

Earth Heritage

The Geological and Landscape Conservation Magazine



**Dudley Museum
at the Archives**



ISSUE
51
Spring 2019

**Conversations
in Stone**



**National Heritage
Lottery Fund**



**DIGS and Film
Makers**

**Trearne Quarry
Restoration**



Cover Image: In September 2018 an 'Access Anglesey' field class was run to explore how to assist inclusion and accessibility in fieldwork and then develop and share good practice. Communication outdoors for a group can be difficult on any field trip so a tour guide system brought the leader's voice into earpieces which everyone wore. Using the system not only allowed everyone to hear what was going on, but it also avoided the need to huddle together, something autistic students find particularly stressful. Inclusive teaching is discussed on page 51.

Photo by Clare Gordon.



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GUEST MANAGING EDITOR
SUSAN MARRIOTT,
glsbm@bristol.ac.uk

EDITORS
HANNAH TOWNLEY,
Natural England
07780 688242
Hannah.Townley@naturalengland.org.uk

COLIN MACFADYEN,
Scottish Natural Heritage
0131 316 2616
colin.macfadyen@nature.scot

RAYMOND ROBERTS,
Natural Resources Wales
0300 065 3896
raymond.roberts@cyfoethnaturiolcymru.gov.uk

DAVID BRIDGLAND,
Geologists' Association and Durham University
01325 484803
d.r.bridgland@durham.ac.uk

MICK STANLEY,
Geodiversity Consulting
07747 863847
mick.stanley1@btinternet.com

JULIE HARRALD,
The Geology Trusts & English Geodiversity Forum
01509 558211
julieharrald@googlemail.com

ELEANOR BROWN
Quaternary Research Association
01684 574333
conservation@qra.org.uk

BARBARA SILVA
Production & Design
07974 711525
bsilva.palaeo@gmail.com

Earth Heritage is produced twice-yearly by the Geologists' Association, Natural England, Natural Resources Wales, Scottish Natural Heritage and the Quaternary Research Association. It can be downloaded free as a pdf file from www.earthheritage.org.uk. You can also purchase a hard copy of any issue via www.geologistsassociation.org.uk/earthheritage. Subscribe to notifications of new issues at www.earthheritage.org.uk/subscribe. We thank all those who have assisted in preparing the publication, including the voluntary geoconservation sector who are major contributors. The opinions expressed by contributors are not necessarily those of the above organisations.

EDITORIAL

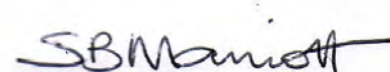
As well as updates and new reports on projects, this issue of *Earth Heritage* has several Articles and Outcrops that bring out the 'theme' of inclusivity: making our geoheritage available to all.

The North Pennines AONB Partnership has been working with the charity Sight Service to provide a hands-on introduction to geology for partially sighted adults. College Lake in Buckinghamshire already has thousands of visitors annually to explore the chalk downland flora and fauna. The site is also an SSSI for its Quaternary geology and it is this aspect, glacial and interglacial features, that the local wildlife trust and geology groups, together with national organisations such as Natural England, the GA and QRA, are endeavouring to secure funds to promote and conserve. A new path for visitors will be provided that is accessible for all.

A makeover at Stackpole Quarry now provides accessible exposures of Old Red Sandstone and Carboniferous Limestone and evidence of the Variscan orogeny that they reveal. Previously visitors could only study these strata and structures in cliff faces that were tide dependent. There is also a report on Access Anglesey, a field class run to explore how best to assist inclusion and accessibility in fieldwork. The report shares valuable information on planning and conducting a field trip and follow-up work so that everyone was included at every locality.

There is a new approach to planning in Wales with the publication of Planning Policy Wales Edition 10. This document recognises the importance that landscape and geology have in promoting a sense of place and people's prosperity, health, happiness and well-being. Many of the projects reported in *Earth Heritage* over the years have been funded by the Heritage Lottery Fund. This fund has now been renamed the National Lottery Heritage Fund and will now give priority to projects that focus on the natural environment, that have a strong community involvement and those that ensure everyone is able to enjoy our heritage.

The *Earth Heritage* Editorial Board has started to plan Issue 52 and will be happy to feature articles about both new and ongoing geological and landscape conservation projects. To contribute, please contact the most appropriate editor.



Susan Marriott - Guest Editor

Brymbo Fossil Forest Project Under Way

The exquisite, *in situ* Carboniferous fossil forest discovered on the grounds of the old Brymbo steel mill (see Issues 26, 43, 45 and 46 for the story so far) received Welsh Government funding in 2018 for the construction of a sheltered excavation building.

This building is the first step in a multi-phased project with the grandiose ambition of protecting, excavating and utilizing the fossil forest site to create a centre for Earth Science learning and a world class geotourism destination. The appointment of a dedicated Fossil Coordinator has seen increased interest in the project and the establishment of a successful fossil forest volunteer training programme. Volunteers have been hard at work cataloguing the thousands of fossils already recovered and will lead the excavations alongside Dr Astrop throughout 2019-2020 to uncover the giant lycopod club mosses, *calamites* horse-tail thickets and other flora and fauna, yet to be discovered! The site will be open to visitors on select open days during the year where the public can observe, talk to and even join in with the team and their work. It is going to be a big year for the Brymbo Fossil Forest and the project is looking for dedicated and enthusiastic people to help with every part of the excavation, specimen curation and science communication, if you'd like to know more go to www.facebook.com/brymboheritageproject

Tim Astrop, Fossil Coordinator, Brymbo Heritage Trust



Top: A large lycopod stump unearthed during initial excavations in 2008. Covering part of the site and upcoming excavations will allow Brymbo Heritage Trust to unearth more awe-inspiring examples of the ancient Carboniferous flora and fauna preserved in this unique treasure trove of natural history.

Photo by Peter Appleton.

Left: Volunteers learning how to identify sedimentary features in the field. A large part of the project is making Earth Science accessible and not the exclusive remit of academics, fostering a new sense of natural heritage by helping locals understand the ground below their feet. Since 2018 over 100 volunteers have attended fossil forest training programmes at the Brymbo heritage site. Photo by Tim Astrop.

Touching the Rock

Geology is an inherently tactile subject. Whether it is the coarse texture of sandstone or the dusty feel of chalk, geology is one of the few sciences that really encourages people to ‘look’ with their hands

This simple fact is the basis for an unlikely link between five hundred million years of geology in the North Pennines, and a partially sighted men’s group from Gateshead. Over the summer of 2018, the North Pennines AONB Partnership worked with the charity Sight Service to deliver a programme of interactive sessions, all aimed at engaging partially sighted adults with the geological and mining heritage of their local Area of Outstanding Natural Beauty and UNESCO Global Geopark.

Their first visit was to the Harehope Quarry Project for a hands-on introduction to geological time and fossil hunting. The second, a trip to



Top: Fossil hunting and building rock towers at Harehope Quarry, County Durham. © North Pennines AONB Partnership.

Bottom: Scaling crags of the Great Limestone at Windmore End, Cumbria. © North Pennines AONB Partnership.



Killhope, the North of England Lead Mining Museum, gave a chance to explore the dark depths of a former mine. The visits gave a confidence boost to a group of people adapting to life with reduced sight. The third and fourth weeks featured visits to the mining village of Allenheads and to Low Force waterfall. Climbing the limestone crags near the town of Brough in Cumbria was a fantastic end to the programme, and a reminder that even with sight loss there are plenty of ways to enjoy geology and get outdoors.

Feedback from the participants was excellent. Many surprised themselves with what they are still able to achieve and most were impressed by how engaging they found the geology and mining history of the region. One participant commented, “When you said geology, I thought, not sure about that, but it’s been really interesting.”

Touching the Rocks was made possible with backing from the Heritage Lottery Fund, through the project ‘Earthworks’, currently in its first year of delivery. This three-year project engages visitors and residents of the North Pennines AONB and UNESCO Global Geopark with its unique geology and heritage. Delivery is achieved through events, workshops, art installations, geotrails and site improvements. Plans are under way to work with other partially sighted groups in the second and third years of the project.

**Naomi Foster & Jake Morton,
North Pennines AONB Partnership**

Recognition for exemplary non-professional research activity

In this year's New Year Honours list (2019) Bob Davidson, who lives in Aberdeenshire, was awarded an MBE for services to palaeontology.

This was not the first time Bob has received an honour in this field having been awarded the Mary Anning Award by the Palaeontological Association in 1999. This award is for outstanding contributions to the study of Palaeontology by a non-professional palaeontologist. Bob is well-known in the field of early vertebrates (fossil fish) having run numerous field trips to the Moray Firth and Midland Valley of Scotland for professionals and amateurs alike. He also took up chairmanship of the charity The Friends of Hugh Miller when the previous chairman Professor Nigel Trewin became too unwell to continue. Bob has co-authored numerous research papers on fossil fish in prestigious journals such as Transactions of the

Royal Society of Edinburgh and Palaeontology. All this demonstrates the highly significant and important role non-professionals make to the world of palaeontology and science in general.

Mike Newman FGS

Bob with his partner and family at Buckingham Palace following receipt of his MBE. © STV News.



Bob Davidson, 3rd from the left, together with his collector and research associates, including staff from the National Museums Scotland and Aberdeen University, during a research excavation at Balruddery Den, near Dundee, in 2006. This work, which helped elucidate an early Devonian fish fauna, continues the amateur and professional working relationship that has been a feature of research at this locality, dating back to the 19th Century. The late Professor Nigel Trewin is pictured at the far right. © Bob Davidson.

eRock: an online repository of virtual outcrops in 3D

Newly developed techniques for digital reconstruction of outcrops are now commonplace in geoscience research. Adam Cawood and Clare Bond at The University of Aberdeen are using this technology to go beyond research - for education, public engagement and digital archiving of important geological sites in the UK and beyond.

eRock was launched in December 2017, with the aim of making virtual outcrops available to a wide range of people, including researchers, students and members of the public. These sites were initially captured and digitised for geological research using modern techniques such as laser scanning, Unmanned Aerial Vehicles (UAVs) and high-resolution imagery. As our collection grew, we recognised the potential for using this technology to involve the wider community in digital geoscience.

A growing number of organisations is using 3D visualisation for teaching, outreach and digital archiving. These efforts represent an important step for digital technologies, allowing them to widen accessibility to physical objects and places. eRock aims to do the same for the geology community by providing virtual outcrop-based field trips, teaching resources and a downloadable repository of 3D material.

Virtual outcrops on the site can be viewed through a standard web browser, are mostly downloadable and are provided alongside short descriptions of sites and with links to other online material. We aim to build eRock by further developing virtual field trips and encouraging others to contribute their own 3D outcrop models. In this way we can provide a resource that

allows a range of people to appreciate the richness and variety of outcrop geology in an accessible, inclusive format. As the resource develops there could be scope for an application in geoconservation allowing condition monitoring of outcrops in statutory protected and local geodiversity sites.

Updates on eRock will appear in future issues of *Earth Heritage*.

Adam Cawood and Clare Bond,
University of Aberdeen

An example page at www.e-rock.co.uk. Web-viewable virtual outcrops are provided alongside a short description of the site, field photographs and part of a published cross section. Integration of a wide range of materials is central to the approach for presenting 3D digital material.

The screenshot shows the eRock website interface. At the top, there is a navigation bar with links for Home, Browse 3D, Collections, Virtual field trips, Contribute, and About. The main content area features a page for the 'Clashach fault' in Moray, NE Scotland. The text describes a seismic scale normal fault in the Hopeman Sandstone Formation, with a fault throw of up to 50 m and a well-developed fault core 50-100 cm wide. A 3D virtual outcrop model is displayed with a play button, and a yellow callout box encourages visitors to visit the website at www.e-rock.co.uk. Below the model is a field photograph and a caption: 'Rotate the virtual outcrop and examine the fault zone. Can you see a greater abundance of lineations close to the fault? These are deformation bands which sometimes form around fault zones in porous rocks such as sandstones.' The footer includes social media icons and a contact link.

A stronger UNESCO Global Geopark thanks to the National Lottery Heritage Fund

The Rock Stop exhibition centre, Unapool, at the heart of the North West Highlands UNESCO Global Geopark. As well as providing superb views of iconic geology over Loch Glencoul the centre has an exhibition on the rocks and landscape of the North West Highlands. There is also a café and a range of locally made arts and crafts for sale. © North West Highlands Geopark.

Scotland's first Geopark in the North West Highlands is delighted to have received a National Lottery Heritage Fund grant of £50,400 to support it through a 12-month transitional period. Following the successful 2017 Crowdfunding appeal, that allowed the Geopark to survive the loss of public funding, this project will help the organisation take the necessary steps to nurture new income streams and the people needed to deliver them. The Geopark now has the resources to focus on preparing for the future and will be looking for volunteers and promoting training opportunities soon. Check the website for further details (www.nwhgeopark.com)

Riona McMorrow, Acting Head of The National Lottery Heritage Fund Scotland, said, "Resilient Heritage allows the heritage sector to build financial independence and resilience in a changing economic landscape of reduced public funding. It provides a tailored package of support that responds to the individual needs of organisations such as North West Highlands Geopark so, thanks to National Lottery players, they can not only survive in these challenging financial times, but thrive."

Laura Hamlet



National Lottery Heritage Fund: a new focus on nature



The Man Engine, which won the National Lottery Best UK Arts Project Award in 2017, was a National Lottery funded project which featured in *EH47*. Other projects to feature in recent editions include: the Limestone Landscapes Project which received money for a series of projects to engage communities, to interpret and conserve sites across the Durham Magnesian Limestone; Rouken Glen (Scotland) received money to deliver conservation and heritage activities; and Brymbo (Wales) received a development grant to create costed proposals for a heritage and education centre at the fossil forest.

The newly styled National Lottery Heritage Fund, which is changing its name from the Heritage Lottery Fund, has announced a priority to fund projects that focus on nature and the natural environment. This is one of three priorities for the next five years, the others will be projects with a strong focus on local communities and those that ensure everyone is able to enjoy heritage.

Other changes will include a devolution of decision-making with around 80% of funding decisions made in Scotland, Northern Ireland, Wales and three new English areas. In a new and simplified portfolio of funding National Lottery Grants for Heritage will provide an open programme for all types of heritage for projects that range in value from £3,000 - £5 million. There will also be funding campaigns: for example, in 2019 these will focus on building organisational capacity, and helping develop digital capability.

The success of previous HLF funded projects has been widely reported in the *Earth Heritage* magazine (for example in issue *EH39*). These have included initiatives from a landscape-scale, museum development and display, working with built heritage, site-based conservation and engagement, and a range of innovative volunteer projects. With a focus on natural heritage, and a strong emphasis on working with local communities and widening involvement in the natural world, this success should continue with new and exciting opportunities.

Drew Bennellick (Head of Landscape & Natural Heritage at the National Lottery Heritage Fund) is clear, these are exciting times and geodiversity is included: “After talking to the players of the National Lottery and other stakeholders, we’ve listened as they told us that investing in landscapes and nature is a great use for Heritage Fund investment. So for the next five years we are making landscapes and nature, including geodiversity, a key priority for funding. At a time when our landscapes and nature have never been so threatened, the call is out to identify and develop projects that will really make a significant difference for landscapes, nature and people.”

So, the call is there, now you just need to apply, and who will be the first to report on their successful National Heritage Lottery Fund project in *Earth Heritage*? I’m looking forward to it.

Jonathan Larwood, Natural England

Further Information

www.heritagefund.org.uk

Spotlight to be shone on Siccar Point

The Edinburgh Geological Society is working with heritage organisations and universities on plans to mark the 300th anniversary of James Hutton's birth in 2026, and to celebrate Hutton's legacy in subjects including geology, agriculture and meteorology.

It is very appropriate therefore in the run up to this major celebration that there has been investment in the interpretive facility at Siccar Point in the Scottish Borders, the site in Scotland most famously associated with James Hutton. It was at Siccar Point in 1788 where Hutton found the decisive evidence he sought for his Theory of the Earth – the never-ending cycles of creation and destruction that shape our landscape today. This theory overturned the last vestiges of the Biblical account of a world shaped by the receding waters of a universal flood. Controversial in its day, Hutton's work is now a foundation stone in the science of geology.

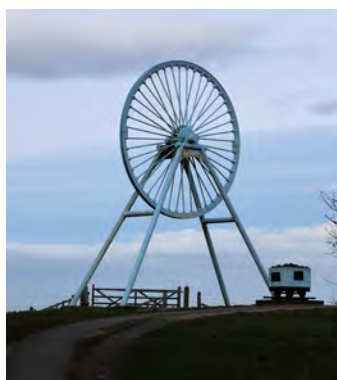
Named after the site, Siccar Point Energy, the oil and gas operator, has formed a partnership with Edinburgh Geological Society to back its efforts to improve the visitor experience at this globally significant locality. Siccar Point Energy has provided funding that has refreshed the existing interpretive panels and produced 20,000 leaflets to increase awareness and understanding about the unique and important features of the site. The company is to explore further opportunities to enhance the site with the Edinburgh Geological Society.

Colin MacFadyen, Scottish Natural Heritage

From left to right – Neil Mackenzie and Bob Gatliff of Edinburgh Geological Society and Doug Fleming, Chief Financial Officer of Siccar Point Energy, at the refreshed interpretive panel located on the hillside above Siccar Point. © Siccar Point Energy.



GA Annual Conference: Manchester 2019



Top: Memorial to the pit miners of Staffordshire. This is sited at a viewpoint in the Apedale Country Park, North Staffordshire. Image by Peter Jones.

Middle: Manchester Town Hall (1868-77) with its 85 m tall bell tower, an iconic landmark in the city. Image provided by Jennifer Rhodes.

Bottom: North Staffordshire bricks and tiles on display inside Apedale Heritage Centre. Image by Peter Jones.

This year's Annual Conference of the Geologists' Association (GA) will be based in Manchester over the weekend of Friday 18th to Sunday 20th October 2019. The meeting will be hosted by the Manchester, Liverpool, North Staffordshire, North Wales and GeoLancashire groups of the GA, together with the NW Regional Group of the Geological Society of London. The overall theme of the meeting is: 'Geological Resources in the North West - Past, Present & Future'.

A varied and exciting Conference programme is planned. This will include: an afternoon guided tour of the geology galleries at Manchester Museum followed by an informal evening social (Friday 18th); talks, posters and exhibits at Manchester University campus followed by an evening Conference Dinner (Saturday 19th) and a choice of field trips to significant North West geological sites (Sunday 20th). In addition, GeoConservation UK will hold their AGM at the Conference venue on the Saturday.

The geological resources of the North West have made significant contributions to the nation's economy dating back to at least the Industrial Revolution. In addition, the natural landscape continues to be an important resource for tourism, leisure and recreation activities. Topics to be covered during the Conference by a range of keynote speakers include regional geology, coal, minerals, construction materials, water supply, salt extraction, geothermal energy and geoconservation. Many sites that were formerly used for resource exploitation now have value for educational purposes. They help us to understand the geological history, cultural heritage and untapped potential of the region by linking the past to the present and the future.

Various aspects of the diversity and historical significance of the North West's geological resources will be explored further during the programme of field trips on Sunday 20th October. Delegates will have the opportunity to choose between a building stones walk in central Manchester, an excursion to the Roscoe Tunnels in Liverpool, an examination of Carboniferous limestone quarries and associated reef structures at Clitheroe or a visit to the Apedale Geotrail and Heritage Centre in North Staffordshire. The latter visit will also include an optional underground tour of a former coal mine.

The Conference Convenors extend a warm invitation to *Earth Heritage* readers and look forward to meeting you in Manchester in October. Registration for the Conference opened on 1st April 2019.

Further details can be obtained via the following link:
<https://geologistsassociation.org.uk/conferences/>

Peter Jones, Geologists' Association.



Deformation of the Chatburn limestone in the vicinity of the Horrocksford Hall Thrust Fault, Lanehead Quarry, Clitheroe. Folding is evident in the face behind the drilling rig. © Keith Hall

Derbyshire Blue John

Trevor Ford (edited by Tony Waltham and Noel Worley). 3rd edition. East Midlands Geological Society. (2019). 80pp. ISBN 9780951971796. £6.50. Available from www.moorebooks.co.uk



Based upon original material by the late Trevor Ford, a renowned specialist on the geology of the Peak District, this is a fully revised and expanded third edition of the classic text first published in 2000. This new edition, edited by Tony Waltham and Noel Worley, provides a comprehensive overview of the geology and mineralogy of Blue John (a variety of banded fluorite found exclusively in Derbyshire) and a description of its mining and usage.

Blue John has been mined for centuries at Castleton in Derbyshire. This book describes

and illustrates the 15 different veins of Blue John found in the area and describes their formation in relation to the geology of the Peak District. Primarily mined as an ornamental stone, the book describes mining and modelling techniques through the ages. It gives brief biographies of the main craftsmen, illustrating some of their finest work, and describes the notable collections found in the UK.

The larger format allows larger diagrams and text, making it easier to read in comparison to previous editions. The greater use of colour in both diagrams and photographic images make this edition both informative and appealing. A very worthy addition to any geological library!

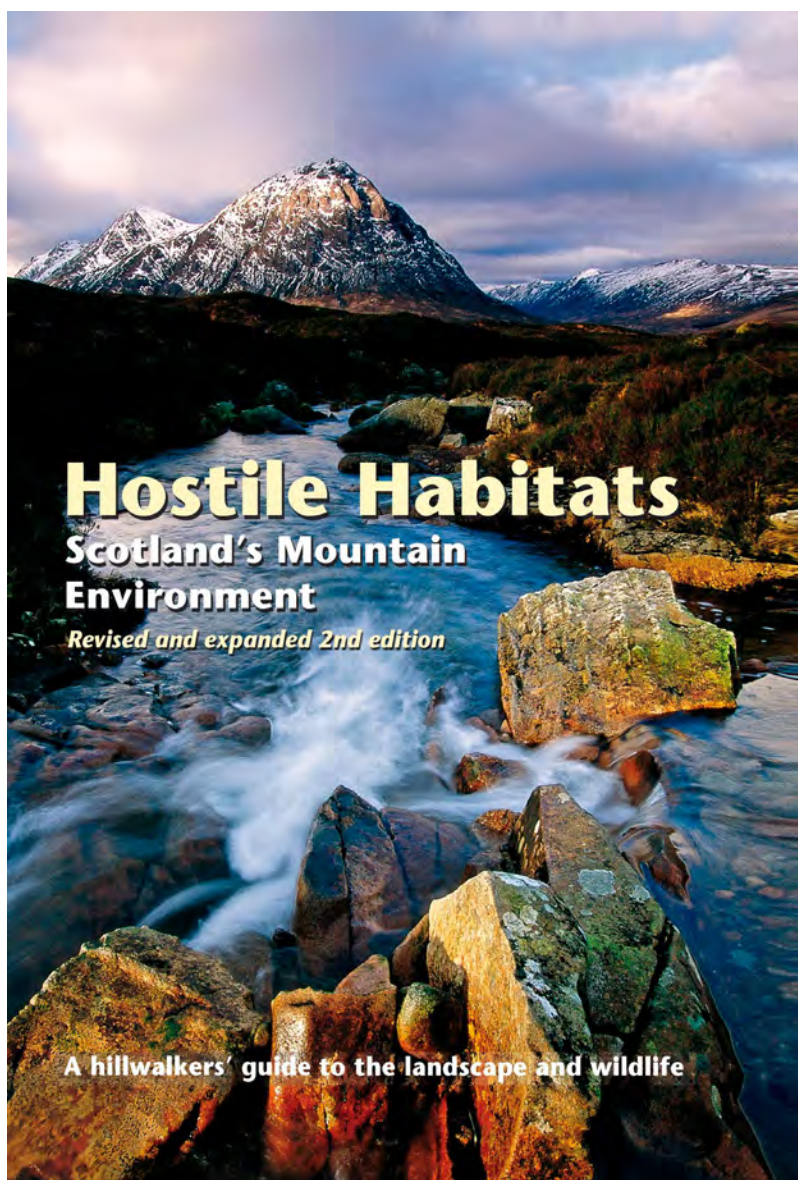
Hannah Townley, Natural England

Hostile Habitats - Scotland's Mountain Environment: 2019 Edition

Edited by Mark Wrightham & Nick Kempe. Scottish Mountaineering Club. 2019. ISBN: 9781907233258. Available from www.smc.org.uk/publications/other

Scotland's first guide to mountain fauna, flora and landscape, written exclusively for hillwalkers and climbers has been updated.

Published by the Scottish Mountaineering Club, this 2nd edition of Hostile Habitats offers a detailed introduction to the natural and man-made environment of Scotland's mountains. Compiled by some of the country's leading experts in their fields, this revised and expanded edition is written by hillwalkers for hillwalkers.



There are nine in-depth chapters combining the latest research and knowledge and presenting it in a non-specialist style. The result is an extremely comprehensive and accessible overview of the upland environment written specifically for outdoor enthusiasts.

Chapters on Climate, Geological Foundations, Shaping the Mountain Landscape, Vegetation Cover, Invertebrate Life, Mountain Birds, Mammals, Reptiles and Amphibians, Human Traces and The Future of Our Mountains, are illustrated by more than 325 photographs and diagrams.

Supplementing these chapters are identification sections detailing some of the rocks, landforms, plants, invertebrates, mammals, reptiles, and human traces to be seen in Scotland's mountains, all of which have been refreshed in this new 280 page edition.

Scottish Mountaineering Trust

The Geopark Way (this issue, p 39): walking through the gently rolling countryside near Newent in Gloucestershire. Here the rocks are Triassic in age and in the distance Devonian. In between there is a narrow outcrop of Carboniferous rocks, which gave rise to the Newent coalfield. Photo by Mike Brooks.



Belshaw's Quarry – science, sculpture and heritage

Michael Dempster, Northern Ireland Environment Agency

Belshaw's Quarry lies around eight miles from Belfast city centre and three miles from Lisburn in Northern Ireland. It will be a familiar site for many amateur and professional geologists from Northern Ireland and beyond. It is visually striking, with the bright white Cretaceous limestone contrasting strongly with the dark Palaeogene basalt and dolerite that overlie and intrude it. Over the years the site has seen countless school, undergraduate and geological society field trips as a small, accessible location perfect for clearly demonstrating key concepts in geology as well as telling the story of much of County Antrim's geology in a nutshell. It is also a popular spot for those wanting to simply enjoy a walk in a quiet, rural setting with butterflies and dragonflies buzzing in the air during the spring and summer months.

It is owned by the Northern Ireland Environment Agency (NIEA) and was established as a National Nature Reserve in 1972. In 2016 it was also declared an Area of Special Scientific Interest (ASSI) specifically for its exposure of the Clay-with-Flints that here records the 10 million years or so that elapsed between the uplift, weathering and erosion of the limestone and the eruption of the basalt lavas during the birth of the Atlantic Ocean. The Clay-with-Flints is found at outcrop in places around the fringes of the Antrim Lavas and recent research indicates the flints are the residue from weathering of the limestone, with the clay component likely derived from the remobilisation of clays from volcanic deposits. Belshaw's Quarry is one

An overview of Belshaw's Quarry. The limestone can clearly be seen cropping out in the lower right of the picture and the upper terrace provides access to the overlying basalt. Several of the art pieces can also be seen. Photo by Michael Dempster, NIEA.



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This shows the exposed plane of a normal fault in the limestone as viewed from the downthrown (hanging wall) side. Displacement is in the region of 5 metres and is easily estimated using the flint bands present in the limestone. The surface of the plane in detail is covered in slickensides. Vegetation has recently been cleared from around the base of the plane and its surface to enhance visibility and access. Photo by Michael Dempster, NIEA.

of a network of locations in Northern Ireland that have been crucial in the study and interpretation of the Clay-with-Flints, formally recognised at Belshaw's Quarry by its protection through ASSI designation.

The site was a working quarry from at least the 1840s to the 1950s. Limestone was the target rock, extracted to produce lime for agricultural soil improvement both in Ireland and further afield. This was a significant local industry and a number of limestone quarries operated in the area, but the majority have long since been filled in leaving Belshaw's the only quarry still accessible. It was a hard working life: a local man who started working in the quarry at fourteen years old recalls spending long days chiselling flint out of the limestone by hand before it could be crushed and quickened. This would be difficult enough if it was the limestone in the south of England, but for those who do not know, the Cretaceous limestone in Northern Ireland is much harder than its equivalent in Great Britain – a hammer can barely mark it!

As a long established NNR, the site has been managed by NIEA and free access to the public has been maintained over the years. There were no plans to change the nature of the site until John Belshaw of the Whitemountain & District Community Association (WDCA) was struck by a great idea. The 'bedrock' of the notion had been laid when John attended a guided walk at the site by former NIEA geologist Ian Enlander in 2015 that opened his eyes to the wealth of heritage contained in the small, disused quarry on his doorstep. While on holiday in county Wicklow later that year, John found himself at a woodland site that had numerous 'totem poles' installed as part of a trail and it hit him that Belshaw's Quarry would lend itself perfectly to such a trail. By the time he got back to his car he already had 16 interpretation themes running through his head and as he hurriedly scribbled them down in the fading light, in John's words, his wife "thought he had gone nuts"!

Despite his surname, John has no known family connection to the quarry, but is a local man with a passion for his patch. He describes his idea as more of a fully formed vision to bring the natural and

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The Whitemountain Cow stands at one of the entry/exit points to the site. It faces out toward the surrounding pasture fields and represents the use of lime from the quarry in agriculture. Parts of an old horse-drawn hay rake have been incorporated into the piece, and its surface is covered in geological terms, local townland names and 'welcome' in several languages. Photo by Michael Dempster, NIEA.

industrial heritage of the site to life through art. John brought the idea to NIEA, who were enthusiastic about the proposal which ultimately led to the creation of the Belshaw's Quarry Sculpture Park, formally opened on 1st April 2017.

The WDCA commissioned six local artists to create eight sculptures as the first phase of the endeavour. The pieces titled Nodule (Jason Mulligan), Hydrosphere (Ngaire Jackson), Earth as a Machine (Jodi Coyne), Dark Whisper (Ngaire Jackson), Geological Cake (Tracey Crossan), Coccolith (Kevin Killen), Plate Tectonics & Mini Earthquake (Brian Connolly) and Volcanic Slice (Patricia Lavery & Tracey Crossan). Each is placed on a wire mesh gabion filled with locally sourced stone, helping them blend in as the wire weathers and plants begin to establish themselves through the mesh and on the stones. A short explanation is provided from the artist of the inspiration and purpose behind their sculptures. They all take an aspect of the quarry's story as their starting point and interpret the natural, industrial and agriculture heritage of the site for the visitor. The organising committee were able to add a further four sculptures by April 2018 (Flora & Fauna – Helen Hanse, Tool & Waste – Ngaire Jackson, Hard Labour – Alan Burke, Whitemountain Cow – Kevin Killen) so that all aspects of the quarry are now interpreted by art. The WDCA are also happy to get their hands dirty by regularly keeping important rock exposures clear of vegetation and maintaining paths, all in their own time and for the benefit of anyone who happens to visit the site – the very essence of conservation volunteering. They hope the sculptures will help draw more visitors to the area and highlight the quarry's heritage story for all. It has already been the subject of a half-hour documentary by Northern Visions Television, a Belfast-based community television station and Lisburn & Castlereagh City Council, who provided catalyst funding for the project, will be including the site in their forthcoming tourism promotion campaign too.

Sculpture commissioning and installation was funded via the Alpha Programme, which funds community and biodiversity projects as part of the Landfill Communities Fund (financed via Landfill Tax Credits) from Mullaghglass landfill site, operated by Alpha Resource Management Ltd.

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Groundwork NI act as fund managers for the Alpha Programme and provided guidance and support throughout the project. The sculpture park project is an example of how simply engaging people with geology through walks and talks can ignite their interest and even inspire some creative thinking. It also highlights the fact that no matter how familiar a site may be, there is always room for seeing it from another perspective – in this way, the artworks truly enhance the site experience.



This sculpture is titled 'Flora and Fauna' (Helen Hanse) and represents the colonisation of the quarry by nature. Behind and to the right of the sculpture in the photo is a natural wet area backed by the limestone quarry face – water percolates through the limestone before springing and ponding where it meets the quarry floor. This has allowed the development of wetland vegetation and acts as a perfect habitat for dragonflies. Photo by Michael Dempster, NIEA.

Further information

<https://www.daera-ni.gov.uk/articles/belshaws-quarry-nature-reserve>

<https://www.daera-ni.gov.uk/publications/belshaws-quarry-assi>

<https://bqsp55.wixsite.com/bqsp/belshaw-s-quarry-sculpture-park>

Opening up the deep freeze at College Lake (Pitstone Quarry SSSI)

Nicholas Pierpoint, Geologists' Association; **Eleanor Brown**, Natural England; **Mark Vallance**, **Leo Keedy & Rodney Sims**, all Berkshire, Buckinghamshire & Oxfordshire Wildlife Trust

College Lake, near Marsworth in Buckinghamshire, is one of the most important sites managed by the Berkshire, Buckinghamshire, and Oxfordshire Wildlife Trust (BBOWT). Annually there is a footfall of 110,000 visitors to the perfectly equipped site and visitor centre (<https://www.bbowt.org.uk/explore/visitor-centres/college-lake-visitor-centre>) to explore the wonders of the Chalk Downland flora and fauna, including a flooded chalk pit providing an excellent habitat for birdlife.

The site also has an SSSI designation for its Quaternary (ice age) geology. There have been a series of significant fossil finds at the site but, more importantly, sedimentary evidence from College Lake and the Marsworth area has helped constrain a series of warm and cold periods from the Middle and Late Pleistocene. However, at present the geological story at College Lake is hidden from view, and here we explain how we are working in partnership to open up the deep freeze for visitors to see.



College Lake, Buckinghamshire. This site is a former chalk quarry which is now a nature reserve run by BBOWT. The Pitstone Quarry SSSI is on the right hand side of the image, and consists of the upper quarry face where the involutions are and the undug reserve behind it. Photo by Eleanor Brown, Natural England.

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The involutions at College Lake, taken in October 1990 when quarrying was coming to an end. This illustrates the usefulness of photo archives of geological SSSIs, particularly disused quarries where talus accumulation and vegetation growth has obscured geological features over time that were visible when the quarry was active. Photo by Stewart Campbell.



Two major channels of different ages have been identified and investigated. The older one, dating from approximately 220,000 years ago, has produced evidence of a warmer interglacial rich in mammalian fauna. This was followed by a cold period when permafrost conditions prevailed, like in Northern Canada or Siberia today. The sediments at College Lake were subject to intensive freeze-thaw cycles which created the involution features that we want to expose. These features are formed where frost heave, soft sediment deformation and cryoturbation occur (Murton *et al.*, 2015), and look like the periglacial equivalent of a lava lamp. The upper channel, now absent due to quarrying activities, represented warmer conditions from around 120,000 years ago.

BBOWT, in partnership with local geologists, the Geologists' Association (GA), members of the Quaternary Research Association (QRA), Natural England and local geology groups, are working to promote our geological heritage and the fascinating geological story at College Lake. The aim is to enhance the visitor experience and open up a new educational resource, whilst the critical geological sections are conserved at a very important location for geoscience research.

In order to better understand how the freshly exposed sediments would behave, a test excavation was dug early in the summer of 2018 with Natural England's consent. Observations were made over a 9-month period assessing how quickly the face would degrade through erosion or vegetation

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A test pit dug in July 2018 by BBOWT volunteers which exposed the involutions in the former quarry face. Photo by Nick Pierpoint.

growth. The results were encouraging, so the next step will be to open up an exposure of the involutions which is approximate 5–8m in length with a vertical section of approximately 1.5m. This will allow visitors to see the involutions more clearly. The exposed 5-8m section of the quarry face will be maintained by hand tools over a 5–10 year period before being closed and a new section opened up further along. The exposed section can roll back and forth over a 40m stretch of the former quarry face. The old sections will be covered using the talus excavated to create the new exposures. This material will be placed on a geotextile to check root penetration into the underlying geology. The original test excavation will be kept open as a control. As part of the future work programme, annual fixed-point photography will be used to monitor deterioration and erosion of the exposure. This will inform the scope of work for future geoconservation at the site, and at other similar sites.

We are still in the planning phase and consents to proceed are being acquired. BBOWT is endeavouring to seek funding for the project. To date, significant awards from the Geologists' Association Curry Fund and the Quaternary Research Association Geoconservation and Outreach Funds have been secured. Once the bird nesting season is over in early August, the physical work to create a new visitor access can commence. This work includes installing a new path (mobility scooter friendly), fencing and a bench, as well as a new interpretation panel supported by online resources. At present it is anticipated to open in November 2019. Hopefully, this will be just in time for an update in the next issue of *Earth Heritage Magazine!*

Further Reading

<https://www.qra.org.uk/top-50-quaternary-websites/>

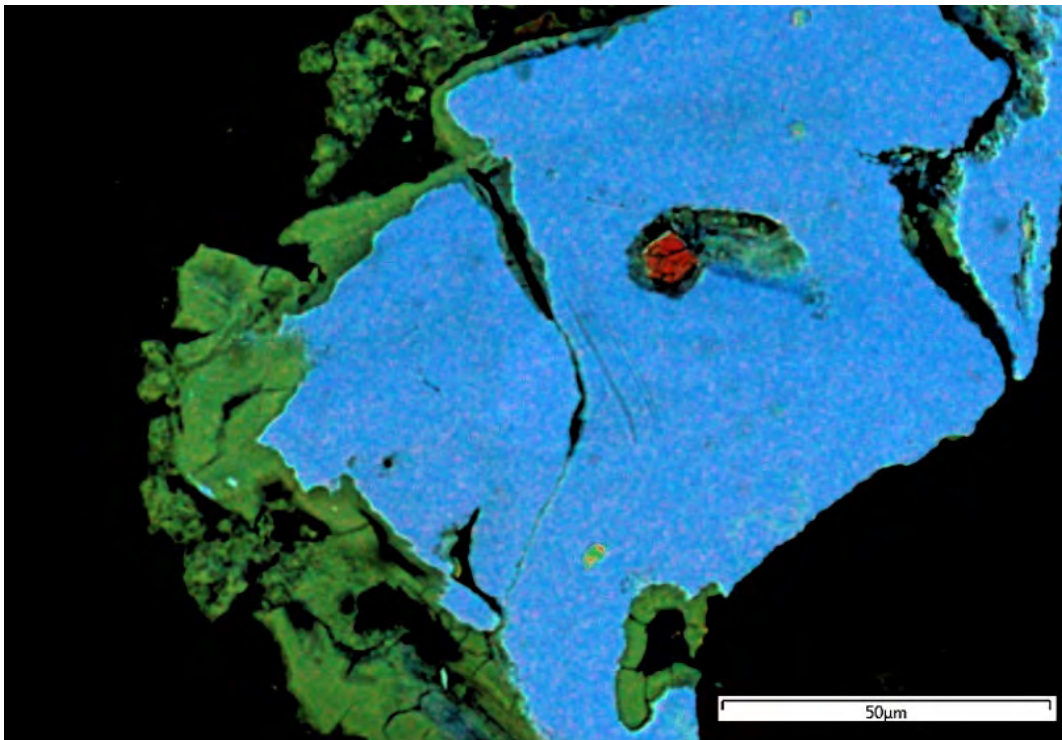
Murton, J.B. *et al.*, (2015) Middle and Late Pleistocene environmental history of the Marsworth area, south-central England. *Proceedings of the Geologists' Association* 126, 18–49

Urgent partnership effort to safeguard globally significant meteorite localities on Skye

Dr Simon Drake, research associate, Birkbeck College, University of London.

In 2015 after extensive PhD fieldwork the author led a team from Birkbeck College, University of London, which published research showing the area that would become the Isle of Skye had been hit by a meteorite between 61.5 and 60 million years ago. This event acted as a driver for voluminous amounts of basaltic volcanism throughout a region known as the BPIP (British Palaeogene Igneous Province) which spans amongst others Skye, Arran, Mull, Eigg, Rum, and Northern Ireland.

The Skye meteorite impact discovery is of considerable geological interest for numerous reasons. Firstly, it provides some information concerning the 'cause' of early volcanism in the BPIP which has traditionally been considered to have resulted from the ascent of a mantle plume. Secondly the team have reported on the minerals vanadium-rich osbornite (TiVN) and niobium-rich osbornite (TiNbN). Neither of these minerals have been recorded on Earth before and indeed the niobium variety is new to science. Interestingly dust from the wake of comet Wild II trailed during the early 2000s NASA Stardust mission did contain TiVN so it is considered that this mineral is extra-terrestrially derived. However, in virtually all cases when meteorite strikes are reported it is the shock to the rocks that were hit by the actual meteorite that is studied. To find part of the actual meteorite (TiVN and TiNbN) is extremely rare so the Skye event is of international interest. Additionally the Skye meteorite strike is only the second confirmed strike in the British Isles and has attracted considerable interest from the academic community, the media, and inevitably meteorite hunters.



What the fuss is all about! The only example known to science of Niobium-rich osbornite (TiNbN) shown by an elemental X-ray map. The TiNbN crystal (red) is surrounded by a terrestrially weathered iron FeO (green) and enclosed within native iron (blue.) © Simon Drake/Birkbeck College.

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In December 2017 the team's work was published in the Geological Society of America Journal *Geology* and selected for international press release. In the next 24 hours it was reported by 106 worldwide news agencies and the author had appeared on BBC Radio Scotland to talk about 'new' extra-terrestrial minerals. In publishing the work the team opted for 'open access' and paid over \$3000 so that the paper was available online free of charge to anyone. The team faced a very difficult decision in whether to quote grid references for two of the localities that had been discovered near An Carnach, on the south-eastern flanks of Blàbheinn, Skye's eastern-most Munro, on the Strathaird Peninsula and near a prominent chambered cairn on the side of the Broadford to Elgol road. There was stark awareness of the potential for meteorite hunters to damage the localities but equally important it was vital that other researchers could review the research work and visit the *in situ* geology.

In early September 2018 the author was alerted to the fact that samples of rock from the roadside locality were turning up for sale on eBay for £10 a slice. The seller was contacted and implored to remove the items from sale, with the international significance of the site being explained. They agreed, but by that time samples had been seen for sale on another much larger space rocks website. The price of these pieces was by negotiation, so clearly the rock was highly prized. The sale of material from the An Carnach locality was extremely concerning and disappointing because rock at this locality is so friable and hence susceptible to erosion, plus the impact layer is only 80 cm thick. Furthermore, only 6 crystals of osbornite had been found in all the rock sampled from the roadside locality. Indeed, the average size of each crystal found was about 10 microns, i.e. less than the thickness of a human hair. Purchasers would therefore have no guarantee that the sample they were purchasing would contain the minerals they wanted. The listing of the rocks on eBay was subsequently picked up by both local and national press, and extensively covered. It was evident that something now had to be done to protect these localities, because 60 million year old rock with global significance was now being sold for the price of a fish and chip supper!

Following publication of the paper contact was established with Scottish Natural Heritage (SNH), to



The roadside meteorite locality near the chambered cairn pictured in 2015 (left) and as it appeared in November 2018 (right). Note the lack of loose rock in 2018 which is clearly evident in 2015. Note also the damage to the right hand side of the outcrop which fellow Skye meteorite impact researcher, Andy Beard, is looking at. A vertically orientated pane of reinforced glass will be driven into the left hand side of the exposure to protect the site in future. © Simon Drake/Birkbeck College.

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establish what could be done to protect both localities primarily from the attention of specimen collectors. Although both localities are situated close to designated areas, namely, Strath and Cuillins Sites of Special Scientific Interest (SSSI), they themselves occurred in wider countryside that has no statutory protection.

Conferring SSSI status on a locality of national/international importance is not a simple procedure. However, given that both localities occur in land owned by either the Scottish Government or John Muir Trust (JMT), and third party theft and damage is currently the greatest threat to the meteorite strike deposits, SSSI status may not be the most appropriate means to protect the meteorite deposit localities. Another approach has to be adopted to manage the localities for their extremely high conservation value and offer protection against large-scale collecting for commercial purposes. Representatives of the landowners, Ewen Macpherson the Scottish Government representative on Skye and Ally Macaskill the Skye representative of JMT were contacted and briefed. Agreement was made with JMT to place signage at the more difficult to access An Carnach locality informing the public that the site is protected, and collection of rock is forbidden. Subsequently a meeting was convened at the roadside locality in November 2018. The aim of the meeting was to establish there and then a strategy for conserving this second locality that, given its roadside position, is most susceptible to irresponsible and damaging collecting activity. Importantly the meeting included



Blàbheinn, on the Strathaird Peninsula, Skye. At An Carnach on the south-eastern flanks of this mountain, the island's eastern-most Munro, a meteorite-impact deposit has recently been discovered. Occurring between Middle Jurassic rock and mid-Paleocene basaltic lava this deposit is not only important for containing extra-terrestrial material but could have an important bearing in the origin of the British Palaeogene Igneous Province. Irresponsible collecting threatens this highly significant and important locality. © Lorne Gill/SNH.

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tenant crofters who are best placed to keep an eye on the locality. The scientific significance of the rock exposures in this crofting land and their vulnerability to collecting were discussed and meeting participants were shown the void where commercial quantities of rock had been removed. On conclusion of the meeting there was unanimous agreement between crofters, Scottish Government and researchers that the roadside locality needed protection from future reckless and damaging collecting. A toughened glass screen will therefore be placed in front of part of the rock exposure so that it can still be viewed, but not sampled. The rest of the exposure will then be buried, and landscaped appropriately as a rather drastic, but not unprecedented, geoconservation measure. It was also agreed to embed a flat sign in the ground indicating the site is of scientific importance and collection of rocks at the locality is not permitted. The work will start in the next few weeks and so it is hoped that this extremely important, very fragile, scientific resource can be adequately safeguarded.



Some of the press coverage regarding the geo-vandalism at site 2

Further information

In time, one of these localities, or indeed another yet to be discovered Palaeogene meteorite exposure, may be added to the Geological Conservation Review, the record of the best and most representative geological sites in Britain. Deciding the Block into which the site should fall is debateable, mineralogy, British Palaeogene Igneous Province, or even a new extra-terrestrial category!

<https://pubs.geoscienceworld.org/gsa/geology/article/46/2/171/525169/discovery-of-a-meteoritic-ejecta-layer-containing>

<https://www.geolsoc.org.uk/Geoscientist/Archive/April-2018/Falling-Skye>

Stackpole Quarry makeover

Chris Byrne, Natural Resources Wales

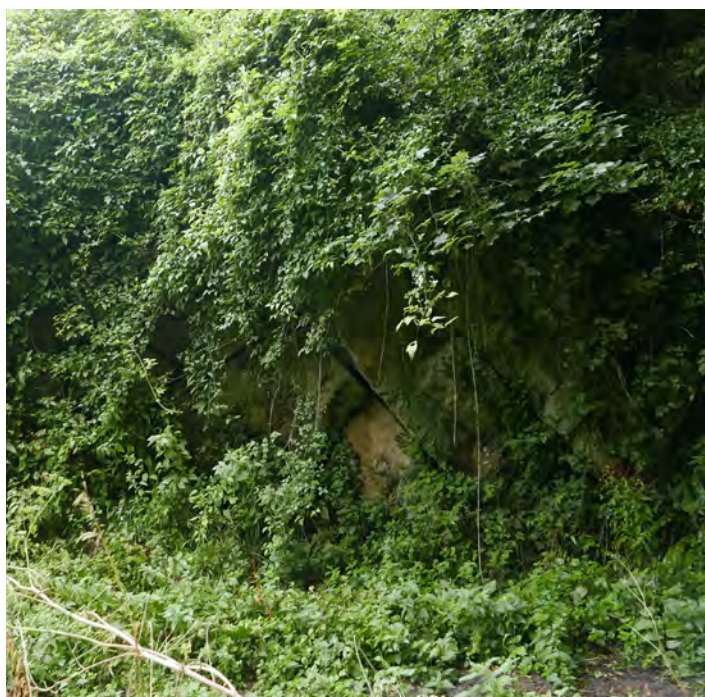
Pembrokeshire has long been known as a great place to go to view structural geology and some fantastic scenery. At Stackpole Quay, a walk eastwards along the Wales Coast Path traverses the boundary between Devonian sediments deposited on coastal alluvial plains, followed by Avon Group/Lower Limestone Shales deposited in coastal lagoons and then the Black Rock/Blucks Pool Limestone deposited in open water during the early part of the Carboniferous Period. However, a detailed look at the cliff faces (if the tides are favourable) reveals this is not a simple stratigraphical change. Folds, faults, and associated features are everywhere, demonstrating the intense folding the strata were subjected to approximately 290 million years ago, during the Variscan Orogeny.



The spectacularly folded rocks exposed around the Pembrokeshire coast can be difficult to study close up and like the syncline exposed at Middle Cove, Stackpole are clearly subject to the tides. Photo by Raymond Roberts.

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In particular, most visitors will be familiar with the impressive coastal stack in Middle Cove, where the core of an asymmetric syncline has resisted erosion and can be examined at low tide. Now, to give visitors a better chance of keeping their feet dry, National Nature Reserve (NNR) staff have been busy clearing vegetation from the inland quarry that lies to the back of Stackpole Quay. The long-disused quarry was landscaped approximately 20 years ago to be used as a picnic site for school parties and as a wheelchair abseiling facility. It had started to fall into disuse, but the encroaching vegetation is gradually being tamed to reveal some easily accessible faces. The before and after pictures show how one impressive fold in the NE corner of the quarry had been almost completely obscured by the rampant vegetation, but is now a safe and easy place for study.



The coastal cliffs and foreshore around Stackpole provide important exposures of Old Red Sandstone and Carboniferous Limestone strata displaying a suite of structural features formed during the Variscan Orogeny. Inland outcrops can offer accessible exposures that are not susceptible to tidal conditions but are however prone to encroachment by vegetation. A monitoring visit by Natural Resources Wales (NRW) geologists in August 2018 identified that the exposures within Stackpole Quarry were practically unusable (Left, Photo by Raymond Roberts, NRW). By November 2018 sterling work by NNR staff had re-exposed this fantastic anticline at the rear of the quarry that is now accessible to all abilities (right). Photo by Paul Culyer, NRW, Senior Reserve Warden.

Further information

Information about the National Nature Reserve:

<https://naturalresources.wales/days-out/places-to-visit/south-west-wales/stackpole-warren-national-nature-reserve/?lang=en>

Information about the SSSI:

https://naturalresources.wales/media/677254/sssi_0113_citation_en001.pdf

https://naturalresources.wales/media/677255/sssi_0113_map001.pdf

Recording the Nunnery Triangle

Peter Kennett, Sheffield Area Geology Trust

Developers are always looking for holes in the ground to backfill to allow new housing. A classic Regionally Important Geological Site (RIGS) in Darnall, in the east end of Sheffield, is no exception.

The site is one of three RIGS, following a triangular series of railway lines near the former Nunnery Colliery. Two of these RIGS are not threatened, as the railway is still in use, but the third was abandoned decades ago. It consists of a 300 m long cutting, through a series of fine sandstones above the Swallow Wood Coal in the Pennine Middle Coal Measures Formation.

Sheffield City Council placed a planning condition on the cutting at the request of the Sheffield Area Geology Trust (SAGT), so that the geology could be recorded before it was lost forever. SAGT met the contractor, MHH Contracting Ltd., on site and amicably agreed a schedule. MHH would clear the site of vegetation and 130 years' worth of slipped material with a digger, allowing SAGT to record the geology. Half the face needed to be done immediately, allowing MHH to perform geotechnical investigations. The rest was allowed a little more time. In spite of excellent cooperation from the digger driver, who took a great interest in the venture (and suffered some impromptu geology lessons in the process!) the physical work involved in shovelling and brushing the face was considerable.

Once cleaned, the face was photographed by Phil Wolstenholme in a series of high-resolution pans. A3 prints of these were produced, onto which geological details were plotted, under the supervision of John Hunter. These will be converted later into digital overlays. Such is the quality of the prints that even individual ironstone nodules can be seen.

Most of the face provided a near-strike section in a series of fine sandstones with a variety of sedimentary structures, including large fluvial dune-fronts and small-scale ripple cross-lamination. So this was one RIGS accounted for. One of the others remains inaccessible beside a live railway line. The third has been fenced off from an active track, and has been designated a gated conservation area. The two leaves of the Swallow Wood Coal crop out here, and with the help of the big digger plus sweated labour by SAGT, the exposure has been greatly enhanced, and recording has begun.

Backfilling of the original cutting is now well under way, with inert material, brought in from other sites, being compacted to provide a base for more homes - so the project was achieved in the nick of time. A paper will be prepared for publication in due course and the information will be then available for all.

The whole project provides an excellent example of collaboration between a volunteer geo-conservation group, a site developer and a local authority. It produced an outcome that benefits geoscience and conserves a rare outcrop of coal for future generations.

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Panoramic photo of part of the railway cutting. Photo by Phil Wolstenholme



Top left: Cleaning up the face after the digger;

Top right: Logging the Swallow Wood Coal, sitting on the upper leaf of the seam;

Bottom left: Recording the geology on an enlarged photo.

Photos by Peter Kennett.

DIGS and film-makers at the Upwey Road Cutting

Alan Holiday, DIGS chairman



The Upwey cutting during construction in April 2011 (top), in January 2012 (middle) and after conservation work in September 2018 (bottom).

All photos by Alan Holiday.

In late summer of 2018, the work of one geoconservation group helped film-makers explore the links between people, geology and landscape.

The DIGS group (Dorset's Important Geological and Geomorphological Sites) has been in existence since 1993 and has around 60 registered local sites across Dorset. However, occasionally, the group looks after other sites, including SSSIs.

At Upwey, around 5km north of Weymouth on the A354, is the Upwey Quarries and Bincombe Down SSSI. The Upwey cutting is the result of a road improvement on the A354 from Weymouth to Dorchester, constructed prior to the 2012 Olympics when Weymouth hosted the sailing events. The cutting exposes the top of the Portland Limestone through the Purbeck Beds to the Wealden Beds, so crosses the Jurassic - Cretaceous boundary. The cutting provides a rare inland exposure for this stratigraphic horizon.

The DIGS group has taken upon itself to try to look after the site. As can be seen from photographs taken in 2011 and 2012, there was an excellent and accessible rock face to begin with. Despite regular attention, however, the site deteriorated, as the rock weathers and calcicole vegetation (vetches) takes over. By May 2018 it was in a poor condition, but a couple of site clearance visits early in the summer of 2018 were relatively successful.

During that time, the DIGS group was contacted by Intfilms, a film company from Belgium, interested in filming the conservation work. The company was in the process of producing a documentary on the relationship between people, geology and landscape. They had previously filmed in north-west Scotland and Cheddar Gorge and were going on to Lyme Regis and South Wales. Following a preliminary visit, the producers decided that the Upwey cutting could help to explore several themes in their film, *SOLID GROUND*. They explained:

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- *SOLID GROUND* reflects on the relationship of man and stone. Where do human time and geological time meet? Where do life and stone meet? What if the stony ground we live on is not actually as stable as we think? What if it were to have a life of its own, and its very own story? And what if we can't see humanity as separate from the geological process but find that stone and man are intricately joined?
- *SOLID GROUND* is a whimsical essay-film, a journey in which the most diverse things – from kidney stones to webcams in Antarctica, from astronauts' ear stones to stone quarries in Palestine, from atom bombs to volcanoes in Iceland - are all interconnected.
- *SOLID GROUND* wants to put our Epoch under the microscope. The film explores our 'now' from the perspective of the deep past and the deep future, with stone as the messenger for all these ages.

A date at the end of September was arranged, and the weather turned out to be perfect for both the filming and the conservation work. The rock face is much better exposed as a result of these efforts and the film is due for release in 2020.

Further Information

For more information on the construction work see Ian West's website <http://www.southampton.ac.uk/~imw/Ridgeway-Railway-Cutting.htm>

For more information on DIGS, see <https://dorsetrigs.org.uk/>



The DIGS group in action with the film crew, helped by excellent weather! During their filming in the UK, the Belgian team also visited the North West Highlands of Scotland, South Wales and Cheddar.

Trearne Quarry: A case study in quarry SSSI restoration

Colin MacFadyen, Scottish Natural Heritage

Restoration of a well-known fossil locality and Site of Special Scientific Interest (SSSI) in the west of Scotland, through its partial infill, has provided a good demonstration of how quarry faces may be conserved providing benefits for the ongoing use of the site for research, collecting and education.

For decades Trearne Quarry, near Gateside, North Ayrshire, has provided limestone for use in agriculture and as an aggregate. The resource that was quarried is the marine Blackhall Limestone of the Lower Limestone Formation (Brigantian substage) dating from the Lower Carboniferous, between 326-331 Mya.

Trearne has been worked in several bays so there are extensive quarry faces revealing rock sections that are almost exclusively within the 7-8 m-thick limestone. Formerly called the Dockra Limestone (now an obsolete name) the limestone provides a unique section through a highly fossiliferous reef mound complex that shows lateral and vertical variations in rock type including crinoidal, massive and argillaceous limestones characterising a topographically varied shallow sea floor setting.

The complex variations in the sedimentary sequence, both laterally and vertically, and the richness of the fossil faunas make this one of the most valuable combined interest sites in Scotland's Midland Valley being of interest to the stratigrapher, sedimentologist and palaeoecologist. Trearne is a type



The restored quarry face at Trearne Quarry containing the internationally significant lagerstätte which contains the well-preserved fossil remains of jellyfish. The full height of the quarry face along a length of over 270 m has been maintained.

All photos © Colin MacFadyen.



The fossilized remains of a jellyfish from Trearne Quarry. Fossils of such soft-bodied animals are incredibly rare and represent a globally significant aspect of Trearne's fossil fauna.

locality for several invertebrate taxa; the fossil fauna having considerable value in providing vital information for correlating Lower Carboniferous successions across the central Midland Valley. Unsurprisingly Trearne has for many years been a Site of Special Scientific Interest (SSSI) and features in the excursion guide to the area produced by the Geological Society of Glasgow.

The reef mounds are composed of sponges, algae, solitary and colonial corals together with bryozoans, brachiopods, bivalves and other invertebrates. The limestone fauna also includes gastropods, trilobites and sharks represented by teeth. In more recent years the importance of the north-western area of the quarry has become recognised as one of the few places that the fossil remains of jellyfish occur. These are found in association with a rich variety of other well-preserved fossil specimens including eurypterids, nautiloids, graptolites and undispersed remains of individual echinoderms and other animals in life position. These were preserved in sediment deposited in deeper water quieter lagoonal conditions that had been protected by, and lay shoreward of, the reef mounds. This fossil deposit provides a window into the past and may be regarded as a 'snapshot' of the hard and soft-bodied organisms that lived in the area during the Lower Carboniferous and is therefore regarded as one of Scotland's lagerstätten.

Although it has been an active quarry, with planned after-use, the designation of Trearne Quarry as an SSSI has ensured that a dialogue can take place to enable an appropriate and economically viable use of the quarry voids that can coincide with conservation of nationally and internationally important geological features. This involves addressing the requirement for maintaining access to and visibility of rock faces and fossiliferous rock.

Mineral extraction has left the site with limited soil resources; it is devoid of almost all subsoil and

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topsoil. The land after quarrying operations offered little by way of an ecological habitat with a limited intrinsic value to support a viable, productive after-use. The organic recycling and land restoration arm of Enva, the waste management, recycling and resource recovery business, is currently restoring the land, creating a soil profile, that will enhance the ecology of the site. Restoration will embrace after uses and the creation of an extended nature conservation area, beneficial to the community and palaeontological/geological interest, ensuring the interest of the SSSI is maintained.

As quarrying was winding down absolutely, key geologically significant areas of the site were identified for retention including the lagerstätte deposit with its internationally important soft-bodied fossil fauna. As the main quarry void in the west was infilled care was taken to ensure that the restoration infill was tapered to the floor of the quarry below the face allowing visibility of the entire face and continuation of access.

This approach is expected to be undertaken elsewhere in the site including the areas of highest conservation value where large loose boulders collected from across the site will be grouped together. Ultimately it is hoped that long after Trearne Quarry has been restored the site will continue to have research and educational value with scope for responsible collecting. Importantly it should serve as a good example of partnership working that marries quarry after-use development with geoconservation.

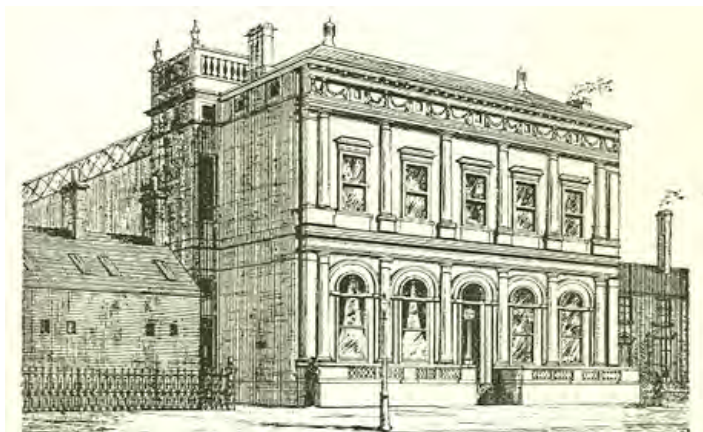


Large quarried blocks of fossiliferous limestone that will be relocated elsewhere within the site where they will be accessible for research and education purposes. Corals, brachiopods crinoids and the occasional shark tooth are some of the fossils that may be seen on this important loose resource.

Dudley Museum at the Archives – The Evolution of Geological Heritage in Dudley

Graham Worton, Keeper of Geology, Dudley Museum @ the Archives & **Mark Jeffs**, Geoteam Volunteer, Dudley Museum @ the Archives

In 2016, after 104 years Dudley Museum and Art gallery on St James Road closed its doors for the last time. This event forced a change and ushered in the next step in the evolution of Dudley Museum. The museum is now found inside the eco-friendly Archives building in the heart of a cluster of heritage and geotourism attractions on the town's Castle Hill. This repositioning offers new opportunities for the museum and geological heritage of the Black Country.



Mechanic's Institute, museum home from 1864.
© Dudley Museums Service.

Dudley Archives, museum home from 2017. Photo by Graham Worton.



From Public House to modern Archive

The first museum in Dudley opened in the Britannia Inn, moved to the Mechanic's Institute in 1864, was housed in St James Road from 1911 (where the geology gallery was opened by Professor Charles Lapworth in 1912), and arrived at its present Archives location in 2017. As the museum has moved so the geological collection, behind the scenes and on display, has evolved. In 1912 one room displayed the geological collection, by 2016 three galleries were devoted to the public display of Dudley's geological heritage and, behind the scenes, the geological collections moved to the off-site store at Himley Hall.

New home – new life

Opening in September 2017, Dudley Museum is now on the upper floor of the new archives building. The site is next to the Black Country Living Museum, Dudley Zoo and Castle, and the Canal and Tunnel Trust, all of which sit on a prominent limestone hill (Castle Hill) that was extensively mined for Silurian limestone, and the overlying coal, ironstone and fireclays of the Carboniferous, Middle Coal Measures (Pennsylvanian). The hill itself is part of an *en echelon* chain of Silurian limestone hills (that includes the nearby Wren's Nest National Nature Reserve) in the centre of the exposed Black Country (South Staffordshire) coalfield. This places the new museum immediately adjacent to the quarries and mines that yielded so many of the collection's geological treasures.

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Entering the new museum (left) and in the Mesozoic display (right), 2019. Photos by Graham Worton.

The new building is eco-friendly and state of the art with parking for 40 cars. Now on a single floor the custom design of the Museum includes wide aisles providing access for everyone, and education rooms are available for meetings, events and lectures. Other spaces in the building are occupied by the Archives service, the Black Country Bugle local newspaper and Adult and Community Learning services adding connections and new collaborations to the new museum.

The new display is designed in the time-honoured tradition of a timeline leading from the oldest geological periods through to the present day. The very best of our local specimens are on display in a context that can show how the climate, environment and ecology of the Dudley area has changed over 428 million years. Bespoke cases with much improved lighting transform the specimens and make the collection come to life.

Since reopening, visitor comments have been used to continually improve the displays and services on offer. This has included adding new interpretation boards, palaeogeographic reconstructions of the Earth throughout our timeline and improved interpretive labelling.

We are now focussing on promoting the Museum, particularly connecting with new audiences through social media, including posting from a large bank of digital images of the collections. 2019 has also seen the introduction of a monthly Saturday morning fossil identification session entitled 'Fossil Finds' followed in the afternoon by a presentation by the Keeper of Geology or a guest speaker.

Dudley Museum at the Archives – future evolution

The museum has a new mission statement that encapsulates this joined up thinking as it states: "Dudley Museums exist for the inspiration, education and enjoyment of everyone. We preserve, promote and provide engagement with local heritage through access to our geology, glass, art and other collections. We aim to enrich lives and make the Black Country a fairer, happier and better place to live, work and learn. We will encourage engagement with all aspects of local heritage and provide a window on the world through our partnerships, exhibitions and events".

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Dudley Museum at the Archives in 2019 remains the primary local geoh heritage centre that it has always been, and through outreach, new technologies, and collaboration will widen its impact and reach to new audiences. Already being considered are mobile phone apps, Augmented Reality and film-making, as well as the expansion of volunteer opportunities and links with apprenticeship schemes. The research programme will grow (there are already 10 active research projects) utilising the museum collection and the rich geosites of the surrounding Black Country.

Perhaps the most exciting, and far reaching, is the Black Country UNESCO Global Geopark Project, for which Dudley Museum at the Archives is the headquarters.

Black Country Geoh heritage and the International Stage

The most strategic function of the new museum at the archives is to be the inspirational starting point and supporting resource for those visitors who will discover that there are heritage riches scattered around the Black Country landscape. This is the primary function that the museum has within the Black Country UNESCO Global Geopark application. It is hoped that the Black Country landscape with its selected geosites will become the UK's next UNESCO Global Geopark and geoh heritage destination.

The Black Country's development is a huge story and involves many sites, events and people through time. The museum plays a vital role across this landscape as a focal point for geoh heritage across the proposed Geopark. As the headquarters and contact point for the Geopark Project the museum creates opportunities to develop stronger geotourism, add value to existing natural and cultural heritage offers, and boost the visitor economy as a result.

Next time you are in Dudley do visit the Museum, spend time in the timeline, and finish in the Geopark Room to see what else there is to discover.

Further Information

Information about the museum, the collections and the Black Country UNESCO Global Geopark Project can be found at the following websites:

Dudley Museum; <https://www.dudley.gov.uk/see-and-do/museums/dudley-museum-at-the-archives/>

Black Country UNESCO Global Geopark Project; <http://blackcountrygeopark.dudley.gov.uk/>

The Geological Collections; <http://geologymatters.org.uk/>

General Black Country Heritage Collections; <http://blackcountryhistory.org/>

Continuing success for The Geopark Way

Sue Knox, Herefordshire & Worcestershire Earth Heritage Trust

After 10 successful years of The Geopark Way and its recognition by Ordnance Survey in 2018 as being a permanent long distance walking route, Herefordshire and Worcestershire Earth Heritage Trust have just produced an updated and revised edition of the Geopark Way guidebook, currently available directly by emailing eht@worc.ac.uk.

Inevitably, with the longevity of the footpath and its use by so many feet, all sections of the Geopark Way needed thorough checking for changes to make sure the new guide book is as accurate as possible. This was done by a band of vigilant walkers with geological knowledge, and the Geopark Way Wardens - the people who keep a regular eye on the Way and its signage, and who reduce any encroaching greenery threatening to obscure the views. The trail encourages walkers to engage with the rocks, landscape and heritage along the entire walkway. The new guide book also addresses recent changes to geological naming, revised knowledge about rock types and minor alterations to the original 109 mile route.

The Geopark Way is divided into 17 sections, allowing for shorter or easier walks of between 4.3 and 8.2 miles along roads, bridleways and public or permissive footpaths. Each section has a sketch map of the direction you will be taking, along with detailed directions to keep you on the right track, and pictures of the fascinating landmarks you will encounter along the way. As you walk, you will be led by the distinctive trilobite waymarkers with an emerald green background. The logo is a stylised



The new edition of the Geopark Way guidebook (left) and The Geopark Way footpath waymarkers. Photos by Sue Knox.

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trilobite *Dalmanites*, many specimens of which have been found along the Geopark Way. Beginning in 290 million year old Permian sand dunes in Bridgnorth at the most northern point, the route follows an amazingly varied landscape through to the terraces and floodplain of the lower Severn Valley, and views of the Cotswold Jurassic limestones in Gloucestershire at the southernmost point. As you travel through Worcestershire and Herefordshire, you take in the Silurian rocks and Permian breccia of the Abberley Hills, on to Old Red Sandstones, drop back into the Triassic of the Worcester basin, across Silurian limestone, take a leap backward into the Precambrian of the Malvern Hills, as well as the Old Red Sandstone of Herefordshire, the ice age erosion of the Leadon Valley and through the Coalfield and the Triassic sandstones of Newent. The guidebook encourages interrogation of the geology along the trail, using a colour key situated along the edge of each page.

With astounding vistas throughout, influenced by what lies beneath and the intervention of human activity, you can enjoy hills, valleys, woodland, uncultivated common, signs of agriculture, settlement and buildings made from the rock they stand on. The new guidebook helps the walker to understand the way these alter along the route and to enjoy the heritage, views and geology that The Geopark Way reveals.

Top: Cross-bedded Permian desert sand dunes beside the Geopark Way in Low Town, Bridgnorth, close to the start of the route.

Middle: Walking along the ridge of Silurian limestones near Abberley. The limestones have been folded into near vertical orientation and in places overthrust other rocks. The flatter landscape beyond the hills is underlain by Devonian rocks.

Bottom: The Geopark Way passes along the spine of the Malvern Hills. The Malvern Hills are formed of some of the oldest rocks in England with an age around 670 million years old.

Photos by Mike Brooks.

The Brecks Earth Heritage Trail - Geology, Wildlife and People in East Anglia

Gilbert Addison, Norfolk Geodiversity Partnership

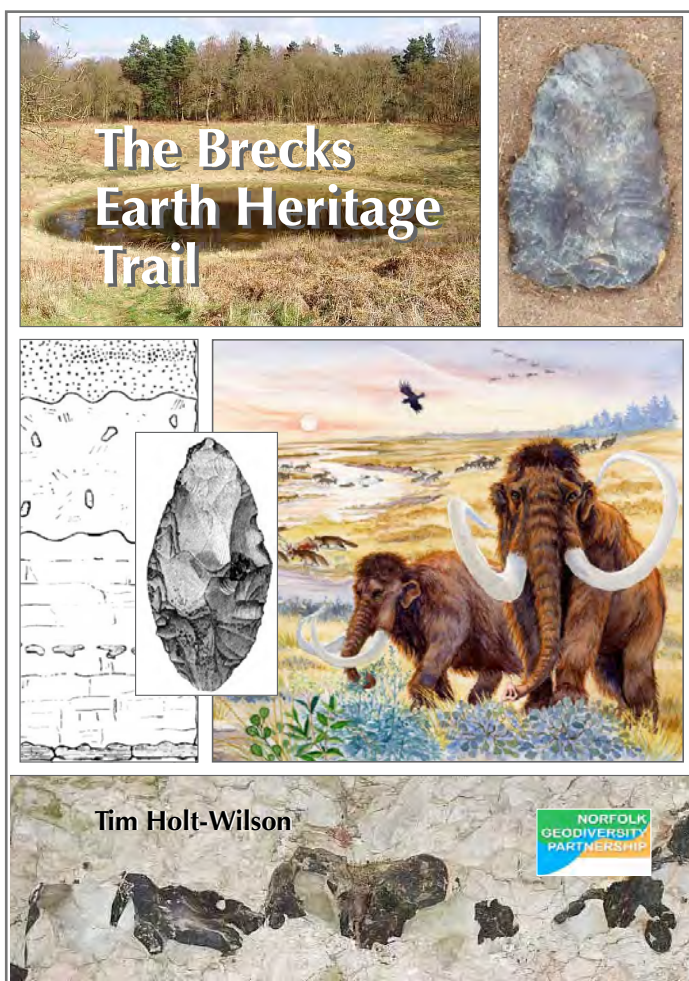
Under wide bright skies, rows of contorted Scots pines border large sandy fields: where else could you be but in the Brecks, straddling the Norfolk-Suffolk border in the east of England? Rainfall here is low and temperature ranges are the largest in England, but the principal source of the region's distinctiveness derives from its geology.

The Brecks developed from an essentially periglacial land system of subdued relative relief with aeolian coversands and abundant flints spread thinly over a low in the Cretaceous Chalk spine of East Anglia. Patterned ground, relict dunes, ground ice depressions and solution hollows are common; natural fertility is poor and outside of the few river valleys, surface water is largely restricted to seasonally fluctuating dolines. The region takes its name from a form of shifting agriculture practised for centuries whereby the land was sporadically tilled, forming 'brakes' in the existing heathland, until the useful nutrients were exhausted after which the land was allowed to revert back to its semi-natural state of extensively grazed heathland.

Today's land use practices are radically different, being split between the largest lowland coniferous forest in Britain, outdoor pig rearing and intensive arable farming based on chemical inputs and pump irrigation, while publicly accessible heathland is chiefly restricted to conservation allocations. Paradoxically, the 'best' remnants of the Brecks are now within the Stanford (military) Training Area (also an SSSI). Yet the underlying historic character of the Brecks still exerts a strong influence on the area and is visible everywhere to those who look.

In March 2014 the Heritage Lottery Fund (HLF) confirmed the award of nearly £1.5 million to the Breaking New Ground (BNG) Landscape Partnership, enabling a £2.2m scheme (the largest of its kind in East Anglia) to deliver a range of exciting Heritage and Landscape Projects in the heart of the Brecks until June 2017. Breaking New Ground was hosted by Suffolk County Council and was supported by Norfolk and Suffolk County Councils, the Norfolk and Suffolk Wildlife Trusts and most of the relevant district authorities.

Tim Holt-Wilson, a member of the Norfolk Geodiversity Partnership, was contracted to develop a 'Brecks Earth Heritage Trail' (BEHT). Its aim would be to connect people via publicly accessible locations to the geological origins of



the Brecks, its resources and their exploitation by humans and wildlife through prehistory to the present day.

Whilst Breaking New Ground was required by the HLF to deliver its projects from within an agreed core area of 231km², many of the projects were specifically devised to reflect the whole of the 1029km² of the Brecks National Character Area, as described by Natural England. Eighteen locations were selected for the Brecks Earth Heritage Trail reflecting key facets of the Brecks such as Pleistocene geology and geomorphology, before and after the principal glacial periods, the rich Palaeolithic heritage, Neolithic flint mines and the regionally distinct post-glacial flora and fauna. The chosen locations of the BEHT can be visited singly or in any order but stringing sites together requires transport; this is definitely not a walking trail.

Each location has been researched in depth, both from the literature and through field reconnaissance and the result is presented as a digest aimed at the enquiring layperson. Entries for each site typically cover an integrated account of geological origins, geomorphological changes, human history and special biodiversity illustrated by copious photographs, together with relevant diagrams and excellent graphical reconstructions by Beverly Curl; as such these represent true 'natural histories'. For instance, Cranberry Rough is included because it is the classic site of Hockham Mere investigated by Godwin and Tallantire and reported in 1951. The BEHT tracks the geomorphological changes to this wilderness area from its origin as a Devensian lake, via its early human exploitation evidenced by local finds of Mesolithic and Neolithic artefacts, through to the eventual loss of much of its open water by the 18th century due to sedimentation and drainage, its successional development of high nature value fen-carr vegetation and finally to recent works aimed at re-establishing areas of open water and grazed fen.



Tim Holt-Wilson - centre-right with clipboard - at the Brandon Country Park BEHT launch. Photo by Gilbert Addison.

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A recently 'restored' section of Hockham Mere - a former late Devensian lake. Photo by Gilbert Addison.

In addition to these basic field resources, selected locations from the BEHT were used as platforms for three types of day-schools: 'Ice Age Brecks', 'Geological Brecks for Land Managers' and 'Church Stones in the Brecks'. These well-attended field trips (90 different people over the course) highlighted the huge changes to drainage patterns in East Anglia wrought by the erosion and deposition attending successive ice advances, the subsequent generation of periglacial features such as patterned ground and ground-ice depressions, and the opportunities and constraints presented to later inhabitants through the availability of building materials. The Brecks has previously been best known and published for its cultural and biological history; the significance of the tie-up between the BEHT and the day-schools was that it raised the profile of geodiversity as an important factor in the natural heritage of the Brecks.

The Brecks Earth Heritage Trail was officially launched with a presentation at Brandon Country Park on 29th June 2017, an event attended by over 60 people. Tim Holt-Wilson then led a walking tour of Brandon Country Park through what is conveniently 'location one' of the Trail, pointing out the landscape changes from classic Brecks sandy waste, sheepwalk and warren through 19th century Pleasure Grounds to 20th century afforestation and dune stabilisation - taking in some history of flint knapping for gun flints and building stones on the way.

In its promotion of geodiversity and its integration into an explanation of the natural heritage of the Brecks, the BEHT was felt by project coordinator Nick Dickson to have been one of the stand-out achievements of the whole BNG project. While the field guide as a pdf download remains available from the website, those who have acquired a glossy hard copy from the original printing should consider themselves fortunate indeed and indebted to the HLF!

Further information

The Trail is available in three formats: an introductory A3 four-fold leaflet, a smartphone app for Android and iPhone and a 48-page glossy colour A4 field guide book. All three can be downloaded from <http://www.breakingnewground.org.uk/earthheritagetrail>

Identification Days with GeoSuffolk

Bob and Caroline Markham, GeoSuffolk

GeoSuffolk has been invited to provide an 'identification' service at a variety of public events at Ipswich Museum, Colchester Natural History Museum and, on one occasion, in Brandon Country Park in West Suffolk. We have helped at about a dozen of these events in the last two years and the best thing is, they are all different!

Each event brings different specimens and different people and we see at least 80 visitors each time. This is an excellent way to meet and talk to people of all ages who are interested in geology, and 'face to face' has the advantage over written information in that you find out exactly what the enquirer wants to know. For example, they may be happy to learn that their specimen is an ammonite of Jurassic age, or they may require further information, for example that it is pachydiscid and Maastrichtian. Of course, the specimen may not be geological at all – furnace slag is a common enquiry and you do need to be able to identify horse teeth! We were once brought a piece of ambergris from Mauritius to identify!

In Suffolk/North Essex most of our enquiries are about fossils - our coast dwellers are avid collectors of molluscs, shark teeth and other beach finds from the Eocene and Pliocene deposits which underlie our shores. We see the large and the small - from an elephant cuneiform bone the size of a dinner plate from Easton Bavents, (its state of preservation suggesting that it is from a Southern Mammoth



GeoSuffolk member Peter Brinkley identifying a specimen at Ipswich Museum. Note the top book under his left arm which is the Natural History Museum's British Cenozoic Fossils – invaluable for identifications in Suffolk/Essex.

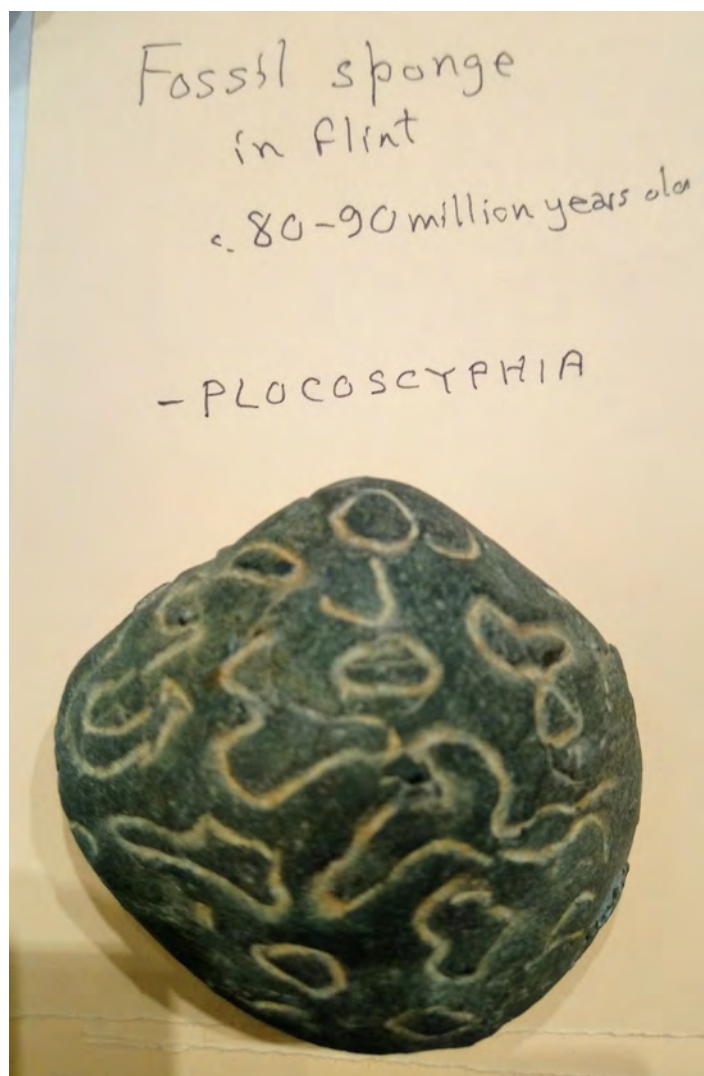


GeoSuffolk members Bob and Caroline Markham with a young enthusiast and handling specimens at Brandon Country Park – here a variety of mammoth teeth plus a Jurassic reptile vertebra.

Photo by P Brinkley.

Photos by Bob and Caroline Markham unless otherwise stated.

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A *Plocoscyphia*, or similar, sponge in flint from Felstead, Essex – with the information we wrote down for its delighted owner. Identifications have to be relatively immediate and so are usually brief, but we always make time for a friendly chat.

and washed out of the Norwich Crag), to tiny seeds from the London Clay at Bawdsey. Our glacial deposits yield a variety of erratics, often beautifully preserved. Examples identified include – a piece of *Stigmara* from Camborn, Cambridgeshire (interesting to find a Carboniferous fossil in East Anglia); a fine Pliosaur tooth from Pakefield (the tooth is unusual, but Jurassic reptile vertebrae are common in our diamictos) and a splendid *Amoeboceras* ammonite from Flixton. Flint in many forms is guaranteed to turn up at any identification session in East Anglia. Our flint specimens have included a double-valved *Inoceramus* from Dunwich (edge-on pieces of such shells often provide puzzles to finders) and a polished Neolithic axe from Holywell Row which was passed to the Suffolk Archaeological Small Finds Unit to record.

These events are popular with GeoSuffolk members as well as the public. We never have any shortage of volunteers – you never know what will turn up! Between us we have a wide range of knowledge and we always take identification sheets and books, a stratigraphical column (vital) and hand lenses. The displays in Colchester and Ipswich Museums are often useful to help explain people's finds – and of course they attract visitors who did not know an identification day was scheduled. For these people, we have a variety of handling specimens on our table and the date and venue of the next event – ready for more fascinating treasures.

Conversations in Stone: Fuelling the legacy of one of Scotland's greatest palaeontologists

Larissa Reid, Freelance Science Writer with Elsa Panciroli, National Museums Scotland & University of Edinburgh

“the dark bituminous shale. . . is so largely charged with inflammable matter as to burn with a strong flame, as if steeped in tar or oil. . . it was as strange a mixture as ever yet bubbled in witches’ cauldrons – blood of pterodactyle and grease of ichthyosaur – eye of belemnite and hood of nautilus; and we learnt to delight in its very smell, all oppressive as it was, as something wild, strange and inexplicable.”

Hugh Miller, *My Schools and Schoolmasters*, 1854

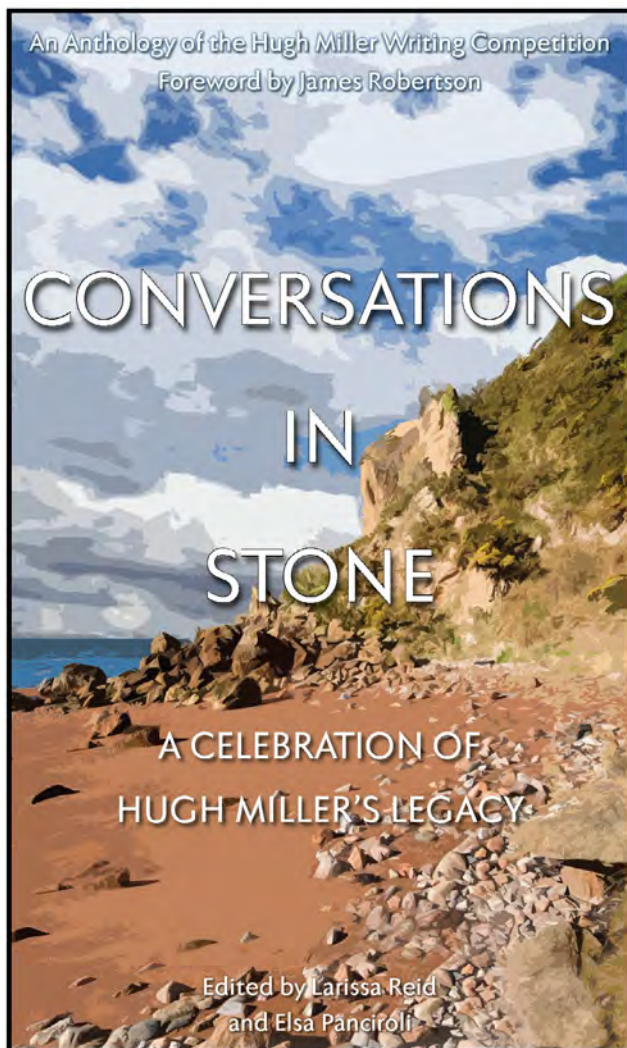
Readers of *Earth Heritage* will be aware of efforts in recent years to revive the legacy of the Scottish Victorian-era geologist and writer Hugh Miller. The Hugh Miller Writing Competition has run biennially since 2015, and the high quality of entries received has led me and the competition judges and winners down many a merry and intriguing path since.

It seemed appropriate and necessary to celebrate the competition’s success, and to use the entries in a way that would create a lasting legacy to both Miller himself, and Scotland’s geoh heritage so our new publication, *Conversations in Stone: A Celebration of Hugh Miller’s Legacy*, was born. Originally intended to be a small booklet comprising our winning competition entries, it blossomed into a 157-page book – a celebration of all that Miller’s legacy began and that he believed in: that Earth Science, and science in general, should be for all people, regardless of their background or educational abilities. “Learn to make a right use of your eyes”, he implores, “don’t waste your days indoors – be outside, be in amongst, be a climber through caves and a seer into deep time”.

Conversations in Stone has been made possible by the generous support of the Scottish Geodiversity Forum, The Friends of Hugh Miller, Edinburgh Geological Society and the Andrew Tannahill Fund for the Furtherance of Scottish Literature at the University of Glasgow. Huge thanks also go to Scottish Natural Heritage, for their support both of this publication and of the 2017-18 writing competition.

The book has been compiled and edited by me and palaeontologist Elsa Panciroli, who is currently completing her doctorate at National Museums Scotland and the University of Edinburgh. I spoke to her about Miller, the reasons she wanted to be involved in both the writing competition, and the creation of *Conversations in Stone*.

“As a judge for the Hugh Miller Writing Competition 2017-18, I enjoyed being transported all across



***Conversations in Stone*, edited by Larissa Reid and palaeontologist Elsa Panciroli, was launched at the Kelvingrove Art Gallery and Museum in Glasgow, Saturday 2nd March.**

“The beautiful writings in this book confirm that Miller’s inspiration as scientist and chronicler of the natural world is very much alive, and they validate our own efforts to sustain his legacy.”

Martin Gostwick, Secretary of The Friends of Hugh Miller charity.

“Nature is a vast tablet, inscribed with signs... and becomes poetry in the mind when read.”

Hugh Miller

Scotland, through space and time, to find out how geology and palaeontology had moved and inspired people. There’s a unique creative niche where rocks and fossils meet the arts, and I wanted to help others experience it. Anthologising the winning entries was the perfect way to do this, and as more writers and scientists began to contribute, the project really grew and crystallised.”

The publication includes new writings by naturalist and writer Kenny Taylor, palaeontologist Bob Davidson (who was recently awarded an MBE for his services to Scottish palaeontology; this issue p 6) and Miller expert Michael Taylor of the University of Leicester and National Museums Scotland. Other voices in the mix include Robert Macfarlane, author of *The Wild Places* and *The Lost Words*, and our foreword has been penned by renowned Scottish author James Robertson. “Miller’s writing is beautiful in itself, he was a household name in his day and his words still resonate. But the humble and conflicted person behind that writing is deeply fascinating too,” says Elsa. “Today, science can be hard to understand as disciplines have become increasingly complex and specialised. Miller represents a bridge between science and the everyday: he understood the latest geological concepts, yet took those abstract ideas and made them into solid and delightful prose. That’s a real gift, one that comes from keeping your boots firmly on the ground, no matter where your work and life takes you. He provides a lesson for us all about communicating science to a wide audience.”

The third Hugh Miller Writing Competition will launch on October 10th 2019, and takes inspiration from a recent project by the Scottish Geodiversity Forum to celebrate the 51 Best Places to See Scotland’s Geology. This year’s competition will invite prose and poetry entries inspired by the geology and landscapes at one or more of the 51 Best Places. We encourage you to explore Scotland with fresh eyes this spring and summer, and gather inspiration with which to enter the competition. Further information,

together with the 51 Best Places map and site descriptions, is available at www.scottishgeology.com.

“We can’t underestimate how our geological heritage shapes us,” Elsa says. “We protect the things we care about and enjoy. Celebrating our geodiversity, by combining science and the creative arts, reaches people from every background, including those who maybe wouldn’t otherwise have thought about geoh heritage. Hopefully this project and others like it will inspire people to get outdoors, revel in our landscapes, be inspired by them, and conserve them for the next generation.”

If you would like to purchase a copy of *Conversations in Stone*, please visit www.scottishgeology.com, where you will find more information about the book and a link to buy it online. The book will also be available at the Hugh Miller Birthplace Cottage and Museum in Cromarty.



An aerial view from the north-east of the Cromarty Firth with Cromarty, the home town of Hugh Miller, appearing as a narrow promontory, toward the top-centre of the image. ‘The Sutors’ of Cromarty, two opposing headlands, marking the entrance to the Firth, are fashioned from Precambrian metamorphosed sedimentary rock and fossil- fish-bearing Middle Devonian sediments. Slivers of fossiliferous Jurassic rocks occur along the North Sea coastline at this point. The nature, particularly the rocks and fossils, and landscape of this area inspired Miller and his writings. ©P&A Macdonald/SNH.

A New Approach to Planning in Wales - Placemaking and the role of Geodiversity

Dr Adrian Humpage, Senior Planning Policy Officer, Powys County Council

In December 2018, Planning Policy Wales Edition 10 (PPW 10) was published. In a change from previous editions, 'placemaking' now lies at the heart of the Welsh planning system. This new policy document is designed to align the planning system with the landmark Wellbeing of Future Generations (Wales) Act with the goals of: a more prosperous Wales, a resilient Wales, which supports healthy, functioning ecosystems and recognises the limits of the global environment, a healthier Wales, a more equal Wales, a Wales of more cohesive communities, a Wales of vibrant culture and a globally responsible Wales.

Earlier editions of PPW recognised geology, landforms and biodiversity as part of the wider natural heritage of Wales. This was particularly important in rural areas, where there was a need to conserve and, where possible, enhance these attributes, balanced against the economic, social and recreational needs of local communities and visitors. This policy guidance was supplemented by Technical Advice Note (TAN) 5 – Nature Conservation and Planning 2009 which recognised and defined 'geodiversity' and highlighted the importance of Regionally Important Geodiversity Sites (RIGS) as 'Local Sites' which played an important role in contributing to the quality of life and well-being of the community.

Whilst the above elements remain very important in national policy and TAN 5 is still relevant, PPW 10 has greatly strengthened the support for non-statutory geodiversity sites, appreciating

What is Placemaking?

Planning Policy Wales Edition 10 provides a clear definition of what is expected from sustainable development and the planning system to support placemaking for the future: 'Placemaking' is a holistic approach to the planning and design of development and spaces, focused on positive outcomes. It draws upon an area's potential to create high quality development and public spaces that promote people's prosperity, health, happiness, and well-being in the widest sense.

Placemaking considers the context, function and relationships between a development site and its wider surroundings. This will be true for major developments creating new places as well as small developments created within a wider place.

Placemaking should not add additional cost to a development, but will require smart, multi-dimensional and innovative thinking to implement and should be considered at the earliest possible stage. Placemaking adds social, economic, environmental and cultural value to development proposals resulting in benefits which go beyond a physical development boundary and embed wider resilience into planning decisions.

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the role landscape and geology have in communities and in contributing to their sense of place. This enhanced recognition not only arises from traditional mineral extraction sites where PPW 10 acknowledges that restoration may result in "...benefits such as the protection of geological exposures and public access" but geodiversity sites such as RIGS are now recognised more specifically in plan making and development plans. Local planning authorities should look to develop policies for the long term to protect and enhance the natural environment, including geodiversity in its own right. Paragraphs 6.3.13 to 6.3.16 of PPW 10 highlight the significance of RIGS as locally or regionally important sites and that planners and developers should look to promote the incorporation of geological features within the design of developments. These paragraphs also emphasise the importance of other geological designations including UNESCO Geoparks and geological Sites of Special Scientific Interest (SSSI) in the planning system.

The enhanced recognition for geological designations and geodiversity in Welsh planning is already being acknowledged. Powys County Council (PCC), in its recently adopted Local Development Plan (April 2018), identified the location of RIGS on its planning proposals maps and developed a local planning policy to protect RIGS and Geological Conservation Review sites. Further guidance for developers on how to protect and enhance geodiversity is given in the PCC's Biodiversity & Geodiversity Supplementary Planning Guidance published in October 2018, which follows earlier excellent work by other Welsh planning authorities including Rhondda Cynon Taff and Neath Port Talbot County Borough councils. With other Local Development Plans in Wales coming up for review, including Pembrokeshire, Ceredigion and Carmarthenshire, many other local authorities will almost certainly be looking to protect their geological features and geodiversity sites. Further information is available here: <https://beta.gov.wales/sites/default/files/publications/2018-12/planning-policy-wales-edition-10.pdf>



Planning Policy Wales Edition 10 provides for mineral extraction developments to offer benefits to their local communities by protecting geological exposures and enhancing public access as part of their restoration programme. Photo by Adrian Humpage.

Inclusive teaching in fieldwork

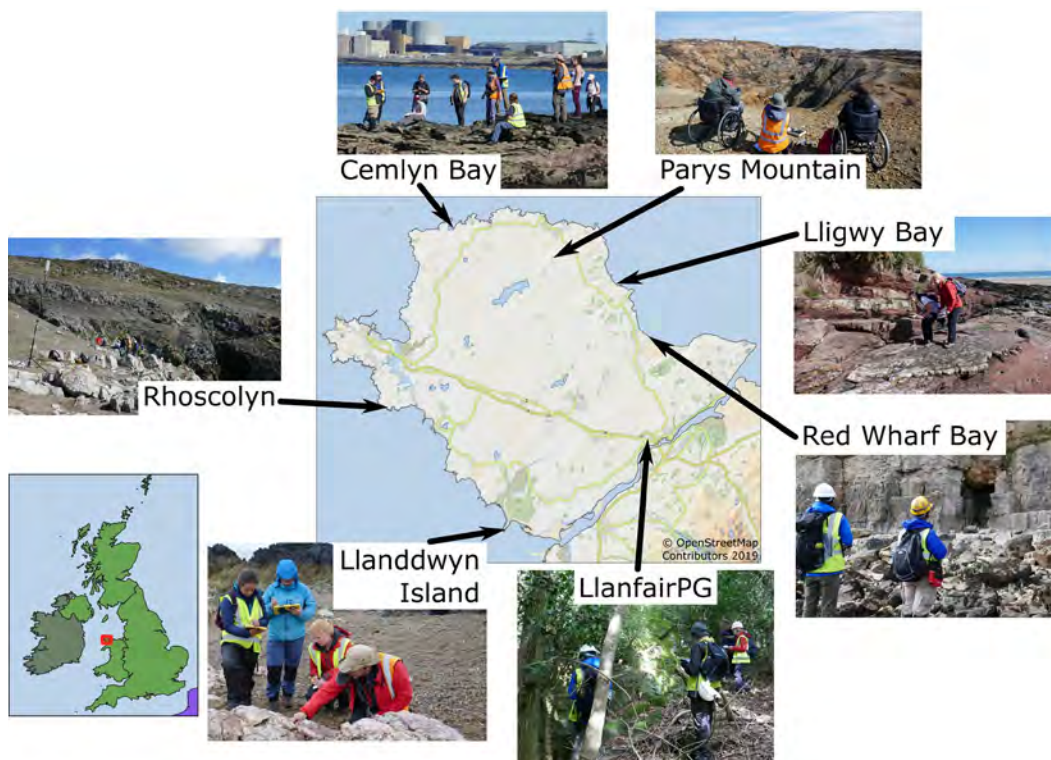
Clare Gordon and Jacqueline Houghton, University of Leeds

In September 2018 we ran the Access Anglesey field class to explore how we could assist inclusion and accessibility in fieldwork and then develop and share good practice (*Earth Heritage Issue 50*). The field trip was run as part of a project on embedding and sustaining inclusive STEM practices funded by HEFCE (now the Office for Students) which involves staff from the Open University and University of Plymouth as well as University of Leeds.

Anglesey is a beautiful place to visit and has a fascinating geological history. Centuries of geological research has attracted thousands of students and the localities chosen for this fieldtrip were picked for their geology rather than their accessibility as we wanted to mirror a standard University field trip as much as possible. The trip was not about getting everyone to every locality; it was about including everyone in the experience at every locality. The field trip participants included six students who identified as having a disability (one of whom had a carer with them) and seven who did not. The students were studying geology or a related subject at a UK university. We also had three observers from other institutions and eight staff from the three project universities.

Accommodation, travel and schedules

We used hostel accommodation for the week. Full board meant more relaxed mealtimes and no need to cook. Rooms were shared, but we provided a quiet room where anyone could get away from the group - a particular need for the autistic students but an opportunity used by others too. Transport was self-drive minibuses and a 4-wheel drive vehicle. This was able to take the wheelchair users off-road and get them as close to the outcrops as possible (with the permission of the landowners).



Map of the localities visited on Anglesey (OpenStreetMap Contributors)

All photos by Clare Gordon.

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The 4-wheel drive vehicle enabled us to take the wheelchair users off-road and get them as close as possible to the Precambrian pillow lavas exposed near Llanddwyn Island. All the students were close enough to be able to hear the discussions over the tour guide system and were able to have a closer look at the rocks.



We knew from pre-trip Skype interviews that a schedule for each day was important and included one on the front page of each day's handout. A planned lunch break is particularly important as an opportunity to replenish energy levels. However, we found that including times on the schedule led to stress for the autistic students as they expected we would keep to those times, which inevitably we did not. A schedule just needs to state the order of events for the day, not the times at which these will happen.

Communications in the field

Communication outdoors for a group can be difficult on any field trip. We hired a tour guide system, as used in museums, so that unobtrusive receivers and a transmitter with a microphone brought the leader's voice into earpieces which everyone wore. A fluffy windshield that resembled a chinchilla cut out wind noise and led to the most memorable joke of the week with the regular announcement of "Chinchilla Radiol!" Using the system not only allowed everyone to hear what was going on, but it also avoided the need to huddle together, something autistic students find particularly stressful.

"The tour guide system's been really good ... now I don't miss anything, because I can't deal with being in a crowd or ... having to sort of back off and go somewhere to the side on my own. I can now do all those things, but I don't miss anything."

Walkie talkies were used for communication between staff, and provided a link with the wheelchair users in the 4-wheel drive vehicle. Thanks to our link with the educational technology team at the Open University we were able to make use of a live feed system. One member of the group used a video camera to film at the outcrop and the people back at the vehicle could ask for particular views to be made available and could hear what was happening.

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Tablets

We took a set of ruggedised iPads and Android tablets loaded with some specifically geological and some general note-taking apps with us and loaned them to students for use in the field. The autistic students found the tablets really helpful and have set up tablets of their own for future fieldwork. Other students tried the tablets, but gave them back. They found that the advantages of tablets were less obvious because they didn't have an issue with using notebooks and were more worried about damaging the tablets. Tablets are worth considering for anyone who finds particular difficulty using a field notebook. However, we would recommend setting them up and gaining experience with them before going in the field.

Alternative exercises in the field

Alternative exercises made up of a set of hand specimens (collected with appropriate permissions) and laminated sheets with printed thin sections and photographs with specific exercises and questions allowed the instructor at the outcrop to cross-reference the images for the students in the 4-wheel drive so that they could see in detail what everyone else was looking at. The hand specimens and thin sections meant those in the vehicle often had unique, additional information they could give to the rest of the group, something they appreciated being able to do.

Mapping and virtual mapping

The final location of the field trip was Rhoscolyn. We spent one day introducing all of the students to the geology with the intention of running a mapping exercise the next day. Before the trip, we created a virtual landscape based on Rhoscolyn. This meant any student who could not participate in the field mapping could do the mapping exercise in the virtual world instead. In the event the weather was bad and everyone stayed in the accommodation, with many people choosing to complete the virtual mapping exercise as a wet weather activity. Feedback from students and staff was enthusiastic but most people stressed the importance of being able to visit the real field area if possible.

“Overall, while work done on the virtual landscape will not replace work done in the actual field, it is a great substitute if conditions within the field are not ideal.”



A tour guide system allows students to spread out and look at the outcrop that is being described, rather than needing to huddle close to the instructor. Now students can look at the outcrop or take notes rather than look at the speaker.

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Where there is no wifi or 4G data connection a live feed system using antennae was set up (left). Video, audio and images could be sent from the group at the outcrop to the students in the 4-wheel drive (right).



“You can get the mapping experience, even if you’re not in a physical state (or mental state...) to actually go out there.”

Evening activities and no assessment

We used the evenings to draw together the ‘geological story’ we were building up and to introduce the next day’s activities. Students also had an opportunity to look at the hand specimens and thin sections. University field trips usually have some element of assessment but feedback from the week showed that without an assessment the students felt that they had more freedom to think for themselves and come up with their own ideas rather than having to find the ‘right answer’.

Conclusions

In conclusion we found that there were simple measures which worked for everyone, and which are worth incorporating in other field trips. Clear schedules gave everyone a framework and helped people to manage their energy levels. Detailed written instructions meant less pressure to take notes and more time to understand what was being shown. No assessment and not attempting to fit too much into each day made everyone more relaxed and receptive. A tour guide system, or another clear way of communicating with students in the field, was a tremendous aid to everyone. Alternative exercises that added to the general pool of knowledge meant that students who could not get all the way to an outcrop could still be included.

Acknowledgements

We would like to thank the landowners who gave permission to drive the 4x4 on their property: Natural Resources Wales (Newborough and Llanddwyn National Nature Reserve); St David’s Park (Red Wharf Bay); Elwyn Owen and Strutt & Parker, Land Management Department (Rhoscolyn); and Ron Clays, Parys Underground Group, Amlwch Industrial Trust and Anglesey Mining (Parys Mountain). Thanks also to the other staff on the field trip: Dan Morgan, Ben Craven and Katy Willis (University of Leeds); Trevor Collins (Open University), Alison Stokes (University of Plymouth) and Christopher Atchison (Cincinnati University). And finally we would like to thank all the participants on the Access Anglesey field class for their enthusiasm and forbearance.

An Extraordinary Society that Shaped Modern Science

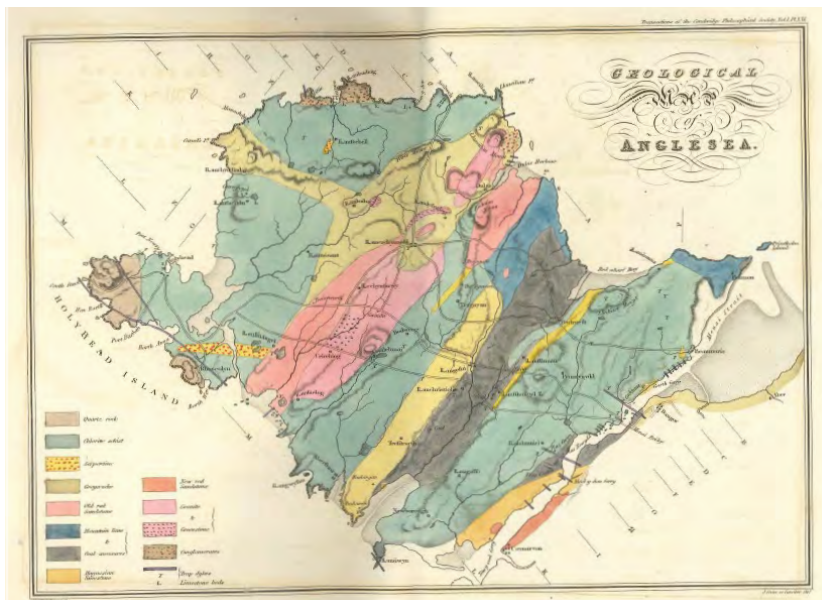
Susannah Gibson, Independent scholar

In 1819, geology was a young and fashionable science. It had been only a few years since William ‘Strata’ Smith had published his intricately detailed geological map of Britain, and interest in the science was booming. In Cambridge, two recent graduates of the University got caught up in this geology mania and decided to teach themselves the rudiments of the science on a field trip. The first was John Stevens Henslow, a young man with a love for the natural sciences. The second was Adam Sedgwick, a mathematics tutor with no experience of geology who had just been appointed Woodwardian Professor of Geology.

At the time, Sedgwick’s lack of knowledge about his subject was not considered a problem in Cambridge. Professors were not necessarily expected to lecture, students were not expected to attend lectures, and subjects like geology were not included in the university examinations. But Sedgwick was a diligent man and set about learning as much about his new subject as he could in just a few short months. He and Henslow journeyed south from Cambridge to the Isle of Wight in the Easter vacation of 1819 and began their explorations. They marvelled at the exposed cliff faces, hunted for fossils, mapped outcrops, and traced the different strata across the island.

The structures they saw and the fossils they found led the two men to begin to think about the deep history of the Earth. They began to think about the geological processes that had shaped the world around them. With increasing excitement, they pored over the latest maps and journals, immersing

themselves in a quest to understand the creation of the Earth. They found themselves at the forefront of a new field, and longed to discuss their findings with colleagues. But what colleagues? There was no scientific community back home in Cambridge. No journal. No scientific library. No forum in which to discuss modern science. And so it was there, on the Isle of Wight, as Sedgwick and Henslow fell in love with geology, that they began to plan a scientific society for Cambridge.



A geological map of Anglesey (Anglesea) from the first paper John Stevens Henslow presented to the Cambridge Philosophical Society in 1821. It was published in their journal *Transactions of the Cambridge Philosophical Society* in 1822. All images © Cambridge Philosophical Society. Used with permission.

The Cambridge Philosophical Society was founded in the autumn of 1819 and its fortnightly meetings have continued uninterrupted ever since. Within a few years of its creation, the Society had opened Cambridge’s first natural history museum, had set up Cambridge’s first scientific library and reading room, and

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Plate II.

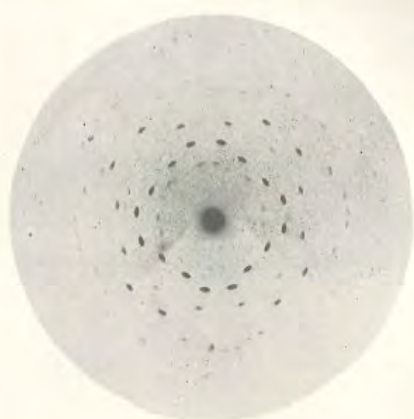


FIG. 3.

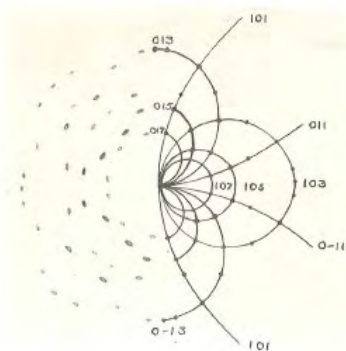
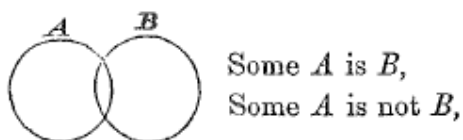


FIG. 4.

Top: An x-ray diffraction pattern from Lawrence Bragg's first paper presented to the Cambridge Philosophical Society in 1912. Bragg was just 22 when he presented this paper; he later won a Nobel Prize for this work.

Bottom: One of the earliest Venn Diagrams. John Venn was a fellow of the Cambridge Philosophical Society and first presented his work on Venn Diagrams there in 1880.

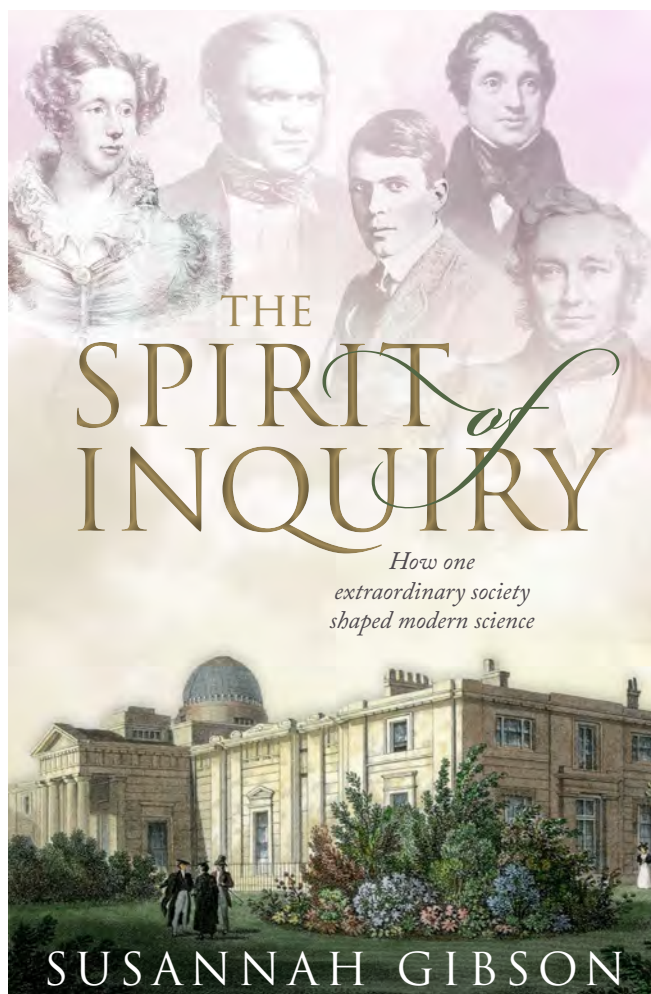


The Spirit of Inquiry: How one extraordinary society shaped modern science. Susannah Gibson. Oxford University Press. 2019. £25. ISBN 978-0-19-883337-619)

had begun publishing Cambridge's first scientific journal. Students and professors alike flocked to the Society to learn about new discoveries being made across Europe and the world, and to find support for their own first forays into research.

This year, the Society celebrates its 200th anniversary. It has supported the work of countless scientists over the years; ranging from Charles Darwin to James Clerk Maxwell. Cambridge has changed enormously in these two centuries, and now is home to some of the most impressive laboratories and scientific facilities in the world. Thousands of researchers work to solve some of the most pressing problems we face today. The Society, now a small part of a large and thriving scientific community, continues to fund blue-skies research, to host open meetings to share that research, and to publish high-impact journals.

The Spirit of Inquiry: How One Extraordinary Society Shaped Modern Science is published this month to celebrate the 200th anniversary of the Cambridge Philosophical Society.



Cross-bedded Permian desert sand dunes beside the Geopark Way (this issue p 39) in Low Town, Bridgnorth, close to the start of the route. Photo by Mike Brooks.





Earth Heritage in print

Earth Heritage is produced twice-yearly by the Geologists' Association, Natural England, Natural Resources Wales, Scottish Natural Heritage and the Quaternary Research Association.

It can be downloaded free as a pdf file from www.earthheritage.org.uk. You can also purchase a hard copy of any issue via www.geologistsassociation.org.uk/earthheritage. Subscribe to notifications of new issues at www.earthheritage.org.uk/subscribe.

We thank all those who have assisted in preparing the publication, including the voluntary geoconservation sector who are major contributors. The opinions expressed by contributors are not necessarily those of the above organisations.

A large lycopod stump unearthed during initial excavations in 2008. Covering part of the site and upcoming excavations will allow Brymbo Heritage Trust to unearth more awe-inspiring examples of the ancient Carboniferous flora and fauna preserved in this unique treasure-trove of natural history.

Photo by Peter Appleton

