Tortoises produced the most faithful imitations of the tracks.

Clashach Quarry has been operating since the mid-19th century. The stone was shipped from the coast below the quarry. Quarrying was suspended in 1940 with the advent of World War II, and Moray Stone Cutters has been working the quarry since 1986. The stone from Clashach is used principally in building work and as flooring, but is also used for fireplaces,

building conservation and sculpting. In 1996, quarrying operations at Clashach were increased to provide facing stone for the new National Museum of Scotland in Edinburgh. Footprints were apparent on some of this stone and staff at National Museums of Scotland liaised with Moray Stone Cutters to preserve the trackways. Drew Baillie, the owner, has kindly donated tracks to the Museum and other institutions, including Elgin Museum, the Hunterian Museum, Aberdeen University and the Museu Príncipe Felipe in Valencia.

Enthusiastic support

The enthusiastic support of Moray Stone Cutters has resulted in the discovery and preservation of many of the trackways. They constructed a display site on a waymarked and well-used coastal footpath by the quarry, and interpretation panels were produced and installed in a joint project between the National Museums of Scotland, Scottish Natural Heritage and myself. Many trackways not destined for museums are displayed here, and the project received the Lasmo Geological Challenge Award in 1999.

The help of the quarry staff has permitted the collection of far more data than would have been available otherwise. They have cheerfully accepted visits from groups as diverse as primary schoolchildren, geologists, students and the public. Bill George, the quarry manager, has spoken about old quarrying techniques at events for Minerals '98, the Scottish Geology Festival and the local coastal ranger service.

Anecdotal evidence from the early finds at Hopeman states that the animals were heading north to the Moray Firth to drink. The trackways from Dumfries were

observed to be heading south towards the Solway Basin.

Constant monitoring of Clashach since 1996 has recorded many *in situ* trackways excavated during quarrying. These observations indicate the animals were heading north towards the Moray Firth basin, possibly a daily movement to fresh water or vegetation. Evaporitic deposits in the basin were thought to be from repeated flooding by the Zechstein, a large inland sea, but a re-examination revealed them to be lake evaporites. It is now thought that there was a desert lake or playa in the basin.

The discovery of *Batrachichnus* tracks on the foreshore at Hopeman supports this reinterpretation. *Batrachichnus* are thought

The quarry at Clashach, with sloping dune bedding visible on the quarry face.





Poster at Clashach showing dicynodonts, mammal-
tracks may have made some of the tracks.



All photos by Caroline Hopkins unless otherwise stated

An unusual trackway pattern from Clashach, originally thought to be made by an animal loping sideways across a dune with its feet pointing upslope. Experiments have shown that this track was probably produced by an animal walking normally across the dune (from left to right of the picture) its toes sliding downslope and leaving scrape marks. Scale bar = 10 cm

Carol Hopkins,
University of Aberdeen

prime partnership

to be the tracks of eryopoids, a group of amphibians usually associated with fluvial or playa type deposits. This is the youngest recorded occurrence. Previously these tracks were only known from the Carboniferous and Lower Permian.

Data have been collected on more than 250 trackways from Clashach alone. Comparison with trackways of similar age from other localities has revealed some anomalies in the Hopeman material. Tail drags are rare in Permian reptile tracks, yet at Hopeman 43 per cent of trackways have tail marks. Analysis of other trackway measurements may help to determine if

there were different animals at Hopeman, or that conditions were not suitable elsewhere to preserve the drags. The range of sizes of the Hopeman tracks is varied, ranging from 10 mm up to 260 mm wide.

Part of PhD project

As part of my PhD project examining the preservation of the Hopeman tracks, I carried out some track-making experiments using leopard geckos (*Eublepharis macularius*) on simulated dunes. This successfully reproduced and explained unusual trackway patterns found in the Permian sandstones of Scotland and Arizona that have puzzled workers for

decades. At a recent vertebrate palaeontology conference, mine was among a number of papers on the use of live animals to simulate the formation of fossil tracks.

The material from Clashach has changed our understanding of the environment, dated the Hopeman Sandstone, resolved some puzzling aspects of trackway formation and given more clues to the identity and behaviour of the track-makers. Interesting and unusual new trackways continue to be excavated at Clashach, and with them the potential for many more questions – or answers. ■

Inquiring mind, inspiring find...

Carol's work at Clashach Quarry has been of major importance in Permian vertebrate palaeontology. Her journey from first-year OU student to acknowledged expert on a site of international significance is inspirational. This is her story.

“Whilst out walking with my father, Dennis Stanistreet, we found some depressions on a cliff ledge at Covesea, east of Hopeman. The depressions looked like a reptile trackway similar to one at Clashach Quarry.

I was in my first year of study for a geology degree with the Open University and, over a pint at OU residential school two months later, I told the guest lecturer and palaeontologist Dr Neil Clark from the Hunterian Museum of the find. He was interested and, after seeing photos,

confirmed they were footprints.

I reported the trackway to Scottish Natural Heritage Area Officer, friend and next-door neighbour Susan Warbrick who provided me with relevant literature to research the tracks. A search of the papers and associated SSSI documents confirmed the trackways were unrecorded and that the recently re-opened Clashach Quarry could be the source of many more.

A rummage around the quarry produced quite a few trackways and I began checking on a regular basis. I was keen to establish a rapport with the quarry operators, and also to show that I would not interfere with the smooth running of the quarry. I would make brief visits during the week to speak to the workmen and keep them informed of developments.

Searching for and recording trackways and sedimentological data was done at weekends with the permission of Moray Stone Cutters.

I have been associated with Clashach Quarry since 1996, have graduated and am now undertaking a PhD project on the Hopeman trackways at the University of Aberdeen. I have received a tremendous amount of encouragement and support from Scottish Natural Heritage, the National Museums of Scotland and various palaeontologists and geologists. However, the success of this project would not have been possible without the enthusiasm, collaboration and generosity of the management and staff of Moray Stone Cutters.”



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ERRATICS

Work has started on a comprehensive RIGS audit of North Wales, following the success of the Gwynedd and Môn and North-East Wales RIGS groups in securing major funding from the Welsh Aggregates Levy Sustainability Fund (ALSF). The grant was reported in *Earth Heritage 21*.

The aim of the project is to establish networks of RIGS related by their geological age or subject matter. These networks will complement the existing network of Geological Conservation Review (GCR) sites/SSSIs. We are consulting a large number of experts to ensure we get the best site coverage.

Gwynedd and Môn RIGS Group is starting to review Quaternary sites on Anglesey by breaking the subject into bite-sized chunks such as coastal sediment exposures, glacial/interglacial landforms, erratic boulders, etc. Ultimately, researchers should be able to use the site network to reconstruct the Quaternary history of the island and elucidate regional variations in ice movement and sedimentary processes. In the interim, though, we are encountering some interesting challenges, initially on erratics.

movement



The Chwaen Goch picrite – an eyecatcher in the landscape, but not an exact match for early photographs

'Chips off the old block'

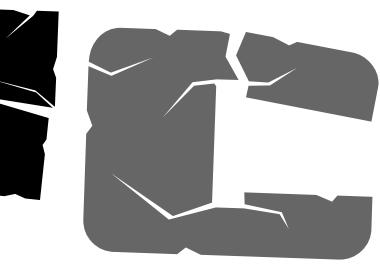
Anglesey is famous for a series of erratics first described systematically by Edward Greenly (1919) in *The Geology of Anglesey*. Some of the stranded boulders he described appear to have come from as far away as Scotland or the Lake District. Others are of distinctive local rock types and indicate ice-flow directions across the island. Some huge boulders have not been moved far at all, but they are still testament

to the immense transporting and erosional power of the Late Pleistocene glaciers. Some of the erratics have considerable archaeological value and some megaliths of erratic origin are protected as Scheduled Ancient Monuments (SAM). Many are the subject of myth and folklore and the exact geological and archaeological context of most of the stranded boulders is still poorly understood.

The biggest problem so far has been finding them! Greenly's work pre-dated grid references and although he described their locations, some of the boulders have been moved and others possibly destroyed. The Chwaen Goch erratic, near Llanerchymedd, in north-east Anglesey, typifies some of the problems. Although it is understood by some local people to be the erratic described and illustrated in a black and



Left: A massive erratic of Carboniferous limestone at Lleiniog, south-eastern Anglesey.



S



Work is going on at Henblas to establish if this is an erratic or a lump from a local quartz inlier.

white plate by Greenly, its appearance doesn't tally exactly with the original photograph. Greenly described a number of picrite erratics which he believed had been transported south-westwards by the Irish Sea ice sheet from isolated outcrops a few kilometres to the north-east. We are currently trying to determine which of the outcrops this erratic came from and have located a small one, near Cae Mawr on the Rhosybol road, which appears to be mineralogically similar. We hope to get some thin-sections made to see if the source can be pinpointed. The search will continue for the example illustrated by Greenly.

At Llanelian, on the north-east Anglesey coast, Greenly described a large granite erratic from 'Galloway'. This was once a pre-GCR geological SSSI, and judging from the map which shows the SSSI boundary, either the erratic has been moved or the Nature Conservancy Council had trouble finding it, since it seems to sit outside the defining line! From a thin-section of the rock, the British Geological Survey has helped us to pinpoint the source of the boulder to Dalbeattie in Scotland. With the help of a GPS, we hope to get the erratic within the RIGS boundary!

We have also looked at a range of large erratic boulders uncovered during the construction of the new A55 dual-carriageway across Anglesey. At the

request of both the RIGS group and Countryside Council for Wales, one of these was put on permanent display in a lay-by. A thin-section taken from a small fragment of the rock shows that the erratic came from a large gabbro dyke in the Irish Sea. We are also trying to resolve whether the megaliths at Henblas, south-west Anglesey, are erratic in origin or whether they were derived *in situ* from a quartzite inlier in the local Precambrian Gwna green-schists.

It is a major concern that some of the large Anglesey erratics appear to have been moved or destroyed. It is an aim of this ALSF project to locate the remaining important examples and afford them protection as RIGS. We hope to go on to



The Llanelian granite erratic, north-east Anglesey, is believed to have originated from the Dalbeattie area of Scotland.

**Stewart Campbell,
Margaret Wood**
Gwynedd and Môn
RIGS Group

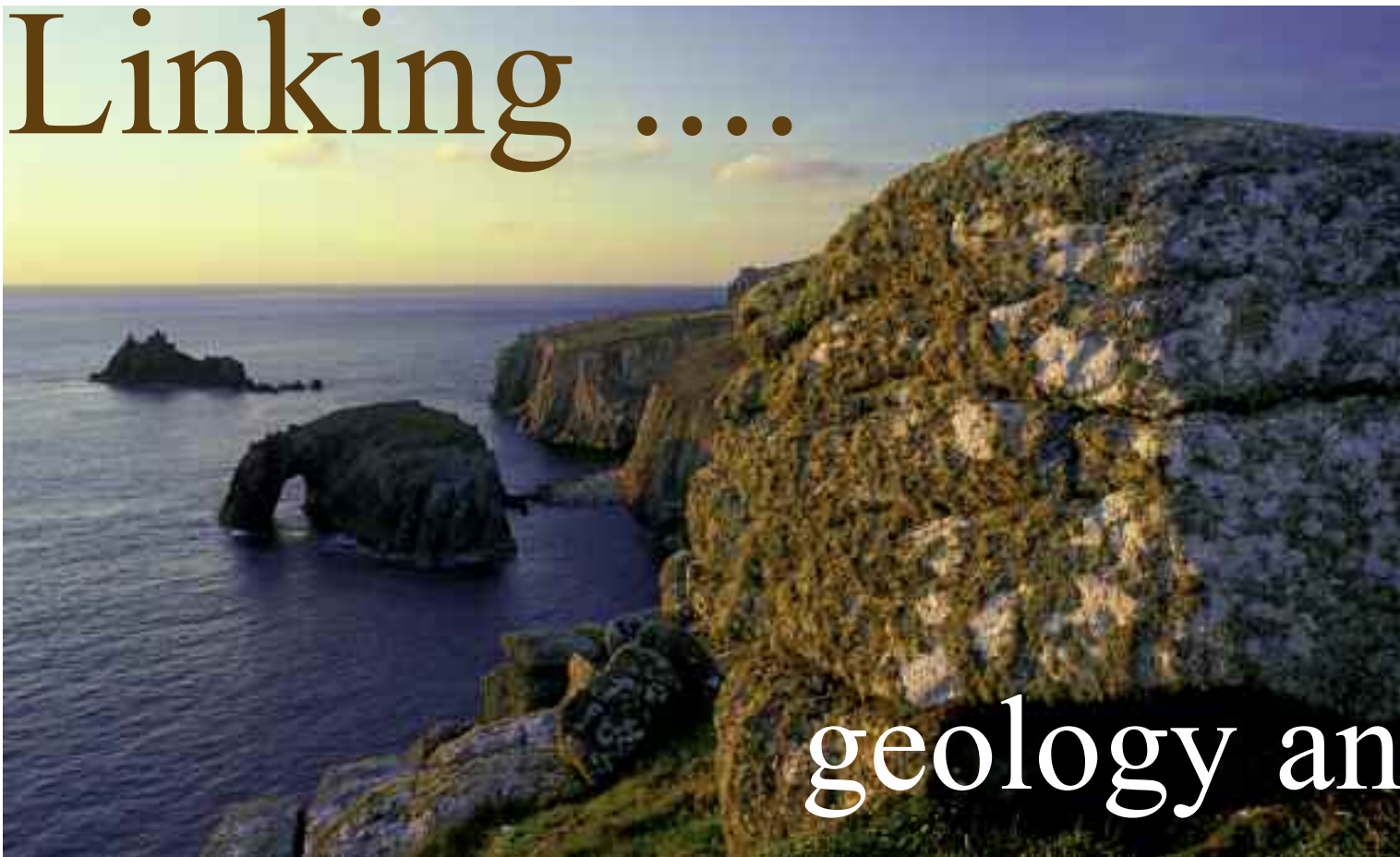


publish an Anglesey RIGS erratic trail. ■

Left: Erratics unearthed during construction of the A55 were stockpiled. One of these, from a gabbro dyke in the Irish Sea (above), was placed on display in a lay-by at the request of Gwynedd and Môn RIGS Group and CCW.

All photos by Stewart Campbell

Linking



geology and

Are there links between geology and biodiversity? If so, how important are they, what are the factors and can we use this knowledge in our conservation work?

These questions have sparked off a series of investigations, and while we are further forward in our thinking, there are yet more questions cropping up.

In some ways the answer is obvious – of course there are links. What about chalk grassland and limestone grasslands? Look at the correlation between the Natural Areas map and the geological map. But that's not the full answer.

When looking at biodiversity, many factors come into play – latitude, altitude, slope, aspect and climate for starters. Then there are substrate, site management past and present, and the impact of the living organisms themselves. So we start to think in terms of ecosystems.

In many ways geology is part of the ecosystem. Geological processes have shaped the land; as a key factor in altitude, slope, aspect, and also a controlling factor in climate. The nature of the rocks and sediments determines the substrate, from lime-rich soils to acidic ones, from well drained to poorly drained.

Anna Wetherell,
English Nature

Working in an organisation such as English Nature you would therefore expect a range of calls on the geologist's time. Surely nature conservation needs close dialogue between the ecologists and the geologists? But this is not historically the case. The geologists look after the rocks and the ecologists look after the wildlife. The Conservation Officers on the ground may need to develop skills in both areas, but integrating the two doesn't often happen. After all, the whole SSSI notification process is based around identifying specific and individual features of interest.

BAP targets

Things may start to change, however. With biodiversity action plan (BAP) targets, the government target of achieving favourable condition on 95 per cent of SSSIs by 2010, and murmurs of using an 'ecosystem approach', a more holistic way of conservation may come into play. How can knowledge of geology help?

Understanding geological maps is one way. Want to know where a species with certain requirements may be found? Use a geological map to pinpoint where the conditions may be located. Shore dock

(*Rumex rupestris*) is an example of this. It grows mainly in the south-west and is found on beaches where head or till deposits meet the beach and flushes occur.

Simon Leach, one of English Nature's botanical specialists, and I sat down one day to identify places that met this criteria.

Granite exposures at Golitha Falls National Nature Reserve,





Far left: Lichens on granite at Land's End, Cornwall

Left: The limestone grassland at Barnack Hills and Holes NNR, Cambridgeshire, supports some rare plants such as the pasque flower.

Photos by Mick Murphy, English Nature

d biodiversity

Simon then used this information in defining the next season's survey for the species, and consequently the known population of shore dock in the south-west went up by 30 per cent. I have also recently provided geological maps to a colleague investigating particular flies that live in tufa springs.

Importance of soils

Soils is another cross-disciplinary area, and one that is evolving further with the development of European and UK soil

strategies and the recognition of the importance of soils in their own right. Soils are fundamental to habitats and agriculture, and also contain an amazingly diverse range of species, each with different roles to play. One of the questions that will need to be answered is whether some soils should be protected, for example as SSSIs, or whether the existing SSSI series provides adequate coverage.

Geological sites can provide a niche for biodiversity. Invertebrates often like the open bare ground, lichens and ferns will grow on and in the rocks, birds use old quarry faces as nesting sites. In areas where agriculture is intensive, disused quarries can provide an important home for a range of habitats and species that would otherwise be absent. A number of sites are Wildlife Trust nature reserves, and RIGS as well as SSSIs can be an important local resource.

I have found that the diversity involved in my geological training is what has provided me with an appreciation and understanding of ecosystems and ecology. I always had an interest in the countryside, but wasn't any good at biology at school. Since studying geology, however, the world has opened up! Ecosystems, natural physical and chemical processes, sedimentary processes, even fluid flow through sediments and rocks. All that has

led on to studying ecology, applications in soil sciences, hydrology, looking at coastal processes, and more. And I think it is recognising these cross-cutting skills that becomes important in this holistic approach to ecosystems.

So where does this take us? One result of the work we have been doing in English Nature has been the booklet *Geology and Biodiversity – Making the Links*, available from English Nature's Enquiry Service, tel: 01733 455100.

This looks at a number of the topics raised above, plus a consideration of past ecosystems and what they can tell us in terms of climate change. A series of three English Nature Research Reports is also being produced. We are working internally to develop the links and their applications, integrating different approaches in our focus on current ecosystems. And we hope to run a conference or series of seminars with University College, Chester.

We would be interested in hearing from those who are also involved in this area of work, as we suspect that there are many more examples and many more people who take this holistic approach.

Please contact either myself or Jonathan Larwood at English Nature, or Cynthia Burek or Jac Potter at University

Cornwall.



Change of focus for conserving soft sediments

Anna Wetherell,
English Nature

Wiveton Downs SSSI (Blakeney Esker): Failure of the chalky till has obscured channel profiles formerly seen in this Norfolk exposure.



Large-scale cross-bedding in Red Crag deposits at Buckanay Farm Pit, Suffolk. The soft sands are rapidly weathered to form talus slopes covering the exposures.

Photos by Mick Murphy, English Nature



How do you conserve those sands and gravels, silts and clays that give us so much information about the last 10,000 years and more? Over the last two years, English Nature has been looking into the challenge of conserving soft sediments on geological sites.

As a result of this research, there has been a change in emphasis for the conservation of these sites. Where, in the past, maintaining an exposure of the features of interest has been the main aim, the practicality of achieving this on soft-sediment sites is now accepted as being a significant problem.

With most geological conservation, the aim is to maintain an exposure of the key interest features. This is easy enough when the rock faces are relatively solid and will support their own weight. Conservation is then generally about managing vegetation, particularly scrub, and perhaps periodic scaling of the faces to remove unstable blocks.

But what about those sites where the geological exposures tend to slump and collapse? Maintaining an exposure could take constant work, could become a Health and Safety nightmare and would probably result in a loss of resource.

The best exposure of Quaternary sediments are often found on the coast, and East Anglia is the prime location. Waves and tides periodically remove fallen material, maintaining fresh exposures. Coastal defence can become an issue, but with the development of Shoreline Management Plans (SMPs) and Coastal Habitat Management Plans (CHaMPs), the scientific interest of the coastline can be considered alongside other needs, coastal processes assessed and a strategic approach taken. Sand and gravel extraction has also

provided some key sites and information, but in usually temporary exposures.

English Nature has encountered problems in old quarries identified as potential sites for development. There are several examples in south Essex, such as Purfleet Chalk Pits. Here the Quaternary sands and gravels overlie the chalk, and provide part of the story about the development of the Thames. The chalk pits are now used for industry and protecting the Quaternary sediments via the planning system took major work.

The essence of the problem is Health and Safety, and the perceived need for landscaping. Good geotechnical investigations have been important to the process, as has the involvement of all parties in discussions at an early stage and the willingness of the developers and planners to take into account the conservation needs.

Site investigations have provided some useful information about the nature and extent of sediments and likely stability issues. This information can then be used to develop stable slope profiles and options for conservation alongside development.

Wardell Armstrong, who carried out research on behalf of English Nature (ENRR 563), have produced a detailed report which assesses the nature of soft, or unconsolidated, sediments, the reasons for stability problems and potential solutions. This highlights the need for thorough geotechnical analysis on sites.

To provide advice to developers and planners, English Nature has also prepared a leaflet, which outlines the legal and planning requirements, the aims of geological conservation, the importance of site investigation, and options for conservation. English Nature now recommends that potential slope designs are assessed and, where maintaining exposures is not practical, that the sediments are covered up – as they are in archaeological conservation practice. The site needs to be thoroughly recorded first and the cover material should make future research possible. Consequently only soil and soft vegetation, such as grasses or grassland mixes are recommended, rather than tree planting. Site maintenance will involve vegetation management and monitoring.

It will be interesting to see the impact of this research, and feedback on it is welcomed. The report and the leaflet are available via English Nature's Enquiry Service, tel 01733 455100. ■



Black Rock
Photo by Colin Prosser/English Nature

Decision at **BLACK ROCK**

Colin Prosser,
Head of Geology,
English Nature

A planning decision made by Secretary of State John Prescott, following a public inquiry held in January 2004, recognises, and goes a long way towards helping to conserve, the nationally important scientific and educational features exposed at Black Rock, Brighton.

Although the decision is to grant planning permission to Brighton and Hove City Council to undertake some engineering work, largely rock bolting, to help stabilise the cliffs, a number of planning conditions have been imposed which prevent the most damaging activities that had been proposed.

Further planning conditions require works to enhance the geological site and to create a public information platform to aid interpretation.

The cliffs at Black Rock, part of the Brighton to Newhaven Cliffs SSSI, contain two GCR sites and a RIGS, and are of outstanding importance for the study of Quaternary stratigraphy. The site demonstrates a 200,000-year-

old cliff and abrasion platform cut into the Chalk, an overlying raised beach deposit (the Black Rock Member), and a sequence of chalk rubble and crudely bedded chalky debris, probably representing a solifluction deposit (together known as the Supermarket Member).

The site has yielded important mammal remains, and is spectacular to look at. It clearly shows the relationships between an ancient cliff-line and later glacial deposits.

The Secretary of State's decision imposes a number of conditions to the planning permission which are worth noting.

Most importantly, he refuses permission for the application of wire meshing to the cliff face, stating that "the meshing element of the modified application would inhibit scientific research and compromise its value as an educational resource".

The impact of meshing was the major concern of English Nature and the geological community, and the

Secretary of State's recognition of this is extremely significant for this site and in future cases.

His conditions also require that erosion control netting and topsoil are not used on the re-profiled top seven metres of the cliff face; that some areas of splash wall are removed to increase geological exposure; that rock bolts are not applied at or below the level of the raised beach; that a public information platform is constructed, and that any excavated material is systematically recorded and made available for scientific study.

Widespread rock-bolting and re-profiling of the top seven metres of the face will result in some damage to the site. Given the complex nature of the case, however, with public safety and safeguard of infrastructure being pitched against geological exposure, the decision is a good one for geological conservation with many helpful statements included in both the planning inspector's report and in the Secretary of State's decision letter.

See page 24

Homage to a

Martin Gostwick,
National Trust for Scotland

An admirer of the Cromarty-born fossil collector and writer Hugh Miller recently called him 'the supreme poet of geology'. The National Trust for Scotland (NTS), agreeing with this compliment, has opened a new museum dedicated to his life and work at Miller House, in Church Street, Cromarty. It took NTS seven years from project approval to completion, and cost nearly £300,000.

The project was the brainchild of former property manager Frieda Gostwick, who saw the need to expand and improve on the exhibits held in the cramped and damp confines of his birthplace in the cottage next door.

The exhibitions are now spread between Miller House, a handsome Georgian villa built by Miller's father in 1797, and the cottage, which his great grandfather built a century earlier. Over Miller House's beautiful oak-grained front door is the museum's theme name, 'In the Steps of Hugh Miller'.

The top floor fossil display aims to justify the tribute to the 'supreme poet' of geology paid by Dr Ralph O'Connor of St John's College, Cambridge, at the Miller Bicentenary Conference in 2002. The National Museums of Scotland (NMS) have helped to form a largely new display, by lending some 40 specimens, most of them from the Miller Collection, and many not publicly displayed for many decades. These have been combined with a selection from the collection formerly held in the cottage.



Spectacularly presented

They are spectacularly presented in two large cases. One houses Miller's finds in the Cromarty environs – the ammonites, belemnites and bivalves of the Jurassic from Eathie Haven, and the Devonian fossil fishes from the Old Red Sandstone at a bay half a mile east of the little Black Isle town.

Panels relate the story of Hugh's explorations as, in his own words, "a sort of Robinson Crusoe of geology," and outline the network of mid-19th century Moray Firth collectors connected with him.

The second case presents fossils which Miller, and contemporaries who assisted him, found all over Scotland. These were drawn and described by him in six books – *The Old Red Sandstone*, *Testimony of the Rocks*, *The Cruise of the Betsey*, *Footprints of the Creator*, *First Impressions of*



Visitors study rock specimens and other items at the hands-on work bench.

from page 23 Students solve make-believe dilemma

From moving the buzzards to constructing a cable-car, students at University College Chester found themselves tested on their approach to the Black Rock dilemma.

The case formed the basis of an exam case study in the Conservation and Environmental Management module taught to final-year biology, geography and environmental undergraduates. It was unresolved at the time.

Forty five students were given details of the situation and the conflicts at the site and were asked to come up with a potential solution. Because a mixture of student degree programmes were being examined, extra hypothetical items had to be factored in. There were birds of prey nesting high on the cliffs, and the

Sussex RIGS group had achieved an unlikely coup in finding the first ever extensive natural cave system in Chalk on the South Downs.

The solutions fell into three main categories:

- Those who wanted mesh erected and the walkway closed, putting people's safety first – an anthropocentric view;
- Those who wanted the path moved to a safe location but close to the local nature interest – more of an ecocentric view;
- Those who devised novel solutions to the issues, taking a holistic view and thinking about future sustainability.

Interestingly, one student saw no way out of the problem.

One solution, which several students mentioned, was to have a covering of some sort, such as a tunnel or a bus shelter, which would not inhibit viewing the scientific interest but offer a measure of protection. This is similar to the structures used in the Alps on some of the high passes.

Relocation figured high in people's solutions – whether it was buzzards, the main trunk road or supermarket. But probably the most outrageous solution was to install a cable car up the cliff so that the general public and researchers could view their scientific interest safely from a distance without fear of rock falls.

– Cynthia Burek and Jac Potter, Environmental Research Group, Department of Biological Sciences, University College Chester. ■



The reception area at Miller House for the 'In the Steps of Hugh Miller' exhibition

All photos by Andrew Dowsett

BP provided £50,000 funding for this project. Other principal funders were Heritage Lottery Fund (£143,000), Garth Weston Foundation (£45,000), Ross and Cromarty Enterprise (£25,000).

poet of science

England and its People, Edinburgh and its Neighbourhood, and *Sketch-book of Popular Geology*.

Outstanding specimen

One shelf, for example, contains three substantial specimens and a plaster cast of the cranial buckler of the giant fish *Asterolopis*, lettered by Miller, together with his drawing of the buckler. This fish formed a key part of Miller's argument against evolution.

The *Glyptolepis leptopterus* from Lethen Bar, near Nairn, is an outstanding specimen. A piece of the fossil wood *Pinitis eiggensis* from the Sgurr of Eigg is another valuable NMS addition, as are the Quaternary clams, scallops and barnacles of Fairlie, Ayrshire, and the roots, stem and bark samples of the Carboniferous around Edinburgh.

In the geology exhibition's second room, the main feature is the hands-on workbench. At the top of the panel above is Miller's injunction to all aspiring young people, to "make a right use of your eyes." Guidance for fossil-hunting today is provided by Scottish Natural Heritage

geologist Dr Colin MacFadyen. On the bench a wide range of fossils is available for handling and inspection.

The final panel backdrop offers 21st century evaluations of Miller by the eminent contemporary practitioners at the 2002 Bicentenary conference, among them Dr Simon Knell and Emeritus Professor John Hudson, both of Leicester University, and Professor T.C. Smout, the Historiographer Royal.

NTS owes much to the NMS team which provided specialist advice on the content and presentation not only of the geology rooms, but of the entire exhibition. NMS also gifted the dressed sandstone blocks referencing Miller's stonemasonry, originally seen in the NMS *Testimony of the Rocks*' bicentenary exhibition, and now on show in the cottage courtyard.

Jane Carmichael, NMS Director of Collections, says: "This loan is a prime example of the way in which the NMS works in partnership with museums across Scotland to promote access to its collections. Our active outreach programme includes the loan of objects

across Scotland and around the world, as well as the provision of expert advice and support. We are delighted to have worked with the National Trust for Scotland on this project, and wish the new Museum every success."

Displayed appropriately

Dr Michael Taylor, Curator of Vertebrate Palaeontology at NMS, said: "It is wonderful to see some of our NMS collection displayed in such an appropriate place, where Miller actually lived and collected some of the fossils which made his name in Victorian times."

Visitor reaction so far has been enthusiastic – from the 11-year-old who wrote: "Hooray. It is so good", to the professional events organiser who saw an "elegant, bright and beautiful display." We also liked "a treat for the mind and imagination," and "a terrific exhibition - long overdue."

Frieda Gostwick's long-cherished dream has finally come true.

Further reading

- Borley, L. (ed.) 2003.** *Celebrating the Life and Times of Hugh Miller.* Cromarty Arts Trust and Elphinstone Institute of the University of Aberdeen.
- Gostwick, M. 1993.** *The Legend of Hugh Miller.* Cromarty Courthouse.
- Miller, H. 1854 (1993 reprint).** *My Schools and Schoolmasters.* B&W, Edinburgh.
- Miller, H. 1835 (1995 reprint).** *Scenes and Legends of the North of Scotland.* B&W, Edinburgh.
- Miller, H. 1858. (2003 reprint).** *The Cruise of the Betsey ... and Rambles of a Geologist.* National Museums of Scotland Publishing, Edinburgh.



A young visitor to the Miller House makes use of an interactive feature at the exhibition.

Asking people to look at landscape in a new way

Ancient peaks and molten rock, tropical mountains and Ice Age glaciers, the Cairngorms is one of the finest assemblages of glacial and mountain landforms in the world. But how do you interpret the dramatic stories within such a spectacular, complex landscape to non-geologists? How do you inspire people to explore the landscape for themselves? How do you help people understand the dynamics of landscape evolution? We hope to do that with *Trails through Time*.

There is a lack of easily accessible information about Cairngorm geology. To fill the gap, we decided to try to provide the next best thing to an enthusiastic, plain-speaking geologist by your side – an attractive, non-technical printed guide to some of the Cairngorms' exciting Earth science stories, something that could be folded up and taken for a walk at leisure.

The Cairngorm Mountains Visitor Management Plan proposes the provision of low-level walks to help alleviate visitor pressures in more sensitive, higher mountain areas. Scottish Natural Heritage supports this aim and uses interpretation to help visitor management in popular places. In 2001, Forestry Commission Scotland provided a new footpath from lower Glenmore to the Ski Centre car park. It gave people a safe route away from the road, and it passed through the Allt Mòr gorge which holds many dramatic glacial features the Cairngorms are known for.



Sue Atkinson,
Scottish
Natural Heritage

We already knew that around 500,000 people visit the Glenmore and Rothiemurchus area every year and with the Cairngorms National Park, this number was likely to increase. The fact that the Glenmore area also has such a spectacular array of glacial erosion and deposition features made Glenmore the natural starting point for this project.

After research, we planned a linked set of trail guides to three popular walks in the Glenmore area. All the walks were owned by Forestry Commission Scotland and the guides became a joint project.

Visual impact

Trails through Time tries to take a fresh look at self-guided trails, using strong images and minimal text to encourage people to explore the landscape for themselves. The works of Janet Swailes, an artist with a passion for landscape and an

understanding of natural heritage interpretation, give the guides their identity. Each guide gives a bold and colourful artist's impression of the walk. Surrounding this main image, magnifying glasses encourage users to look at the landscape more closely and informal text reveals the significance of what can be seen. The text blocks can be read in any order, doing away with the need for regimented stops. Each guide also has a section that examines one aspect of a site in more detail, introduces human interest and sets the trail in a wider context. Other sections give directions, trail information and suggestions for where to see more of the landforms in question.

Themes

We thought long and hard about themes that supported the objectives and locations of each trail. The themes gave structure to the work and, when it came to the crunch, helped us decide what to leave out. Our themes were:

- Allt Mòr Trail:* The immense power of ice and water that shaped the landscape.
- Ryvoan Pass Trail:* A pass bulldozed by ice sheets that became a thoroughfare for animals and people.
- Farlitter Crag Trail:* How quiet biological processes can sometimes reveal more about past landscapes than large, dramatic features caused by earth shattering events.

Copies of *Trails through Time* are available, priced £2 each, from Scottish Natural Heritage, Publications Dept, Battleby, Redgorton, Perth PH1 3EW. Tel: 01738 458530, fax: 01738 458613.



A user-friendly map encourages people to use the trails



More guides through the Scottish landscapes...

Two new titles in the Landscape fashioned by Geology series, produced by Scottish Natural Heritage in partnership with the British Geological Survey, have been published:

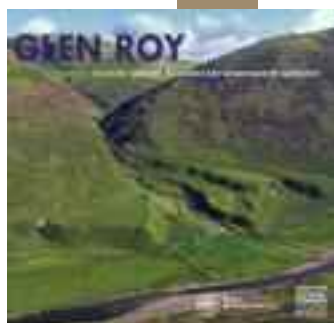
Rum and the Small Isles: A landscape fashioned by geology.
Kathryn Goodenough and Tom Bradwell.
ISBN 1 85397 370 2. £5.95.



The silhouette of Rum is one of the most dramatic sights on Scotland's west coast. Its diverse rocks and the landscapes they form have developed over billions of years as this part of the Earth's crust moved across the planet. This guide beautifully illustrates the traces of ancient seas and rivers in the rocks and, more recently, Rum's violent volcanic history as the North Atlantic rifted open. Finally, ice carved the land here as over all of Scotland. The perfect book to take along as you explore.

– *Aubrey Manning, author and broadcaster*

Glen Roy: A landscape fashioned by geology.
Douglas Peacock, John Gordon and Frank May
ISBN 1 85397 360 2. £4.95.



Not all geological processes are slow. The torrents of water that poured through Glen Roy as its successive ice dams broke, rapidly carved out its dramatic valley sides and floor. The lake shore lines and the landslides still show the rawness left as the ice melted, ice which at an earlier stage had carved out the valley. This splendidly produced booklet takes us through all the Glen's dramatic history. No place better exemplifies the series' theme, 'a landscape fashioned by geology.'

– *Aubrey Manning, author and broadcaster*

To order copies of either book, or for details of others in the series, please contact Scottish Natural Heritage Design and Publications, Battleby, Redgortan, Perth, PH1 3EW. E-mail: pubs@redgore.demon.co.uk Web: www.snh.org.uk

Studies of a Welsh wonderland

Precambrian Rocks of the Rhoscolyn Anticline. Margaret Wood.
ISBN 0-9546966-0-3. £4.50. Order from
Margaret Wood, College, Llansadwrn, Menai
Bridge, Anglesey LL59 5SN, tel: 01248
810287. Cheques payable to AWRG

Stunning photographs by *Earth Heritage* Managing Editor Stewart Campbell make this A4 bilingual book special. Ten years from concept to print, the book is both a study trail guide and a vivid illustration of the magnificent Precambrian rocks at Rhoscolyn, Holy Island, Anglesey. With comprehensive text by Margaret Wood, the book is dedicated to the late Dennis Stephenson Wood (no relation), who worked on the publication in its early stages and who was chair of Gwynned and Môn RIGS Group at the time of his



...and the West Midlands

Neatly timed to coincide with the launch of the Abberley and Malvern Hills Global Geopark, these four Explore leaflets are the latest in a successful line from the Herefordshire and Worcestershire Earth Heritage Trust.

Each laminated guide is priced at £1.95 and follows the stylistic template of its predecessors: interesting and colourful photographs, useful illustrations, clear trail instructions (whether walking or motoring), and concise descriptions. Feature panels contain plain explanations for non-geologists of how stone types were formed, and of various technical expressions like cross bedding.

One delightful example of broad thinking is the inclusion with the Hereford city guide of a free leaflet detailing local archaeological and biodiversity interests.

Joe McCall was heavily involved with researching the two Hereford trails, Peter Oliver wrote the Bewdley trail and Moira Jenkins the Byton trail.

Explore Hereford Cathedral.
ISBN 0-9543572-3-X
Explore Hereford City Centre.
ISBN 0-9543572-2-1
Explore Bewdley Town Centre.
ISBN 0-9543572- 5-6
Explore Byton and Kinsham.
ISBN 0-9543572-4-8

To order copies, contact the Trust, tel: 01905 855184, or e-mail: eht@worc.ac.uk



Earth Heritage magazine is published twice a year to promote interest in geological and landscape conservation.



Castlehill, a site of historic importance to the Caithness flagstone industry of many years ago, and the view across Dunnet Bay towards Dunnet Head, the most northerly point on the British mainland. The cone-shaped structure represents the remains of a windmill, used at the height of the flagstone industry. The wall in the foreground is made of slabs of flagstone.

Once the bustling hub of James Traill's 18th century estate, the buildings at Castlehill, a few kilometres east of Thurso, look a little forlorn. But not for long. Castletown Heritage Society, Highland Council and many others are in the process of setting up a project to bring back life to this attractive far north corner, which is well-known to bird-watchers, photographers, geologists and holiday-makers.

Soon visitors will be able to relive the history of the village of Castletown. Its origins, flagstone industrial archaeological heritage and more recent past will be interpreted in a museum at the former home-farm steading.

A stroll in the fossil garden in the courtyard will recall the county's geological wealth, and the rocks and fossils on display will help reveal the story of the 400 million-year-old Devonian geology that is all around, in both the natural and the built heritage.

– *Muriel Murray, Chair, Castletown Heritage Society*

Image courtesy of John Baikie (Highlands & Islands Photographer of the Year)

