

Earth Heritage

The Geological and Landscape Conservation Magazine

ISSUE

49

Spring 2018

**Geological
Interpretation
at Porth y Swnt**



**Mapping the
Knighton Sheet**



**Replica Fossils
at Joint
Mitnor Cave**



**The Elgin
Reptile Quarries**





COVER - A new geology display to the Porth y Swnt visitor centre in Aberdaron is not only visually impressive but also interactive and informative for all ages. Nowhere else on the Llŷn Peninsula is it possible to see the full range of rock types with a natural and polished finish (see page 18). Photo Laura Hughes, National Trust



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Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad



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Wales



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EDITORIAL

Having long been an admirer of this incredibly informative magazine, I was delighted to have the opportunity to edit this issue and to have a preview of all the excellent articles it contains.

Earth Heritage 49 is another bumper issue and contains a wide range of articles and reports on conferences, funding successes and other geoconservation news. To highlight just a few of the special features in this issue - in the Outcrops section we celebrate GeoMôn Geopark's second successful revalidation and the launch of two important documents: Scotland's Geodiversity Charter 2018-2023 and the Government's 25-year environment plan.

Art and geology are also in the news with artist Colin Bentley being appointed as artist-in-residence at the Jurassic Coast Trust, a new writing competition inspired by the work of Hugh Miller and organised by the Scotland's Geodiversity Forum and partners and a visionary display of the rocks of the Llŷn Peninsula by sculptor, Ivan Murray, to accompany a poem Braich y Pwll by Christine Evans at the Porth y Swnt visitor centre.

Outreach is an important aspect of our work in geoconservation and this issue highlights the work of various programmes, such as the Jurassic Coast volunteer ambassadors, the GeoBus that brings geology education resources and workshops to schools in Scotland, and EarthCaching – a great way to introduce non-specialists to the wonders of Britain's geological heritage.

The *Earth Heritage* Editorial Board is actively planning the landmark 50th Issue, which will be published later this year.

As ever, we want to hear your views and to learn of new projects.

To contribute, please contact the most appropriate editor (left).



Susan Marriott, Guest Editor

Revalidation success for GeoMôn UNESCO Global Geopark

GeoMôn Geopark is celebrating another successful revalidation with the award of a 'green card' by UNESCO. Global Geoparks are assessed on a four-yearly cycle and the rigorous assessment requires evidence of visibility, activity, audited accounts and a field evaluation by two UNESCO assessors. The report is then put forward to the UNESCO Global Geoparks Council for approval. This is the second successful revalidation for GeoMôn since its creation in 2005.

During the two-day field evaluation GeoMôn was scrutinized by Alessandra Casini from Tuscan Mining Geopark, Tuscany, Italy and Zhang Hai from Karst Geopark, Guilin City, China. The evaluation included meeting key partners such as Anglesey County Council and Natural Resources Wales and site visits to a selection of key geosites on the island.

Although the revalidation was successful, feedback included recommendations for future work. The UNESCO Global Geoparks Council recommended:

- formalising agreements with GeoMôn's partners
- building on the good relations GeoMôn has with community partners
- improving visibility on the websites and social media activity of partners and tourism providers
- making greater use of new technologies and integrating biodiversity interests with geodiversity in future interpretation initiatives
- putting Geopark signage on the A55
- strengthening and developing new partnerships with other Global and European Geoparks

One of the key GeoMôn sites is Llanbadrig headland near Cemaes which is composed of Precambrian melange. Margaret Wood (centre) describes the limestone and dolomite with the melange to the UNESCO assessors. Photo by Raymond Roberts



The continuation of GeoMôn as a UNESCO Geopark is a feather in the cap not only for the Geopark and its partners, but also for Wales as a country. The two Welsh Geoparks (GeoMôn in Anglesey and Fforest Fawr in South Wales) highlight the importance of Wales' geodiversity at a global level and will continue to be exemplars in using geodiversity as the focus for sustainable economic development.

Raymond Roberts, Natural Resources Wales and Margaret Wood, Director GeoMôn Geopark

Earth's Climate Evolution - a New Geological Perspective discussed at the GA conference.

Since the 20th century, the Pleistocene sediments at Rotherslade have played a key role in the reconstruction of the Quaternary depositional environment of Wales. Traditionally regarded as the most eastern exposure of *in situ* till on the Gower, Rotherslade was thought to mark the limit of the LGM ice on this part of the peninsula. Recent work suggests that the sediments at Rotherslade represent periglacial, glacial outwash and mass movement deposits. As a protected geological conservation site Rotherslade will continue to be a key locality for Quaternary research in the UK. Photo by Stewart Campbell

Attendees at the Geologists' Association 2017 conference spent a fascinating day listening to a series of lectures examining many aspects of our planet's changing climate through geological history; hosted in the splendid surroundings of the National Museum Wales in Cardiff.

In a wonderfully well-thought-out program, the theme took us from the extremes of Snowball Earth, to examining the impact of pioneering colonisers of the land on the biosphere, lithosphere and atmosphere. Talks detailed the wonders of Devonian forests, of Carboniferous coal-swamps and the extreme climate change at the Permo-Triassic boundary, the Cretaceous greenhouse climate, Cenozoic climate change and ice sheet stability; before finally coming back to the present day situation of Antarctic ice shelf warming, and into the future with a fascinating talk on our new potential geological epoch, the Anthropocene.

On the second day of the conference, several field excursions were on offer. Some headed to the stunning coastline of the Gower peninsula, to do some serious thinking about the late glacial record as well as to re-examine the evidence for the number, timing, style and extent of glaciations that have affected this part of South Wales. During this visit some critical questions were asked: where was the western limit of Last Glacial Maximum (LGM) ice, was it at Rotherslade? Are there any exposures of *in situ* subglacial till on Gower? Is the Paviland moraine really a moraine, and what age should we give it?

Others headed inland, to the beautiful Fforest Fawr Geopark. Here, set within the Brecon Beacons National Park, delegates had the option of seeing the fascinating exposure of karst that overlies Britain's deepest cave or explore the structural delights of the Variscan anticline of Cribarth. As well as geological interest there was time to look at the industrial archaeological interest of quarrying and firebrick manufacture.

Chris Byrne, Natural Resources Wales



Launch of Scotland's Geodiversity Charter 2018-2023

On 16th November 2017 Bridget Campbell, the Director for Environment and Forestry for the Scottish Government launched Scotland's Geodiversity Charter at a conference in Dynamic Earth in Edinburgh. This was the culmination of a year-long effort by the Scottish Geodiversity Forum to refresh the world's first geodiversity charter, originally published in 2012.

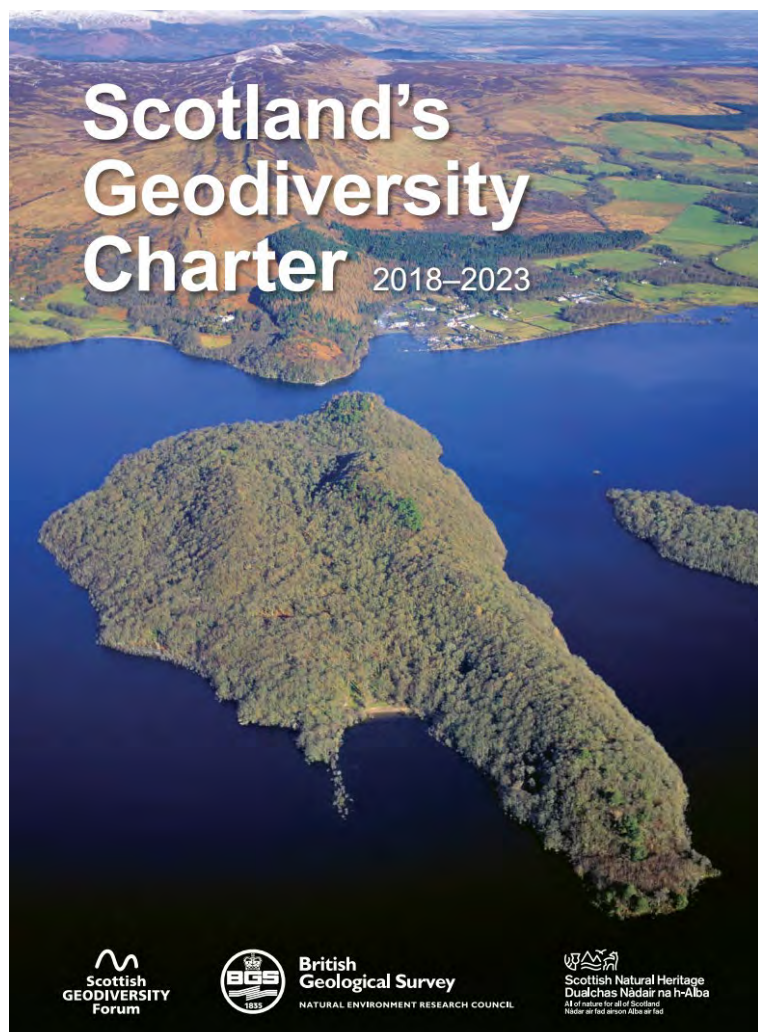
The conference resulted in energetic discussions and networking based on a keynote presentation by Prof Iain Stewart, Patron of the Forum, and a series of case study presentations covering a wide range of topics, from Geoparks to education and outdoor learning to restoring active river processes.

The Charter now has the support of an impressive list of 87 signatory organisations who appreciate the importance of Scotland's geodiversity and support the vision of the Charter 'that Scotland's geodiversity is recognised as an integral and vital part of our environment, economy, heritage and future

sustainable development, to be managed appropriately and safeguarded for this and future generations'. These signatories include Universities and Local Authorities, key government agencies, Geoparks, NGOs and small businesses.

Relaunching the Charter has proved to be a very valuable exercise in raising the profile of geodiversity with these organisations, and giving opportunities for promotion and the development of new projects. New case studies that illustrate what has been achieved in the first five years has been particularly important, and the Forum website now hosts 35 relevant and varied examples of projects carried out by a wide range of organisations at different scales. The challenge now is to support this wide network of signatory organisations to take forward the Charter's vision. A growing network of interested parties and skilled individuals makes this possible, and we look forward to further activity that will keep the Charter live and relevant during the next five years and beyond.

Angus Miller,
Chair of the Scottish Geodiversity Forum



Jurassic Coast artist in residence

In 2017 the Jurassic Coast Trust commenced a three-year artistic collaboration with Colin Bentley, a fine artist based in Ottery St Mary in East Devon. In October Colin prepared his first Jurassic Coast exhibition, showcasing the landscapes of the coast between Exmouth and Beer at Sidmouth's Kennaway House. The exhibition featured 35 landscape paintings, as well as a gallery of eight portraits of local Jurassic Coast Ambassadors, see article on page 35.

Throughout 2017, Colin walked East Devon's section of the Jurassic Coast alongside the Trust's Ambassadors (see article later in this issue), drawing inspiration from their knowledge of the coast and incorporating it into his artwork. He also became an Ambassador himself, utilising his previous experience as a primary school teacher to lead art workshops at the Trust's family events.

Waves crashing against Salcombe Hill, Sidmouth. Oil on Canvas, 60 x 40 cm. Picture by Colin Bentley



In 2018, Colin turns to Dorset. He is currently exhibiting at Dorset County Museum in Dorchester during the residency of 'Dippy', the Diplodocus from the Natural History Museum. He will then be preparing his second Jurassic Coast exhibition later this year, displaying another set of Ambassadors' portraits alongside paintings of iconic West Dorset landscapes like Golden Cap, Lyme Regis and the Isle of Portland.

Colin donates a proportion of sales from his artwork to the Jurassic Coast Trust, enabling them to continue their work protecting the World Heritage Site and inspiring people with its stories. His first exhibition raised over £8,000 for the Trust, and he hopes to replicate this across the next two years.

Colin said of his first exhibition, "It's always a pleasure to see so many people at the exhibition who share my passion for this coastline. Knowing that the paintings will be enjoyed for generations to come is something I'm very proud of. I've had a fabulous year painting this section of the Jurassic Coast, and I can't wait to start the next set of paintings."



Colin at the exhibition's opening evening. Photo by Jurassic Coast Trust

Guy Kerr, Jurassic Coast Trust

A Green Future: Our 25 Year Plan to Improve the Environment

The Government's environment plan sets out its goals for improving the environment over the next 25 years. It details how it will work with communities and businesses to do this.

Although there are no specific actions for geodiversity, the plan and annexes provide some hooks which can hopefully be used by stakeholders to engage in the delivery of the plan. Geodiversity and geoconservation are recognised in the context of protected sites and their contribution to culture, society and the economy, for example through the Jurassic Coast World Heritage Site and the UNESCO Global Geoparks. General measures such as reducing waste, improving water quality and connecting people with nature, should also have a positive impact.

Thought will now be needed on how to progress geoconservation in the context of this plan. To download the documents visit <https://www.gov.uk/government/publications/25-year-environment-plan>

Hannah Townley, Natural England

Countryfile Live

Countryfile Live is a massive country show that is now held annually over four days in August in the grounds of Blenheim Palace in Oxfordshire. It is an offshoot of the popular BBC television programme, Countryfile, and the celebrity presenters attend events at the show.

For the last two years, Gloucestershire Geology Trust has had a stall in 'Go Wild' – the wildlife zone at the show. They have been able to sell their popular trail guides, put on fun activities for children and talk to the public about our wonderful rocks and landscapes. A roving dinosaur was a hit with visitors and fellow stallholders alike. On a couple of days last year they were joined by members of other Geology Trusts from Oxfordshire, Herefordshire and Worcestershire, bringing extra activities to engage visitors.

Countryfile Live is attended by many thousands of people of all ages, so it is a great place to reach the public, and also led to BBC radio interviews for Gloucestershire Geology Trust. Commercial exhibitors pay high fees, but stalls are free to charities. Application details can be found on the Countryfile Live website: <https://countryfilelive.com/>



Come and meet T-Rex!
Photo by Julie Harrauld

Julie Harrauld, The Geology Trusts

Exposed geology provides a new landmark at the Queensferry Crossing

When the Queensferry Crossing opened to traffic on 30 August 2017 road users not only experienced for the first time the longest three-tower, cable-stayed bridge in the world but were also treated to a new and remarkable insight into the geology of the area. In contrast to the dark coloured dolerite of the Midland Valley Sill exposed in road cuttings to the north of the old Forth Road Bridge, fresh cuttings into bedrock on the southern approach to the Queensferry Crossing illustrate spectacular exposures of gently undulating Carboniferous strata comprising sandstone and other finer-grained sedimentary rocks.

Permanent rock exposure was retained during the road infrastructure development, associated with the bridge construction, to promote a natural appearance and achieve aesthetic objectives. These were aimed at reducing and avoiding adverse landscape and visual impacts. Regularly spaced 'half barrels' created by pre-splitting of rock faces were removed to ensure an irregular naturalistic appearance of the faces.

The rock exposures provide landmarks along the M90 and create a 'sense of place'. It is reassuring that within the scope of this major development that geodiversity was considered and utilised to good benefit, an ethos which is at the heart of Scotland's Geodiversity Charter.

Colin MacFadyen, Scottish Natural Heritage



Beds of sandstone and shale exposed in new road cuttings that border the M90 on its approach to the recently completed Queensferry Crossing over the Forth. Photo by Lorne Gill/SNH

The Ice Age in Worcestershire

Two exhibitions in Worcester this summer will bring together the work of geologists, natural historians, and archaeologists in the West Midlands to tell the story of the Ice Age in Worcestershire. Thanks to funding from the Heritage Lottery Fund and Arts Council England, visitors will get an insight into the way the Pleistocene shaped the modern landscape, and find out more about half a million years of human history in the region.

The Lost Landscapes project, working with volunteers, local schools and the public, explores our understanding of the Ice Age objects and information in the care of Worcestershire Archive and Archaeology Service and Museums Worcestershire, as well as the collections of institutions across the West Midlands. These collections, amassed since the formation of the Worcestershire Natural History Society in 1833, tell a story of antiquarian study and the emerging understanding of the most remote of periods in human history. Wonderful artefacts and specimens were collected from key Ice Age sites in Britain and Europe throughout the 19th and 20th centuries. The exhibitions and activities will bring together what we know of Worcestershire's lost Ice Age landscapes from two centuries of collecting and study. The effects of our scientific endeavours on the ferocious debate surrounding the origin of our species, and what it means to be human will also be examined.

Neanderthal hunters at Kemerton, Worcestershire, around 40,000 years ago. Picture by Steve Rigby



Two free exhibitions will run from June 16th to September 8th 2018. Worcester City Art Gallery and Museum will tell the story of the Ice Age, and The Hive will examine the origins of humanity and the progression of our scientific understanding, as well as hosting a digital art installation. Throughout the summer there will be a programme of events, children's activities, workshops, and public lectures. Find out more at iceageworcestershire.com.

Rob Hedge, Worcestershire Archive & Archaeology Service

Graham Worton awarded the Brighton Medal

Dudley Borough Council geologist Graham Worton has worked for the council for 17 years and has been closely involved with Dudley Museum for more than 35 years. Graham has dedicated his life's work to promoting the area's geological heritage, and in recognition of this work, he has been awarded the prestigious Brighton Medal by the outgoing chair of the Geological Curators' Group (GCG).

Graham Worton (left) describes the geology of Wren's Nest National Nature Reserve during a UNESCO mission to assess the proposed Black Country Global Geopark. Photo by Colin Prosser

In presenting the award, outgoing chair of the GCG, Giles Miller, recognised the breadth of Graham's work to engage with local communities through local fun days, art projects and the rock and fossil festivals (for examples see *Earth Heritage* no 21, page 5 and no 47, page 4). The award also acknowledges Graham's involvement in regional and national geoconservation programmes and his research on collections, geoconservation and local geology.



In acknowledgement of the award Graham said:

"Dudley is a special place and I'm fortunate to have done a job that I love for many years in a borough that I have called home all of my life. Its an honour to be recognised in this way by my peers but I must share this award with all the colleagues, volunteers, visitors and students that I have worked with over many years, who share the same passion and drive to protect and celebrate our world class geology and heritage."

Hannah Townley, Natural England

Further information

The Brighton Medal was set up in 1992 in memory of Bertie Brighton, who catalogued more than 375,000 specimens in his lifetime and was known for his inspirational teaching. It is awarded every three years to a geological curator by the outgoing chair of the GCG.

The Geological Curators' Group <https://geocurator.org/>

Looking after the Ice Age - New QRA Geoconservation Fund

The Quaternary Research Association (QRA) is pleased to announce a new fund for geoconservation, which was launched in January 2018 at their Annual General Meeting and conference in Plymouth.

QRA members and organisations who deliver and promote the conservation of our Quaternary geoheritage are invited to apply for the new QRA Geoconservation Award. Grants of up to £1000 will normally be made although larger requests will be considered. Awards are open to individuals and organisations to deliver geoconservation projects and activities, and organise geoconservation themed events, as well as to share good practice on Quaternary geoconservation.

Applications for the QRA Geoconservation Award can be for site-based works and off-site projects. If you have a Quaternary site that needs clearing, monitoring or protecting, or a museum collection that needs conserving, or indeed a geoconservation-themed event that needs funds, please contact the QRA Conservation Officer to discuss your project. If interpretation and public engagement are part of your project, you can also apply to the QRA Outreach Fund <https://www.qra.org.uk/outreach-funding/>.

The QRA Geoconservation Award and the QRA Outreach Fund both have two deadlines each year, 1 March and 1 September, although urgent applications will be considered throughout the year.

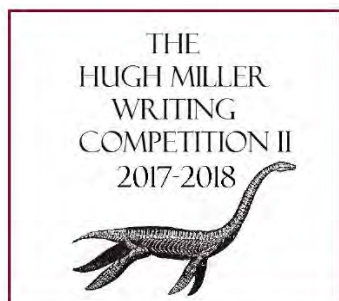
Conservation work to clear vegetation and open up a section in the Lower Loam (deposited during the Hoxnian Interglacial approximately 400,000 years ago) at Swanscombe Skull Site National Nature Reserve in Kent. The Lower Loam is significant due to the presence of animal footprints and knapping scatters. This work was carried out in advance of the European Society for Human Evolution visit in September 2015. Photo by Eleanor Brown, Natural England



For further information and an application form, please contact the QRA Conservation Officer (conservation@qra.org.uk) and/or the QRA Outreach Officer (outreach@qra.org.uk).

Eleanor Brown,
QRA Conservation Officer

Scotland's fossils to inspire new writing



***Footprints in the Sand: The Hugh Miller Writing Competition* carries the name of one of Scotland's most endearing geologists, Hugh Miller (1802-1856), and aims to honour his legacy by inspiring new, original prose and poetry on the theme of Scotland's rich fossil heritage. The competition is organised by the Scottish Geodiversity Forum, The Friends of Hugh Miller and other partners.**

This year, poetry and prose entries are invited that are inspired by fossil discoveries made in Scotland over the last 30 years. As a prolific writer on the subject of fossils, particularly his beloved Devonian fish, Hugh Miller's texts also provide the reader with a wealth of potential inspiration. We hope that this writing competition, which is open to all ages, will encourage a renewed interest in Miller's work and contribute to a catalogue of new writings inspired by one of Scotland's greatest nature writers.

The Middle Devonian age fossil remains of *Dipterus* from Achanarras Quarry in Caithness. Hugh Miller collected and studied fossils of similar age in Cromarty, around the Moray Firth and further afield and these provided inspiration for his writing. *Dipterus* was probably capable of living in water with a low oxygen content and was able to gulp air. It is related to modern lungfishes that inhabit rivers in Australia, Africa and South America. Photo by Nigel Trewin

Lara Reid, organiser of the competition and volunteer with the Scottish Geodiversity Forum and Friends of Hugh Miller charity, says, "The first competition, which ran in 2015-16, was a huge success, and we were delighted by the unique, high quality entries we received that had Miller and his legacy at their heart. We hope that basing this second competition around Scotland's fantastic fossil record will inspire writers young and old from across Scotland and beyond to take part."

Angus Miller, chair of the Scottish Geodiversity Forum, says, "This is a great opportunity to build on Hugh Miller's impressive record of fossil finds and his ability to bring these fossils to life through his magnificent writing. In recent years, there have been amazing new fossil finds in Scotland, helping to fill gaps in the evolutionary record, and we are delighted to be part of this project to build on Hugh Miller's legacy and encourage new writing about Scotland's fossils."



We also aim to highlight the role that Scotland's geology plays in filling gaps in our understanding of the evolution of life and to foster greater awareness and appreciation of Scotland's geodiversity.

The Hugh Miller Writing Competition will close on 15th April 2018. Further details, including how to enter, can be found here: www.scottishgeology.com/hughmiller/

Lara Reid, Freelance Science Writer

New Proceedings editor and President for the GA in 2018



Nick Pierpoint, the new GA President, enjoying the view at the top of Worcester Beacon. Photo by Liam Gallagher

Incoming President: Nick Pierpoint

From May 2018 the GA will have a new President, with Natural England's Colin Prosser standing down to Senior Vice President after two years at the helm. The new President is no stranger to *Earth Heritage*, having co-authored the article 'Geoconservation of the Little Heath SSSI, Hertfordshire, in [EH 48](#). With a geology degree (1980) from Liverpool Polytechnic, his early career was in the oil industry as a mud logger and wellsite geologist for Aramco in the Middle East. Following the oil price crash of 1984/5 Nick studied for a Postgraduate Diploma in Offshore Engineering at Robert Gordon's Institute of Technology in Aberdeen. This was followed by a four-year assignment with Texaco in Angola as a Wellsite and Operations Geologist. From 1992 to 2016 he was manager of Geological Operations for BG Group, supporting activities in the Santos Basin, Brazil, the Surat Basin in Queensland and in high-pressure wells in the UK Central Graben, targeting Jurassic and Triassic reservoirs (of particular interest was pore-pressure surveillance and evaluation of hydrocarbon gases liberated during drilling). He was instrumental in establishing Geopressure Management Network (an oil industry forum for operators), initially across Europe but which now extends to North America and Australia. Nick has been an active member of the Hertfordshire Geological Society for many years and, since joining the GA's Council, convened the Association's first Student Symposium in 2017.



Malcolm and a party of geologists leaving the K/Pg boundary section near Gams in the Styrian Eisenwurzen UNESCO Global Geopark in the Austrian Alps. Photo by Dr Tatyana Kodrul

PGA Editor: Malcolm Hart

The PGA has a new editor from January 2018. Replacing Jim Rose, who served for nine years and oversaw the transfer of the journal to Elsevier and to Science Direct (during which time the journal took over the continued publication of the *Geological Conservation Review*), the new PGA Editor-in-Chief is Malcolm Hart, Emeritus Professor of Micropalaeontology at Plymouth University. Malcolm has a degree in geology from Imperial College, where he remained for his PhD research on the micropalaeontology of the mid-Cretaceous (with emphasis on S.W. England). With a primary interest in foraminifera, Malcolm has also published on ostracods, pteropods, heteropods, radiolaria, holothurian sclerites, otoliths (fish ear bones), Jurassic statoliths (squid ear bones) and Jurassic squid arm hooks.

During 2000–2006 Malcolm served on the Council of English Nature and assisted in gaining World Heritage status for the Dorset and East Devon Coast. He served on the Science and Conservation Advisory Group of the World Heritage Site for many years and chairs the Science Panel of the English Riviera Geopark. In 2009 he authored a non-specialist book on the geology and landscape of Dorset and East Devonshire. As a founder member of the Devon RIGS Group, he has served in a number of roles and is currently the chair.

David Bridgland, Geologists' Association

Centenary Excursion to Richmond Park, Kingston Hill and Wimbledon Common, 20 May 2017

Gravel exposure at the view point in Richmond Park.
Photo by Diana Clements

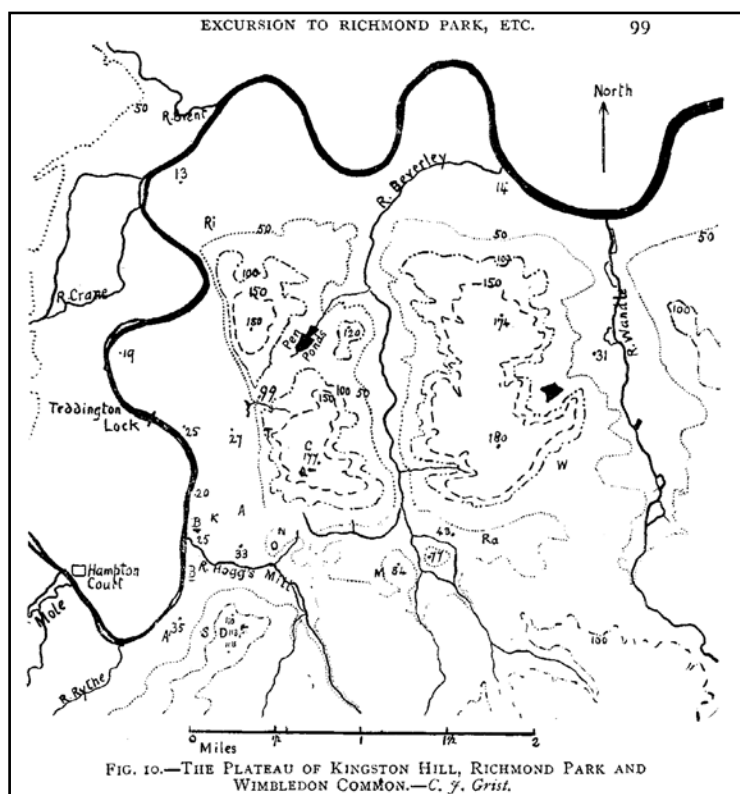


A joint enterprise of the London Geodiversity Partnership, the Geologists' Association (GA), the Friends of Richmond Park and the London Natural History Society, this was a re-enactment, after 100 years, of the GA excursion of 19 May 1917 to the gravels capping the Richmond Park - Kingston Hill - Wimbledon Common plateau.

In 1917 the exposures in Richmond Park were little better than in 2017, both relying on gravel exposures in the slope near a viewpoint. Since 1917 the gravel has been identified as the oldest of the Lower Thames staircase, the Black Park Gravel, here with Lower Greensand chert from the south-bank tributaries and quartzite pebbles from the Midlands via the main Thames adding to the dominant flint.

In 1917 there was a working quarry on Kingston Hill, now much overgrown and within the Coombe Wood golf course, which could not be entered on a summer Saturday. On Wimbledon Common the 1917 party examined the gravel in trenches that had been opened up for military purposes but there was no such luxury in 2017, although at Caesar's Well the group could drink the pure water coming from the junction of the gravels and the underlying strata and study an exposure of Bagshot Sand, finishing with a look at exposed areas of London Clay on the shores of Queen's Mere.

A more complete report of this event appears in the GA Magazine (December 2017).



Diana Clements,
London Geodiversity Partnership
(www.londongeopartnership.org.uk)
and the Geologists' Association
(www.geologistsassociation.org.uk)

The plateau of Kingston Hill, Richmond Park and Wimbledon Common, as illustrated in the report of the 1917 excursion by its leader, C. J. Grist, in the PGA of that year (pp 98 – 104). Such reports of former excursions are available online; when Elsevier took over the Proceedings in 2008 they scanned the back issues to 1858 when the GA was founded and all are on ScienceDirect (more information is available here: <https://geologistsassociation.org.uk/pgar/>). These reports are an invaluable resource for geoconservationists, as often there are photographs as well as descriptions of sites and exposures. With thanks to the GA Mag for permission to reproduce.

Culturally Natural or Naturally Cultural?

Editors: Jonathan Larwood, Sarah France and Chris Mahon. IUCN National Committee UK (2017), 72pp., Free (Soft cover).

Culturally Natural or Naturally Cultural? explores the relationship between natural and cultural heritage through case studies of mainly UK World Heritage Sites (WHS) in a report of a workshop held in 2014 at the Studley Royal Fountains Abbey UNESCO WHS in North Yorkshire.

Unusually, there are three forewords, from Tim Badman, Director of the IUCN's World Heritage Programme, Kerstin Manz of the UNESCO World Heritage Centre and one from me as the former Mayor of Ripon, and instigator of the workshop. Jonathan Larwood and Sarah France introduce the concept behind the workshop. Adrian Phillips and Christopher Young give an overview of cultural and natural heritage within the World Heritage Convention by reference to WHSs across the world, and discuss the difficulties of managing culture and nature together in the UK.

The two-day workshop brought together 42 delegates including representatives from all of the UK WHSs who gave 12 contributions, lavishly illustrated in the workshop, less so in the publication, further dissecting the out-dated split into natural and cultural WHSs, and offering the more holistic concept of cultural landscapes. The Jurassic Coast and the Giant's Causeway are the only natural sites in the UK. All other sites are classed as cultural except St Kilda, which is classed as mixed. It is hard if not impossible to regard Hadrian's Wall and the English Lake District as anything other than cultural landscapes rather than sites.

Research carried out by Chris Mahon with support from WWF-UK's Alma Roberts, concluded that 56% of the UK's WHSs have a Significant or High level of nature interest, making real contributions to nationally important habitats and species conservation targets.

Nicely illustrated throughout, this report is recommended for anyone with an interest in the UK's cultural and natural environment, its UNESCO WHSs and the interfaces that can be found.

Mick Stanley, Geodiversity Consulting

View across Studley Royal water garden in the bottom of the post-glacial valley looking south towards Fountains Abbey ruins. Photo by Mick Stanley



Further information

<https://iucnuk.files.wordpress.com/2017/05/naturally-cultural-web.pdf>

Geoheritage Assessment, Protection, and Management

Edited by Emmanuel Reynard and Jose Brilha, Elsevier (2017), 482pp., ISBN: 9780128095317, £118.



This is a new reference book presenting state-of-the-art research on geoheritage and geoconservation around the World. From the publisher's description: "For the last 20 years there has been a growing interest in the geosciences for topics related to geoheritage: geoconservation, geotourism and geoparks. Geoheritage: Assessment, Protection, and Management is the first and only reference book to cover these main topics as well as the relationship of geoheritage to other subjects such as landscapes, conservation, and tourism. The book also includes methodologies for assessment, mapping, and visualisation, along with case studies and colour images of some of the most important global geosites."

Hannah Townley, Natural England

Further information

www.elsevier.com/books/geoheritage/reynard/978-0-12-809531-7

Herefordshire's Rocks & Scenery - A Geology of the County

John Payne (Editor). Logaston Press, 2017, 234pp., ISBN: 97819010839164, £15.00.

A general introduction covering the geography and geology of Herefordshire is followed by a chapter on basic geological principles to facilitate the understanding of the subsequent detailed sections by readers without a geological background. Chapters comprehensively cover the geological history of the county, with scholarly accounts of the rocks of each Period starting with the Precambrian complexities of the Malvern Hills and continuing through time up to the last Ice Age. The Malvern Hills are put into the context of global plate tectonics in an easily understandable way, explaining the environments of deposition of the sedimentary rocks and the reasons for tectonic and igneous activity as the continental crust beneath this part of England moved across the globe from the southern to the northern hemisphere over geological time. Finally, the impact of the underlying rocks on people and the man-made landscape is considered, including building stones, agriculture and settlement patterns.



The level of geological detail in this book will satisfy geologists but it is also accessible to non-specialists. High quality annotated photographs, maps and diagrams greatly enhance the publication. Grid references indicate the locations of the points of interest, with detailed descriptions of key localities. In fact an Ordnance Survey map of the county would be helpful to the reader as the plethora of place names (too many, probably, to mark on the maps) assumes local knowledge. The book is the first county geology of Herefordshire, so is long overdue.

Isobel Geddes, Wiltshire Geology Group

Developing the geological interpretation at Porth y Swnt, Aberdaron

Laura Hughes, National Trust and **Raymond Roberts**, Natural Resources Wales

Opened in March 2014 as part of a Visit Wales and ERDF funded Coastal Centre of Excellence project, Porth y Swnt is a National Trust visitor centre that aims to promote and interpret the unique qualities of the Llŷn Peninsula through an innovative mix of poetry, art installations, technology and audio visual elements. As well as being a destination in itself Porth y Swnt acts as a year-round gateway to what the area has to offer in terms of walks, activities and attractions. The National Trust also welcomes groups and school visits and organises a series of community events throughout the year.

The visitor journey through the four areas of the centre — The Deep, The Way, The Light and The Fold — is designed to encapsulate what makes the area special and to give teasers that inspire further exploration. Instead of attempting to replicate information and experiences already available digitally, or at other attractions, the journey provokes, facilitates and inspires the visitor to go out and explore the wider Llŷn area first hand.

During 2017 it was decided to refresh some of the interpretation in the centre to evolve the experience for visitors and respond to feedback requesting more tangible information on certain topics. Geology, agriculture and wildlife were the key topics we decided to explore further during this phase of development and a creative interpretation brief was put out to find an artist to collaborate with. The brief was to add depth to the understanding and appreciation of the three topics by creatively building in elements of information whilst keeping true to the artistic and innovative nature of the centre.



Aberdaron beach is one of a series of expansive bays on the Llŷn which is backed by thick Quaternary deposits. Only a few hundred meters from Porth y Swnt visitor centre it is a fantastic site to study the geological history of the Llŷn by just picking up a pebble. Photo by Raymond Roberts, Natural Resources Wales

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Artist Ivan Murray completes the Quaternary segment by slotting in a specimen of Snowdonia volcanic tuff transported by the Welsh Ice sheet and collected in Gwydir Bay.

Photo by Raymond Roberts, Natural Resources Wales

One of the six segments which represent the geology of the Llŷn peninsula. Here specimens collected from glacial till include material transported from as far afield as Scotland, Anglesey and Snowdonia. Photo by Laura Hughes, National Trust

Previously geology was visually represented by the poem Braich y Pwll by Christine Evans, on a painted ply background depicting layers of rock. Feedback from the public suggested a thirst for more information and the opportunity for more hands-on geology. We decided to work with Ivan Murray a sculptor from Rhiw near Aberdaron. Ivan was asked to re-vamp this space to illustrate what makes the geology of Llŷn special through a visually striking, creative installation that provides:-

- tangible information about the peninsula's geology
- something hands on to engage with
- inspiration for further exploration out in the landscape
- an appeal to different audiences

Ivan set about creating a piece that not only reflects the varied geology of the Llŷn, but also the industrial legacy linked to the exploitation of the local geodiversity. A challenging task! It was agreed that as wide variety of specimens as possible would be used together with a simplified geology map. The link to the industrial heritage would be provided by three large cogs which can be turned allowing the user to rotate the specimens to suit eye level. As well as encompassing the poem, the space now provides an opportunity to look closely at the samples of different rock types and link these to a simplified geological map of the area.

Geological Diversity of Llŷn Peninsula

A quick glance at the geology map of Wales will tell you that the geology of the Llŷn peninsula is as diverse and



INTERPRETATION

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complicated as anywhere else in the country. It was decided that there were five 'chapters' to the geological story and would be represented by the Precambrian, Cambrian/Ordovician, Llŷn Shear Zone, Quaternary and Mineral Wealth.

The oldest rocks on the Llŷn are Precambrian in age and are found at its western tip. The majority of the remainder of the peninsula is covered by Cambrian and Ordovician rocks and a large number of igneous intrusions. Another prominent geological feature of the peninsula is the Llŷn Shear Zone. This zone of structurally and mineralogically altered rock extends across the Llŷn from Nefyn on the north coast to Aberdaron in the south. To represent the Quaternary history, in particular the story of both the Irish Sea and Welsh ice sheets which covered parts of the Llŷn during the last Ice Age, a selection of pebbles was collected from beaches on the northern and southern coasts. The final piece in the geological jigsaw is the exploitation of the rich natural resources. The Llŷn is famous for the 'granites' that have been quarried and processed into setts to pave the streets of north-west England and beyond. There is also a rich mining heritage with manganese, lead, copper and barytes mines. The manganese deposits were extensive enough to be reopened during the Second World War to supply manganese to the steel industry.

In order to represent as much of the Llŷn's geology as possible a rigorous sampling programme was required. Consultant geologist John Mason was employed to collect the bulk of the samples and help in identifying the samples collected by the rest of the team. Much of the collecting was undertaken along the magnificent coastal sections and help was given by the quarry owners at Trefor and



Mynydd Penarfynydd GCR site is one of the best examples of a layered intrusion in southern Britain. The site also offers fantastic views of Porth Neigwl GCR site and northwards along the spine of the Llŷn. The distinctive gabbro of Mynydd Penarfynydd is widely used as a building stone in the local villages and farms. Photo by Raymond Roberts, Natural Resources Wales

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To represent the variety of igneous rocks on the Llŷn, artist Ivan Murray created a number of sculptures. Here 'Gwil y Gwyliwr' (Wil the Lookout) is made of granite from Penrhyn Bodeilas which is characterized by abundant xenoliths. Photo by Laura Hughes, National Trust

Llew Llanbedrog' (Llanbedrog Lion) porphyritic microgranite. Photo by Laura Hughes, National Trust



Nanhoran quarries. Trefor Quarry even donated one of their famous curling stones.

To make the interpretation visually more attractive, but also geologically more informative, it was decided to have some of the samples cut and polished. This can bring to life even the duller looking specimen! Having previously been involved in the construction of the Darwin Wall in Snowdonia (see *Earth Heritage* 40 and 41), Cerrig Granite and Slate Ltd of Pwllheli helped with the cutting and polishing of the specimens. The opportunity to see polished specimens of the granites and minerals of the Llŷn has been particularly well received by visitors to Porth y Swnt.

In order to provide more opportunity to showcase the variety of intrusive igneous rocks on the Llŷn, larger specimens have been imaginatively displayed as carved figures representing the different quarries. The industrial quarrying and mining heritage of the peninsula is further symbolised by the old chain and cogs and examples of stone sets. The finished design is an effective melding of moving cogs, a variety of rock samples, chains, and figures carved in granite that fits perfectly within the space.

Future developments

The question of how much information should be displayed alongside the interpretation (or elsewhere e.g. iPad, leaflets, website, audio guide etc.) has been discussed. At the moment limited funds prohibit the creation of anything more advanced than labels for specimens and laminated information sheets that give an overview. We have also adapted the scrapbook we hand out to children at reception to include an activity based on the new geology interpretation – to complete the activity they use a hand lens to take a closer look at the different samples, choose their favourite and find out its name. It is hoped that as we get feedback from the public and we learn how the visitor centre is used, we can expand on how much information is available. In the future, we hope to develop a series of walks that highlight the geological features of the area and if funds become available look into ways of providing more information so that visitors can delve deeper in to the geological wonders of the Llŷn.

Join us for GeoWeek 2018



Chris King and John Stevenson, Earth Science Education Forum

4,000 people graduate with geoscience-related degrees in the UK every year, so there must be 150,000 or more geoscientists across the whole country. If a fraction of them could become involved in geoscience outreach, we could bring geoscience awareness to more people across the UK than ever before.

Fossil collecting from the Oxford Clay of Kingsdyke Nature Reserve, Peterborough. Photo by Colin Prosser



This is not an impossible task, as in Spain, 150 geoscientists across the country take 10,000 members of the public on field trips every May. Similarly, on a single day in May each year, nineteen geosites across Ottawa (Canada) are 'manned' by geoscientists. Members of the public are given a passport encouraging them to discover as many of the sites as possible.

The Earth Science Education Forum approached geoscience organisations across the country to encourage them to become involved in a UK initiative. The name 'GeoWeek' and the dates Saturday 5th May to Sunday 13th May 2018 were chosen by vote. Later the strapline of 'Active geoscience week' was added and the British Geological Survey kindly designed our logo for us.

We hope that all geoscience groups around the country will be willing to become involved. Some groups who already engage with the public have agreed to run an activity in GeoWeek, which is wonderful, but we are really hoping for even more – more activities, more people and more of a profile for geoscience. This is most likely to involve outdoor activities, such as field visits and guided walks.

Different strategies you might consider are:

- planning a 'normal' geoscience fieldtrip locally
- planning a 'normal' geoscience fieldtrip locally - but also making some of the sites into EarthCache sites (see the article in this issue)
- stationing people at a number of sites in the area, and giving attendees a map and a 'passport' to help them discover as many of them as possible

Whatever you decide to do, in town or coast or countryside, please let us know so we can monitor and evaluate the effectiveness of GeoWeek to help us to increase its scope in the future. Please post your event plans to www.facebook.com/GeoWeekUK1

Please note that:

- GeoWeek does not carry any funding. All costs must be covered by your organisation or the participants.
- Please ensure that your activity is risk-assessed and insured.
- Please use the GeoWeek logo in your publicity, and publicise your event(s) as widely as possible.

We see 2018 as a pilot year, and hope our collective experience will boost the initiative in the years ahead – so please give us feedback to help us to be more dynamic and reach a wider and more enthusiastic audience in the future.

For more information about GeoWeek contact:

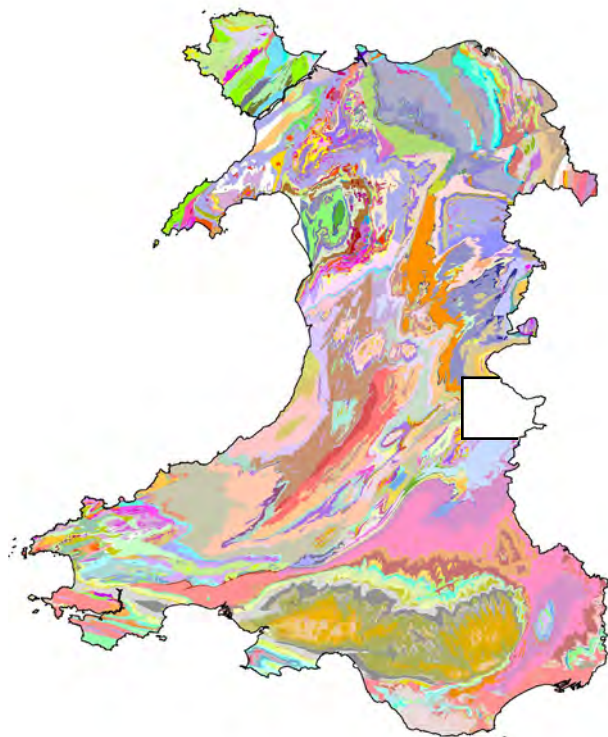
Chris King (chris@earthlearningidea.com) or John Stevenson (esefew@gmail.com).

Mapping the Knighton Sheet – The final piece of the jigsaw

Rhian Kendall, British Geological Survey and **Raymond Roberts**, Natural Resources Wales

More than 180 years since Sir Henry De la Beche oversaw the original 1" mapping of mid Wales and the Borderlands, the British Geological Survey has begun fieldwork on the final sheet (the Knighton District, Sheet 180) that will complete the 1:50,000 coverage in Wales and England. This work will continue the long history of geological fieldwork in Wales, building on early Survey mapping and numerous academic studies that focussed on the area, utilising modern field mapping techniques to produce a new map for the area.

The bedrock geology of the Knighton District is principally Silurian in age with lithostratigraphical units from Llandovery through to the Pridoli. The area is also cut by the Welsh Borderland Fault Zone which carries within it fragments of older Ordovician and Precambrian rocks. In the west, the Ludlow and Wenlock strata record slope to basinal depositional environments with periods of variable sea bed oxygenation. To the east of the district, the rocks of the same age are characteristic of deposition in shallower waters, reflecting the shoaling on to the Midlands Platform. Although eustatic controls on deposition are important in the area, the Welsh Borderland Fault Zone imparted its tectonic influence on deposition, affecting base levels, controlling the basin architecture and the transition from platform to basin environments. This complex interaction between eustasy and tectonics results in complex sedimentation across a relatively small region.



The Quaternary geology of the region is only moderately well understood, with little modern work having been undertaken. The Devensian glaciation limit is presently understood to lie to the extreme east of the area and there exist complex assemblages of landforms and deposits in the vicinity of this former ice limit. Indicators for strongly active glaciation are limited, with some evidence for local, cold-based ice caps on the Clun and Radnor Forest massifs. A modern revision of the Quaternary geology will elucidate not only the evolution of the landforms and deposits, but also the extent of resources or reserves of sand and gravel and provide information on slope stability.

The Knighton sheet straddles the Wales - England border with approximately two thirds in Wales and a third in England. The Welsh name for Knighton, Tref y Clawdd, roughly translates as 'the town on the dyke' and gives a clue to its location near Offa's Dyke. Image by Rhian Kendall, British Geological Survey

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The rolling countryside to the east of Llanbister in the west of the Knighton District. The quarry in the centre of the photograph exposes rocks of the Nantglyn Flags Formation. Photo by Rhian Kendall

The programme of work in the Knighton District has begun with a review of a wealth of previous work. The Survey is also building collaborations with people with an interest in the region (amateur, academic and commercial) in order to build up a picture of what is already known. Technologies such as GIS and 3D visualisation are being used to interpret landforms which can subsequently be ground truthed in the field. In this way, areas where there is less information can be identified and targeted as a priority for field investigation.

Geology maps are vital for a wide range of statutory, non-governmental and private organisations or individuals who require information on the bedrock and superficial geology. This may be for high-level strategic planning, major infrastructure projects, mineral development, waste and water resources management or the building of your garden shed. However, the importance of understanding the geology has been given added impetus in Wales with the prominence of geodiversity in the definition of natural resources in the Environment (Wales) Act (2016). As defined in the Act, natural resources include minerals, geological features and processes, physiographical features and soil. The main aim of the Act is to promote the sustainable use of natural resources and a key element of this is gathering evidence and data. Data collected during mapping and the publication of the map will be used by wide range of stakeholders, but there is also an important geoconservation slant to the mapping work. BGS staff will use GCR sites and RIGS as key locations to interpret the underlying geology but also, through working with Natural Resources Wales geologists, look at possible improvements to the sites and any gaps in the network.

It is hoped that following completion of the Knighton Sheet there will be renewed interest in the geology of the area.

The British Geological Survey website has a range of free resources for you to learn about the geology of the UK. Amongst these resources is the Geology of Britain Viewer which is available through the website <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> which shows you the 1: 625 000 and 1: 50 000 geological maps of Britain (for most areas!) along with any available 3D models, boreholes and even the positions of historical earthquakes! Many of the BGS maps are also available on the BGS website via the BGS Maps Portal which can be found here: <http://www.bgs.ac.uk/data/maps/>. There is also the iGeology app which allows you to interrogate geological maps on your smart phone when you are out and about (<http://www.bgs.ac.uk/igeology/>).

Mapping the Knighton sheet – a volunteer's perspective

Arthur Tingley, Independent Field Geologist



Members of the Woolhope Club, on one of a number of graptolite-seeking field-days, in the Knighton area.

All photos by Mike Brooks

The online database developed and used by the surveyors for data archiving and sharing.



During Local Geological Site assessments in Herefordshire in 2012, I realised that the Knighton Sheet had never been surveyed by British Geological Survey (BGS). I decided to assess whether a project to survey and publish the map independently might be feasible.

Following wide consultation with a variety of societies and individuals, including with BGS, it seemed the only way forward was to build a volunteer survey team, and seek a small grant from the Geologists' Association to progress the map.

Fieldwork started in 2015 with a workforce of eight volunteer surveyors from the Teme Valley Geological Society, and a variety of working parties from the Woolhope Club (Geology Section), under the guidance of Moira Jenkins. Over the past three years we have surveyed almost the whole map area, using volunteer time exceeding 300 field-days, and a further 500 days of desk study. The project also received generous help from a range of professional colleagues in academia, museums and BGS.

The informal Knighton Mapping Project has now entered its final stages, and we shall provide a provisional map during 2018 for testing. We are delighted that there has been a change in policy at BGS, and we have been in discussion about collaboration or co-operation. We hope that BGS's superior technology and access to various specialists will help to iron out our uncertainties.

Further information

http://www.geo-village.eu/?page_id=2528 provides a running log on the progress of the project.

EarthCaching

Audrey Brown, Chair, Cumbria GeoConservation

The activity known as Geocaching has been described as ‘using billion pound technology to look for Tupperware boxes in the woods’. It started in the year 2000 when accurate positioning using a GPS receiver became available to the general public. There are now more than 3 million geocaches worldwide, published on the geocaching.com website, and probably three times as many geocachers involved in searching for ones local to them. These are people who are regularly out and about in town and country, but many have little knowledge of geology and geomorphology. That’s where EarthCaching comes in.

EarthCaches are a subgroup of geocaches, where there is no box to be found at the location, but instead there are aspects of geology to explore. The person setting the cache writes a brief description of the geology, together with a few questions that the finder is required to answer at the location. The idea is that these should combine to provide a short Earth Science lesson for an adult with no previous knowledge of geology. Photographs and diagrams can be included in the description, but diagrams and text need to be kept simple, remembering that many cachers will be reading the material on the screen of their smartphone or GPS, not on a computer screen. Finders subsequently contact the cache owner with their answers, and can then log the cache as a ‘find’ on the geocaching website. Many EarthCaches are at conventional geological outcrops, others relate to building stones, and some look at geomorphological features such as modern dunes or glacial moraines. There is more advice on setting an EarthCache in the Help section of the geocaching.com website.

All geocaches are graded according to their difficulty and terrain, on a nine-point scale running in half units, from 1 to 5. In general, EarthCaches would have a low difficulty rating, since the questions should be relatively straightforward to answer. The terrain rating will depend on how tricky it is to get



Identifying an ammonite for an EarthCache at Kimmeridge Bay, Dorset.

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Monolith and Shadow - the site of an EarthCache outside University College Hospital, Euston Road, London, where cachers answer questions about the types of rock present in this fascinating sculpture.

Photos by Audrey Brown

to the cache site. One near the summit of a Lakeland fell might have a terrain rating of 4 or 4.5, while one looking at polished stones in a shopping centre, accessible to a cacher who uses a wheelchair or with a child in a buggy, would have a terrain rating of 1.

Before an EarthCache can be published on the geocaching website, it is submitted to be checked by a reviewer with a geological background, who satisfies themselves that the geological information provided is accurate and the questions appropriate. They also have to be confident that relevant permissions have been obtained if the cache is on private land, or land owned by organisations such as the National Trust. For this, the government sponsored MAGIC map (Multi Agency Geographic Information for the Countryside) is invaluable and most landowners are happy to give permission. The number of visitors to an EarthCache will, of course, depend on its location. One of the author's EarthCaches in central London is currently getting about 20 visits a month, while another, at one of Cumbria GeoConservation's Local Geological Sites, on the west coast near St Bees, has had about 20 visits in the last year. This represents 20 people, or groups of people, who might never have given these lovely rocks a second glance as they walked along the coastal path and who have now had an introduction to features in Triassic sandstones.

EarthCaches are a great way to encourage non-geologists to learn a bit more about our fascinating subject. There are already EarthCaches at Land's End and John O'Groats, but choose somewhere between and you can set your own!

Further information

- Register for an account at www.geocaching.com
- The author would be happy to help anyone wanting more information about setting an EarthCache. Email Audrey Brown on audrey50brown@gmail.com
- Read more about exciting geocaches at www.geocaching.com/blog/2015/06/11-stunning-earthcaches-and-how-to-find-them/

Scotland's Dynamic Coast

Alistair Rennie, Scottish Natural Heritage and Scottish Government, **Jim Hansom**, University of Glasgow and **James Fitton**, University of Aalborg, Denmark

Coastal erosion is increasingly affecting our coastline. Path breaking research has established the increasing extent and rate of coastal erosion in Scotland and suggests that we need to act now to avoid greater future impacts on our coast, its assets and communities.

A major project considering how Scotland's coastline has changed over the last 130 years has recently been completed. DynamicCoast is a three-year project, funded by the Scottish Government via CREW, Scotland's Centre of Expertise for Waters. The project compared the position of all 3,800 km of Scotland's soft (i.e. 'erodible') coast as shown on the 1890s, 1970s and modern map data. The University of Glasgow research analysed over two thousand maps, involving a million data points, to provide a level of coastal detail never achieved before in Scotland. The interactive maps, results, summary reports and videos are freely available at DynamicCoast.com. The work also established the *Natural Capital* value of soft coastal landforms in Scotland: the natural elements that directly or indirectly produce value to people, including ecosystems and natural processes and functions, which can help mitigate against the effects of sea-level rise.

DynamicCoast aimed to quantify the extent and rate of past and present erosion and identify areas of potentially erodible coastline in Scotland, together with assessing whether the extent and rate of erosion is increasing over time. It also identified assets vulnerable from continued erosion. The Scottish Government and public sector need answers to these questions to deliver duties under the Climate Change Act, Marine Act and Scottish Planning Policy and to shape future coastal policy. Businesses and communities affected by present and future erosion are also involved.

What has DynamicCoast established?

DynamicCoast established that since the 1970s 865 km of the soft shoreline has moved position, 11% of the soft shoreline has advanced seawards, whilst 12% has eroded landwards (442 km: the distance from Edinburgh to John O'Groats). Comparing this against the historical baseline for the soft shoreline (1890s-1970s), the proportion advancing has fallen by 22%, the proportion eroding has increased by 39%, together with a doubling of the average erosion rates to 1 m/yr. These temporal changes are consistent with expectations of climate change.



At St Andrews, historical natural accretion of sand deposits has provided the basis for expansion of the Old Course seaward and northward. More recently local erosion in the south has been remedied by dune repair through adding sand and dune planting undertaken by the West Sands Partnership. Natural Capital is key to the current and future sustainability of the home of golf. Picture by West Sands Partnership at St Andrews.

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A strong spatial element exists with the greatest changes on 'more open' Scottish east coast shores, the indented north, west and south shores being more sheltered by surrounding hard-rock geology. Thus, the east coast is more exposed to erosional risks but it is also more developed than other coasts and subject to greater human intervention via coastal defences and harbour dredging. The latter are important factors reducing the sediment supply that is the life blood of our beaches.

DynamicCoast enables national comparisons. For example, classifying into three coastal types (hard & mixed, soft or artificial) allows the asset data (roads, railways and buildings) for each type to be identified, quantified and costed. 9,400 buildings are protected by artificial defences - comparable numbers are protected by 'natural defences' like beaches and salt marshes. DynamicCoast has identified a total of £13bn of road, rail and building assets protected by natural defences, compared with only £5bn behind sea walls – nature protects more asset value than sea walls. If recent erosion continues to 2050 then an estimated 50 buildings, 2 km of railtrack, 5 km of roadway and 2 km of the water supply network is expected to erode, as well as substantial areas of cultural and natural heritage. Since the data already shows acceleration in erosion rates and extent and falling accretion, these estimates almost certainly underestimate future risk.

“In a changing world, ‘business as usual’ plans will fail”

Recent research suggest that we are now locked into sea-level and temperature rises for the rest of the century (helix climate) and, worryingly, current projections for the UK are thought to underestimate sea-level rise by the end of the century by 20 to 30% (Met Office). The extra 30 cm of sea level expected in Leith by 2080 under a medium emissions scenario, will increase the chance of flooding in any one year from 1% to 12% (DEFRA). As erosion and flooding are linked, this greatly increases both flood and erosion frequency and extent.

DynamicCoast take home messages?

- Our coastline is already responding to climate change placing a wide range of assets at risk,
- DynamicCoast vulnerability assessments underestimate the likely future risk,
- Our *Natural Capital* is hugely valuable now, and increasingly so as we attempt to manage future erosion
- Given the observed changes and future climate change expectations, a window of opportunity now exists to plan, mitigate and adapt in advance to avoid widespread harm and cost.

“Our greatest adaptation challenges are likely to be along our coastline. . . We have to value our natural assets, recognise the strength of our saltmarshes, sandy beaches and dunes and the protection they give us because people don't often see that. . . DynamicCoast gives Scotland it's most advanced nationally consistent and locally informed understanding of the causes and consequences of coastal change that it has ever had so we have to use it and build on it now”

**Roseanna Cunningham (MSP) Cabinet Secretary for
Environment, Climate Change and Land Reform**

The DynamicCoast continues - for more information see www.DynamicCoast.com

The 51 Best Places to see Scotland's geology

Robina Barton and Angus Miller, Scottish Geodiversity Forum

Scotland's tourism industry is booming, with 15 million visitors per year contributing to £12 billion of economic activity. Over many years now, surveys have shown that the beauty and drama of Scotland's scenery is the most important factor in encouraging people to come to Scotland. What resources are available for people who want to find out more about what lies beneath this fantastic scenery, to explain the landscape? There are plenty of good books and a variety of on-the-ground resources in some areas, such as the Geoparks, but until now the information available online has been patchy and it has not been easy to get an overview of Scotland's geological story or the best places to explore this story and find out more. The Scottish Geodiversity Forum has published a list of 51 Best Places to see Scotland's Geology, aiming to provide an introduction to a wide range of sites across Scotland, and to encourage people to explore these places.

Scotland's spectacular scenery derives from geological activity stretching back 3000 million years. The distinctive rocks and landscapes have played a crucial role in our understanding of how the Earth works, dating back to the revolutionary ideas of James Hutton in the 18th century. Earth's continents are forever moving, splitting apart to make new ocean basins and colliding to form mountain ranges. Scotland has been caught up many times in these processes, resulting in a wide variety of rock types of different ages. This geological diversity is reflected in Scotland's scenery, as the rocks have been sculpted over millions of years to create the Highlands and Lowlands, the firths and the islands, the glens, lochs and serrated mountain ridges.

Now, many of the stories that can be read in the rocks have been made easily available thanks to a project delivered by the Scottish Geodiversity Forum. 'Revealing the stories in the rocks: raising



The prelaunch promotional event for the '51 Best Places' on the steps of Dynamic Earth in Edinburgh, in October 2017, ahead of the official launch. As the UK's only science centre dedicated to the story of our planet, inspired by the work of James Hutton, the founder of modern geology, it was the perfect launch venue. The well-attended event involved organisations from across the country providing hands-on activities, exhibits, items for sale and an art competition to inspire the public and help people gain a new appreciation of Scotland's rocks and landscapes. There were short talks on a selection of the sites, amidst an impressive backdrop of large scale photographs with all the sites represented. Picture by Lara Reid

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The St Ninians Isle tombolo, Shetland. This, largest active shell sand tombolo in the UK, helps tell the story of Shetland's fate following the retreat of the last ice sheets. © Lorne Gill/SNH

awareness of Scotland's outstanding geoheritage' was funded by the Heritage Lottery Fund, linked to their 'Stories, Stones and Bones' programme, and in partnership with the 'Year of History, Heritage and Archaeology' (a Scottish Government 'Themed Year'). The project engaged a network of volunteer geologists who knew the sites well to write short descriptions and provide photographs. Lara Reid, an experienced science writer with a good knowledge of the geology of Scotland edited these descriptions to a standard style, bringing out the key stories of interest to the general public while still allowing the enthusiasm and interests of the authors to shine through. The written descriptions are backed up with links to further resources where readers can find out more.

A network of 51 sites across the country were chosen by a panel of expert volunteers as the Best Places where people can see, enjoy, engage with and explore Scotland's incredible geology – you can see the list at www.scottishgeology.com/best-places/. Those of you who read about this project in the last edition of *Earth Heritage* may now be saying "Hang on a minute, why 51 sites? Surely it was supposed to be 50?". Well, that was certainly the intention, but Scotland has such a wealth of amazing geological sites that it proved impossible to agree on a list of 50!

The network of sites was deliberately designed to include some hidden gems, to span the length and breadth of Scotland and to try to cover all aspects of Scotland's geological past including the Ice Age – but also to demonstrate the links between geology and culture, and explore the ongoing processes that continue to shape Scotland. You can find out how geology underpins archaeology in the Neolithic Heart of Orkney, explore the tectonic landscape of Beinn Eighe National Nature Reserve (NNR), find evidence for the birth of oceans on Luing and the Atlantic Islands, visit Scotland's oldest rocks at Scourie on the northwest coast, view the effects of glaciation at Loch Skeen in Dumfries and Galloway and find startling evidence of ancient forests at Fossil Grove in Glasgow.

The launch event was part of a month-long Scotland-wide Geoheritage Festival, with events as varied as the nation's geology. Both Edinburgh and Glasgow were well served, with guided tours of Fossil Grove and Linn Park in Glasgow, 'pavement palaeontology', Earthcaching and a volcano fun

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Corrieshalloch Gorge National Nature Reserve. A spectacular gorge cut by glacial meltwater and the 45-metre-high Falls of Measach tell the dramatic story of what water and ice can do to a landscape. Picture by Lorne Gill/SNH



Stuart Monro extols the importance of Siccar Point on an Edinburgh Geological Society event during the month-long Scotland-wide Geoheritage Festival that helped to continue to promote the '51 Best Places'. Picture by Angus Miller

day in Edinburgh. There were opportunities to explore areas of great natural beauty across the country, including walks in Eigg, Faraid and Muir of Dinnet NNR, and canoeing on Loch Lurgainn – not to mention a guided walk to Siccar Point, arguably the most important geological site in the world, which inspired James Hutton with the concept of deep time. There was a chance to hunt for fossils in East Lothian, discover evidence of 'snowball Earth' in Islay, and find out more about 'Scotland's Rock Story' at Aberdeen Science Centre. Man's relationship with rocks was explored through the limestone of Charlestown and the granite of Kemnay. Scotland's UNESCO Global Geoparks were represented, with a geology course in Shetland and a Climbing Festival in the North West Highlands.

It is fair to say that the 51 Best Places have captured people's imagination. On the day of the launch, Twitter was alive with people sharing the list and counting up how many of the sites they had visited to date. Nobody has yet claimed them all, but we can certainly expect to see some 51 Best Places bagging in the coming years. And we are delighted that at the end of this successful project, there is a solid foundation for people to get an introduction to all aspects of Scotland's geology. There is something for everyone here, even if it is just a quick look to enjoy some stunning photography and gain an appreciation of the diversity of Scotland's landscapes. The list can be used to plan a visit to Scotland, as a quick introduction to places you haven't heard of before, and as a gateway to more detailed information about all aspects of Scotland's geology.

The 51 Best Places is also a platform to build on, and as time goes on the Forum will keep the information and links up to date and promote different aspects of the network of sites. We expect that as people explore further, they will share photographs, film and other creative materials that inspire others to get out there and experience the awesome examples of Earth heritage that are on our doorstep.

HLF success at Brymbo – the 300 million year old journey continues!

Raymond Roberts, Natural Resources Wales

Brymbo Heritage Trust has received a significant financial boost with the award of more than £800,000 from the Heritage Lottery Fund (HLF) to drive forward its vision to develop the fossil forest and industrial heritage at Brymbo into a world-class visitor attraction and vibrant local learning centre. This grant will allow the development of fully costed proposals for the design, engineering and planning for the second round of funding which, if successful, would release £4,986,500 towards the full implementation of the Brymbo masterplan.

Since its discovery in 2005, the fossil forest (see [EH 26](#)) has been at the forefront of the plans to develop the site of the former steelworks at Brymbo as a world-class visitor attraction – the geological interest is seen as the unique selling point within a wider heritage area that includes a range of industrial archaeological features stretching back at least 220 years. There have been challenges



The announcement of the successful HLF bid came 27 years to the day after the closure of the steelworks in 1997. The fossil forest area is highlighted by the white circle and shows the scale of the industrialisation of Brymbo over more than 200 years. Photo by Brymbo Heritage Group

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with conservation of the fragile specimens ([EH 45](#)) and important events to raise the profile ([EH 46](#)), but now there seems to be an impetus with various funding streams coming together. In addition to the recent HLF announcement, Brymbo Heritage Trust has been successful in securing grants of more than £350,000 from other smaller HLF schemes, part of a wider £2 million Big Lottery Fund scheme and grants from key stakeholders such as Cadw and Natural Resources Wales. In conjunction with the work to develop their Stage 1 HLF project, Brymbo Heritage Trust is investigating an innovative approach to build a temporary structure to cover part of the fossil forest in order to start excavation work. Since the discovery of the fossils, weathering has been a significant problem and there is currently a moratorium on fossil collecting and excavation until the site is protected from the wind, rain and frost. Covering of the site, and the recent appointment of a Fossil Co-ordinator, will help to drive forward research and knowledge of the fossil interest and open up this part of the site to the public.

Things are moving at speed, therefore, with numerous strands of the project gaining momentum. Hopefully in the next update in *Earth Heritage* there will be a structure over at least part of the site and we can highlight some more new and exciting fossil finds from the Brymbo Fossil Forest.



Carboniferous Coal Measure sites such as Brymbo are particularly prone to damage when exposed to weathering. The fluvio-deltaic sequence consists of coal, mudstone and sandstone units but the mudstone is particularly susceptible to the effects of drying and wetting and will often disintegrate in a relatively short period. Trace fossils such as burrows (*left*, photo by Peter Appleton) and areas of fern debris (*right*, photo by Jacqui Malpas) would only last a couple of months unless removed from the site or covered to prevent weathering.

Volunteer Ambassadors' programme on the Jurassic Coast

Guy Kerr, Jurassic Coast Trust Programme Manager

The Jurassic Coast is England's natural World Heritage Site, covering 95 miles of coastline between Exmouth in East Devon and Swanage in Dorset, and offering a globally unique 'walk through time' across 185 million years of Earth's history. The Site is managed by the Jurassic Coast Trust, a small independent charity with just six staff, focusing on protecting the Site's status, engaging people with its extraordinary stories, and deepening our knowledge and understanding of the Site.

With such a small team covering such a large and globally renowned place, our volunteer 'Jurassic Coast Ambassadors' are indispensable in allowing us to fulfil our charitable objectives and to embed a feeling of pride, value and understanding of the World Heritage Site amongst the coast's many communities.

The Ambassadors' programme began about five years ago, initiated by Mike Green from Beer in East Devon. Mike sought out like-minded people in neighbouring areas to become a unified team of volunteers, delivering talks about the Jurassic Coast for local communities, and guided walks along some of its stunning paths. This led to my appointment in 2014 as Community Coordinator for the Trust, supported by a Heritage Lottery Fund grant, with the aim of taking what Mike had started and expanding it across the Site's 95 miles.

In the three and a half years since, the Ambassadors' programme has grown and now includes almost 50 individuals from across a broad range of backgrounds, ages and interests. My focus is to bring in people from outside the realms of science and academia, in order to expand the relevance of the World Heritage Site to all those who love it; whether that is as a local resident, regular holiday visitor, or those experiencing it for the first time.



Children from Weymouth complete their worksheet at our Dinosaur Sleepover. Photo by Eddy Pearce

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Anjana Ford from the Jurassic Coast Trust leads our Ambassadors in a field trip to Lyme Regis. Photo by jurassicphotographic.com

Our Ambassadors' remit is broad but flexible, focusing on engaging people with the Site in the manner most effective for them. We have a strong coterie of Ambassadors in Exmouth, the Site's western-most point, who amongst other things, deliver guided walks and family activity days for Ladram Bay Holiday Park, one of the Trust's business partners. Walks from Ladram Bay to Budleigh Salterton are particularly popular and are led by Anthony Cline, a retired geology teacher and Jurassic Coast enthusiast.

Elsewhere Ambassador Sarah Acton, a poet from Beer, has spent time with museums across East Devon, developing a selection of site-specific poetry and poetry walks whilst Ambassadors regularly help at the new Seaton Jurassic Centre.

Heading into Dorset, business partner Hensleigh House B&B in Charmouth hosts evening talks, this year from our Ambassadors Martyn Allen and Paula Smith, about the connections between the oil industry and the Jurassic Coast, and theories about the end-Cretaceous extinction event respectively.

Ambassadors also help deliver our family-focused events such as our 'Dinosaur Sleepover' at Dorset County Museum in Dorchester. Each year between 10 and 15 of our Ambassadors unite to assist with this event for 100 people, engaging children and their parents with the Museum's superb fossil collection and, hopefully, establishing a lifelong love of rocks and fossils. On Purbeck, Ambassador Julian Sawyer delivers talks for Duke of Edinburgh students who have booked Jurassic Coast packages with business partner Cumulus Outdoors.

A number of Ambassadors who are recent university graduates, have developed their science communication skills. For example Anna Holbrook, a Masters graduate from Royal Holloway University, worked tirelessly at the Trust's Camp Bestival stall in 2017, speaking to hundreds of children and families about fossils and the Jurassic Coast. She has since been appointed as a

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Seasonal Warden at the Charmouth Heritage Coast Centre for 2018, where she will be assisting on fossil walks and with the centre's schools programme.

Ambassadors also contribute virtually, through writing blogs for our website or sharing photographs. An example is Steve Belasco, a local photographer who shoots the Jurassic Coast from the sea, offering outstanding views of our Site's unique geology. Steve has generously given the Trust use of his extensive photo archive, which covers the whole of the Site and provides a unique glimpse of some very hard to reach places.

Our Ambassadors are now a community of kindred spirits, with a diverse range of interests brought together by a common love for the Jurassic Coast and a desire to communicate its extraordinary stories to a wider audience. To reinforce this bond the Trust operates an annual series of field trips dubbed 'Winter Watch'. These well-attended days out allow Ambassadors from one part of the Jurassic Coast to experience another part up close, absorbing facts and experiences which they can then incorporate into their outreach work. The days are led by my fellow Jurassic Coast Trust Programme Managers, Sam Scriven and Anjana Ford, who use their scientific knowledge and interpretative expertise to bring the coast to life for our group. The field trips are made available not just to our Ambassadors but to volunteers from our partner museum and visitor centres, and to our business partners, further solidifying the Trust's role as a facilitator of experiences, building a community of individuals and organisations who feel a sense of ownership of the Site.

This sense of community ownership of the Site can have unexpected positive outcomes for the Site's protection. An example is Alison Greenalgh, a councillor from Exmouth who attended a 2016 Jurassic Coast training session. The training was in the importance of erosion and natural change in maintaining our Site in the stunning condition we know and love. Alison then used this information in one of her future planning meetings, stressing to her colleagues the necessity of allowing natural erosion. Alison sadly passed away not long afterwards, but her advocacy for the coast created a strong legacy.



Guy Kerr with Ambassadors Geoff and Valerie Rowland at the Spring Tide Festival in Burton Bradstock, 2016. Photo by: diamondimages.co.uk

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With our Ambassadors' programme now well established, where can they have the most impact? An example is Dippy on Tour, a major project of 2018, in association with the visit of the Natural History Museum's largest resident to Dorset County Museum. These events will include guided tours of Keates Quarry's dinosaur footprints, a day exploring the links between dinosaurs and birds at Seaton Wetlands, and a creative arts day in Poundbury, where people will be encouraged to use everything from Portland Stone to willow to fashion Jurassic Coast-related artistic works.

In the future the Ambassadors' programme will grow and strengthen, as Ambassadors become leaders of their local communities and more people join us. A key focus will be to recruit more Ambassadors in the area from Portland to Purbeck, as that is currently under-represented amongst our group, and represents a crucial part of our Site's story. The Jurassic Coast Trust's core funding is provided by Dorset and Devon County Councils, Natural England and the Environment Agency, and with our recently acquired responsibility for managing the Site, raising additional funds will be a key area for us. Our Ambassadors will be instrumental in this endeavour, helping run fundraising events, recruiting Business Partners, or encouraging members of the public to join our planned membership scheme. Whatever they may be doing, our Ambassadors have become a core part of the Trust's work, and are one of the most essential resources we have to help look after, and inspire people with, our incredible World Heritage Site.

For more information about the Jurassic Coast Trust and its work please go to:

<https://jurassiccoast.org/>



Steve Belasco photo of Worbarrow Tout in Purbeck. Photo by jurassicphotographic.com

Northamptonshire celebrates having a real 'Jurassic Park'

Julie Harrald, The Geology Trusts

On a beautiful sunny day in June 2017, a celebration was held at Irchester Country Park, near Wellingborough, Northamptonshire, and geology was centre stage! Over 100 people, including local VIPs and children, and those representing a variety of organisations, gathered in an open-air education arena with tiered stone seating representing the local Jurassic stratigraphy. They then walked part of a heritage trail to a spectacular viewing platform overlooking an enormous quarry face. The event marked the achievements of a three-year Heritage Lottery Funded project, but reflected decades of commitment and collaboration.

The history of the park

Irchester Country Park is located on the site of Wembley Pit, a very large old ironstone quarry. Iron ore had been extracted in this area in Roman and medieval times, but was not worked commercially until the mid 19th century. Initially dug by hand, mechanisation was gradually introduced, and by the 1920s the Cargo Fleet Iron Company was blasting the rock face and transporting the material directly from the quarry face by rail.

Rather than sending the ore for local smelting, Cargo Fleet used it to feed their busy furnaces on Teesside, which had a global market. The ore was first transported a short distance to the 'calcining



Guests gather for the opening of the viewing platform overlooking the quarry face at Irchester Country Park.



Visitors venture out onto the new viewing platform high above the quarry floor.

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banks' where it was burnt under heaps of coal and earth to reduce its weight before it was shovelled back into wagons to complete its rail journey north.

The quarry face of Wembley Pit advanced rapidly and the overburden was piled up in ridges behind the working area, creating an artificial hill and dale landscape of mud and broken rock. Within 20 years, the quarry face was approaching the village of Irchester and the ironstone was being extracted from beneath 10 m of overburden; the pit had become uneconomic. Operations ceased in 1944, at which time there was no obligation for restoration. The spoil ridges were planted with trees for commercial timber, which grew more slowly than expected on the rough, soil-stripped ground.

Northamptonshire County Council purchased the derelict pit and its neglected woodland in 1971, including the calcining banks and locomotive sheds. The woodland was managed for wildlife and former access tracks and firebreaks became footpaths for visitors. Open ground around the quarry proved a valuable limestone grassland habitat for flowering plants and insects. A narrow gauge railway museum was established at the locomotive sheds and the old Cargo Fleet quarry office of the 1920s became the Quarryman's Rest Café. The country park became a very popular attraction, especially with the addition of an adventure playground and zip wires through the forest in more recent years.

The final gullet at Wembley Pit exposes no less than three geological formations in a face that is around 1 km long and up to 16 m high. Beds of sand, clay and limestone record changes in sea level and environment over 13 million years of Middle Jurassic time. Some of the marine beds are fossiliferous and plant horizons are recognised by rootlets.



Tiered seating in the education area represents the stone seen in the quarry face opposite.

All photos by Julie Harrauld

Upon recommendation from the local geoconservation experts, Northamptonshire RIGS Group (NRG), planning authorities approved Irchester Country Park for RIGS designation in 2000. With visible links to industrial heritage, on a site with excellent public facilities, the geo-education potential of the park was evident to members of NRG, yet the information and activities available at the park barely featured the geology at all. A prime opportunity was being missed.

Geology in the limelight

Not long after the country park opened, Leicester University conducted adult education courses that included fieldwork at the Irchester quarry. This led to the publication of a geological

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guide in 1982. In 1990, the quarry also featured in a series of books called *The Ironstone Quarries of the Midlands - History, Operation and Railways* by Eric Tonks. Members of NRG had been involved in the adult education courses. They maintained an interest in the geodiversity of the park and built a relationship with the county council staff.

In 2008 a project funded by the Aggregates Levy Sustainability Fund and Natural England invited geology groups across England to write site management plans for local geological sites. A member of NRG wrote a detailed plan for the geological interests at Irchester Country Park. This helped the council to see the potential for geology-related initiatives and they began to look for ways to act on it.

Diana Sutherland of Northamptonshire RIGS group has championed the geology of the Irchester quarry for many years. She wrote a site management plan for the country park which inspired the county council to seek funds for the 'Jurassic Park' project and provided the geological text for the information boards on the new heritage trail.



The Countryside Services Manager eventually drew together the geodiversity plan with a biodiversity plan produced by the local Wildlife Trust to make the case for a Heritage Lottery grant. The aim was to help visitors understand the geological, industrial and biological heritage of the park and to bring the quarry back into active management.

A £130,000 project entitled *Irchester Country Park - Protecting and Interpreting a Real Jurassic Park* was approved in April 2014. The county council has worked with the Northamptonshire RIGS group, Northamptonshire Industrial Archaeology Group, Irchester Narrow Gauge Railway Trust, Moulton College, Northampton University, Wellingborough U3A geology group, local schools and a range of individual volunteers to deliver the project on the ground.

An accessible interpretation trail around the park has been created, explaining all aspects of the heritage of the site, from the Roman settlement nearby to the geology, quarry, railway, plants and wildlife. The new education zone has been built with seating set on tiered cages filled with stones representing the rock strata. A unique viewing platform has been constructed above the gullet and the quarry face opposite is being cleared of scrub to expose some of the best geological features. In other areas restoration will help the limestone grassland to develop. Sections of the rail track have been re-laid and train silhouettes feature along the way. Finally, there is a map-based smartphone app with quiz trails and optional links to further information.

As identified in Tonk's book, the park "has some of the best visible reminders of the ironstone mining industry in Northamptonshire", and now the role of geology underpinning the area's diverse heritage has been recognised

GeoBus & Geology in Scottish Schools

Jen Brooke, GeoBus Co-ordinator

In 2012, GeoBus – a free outreach project for secondary schools – was launched by The University of St Andrews, with the aim of supporting teachers delivering Earth Science related topics. At the time, support was particularly required in Scotland as very few schools were offering a qualification in Higher Geology (in part due to a lack of newly trained teachers in the subject) and there were discussions about dropping it as an available subject. With the introduction of revised qualifications under Curriculum for Excellence in 2015, Geology was indeed excluded from the curriculum and is now only available as a formal qualification in a handful of schools in Scotland, teaching from English or Welsh exam board courses (as highlighted in *Earth Heritage* 46 by Emma Smith, Gairloch High School). At the time of writing, GeoBus is aware of three schools in which GCSE and/or A-level Geology is taught in Scotland – two state-funded schools (Gairloch High School, Mintlaw Academy) and one private (Loretto).

GeoBus

Designed to provide engaging, interactive workshops introducing and developing earth science concepts, GeoBus now offers a range of 26 different workshops, many of which have evolved to fit in with the current Geography curriculum, but providing a geological perspective. All of these workshops are regularly updated and refreshed with new content and input from researchers and professionals, and one of the key aims of the project remains to bridge the gap between industry, academia and education. As of January 2017, GeoBus has worked with over 63,500 pupils in 250 schools, representing 691 individual visits, delivering workshops on everything from Tectonic Hazards to Climate Change to Earth's Resources – emphasising the applied nature of Earth Science and the opportunities available in a diverse range of careers.

Another of the key principles of the project has been to remain completely free for all state schools (a small charge to cover resources is requested from privately funded schools), offering an equal opportunity to all pupils (and



Map of Scotland illustrating the geographical coverage of the GeoBus project in Scotland, which has visited 60% of state-funded schools, including over 80% of those designated as being in 'rural' areas.

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Pupils investigating Scotland's Oldest Rock (2.7 billion year old Lewisian Gneiss) as part of a GeoBus challenge day introducing 'Scotland's Rock Story'. Specialist equipment, such as microscopes, and high quality samples are a feature of workshops often praised highly by teachers, who feel they would otherwise be unable to access to such resources.

All pictures by GeoBus unless otherwise stated

GeoBus Jen helping pupils' investigate the nature of igneous intrusions during a workshop on Volcanoes in Scotland. Unsurprisingly, the hands-on nature of activities has been shown to increase not only pupils engagement at the time, but also knowledge retention.



teachers) across the country. As demand for school visits has increased (commonly GeoBus has 2-3 schools per local authority group on a waiting list), and the project is unable to meet every request, some attention has been on developing support materials and online resources that can be used independently by teachers, as well as in conjunction with a GeoBus visit. Examples include a series of educational resources developed (in conjunction with published climate scientist Dr James Rae, University of St Andrews) to provide an engaging, reliable, straightforward, and logical framework for teaching climate change – often a challenging topic – and a Mission to Mars! package (in conjunction with Dr Claire Cousins, University of St Andrews, and with support from the UK Space Agency) with the aim of bringing planetary science directly into the classroom environment, in a manner that is not only inspirational, but constructive in helping pupils obtain their secondary school (high school) qualifications. Engaging directly with researchers to create such resources not only ensures that materials taught are as current and relevant as possible, but also serves to link school pupils with 'actual' scientists – even if only indirectly – and can help to remove some of the perceived barriers to involvement in science.

Thanks to the recent rise in ubiquitous technology, social media has increasing potential for outreach and education. As such, GeoBus has been developing an online presence as a tool to promote Earth Science, link researchers and schools, and highlight relevant current events and discussions. A successful recent example is a Twitter-hosted discussion that allowed us to put volcanology questions from pupils at a Highland school to experts who had taken part in BBC program (Expedition Volcano).

As well as supporting the introduction of geological concepts to pupils throughout secondary school, GeoBus has made a specific effort to give senior pupils the opportunity to experience Earth Science as a potential subject for further study by running a week long residential course in the summer. Focussing on

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fieldwork skills (with excursions to the Fife Coast and Holyrood Park, Edinburgh), the course has run successfully for the past three years, with over 50 pupils taking part. Six of the participants (that we know of) have gone on to study geology or Earth Science courses at a Scottish university, and 81% (of 85% of participants who responded to the post-course survey) indicated they were now considering a related subject.

Geology in Scotland

When geology was removed from the Scottish curriculum, part of the justification, by the Scottish Qualifications Authority, was that a school qualification in the subject was not required by any of the Scottish universities for entry in to an Earth Science or related degree. Additionally, it was indicated that central concepts would be incorporated across other subjects (namely geography and the sciences). While the first point remains true, it is increasingly the case that – without being taught it as a defined subject – many school leavers are unaware of the wide range of opportunities that studying geology is able to offer, or even that it is a viable degree choice at all. There seems to be a wide-ranging view that geology is ‘just rocks’ and leads only to employment in ‘Big Oil’ – although this is, of course, variable across schools. There are some schools in which enthusiastic teachers share a passion for Earth Science with interested pupils and go out of their way to provide engaging resources and access to materials. The introduction of geology during GeoBus workshops is now often met with surprised enjoyment and this is illustrated well by a typical quote from our pupil feedback survey: “geology was completely new to me but I enjoyed learning about it”. Even in those schools where geology content is being included across the curriculum, pupils often lack the frame of reference to relate to the subject as a whole, and the overall essence of the subject is lost – resulting in a lack of enthusiasm for further study.

Looking to the future

Earth Science has an important role in the education of the next generation, particularly in an era where issues such as climate change and planetary exploration have the potential to shape the future and where geology is becoming relevant for so many other industries. Regardless of future career path it is surely important to ensure that those in all walks of life have a broad appreciation of earth science. By engaging pupils who might not otherwise have been exposed to the subject, GeoBus is able to have an impact, but coordinating a visit for a non-curricular activity is increasingly a challenge for some schools and, while enthusiasm for GeoBus continues to grow, funding is becoming increasingly difficult in the current financial climate. Therefore, we would like to see a reopening of the discussion involving interested parties in academia, industry, government and education, on how best to support Earth Science education in Scotland in a wider and more sustainable way.



Participants in GeoBus summer fieldcamp (2017) taking in the views from below St Anthony's Chapel in Holyrood Park, during an excursion to investigate the geological history of Arthur's Seat. Picture by Fraser Wotherspoon

If not we face the possibility of Scotland, the very birthplace of geology, producing a generation many of whom have no real awareness of the importance – or the potential – of Earth Science.

Making replicas of stolen fossils at Joint Mitnor Cave, Devon

Alan Finch, Honorary Secretary, William Pengelly Cave Studies Trust

In September 2015 some members of the William Pengelly Cave Studies Trust went to check Joint Mitnor Cave before the winter shut down for the greater horseshoe bat hibernation. To their horror they discovered the steel cave door that protected the cave had been forced open, part of the display area of bones from the last interglacial had been vandalised and irreplaceable artefacts stolen. The initial shock and disbelief was tremendous as the site is not only a priceless Site of Special Scientific Interest (SSSI) but part of a Special Area of Conservation.

Joint Mitnor Cave came to prominence in the late 1930s when a deposit of bones from the Ipswichian Interglacial stage, about 125,000 years ago, was discovered. The cave had been known for some considerable time, revealed by quarrymen taking out the limestone, but the significance of it had lain undetected throughout the years. In 1938 the caves of Higher Kiln Quarry were being explored by three young men (Joint, Mitchell and Northey, thus giving the name Joint Mitnor), when they discovered a piece of bone. They wanted to know how it got there and if it was significant so a colleague, Edgar Reed, sent the bone to Torquay Natural History Museum for validation. He received in return a polite but dismissive letter stating simply it was Bos (ox).

The bone was then sent to the Natural History Museum in London where it was identified as bison which had existed during an interglacial stage. The resulting interest brought attention to the cave and excavations produced many thousands of bones. The number and variety were quite astonishing, and included cave lion, bear, hyena, hippopotamus, narrow-nosed rhinoceros, wolf, bison, giant deer and a baby straight-tusked elephant. The deposit had been formed due to the collapsing roof of the cave; animals fell in, some walked in and others were taken in, perhaps as food. Since the 1960s the William Pengelly Trust had been looking after the cave and developing an on-site museum to explain the deposits remaining underground that the public could still view in situ. The discovered break-in was devastating and it was incomprehensible that anyone could do such a thing. Firstly it was necessary to inform the police and send word out into the scientific and caving communities. Despite press, radio and television appeals the missing exhibits have not been recovered nor have the perpetrators been brought to justice. The trust were keen to save and restore this wonderfully accessible site for future generations, but they were unsure whether the damaged area could be rebuilt or restored and whether replacement bones could be found. The answer to these questions was 'yes', but how could it be done?

In the basement of the Natural History Museum in London, there are many bones from Joint Mitnor. It was obvious that we could not take one and simply place it back in the cave. Firstly, all the bones held by NHM had been cleaned, preserved and catalogued as part of the National Collection. Secondly, there were no other sources for 'spares'. Finally, putting back foreign bones, those removed from other caves, could only cause confusion with authenticity.

Could we copy some that were nearly identical to those stolen? Following phone calls, letters and eventually a meeting in London, the possibility of replicating as near as possible identical bones was considered. This would involve the 3-D scanning of originals to create models, aided by the

expert eye of Roula Pappa, Curator of British Pleistocene Mammals at the Natural History Museum. Then we had to consider whether using sympathetic material for the cave environment to make the replicas was a viable option. Andrew Chamberlain, Professor of Bioarchaeology at the University of Manchester helped select the possible exhibits, as it was going to be his task to rebuild the damaged area within the cave.

The next stage was to gain permission from Natural England to carry out the restoration using the replicas within the SSSI. As far as Natural England were aware, this approach was innovative and worthy of consideration. It did however need a properly submitted methodology describing the plan and techniques to be used, as well as details of how the replicas would be monitored once placed in the cave environment.

Through spring and summer 2016 things progressed, albeit slowly. The Natural History Museum agreed to scan the chosen bones to a very high resolution. Signed legal agreements were necessary to establish who could use the data and the final replicas created. By a stroke of good fortune Professor Robert (Bob) Stone, University of Birmingham, Department of Electronics, Electrical and Systems Engineering, had been visiting the caves and centre in Buckfastleigh with some of his postgraduate students, and so his expertise in modern virtual reality and 3D printing was sought. He readily agreed to help with the project.

The summer drifted into autumn. Andrew Chamberlain had begun the on-site restoration within the cave but time was running out. The cave was due to close for the winter bat roost again and the planned completion moved forward into 2017.

During the winter months Bob Stone and his team completed the work building the replicas from the data supplied by the Natural History Museum. It was not as simple a process as first thought and a number of machines suffered breakdowns as a result. However, the end products were very fine indeed, and suitably coloured they really looked the part, though there was concern over the material used to make them and whether it could cause contamination in the surrounding area if breakdown occurred.



The next stage was to bring in Dr Dave Williams, GeoEd Ltd, an expert in casting replicas using a special form of gypsum. The 3-D replicas were taken to his workshop and moulds made, into these the material suitable for the underground environment was poured. The end result was again very pleasing, with natural pigments used to colour the replicas which then looked quite authentic.

Bone deposit before 12.09.15. The cave deposit with original fossils in place.

Photos by William Pengelly Cave Studies Trust

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Top: 3D models of teeth of wolf (left), bear (right) and bison (lower), with 50 pence for scale.

Mid: 3D model of a straight-tusked elephant tooth, with 50 pence for scale.

Bottom: Restored areas 12.08.17. The cave deposit after restoration, with replica fossils in place.

With the replicas made and permission granted to proceed, Andrew Chamberlain began the final stage of the restoration. During the early summer of 2017 Andrew rebuilt the damaged deposit, placing the replicas where those stolen had been. With newly installed LED lighting the result was visually wonderful, everyone involved felt relieved that the plan had come together to such great effect.

The official opening was held on Saturday, 12th August 2017. Local dignitaries and people involved in the project assembled at Higher Kiln Quarry, Buckfastleigh. BBC television was present along with various magazines and newspapers. After the speeches and an explanation of the project the cave was re-opened by the great grandson of Wilf Joint, the man who started everything off back in 1938.

It had taken 23 months to complete the task, longer than anticipated. The final cost is difficult to calculate as so much support was given freely by so many people and organisations; suffice to say the true expense would have run into thousands of pounds.

For the William Pengelly Cave Studies Trust it was a considerable challenge but it brought people together and refreshed the approach to the guided walks through the quarry and cave. The on-site museum now has another story to tell: visitors can pick-up and examine the 3D models and replicas and then compare them with the original exhibits. The response from the public on seeing the result underground and being made aware of the difficulties encountered has been extremely gratifying indeed.

We will continue to monitor this unique method of replacing fossils with replicas in a cave environment. Hopefully, the experience gained will enable this innovative technique to be added to our geoconservation, research, interpretation and education toolkit for the future.

The Elgin Reptile quarries: should they still be designated as SSSIs?

Elsa Panciroli, University of Edinburgh & National Museums Scotland

It was a test of mettle when I joined colleagues in Elgin this November, to make chilly Sunday afternoon visits to the sandstone quarries of Clashach and Spynie. These quarries played important roles in Scotland's palaeontological history, resulting in their addition to the Geological Conservation Review (GCR) site register and subsequent designation as Sites of Special Scientific Interest (SSSIs). I was joining representatives from Scottish Natural Heritage, The Elgin Museum, National Museums Scotland, and local geology groups, to discuss the potential for new fossil discoveries. Our goal was to help Scottish Natural Heritage (SNH) assess the current conservation value of these quarries, and decide what action might be taken to preserve, record and protect finds at these sites.

The quarries around Elgin, in Moray, Scotland, have been yielding sandstone for building since the 1700s. More recently, Clashach quarry provided stone for the building of the National Museum of Scotland in Edinburgh. The first of the 'Elgin Reptiles' was discovered in 1844 in these pale yellow rocks, but as it comprised only a few scales, this initial fossil was thought to be an Old Red Sandstone fish. Such Scottish Devonian fish fossils were common and well-known to the natural scientists of the day. A second Elgin fossil, discovered seven years later, shocked everyone: it was indisputably reptilian. Everyone knew there were no reptiles in the Devonian (they appeared in the Early Carboniferous). So how could this be?

The conundrum of the Elgin sandstones puzzled geologists for many years. The answer lay in understanding processes of erosion, deposition and stratigraphy. The lake-deposited layers of the Devonian Old Red Sandstone were overlain by the almost indistinguishable younger sandstones of Late Permian and Early Triassic desert dunes. 100 million years of rock record were absent in between and are entirely missing from the stratigraphic sequence in this area. Understanding this unconformity was one of the many great achievements of Victorian geology.

The Late Permian and Early Triassic 'Elgin Reptile' fossils include bodyfossils and an impressive array of ichnofossils; namely footprints and tail-drags. Many of the fossils are of international importance, and continue to be studied. For example the Triassic *Saltopus elginensis* – long referred to as the earliest dinosaur – was recently re-analysed, and is now considered to be a dinosauriform; a forerunner to the dinosaurs (Benton, 2010). The Permian Dicynodonts and pareiasaurs, such as *Elginia* and *Gordonia*, reveal

The group gathered to discuss the ongoing status of Spynie quarry, Elgin. Spynie is the first recorded source of the reptiles *Leptopleuron lacertinum* and *Ornithosuchus woodwardi*. Many of the fossils were found in the 19th century; renewed quarrying offers the chance of new finds.

All pictures by Elsa Panciroli



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Bone found in Spynie quarry looks whiter than the surrounding sandstone, like this fragment. We are providing quarry workers with images like these in the hope they will alert us to any fossil discoveries during the extraction process.



The group examines previous footprint finds at Clashach quarry, Elgin. Footprints range in size from a few centimetres across, to over 15 cm across. They can reveal information on behaviour and locomotion in extinct animals.



a totally alien world of pre-Mesozoic reptiles, and stocky, 'reptile-like' animals on the evolutionary road that would eventually lead to mammals. Many of these historic finds are housed in Elgin Museum and National Museum of Scotland.

We began our visit at Spynie, rubbing our hands together against the cold. It is possible for the public to visit the both sites, any collecting being undertaken with the proviso that visitors follow the Scottish Fossil Code. Securing access permission is key and caution is obviously necessary during operating hours. Tennants, a local quarrying firm, works both sites, and a representative met us at Spynie to discuss their extraction process and the ease of access for volunteers to prospect for fossils.

We walked the whole quarry; a site on two levels and approximately 150 metres in diameter. The lower sections are the original quarry, where most of the Triassic reptiles were discovered. In the newer upper section we spotted a tell-tale white streak in the rock: fossil bone. The 'Elgin Reptile' fossils are usually paler than the surrounding yellow and pink sandstones. They often survive only as voids in the sandstone, with sparse bone fragments, if any. The original method of study was to flush the void with acid – dissolving any remaining bone – then fill the void with rubber. The surrounding rock casing was sometimes smashed, leaving a rubber cast. Later techniques avoided acid or breaking the casing, but the rubber casts removed grains from the surface of the fossil, diminishing their fine details. These damaging processes have been superseded by CT-scanning technology, allowing palaeontologists to see inside the rock and make digital models of the fossil void, which can be cast or printed in plastic (Clark, 2008).

Excitingly, we also found the last remnants of some *Stagonolepis* armour plates in an abandoned part of the quarry. Too eroded to merit collecting, they provide evidence that finds are still to be made. The quarry operator was happy for conscientious amateur and professional palaeontologists to visit. We agreed to create an information sheet for the quarry workers, helping raise awareness of potential fossil finds during their daily excavation and processing.

Clashach quarry is a startling place. Not visible from the road, you walk towards the sea through a corridor of gorse, only to round a corner and find yourself staring across a 200 metre wide hole in the ground. Belted and buffeted by icy Northern winds, our group circuted the quarry. Clashach has not yielded many body fossils, but provides footprints in abundance. The operators obligingly place

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The group explores the disused section of Spynie quarry, Elgin. The armoured aetosaur *Stagonolepis* has been found here. It resembled a crocodile with armoured skin, but ate plants like cycads and horsetails.



New footprints were discovered by E. Panciroli during the visit. They are unusually small, with claw swipes at the front. Recording prints like these will be part of ongoing research at Clashach, and tell us more about diversity in this arid Permian environment.



these tracks to one side, where palaeontologists (and the public) are welcome to study them. I was delighted to find fresh footprints among the rubble in the centre of the quarry (pictured), complete with tiny toe claw-marks. Most footprints are on immense boulders, metres across and over a metre deep. This makes them impossible to collect for curation in museums. Some years ago an 'amphitheatre' of these slabs was laid out at the mouth of the quarry, alongside a public information board. Unfortunately, water and bioerosion had not been kind to this display, removing the details of the footprints. The information board was damaged so badly, it was removed.

It was clear to all of us that if we could find these fossils, under less than ideal field conditions, in one afternoon, both sites still have enormous potential for future discovery and research. Both sites clearly maintain their conservation value, securing their inclusion in the GCR and meriting their SSSI designation. Both sites also clearly deserve increased palaeontological attention. Ongoing quarrying of fossil-bearing rock could result in the destruction of important fossil material, however, without quarrying operations at historically important quarries like Spynie and Clashach, there would be little prospect of making new discoveries. In an effort to increase the amount of fossil material being recognised and saved we are helping to ensure the local operators know what to look for in these unique fossiliferous rocks. We are also now encouraging local groups to visit these sites and search for new fossils, and taking steps to help volunteers record the footprints before they are lost to the elements. Hopefully a more intensive programme of research can be arranged and funded in the coming years.

Further information

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The Farnham river terrace staircase: an optimal record of the Thames Palaeolithic

David Bridgland and Mark White, Durham University

In *Earth Heritage* 47 the authors expounded upon the importance in Pleistocene river gravels of handaxes as indicative (i.e. in the form of ‘trace fossils’) of early human activity and of potential value as chronological indicators in much the same way as conventional assemblage-based biostratigraphy. Subsequent activity in association with the Farnham Geological Society has rekindled interest in a remarkable sequence of terraces in a tributary of the Thames, at Farnham in Surrey. The Thames terrace system benefits from a richness of fossils (especially mammalian and molluscan) within its Pleistocene sediments, as well as an abundance of flint from the Chalk as a high-quality raw material for tool making during the Palaeolithic (see *EH* 46, p. 35–6; *EH* 43, p. 26; *EH* 42, p. 12; see also volume 7 of the Geological Conservation Review (GCR) series). Here we briefly review the importance of the Farnham terraces and comment on their conservation.

The variety of handaxe forms, and in particular the six handaxe groups defined by the Oxford archaeologist Derek Roe (see table), offer the means for dating river gravels that otherwise lack evidence for their age. The distribution of these tool types within the Thames terraces is something

						
GROUP	← POINTED TRADITION → Group I (with cleavers) Group II (with ovates) Group III (plano-convex)			← OVATE TRADITION → Group V (crude, narrow) Group VI (more pointed) Group VII (less pointed)		
AGE (years)	300,000	400,000	300,000	500,000+	400,000	500,000
LOCATION	Furze Platt Bakers Farm Cuxton Stoke Newington	Swanscombe MG Chadwell St. Mary (Hoxne UI) Dovercourt Hitchin (Foxhall Road Red Gravel)	Wolvercote	Fordwich Farnham Terrace A Warren Hill worn (Kents Cavern Breccia)	Elveden Bowman's Lodge Swanscombe UL (Wansunt) (Foxhall Road Red Grey Clays) (Hoxne LI)	High Lodge Warren Hill fresh Highlands Farm Corfe Mullen (Boxgrove)
						

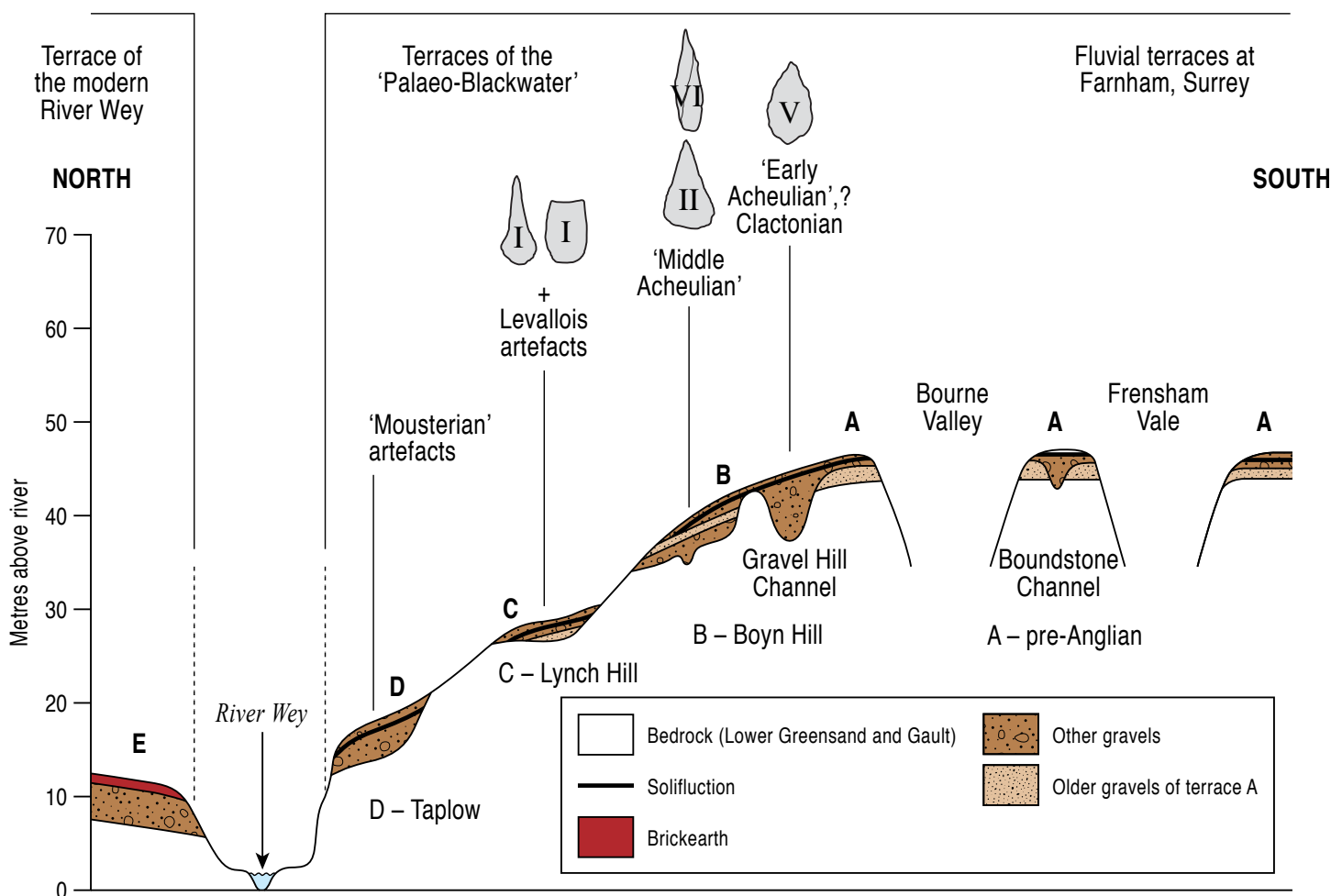
Derek Roe's handaxe groups from 1968, with later additions in parentheses. Roe's Group IV, to which he allocated material transitional between the ovate and pointed traditions, is excluded, as it contains mixed and seemingly unreliable assemblages.

Chris Orton (Durham Geography Cartography Unit) is acknowledged for drawing this and the other illustrations.

COMPLEMENTARY DISCIPLINES

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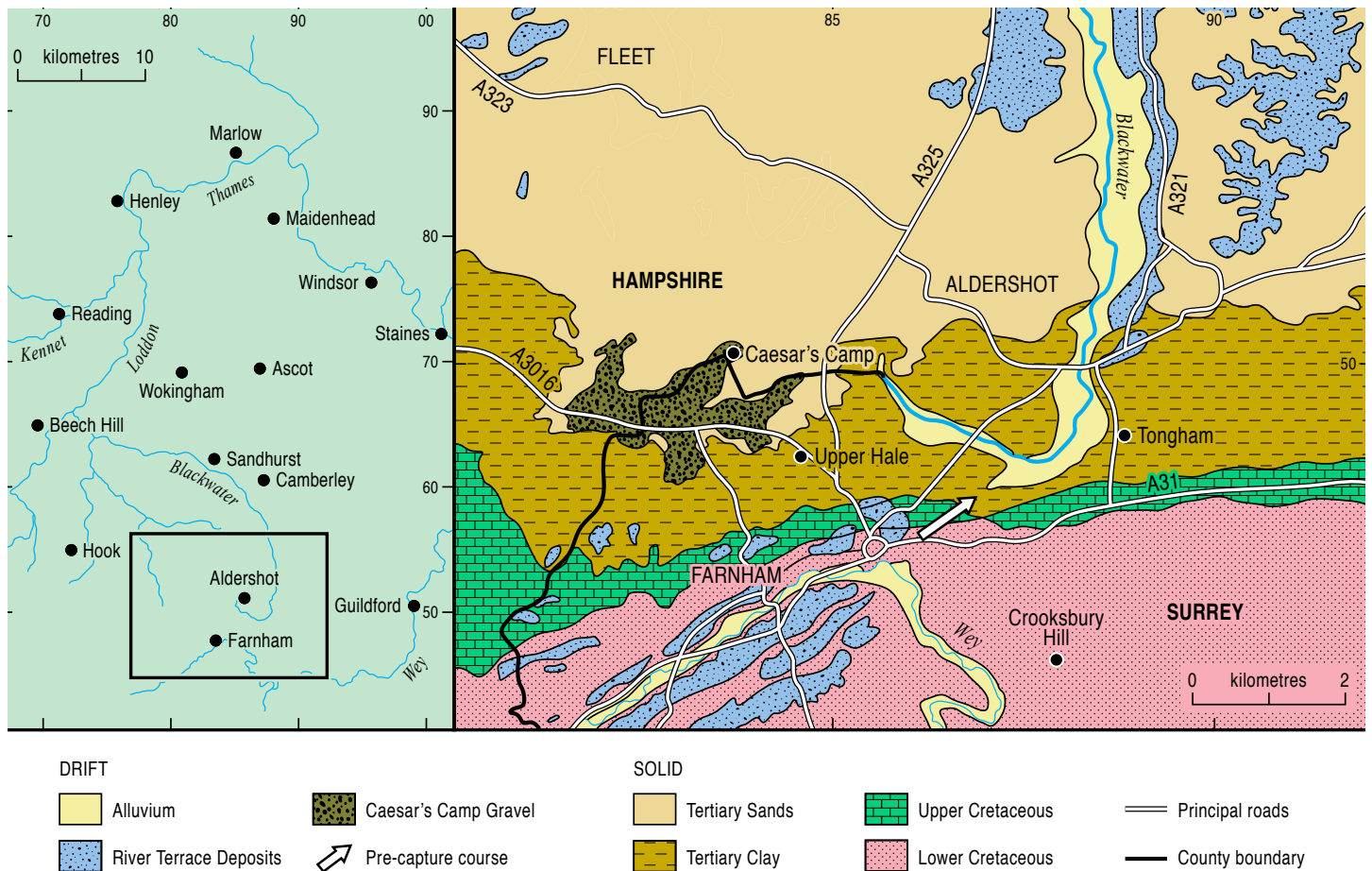
that has been established by comparison of sites in the middle and lower part of the valley, i.e., upstream and downstream, respectively, of central London. There is one place, however, where the entire panoply can be recognized within a single valley-side staircase and this is at Farnham. The terrace gravels at Farnham were rich sources of Palaeolithic material in the early 20th Century, and Derek Roe recognized an assemblage here attributable to his Group V, his 'Early Acheulian', now indeed recognized as the oldest (made c. 0.5 million years ago), in the highest of the Farnham terraces, designated 'Terrace A' (see cross section). Although no other material from Farnham was considered by Roe to represent a high-integrity assemblage, it is apparent that handaxes from the next oldest terrace ('B') resemble those from the Boyn Hill Terrace of the Thames, e.g. at Swanscombe, and those from Terrace 'C' resemble those from the Lynch Hill Terrace of the Thames. Furthermore, Levallois technology appears Terrace 'C' and is well developed in the next terrace ('D'), inviting comparison with the Lynch Hill and the Taplow terraces of the Thames, respectively. Although there is no great richness of fossils at Farnham, the abundance and variety of artefacts in the gravel terraces there represent an unprecedented Palaeolithic record and an important aid in correlation and age determination of the terrace sequence.



Cross section through the Pleistocene terraces at Farnham, showing the different types of Palaeolithic material that characterizes the different terrace levels (Updated from John Wymer's 'The Lower Palaeolithic Occupation of Britain', 1999). Handaxe types in insets.

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The Farnham terraces in relation to the Thames drainage system SW of London. The former drainage route of the Farnham Wey into the Blackwater is arrowed. Left – drainage in the wider region; Right – geology of the Farnham–Aldershot area.



The handaxe-bearing Farnham terraces were formed on the floodplain of what was, in the Middle Pleistocene, the headwater stream of the River Blackwater, which is now confined to the area to the north of the Chalk outcrop, joining the Thames, via the Loddon, in the Reading area. It has long been recognized that the Farnham stream was ‘captured’ from the Blackwater by the River Wey (see map), probably between the formation of Terraces D and E, to flow (as now) into the Thames much further downstream, this classic drainage-modification story adding further interest to the Pleistocene fluvial archive from Farnham.

Sadly no Farnham terrace gravel locality is currently recognized as a geoconservation site; of the two possible localities representative of Roe’s ‘Early Acheulian’ (Group V), that at Fordwich, Kent, was selected for the GCR ahead of Farnham Terrace A, partly because the latter was substantially built over whereas quarry sections still existed at the former. In cases such as this, where a site does not fulfil the criteria for GCR selection but is still important for science and our geoheritage, it is essential that other conservation options are explored, including identification of a Local Geological Site where possible, and/or offsite conservation of fossils and artefacts by museums.

The Curry Fund – An Award for Excellence

Christopher Green, Geologists' Association

To celebrate the work of the Curry Fund over the thirty years since its formation in 1986, the Curry Fund Committee has decided to create an award that recognises the high standard of the projects that it funds. The award will take the form of a certificate presented annually for the funded project completed in the previous year that in the opinion of the Committee best reflects the spirit of the Curry Fund.

The spirit of the Fund is neatly summarised in the opening paragraph of the 'Guidelines for Applicants':

"To encourage initiatives within Geology which might otherwise not be possible, to encourage innovation, and through far-sighted developments help a wider public to understand and enjoy Geology."

The spirit of the Fund was established early in its history. One of the first awards in 1986 was to the West London Wildlife Trust towards securing a tip of fossiliferous material from Lower Writhlington colliery. This initiative has since then been a source of pleasure and scientific interest to generations of geologists, young and old, professional and amateur. Since 1986 the Curry Fund has supported over 200 publications, ranging from leaflets describing and explaining local geology to substantial scientific monographs. It has made possible the purchase, conservation and display of all sorts of geological specimens, supporting such projects in more than forty different museums. Specimen conservation alone includes among the more spectacular examples, Pliosaurus, Plesiosaurs, Ichthyosaurs, a Stegosaur and a hippopotamus. The Fund has also made grants available for the purchase and conservation of important geological sites in many parts of the country, from Powys to Suffolk, from Sussex to Aberdeen. Among

the more esoteric awards, the Fund has supported the restoration of the tomb of Gideon Mantell and the purchase of Matthew Boulton's specimen cabinet.



Pliosaurus carpenteri at Bristol Museum, mounted for display by conservator Nigel Larkin.

In the first thirty years of the life of the Curry Fund, six hundred and sixty awards have been made totalling £660,000 in grants and loans ranging from a few pounds to £10,000. The value of the award is not the most important thing, however, what matters is how well the geology is presented, how many people will value and enjoy it, and what lasting interest and significance it will have. The new award announced here will recognise those projects that succeed best in fulfilling all these outcomes.

Further information

<https://geologistsassociation.org.uk/curry/>



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The Precambrian rocks of Bradgate Park, Leicestershire are part of the Charnwood Forest, which has been successful in a £2.75m grant bid for initial support by the HLF through its Landscape Partnership programme. The funding will help promote awareness of the local area and showcase its specialness in terms of biodiversity, geology and landscape.

Photo by Michael Murphy

