Earth Heritage

The Geological and Landscape Conservation Magazine

Post-pandemic museums & Earth heritage

ISSUE 55
Summer 2021

In & out of the deep freeze - Part 2

Let's Circus & the Rock Showman

Camp Siluria revisited

Shells & forms: a fossil conservation strategy

Earth Heritage

INSIDE

Cover: **Ordovician-age pillow lavas on the Ayrshire coast south of Ballantrae (the focus of a new film discussed on p.22). These together with other elements of the obducted ophiolite including serpentinite, jasper, and fossil-bearing deep water sediments have played an important role internationally in understanding ophiolite generation and obduction. Photo by Stuart Graham**

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OUTCROPS

PUBLICATIONS

ARTICLES

NatureScot Scotland's Nature Agency Buidheann Nàdair na h-Alba

Cyfoeth Naturiol Cymru Natural Resources Wales

Geologists' Association 1858

Natural England

QRA Quaternary Research Association

Earth Heritage

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From the Editor

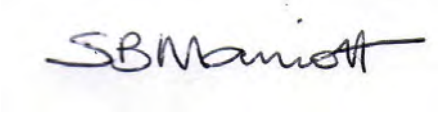
I've found it surprising how quickly another six months have passed even with all the pressures of the continuing lockdown and the great unknown of what the 'new normal' will be like. However things turn out, conserving Britian's geodiversity is perennially worthwhile and our connection with the natural environment plays an important part in maintaining our mental and physical health. As always, this issue of *Earth Heritage* brings you a broad spectrum of geoconservation news and comment, including some innovative and colourful ways of publicising and celebrating it virtually—see for example the article about '*Let's Circus and The Rock Showman*' and '*Camp Siluria*'.

Museums are now reopening and there are articles on new collections at the Seaside Museum in Herne Bay, Kent and the public engagement work of the Sedgwick Museum in Cambridge that is targeted at those groups that have been most negatively impacted by lockdown.

Irresponsible sampling and fossil collecting are recurring problems and best practice guidelines still need to be highlighted. The Scottish Fossil Code is due to be reviewed and interested parties can make their views known in an attempt to ensure the new Code conveys best practice guidance of the collection of fossils in Scotland. As Rachel Wood notes in her article on 'Sustainable Geological Sampling', "*…scientific research is not incompatible in a world where our landscape is increasingly treasured as a resource for the well-being of all*".

This issue and all back issues can be downloaded free by visiting *www.earthheritage.org.uk* and if you want to find out if anything has been included in a previous issue about a particular site there is now a searchable database of all articles at https://www.earthheritage.org.uk/searchableindex/

If you would like to contribute an article to Earth Heritage, please contact the most appropriate editor (left) to discuss your ideas.



Susan Marriott - Guest Editor

OUTCROPS

North West Highlands Geopark draws in more support

A new Supporters' and Ambassadors' subscription scheme has just been launched by the Geopark in the North West Highlands. It is an area of very low population density and is particularly remote from the main service centres, currently with poor infrastructure and transport links. The idea of producing a network of businesses and organisations that can help provide mutual support, under the umbrella of the Geopark, has great potential. Many of the businesses are linked to the tourism industry and are closely associated with the landscape that surrounds them. Over the 2000 square kilometres there are currently 25 Ambassadors and 24 Supporters, the Ambassadors having a greater level of commitment to training and engagement with Geopark staff.

This scheme follows on from achieving 125 'Friends' in our Friends Membership Scheme, who support our work through volunteering time or by making a one-off or annual financial donation. New Friends recruited, following a series of five Geoheritage Festival 'Zoom talks' during the spring of 2021, have boosted these numbers. Each talk attracted between 120 and 230 participants.

https://www.nwhgeopark.com/

Pete Harrison, North West Highlands Geopark Geologist

Scottish Fossil Code review 2021: invitation to participate

The Nature Conservation (Scotland) Act 2004 directed Scottish Natural Heritage (now named NatureScot) to prepare the Scottish Fossil Code. This voluntary Code, published in 2008, set out recommendations, advice and information relating to fossils and was the Scottish Government response to enduring issues concerning irresponsible fossil collecting activity. NatureScot is required by the Nature Conservation (Scotland) Act to review the Scottish Fossil Code when it is deemed that it is required. Such a review is about to commence and as part of the process all those with an interest in Scottish palaeontology will have a chance to make their views known. To have your say watch out for details on NatureScot social media outlets.

https://www.nature.scot/landforms-and-geology/protecting-our-geodiversity/codes-researchers-and-collectors/scottish-fossil-code

By Colin MacFadyen, NatureScot

A superb fossil specimen of the lungfish *Dipterus* from Achanarras Quarry in Caithness. Revision of the Fossil Code should result in a document that will be more impactful in conveying best practice guidance on the collection and care of fossils, such as this, in Scotland.

QRA Geoconservation and Outreach Funds

The Quaternary Research Association (QRA) has a Geoconservation Award which provides grants of up to £1000 to deliver Quaternary geoconservation projects and activities. Applications for the QRA Geoconservation Award can be for site-based works and off-site projects, for example see the Herne Bay museum article later in this issue.

For Quaternary interpretation and public engagement projects, the QRA has an Outreach Fund https://www.qra.org.uk/outreach-funding/. For projects that combine Quaternary outreach and geoconservation, it is possible to apply to both funds at the same time, for example see the article on Pitstone later in this issue.

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

By Eleanor Brown, QRA Conservation Officer and James Lea, QRA Outreach and External Liaison Officer

Fforest Fawr Geopark Discovery Point Open

Fforest Fawr UNESCO Global Geopark has opened a new Geopark Discovery Point at Craig-y-nos Country Park in the Upper Swansea Valley. The Discovery Point is a starting place to explore the western half of the Brecon Beacons National Park and was officially opened during what would have been Geofest: a two-week festival of the Geopark that had to be cancelled due to the pandemic.

Situated on the outdoor terrace at Craig-y-nos, the Geopark Discovery Point consists of a tactile bronze relief model, three informative monoliths and three interpretation tables. The bronze model, designed by local artist Rubin Eynon, depicts the mountains and valleys of the Geopark around Craig-y-nos. The three monoliths, also designed by Rubin, raise awareness and understanding of the Geopark's UNESCO designation and introduce visitors to the Geopark's key stories of ice, industry and people. The interpretation tables, the first of their kind in the Park, were designed by Ingleby Davies Design, with each telling a different Geopark story. You can journey from the Big Bang to present day at the timeline game table where you will encounter millions of years of adventure, learn about how Cribarth (the hill above Craig-y-nos) was shaped by industry and find out how humans re-made the Geopark's landscape over the centuries.

The project to create the Discovery Point was led by Suzanna Jones, National Park Authority Interpretation Officer and Alan Bowring, Geopark Development Officer from the Brecon Beacons National Park Authority. Funding contributions were received from the Welsh Government, Interreg Atlantic Area and Brecon Beacons National Park Authority. Craig-y-nos Country Park is open everyday 10am-5pm (parking charges apply) and people are asked to adhere to social distancing guidelines when visiting the Geopark Discovery Point and the wider Country Park.

Clarissa Price,
Communications Officer, Brecon Beacons National Park

The bronze relief model depicts the mountains and valleys of the Geopark around Craig-y-nos. On a good day the limestone crags of Craig y Rhiwarth (Carboniferous - Asbian/Holkerian) can be admired from the terrace, with the flat-topped sandstone mountain of Fan Gyhirych (Devonian) in the background.

All photos by Brecon Beacons National Park Authority.

One of three timeline game tables at Craig-y-nos will take visitors through the geological and industrial history of Fforest Fawr UNESCO Global Geopark.

Geologists' Association Geology Photographic Competition 2021

A great opportunity for imaginative photography of geosites and geoheritage!

Up to three photographs on any geological topic can be entered. These will be put on display at the GA's Virtual Festival of Geology from 6th November 2021.

Amateur photographers only. But otherwise open to all – not just GA members.

First Prize £100, Second Prize £50, Third Prize £25.

Your entries will also be considered for inclusion in the 2022 GA Calendar which will be on sale at the Festival and may be published in the Geologists' Association magazine and used for publicising and promoting the work of the Association (full credit will be given).

For more information and to download the Geology Photographic Competition rules and entry form, please visit: https://geologistsassociation.org.uk/photocomp/

Gerald Lucy, Geologists' Association

Ammonite Pavement, Lyme Regis, Dorset taken by James Codd. First prize winner in the 2020 GA Photographic Competition that was published in *EH54* alongside a selection of other competition entries.

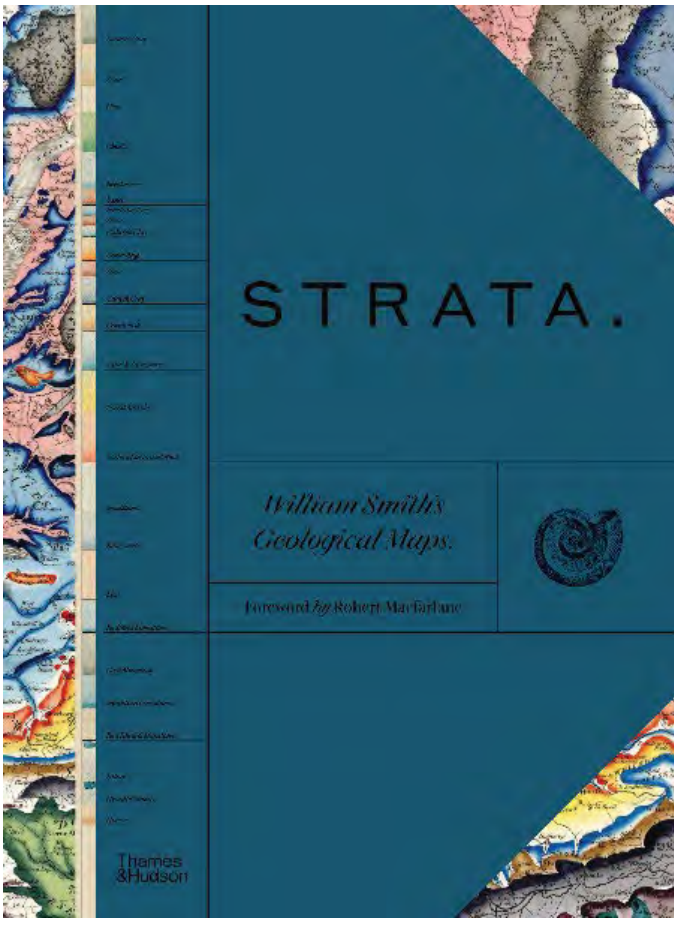
The unusual chalk shore platform in Whiteness Bay (part of the Smugglers Trail. p.54) exposes the Barrois Sponge Bed which developed as a mineralised fossil hardground. It records a time of swirling bottom currents when very little if any chalk ooze accumulated on the seabed. It was a time of relatively low sea level within the overall Thanet chalk sequence. The hardground forms the boundary between the Broadstairs Chalk below and Margate Chalk above. Note the 18th century smugglers' caves in the white chalk cliffs forming the distant headland. Photo by Tina Hubbard.

PUBLICATIONS

STRATA: William Smith's Geological Maps

STRATA: William Smith's Geological Maps. **Foreword by Robert Macfarlane. Thames and Hudson Ltd, London (Published 2020), 256pp. Hardback, ISBN: 979-0-500-25247-5. £50.00**

This beautifully illustrated hardback book, printed on high-quality paper, is as aesthetically pleasing as it is informative. In short, it showcases William Smith's 1815 hand-coloured map, *A Delineation of the Strata of England and Wales, with part of Scotland*, and illustrates, in a variety of ways, his life and career. The Foreword by Robert MacFarlane is followed by an introduction and four sections, Borders and the North, Wales and Central England, East Anglia and the South East, and the West. There is also a bibliography and index. Unlike previous publications on Smith, it features the work that led up to the 1815 map. It includes Smith's first geological maps of the geology around Bath, his county geological maps and cross sections, the Sowerby fossil illustrations from Smith's *Strata Identified by Organized Fossils*, and extracts from his diaries and letters. From a historical point of view, the inclusion of contemporary illustrations, engravings and paintings of people's daily lives including canals and mines are of particular interest. The illustrations in the book sit alongside eight essays that chart Smith's fascinating and, at times, challenging life.

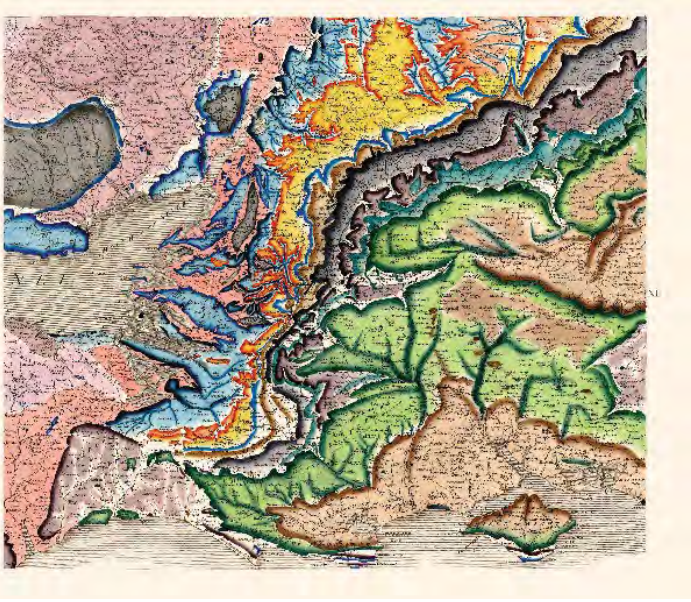


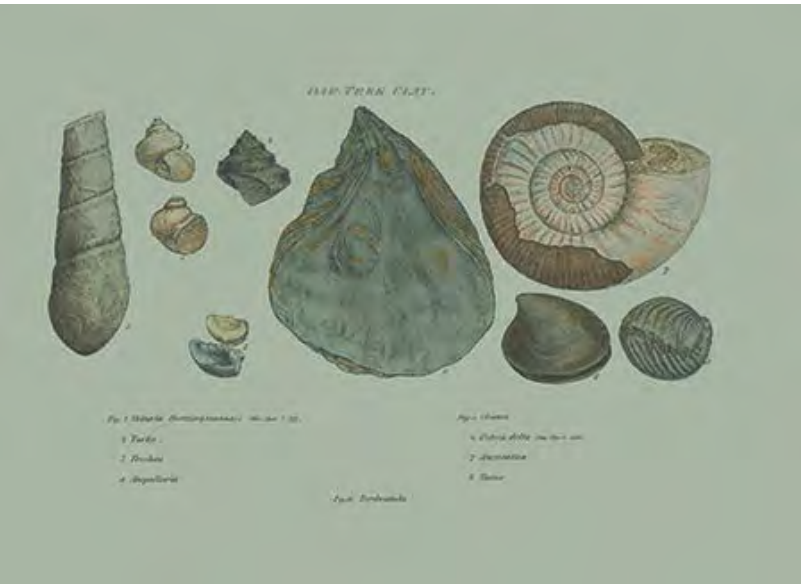
In terms of geodiversity and geoheritage, the colours used by Smith to depict different geology in his maps, which are reproduced to such great effect in this book, are a simple and visual reminder of Britain's rich geodiversity, one of the factors that undoubtedly inspired pioneering geological study and eventually geoconservation in Britain. It is now widely accepted that making an audit of geological features to determine what there is, and where, is the first step in developing a systematic approach to geoconservation.

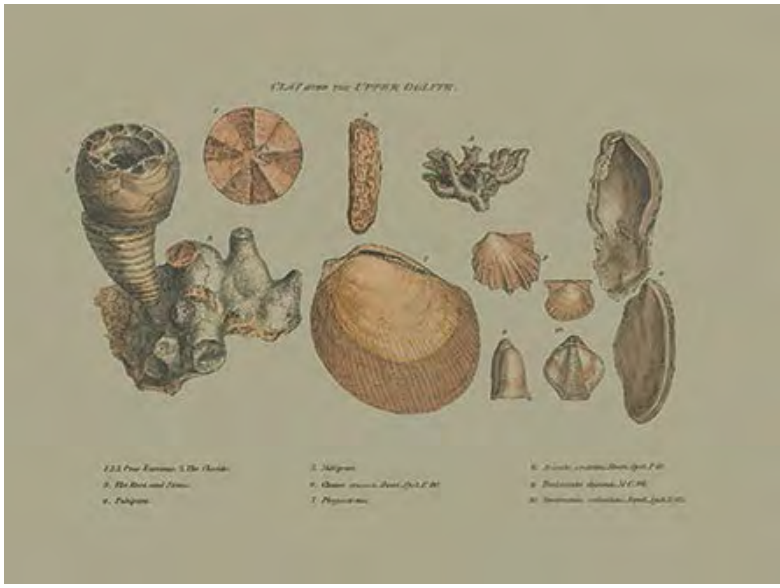
Right: **A Delineation of the Strata of England and Wales with part of Scotland. William Smith, 1815, p.12-13 © University of Oxford, Museum of Natural History.**

Below right: **Fossils found in clay over the Upper Oolite. Strata identified by organised fossils: containing prints on coloured paper of the most characteristic specimens each stratum, William Smith Printed by W. Arding, London 1816.**

Below left: **Fossils found in Oak Tree Clay. Strata identified by organised fossils: containing prints on coloured paper of the most characteristic specimens each stratum, William Smith Printed by W. Arding, London 1816.**







Geological maps and descriptions of geological sections have always played a big part in such audits; the Geological Conservation Review for example drew heavily on BGS maps and memoirs, and Smith's maps as illustrated in Strata represent the start of the geological mapping process.

The book includes some specific reference to features which are now geological SSSIs, e.g. it features a page of his notes on the strata at Castle Cliff, Newhaven, Sussex on page 24. However, in reproducing beautiful and historic geological maps of England, Scotland and Wales it is perhaps most useful as a tool through which to inspire people anywhere in the country about their local geodiversity, the history of its discovery, its importance to science and society and the need to protect it.

This book will be of interest to geologists, historians and anyone who likes beautiful books. A major challenge for anyone involved in geoconservation is to persuade land managers, decision makers and members of the public that our geoheritage is interesting and worth visiting and conserving. This book, along with a narrative linking the work of William Smith to what we understand about the sites we are seeking to protect today, is one way of helping to grow understanding and support. All you need is a bookcase large enough to host it!

Colin Prosser, Natural England

Massive sub-cordate hand axe collected by Dr Tom Armstrong Bowes from Whatmer Hall gravel pit, Sturry, part of the Palaeolithic collection at the Seaside Museum, Herne Bay. The museum was recently awarded a grant from the Quaternary Research Association (QRA) Geoconservation Award, to help with upgrading its facilities to house, conserve and curate these collections which are of local and national significance (for more details, see article on p.16). Photo by Pete Knowles.

ARTICLES

Post-pandemic, how can museums help to make Earth heritage accessible for everyone?

Liz Hide, Director, The Sedgwick Museum of Earth Sciences, University of Cambridge.

For many of us, the opportunity to reconnect with our local natural environment has been an important part of lockdown over the last year. Spending time in the outdoors plays a key role in our mental and physical wellbeing and is central to helping people feel invested in looking after their environment. Getting out to look for rocks, fossils and minerals, and learning about the landscape around us are powerful ways to encourage and inspire the next generation of Earth scientists.

Yet not everyone has access to green spaces close to their home or has transport to visit them. People on low incomes, BAME (Black, Asian and minority ethnic) people, and those with a long-term illness or health condition are less likely to have visited a natural space in the last 14 days. Early research suggests that the COVID-19 pandemic has exacerbated the impacts of this 'green poverty'. As we move optimistically towards post-lockdown recovery, how can we make sure that as we encourage people to get out and get interested in their Earth heritage, we don't amplify this inequality?

Sponge fossils such as these are relatively common in some flint gravels.

Photos by Nicola Skipper unless otherwise stated.

***Left*: Gravel Hunters gets families out and looking for gravel on their drive, in car parks, or, in this case, in a sack of gravel bought from the builders' merchant. Photo by Liz Hide.**

***Top*: Fragment of an echinoid found in flint gravel.**

Given that this is about getting people outside and into nature, an immediate reaction might be that museums have only a limited role to play in this challenge. In fact, their locations, frequently in urban areas, mean that they are close to many of the communities who do not or are not able to spend much time in nature. Museums have good links with schools and young people and are widely understood as being importance places for informal learning. Research has shown that visitors consider natural history galleries in museums to be the most family friendly, and case studies demonstrate that family interactions with museum collections can support nature connectedness. Earth science and natural history museums such as the Sedgwick Museum in Cambridge can act as gateways, providing ways in which people can build their confidence and interest in their Earth heritage.

Why does this matter to us in Cambridge? While many consider our city to be well educated and wealthy, there are parts of the city and of the wider Cambridge region which are among the most deprived in England. The Centre for Cities, in their 2018 report on the state of urban Britain dubbed Cambridge the most unequal city in the UK. A young person growing up poor in Cambridge will have very limited opportunities to reach their potential. As a museum committed to supporting young people's learning and encouraging them to consider STEM (Science, technology, engineering and mathematics) careers, if we are to play our part in making Earth sciences inclusive and welcoming to everyone we must take into account the disproportionate challenges faced by disadvantaged young people.

This is the thinking behind the public engagement work of the Sedgwick Museum, and of the University of Cambridge Museums consortium of which the Sedgwick is part. Using data about demographics, for example the government's Indices of Multiple Deprivation, we can target our resources most effectively. Partnering with organisations that have relevant expertise and are already working with young people is a powerful way to reach those who will most benefit, and to help us make sure that we deliver activities effectively and respectfully.

The Sedgwick Museum's Gravel Hunters project is an example of a targeted project aimed at supporting the most disadvantaged families and young people to engage with geology and the outdoors—those who have been most negatively impacted by lockdown. It also demonstrates how the Museum team were able to rise to the challenge of reshaping their public programme and rapidly learn new digital skills.

We focused on a resource that was available in back gardens, driveways, car parks and public spaces that was easily recognisable and required no money or specialist equipment. Flint gravel, from deposits which accumulated during or soon after the Quaternary glaciations, is the source of a wide variety of fossils. These include sponges, oysters, belemnites, with rarer corals, gastropods and echinoderms, sometimes mixed with occasional pieces of igneous, metamorphic and sedimentary rocks. Flint gravel fossils are generally easily visible with the naked eye and relatively easy to identify through digital photos or while maintaining social distance. Together finds from the gravel help to build up a picture of a warm shallow sea 90 million years ago across much of southern England, bringing geological history alive in a part of the country lacking in dramatic hills, cliffs and beaches.

Sorting gravel finds as part of a school workshop.

The Museum's public engagement team put together a short Gravel Hunters film, telling the story of how gravel is formed. A downloadable sheet helps with identifying some of the most common flint fossils. We launched the film in conjunction with Cambridge City Council's Children and Young People's Participation Service as part of their PlayDaze programme. The University of Cambridge Museums have a long-standing relationship with this agency, whose work targets families with primary-aged children in some of Cambridge's more disadvantaged wards.

We were later able to share the resource with a wider family audience, and in October 2020 took advantage of some good weather to deliver outdoor, socially distanced workshops for two Year 4 classes from a local school in the north of the city. They searched for fossils in local gravel, as well as from a bag sourced cheaply from the builders' merchants. Since then we have collaborated with colleagues in the University of Cambridge Museums consortium to develop 'Inspire Nature' primary teacher resources based on the Gravel Hunter activities and made the film available to for families and teachers to use.

We have been able to continue to engage with people through social media as we identify and share peoples' finds, as well as our own. Despite closure of the Museum, we've been able to raise awareness of our identification service and seen an increase in its use. Whereas in the past we would ask people to bring their finds into the museum for identification, we are now much more confident in identifying fossils, rocks and minerals remotely.

A further impact of the pandemic has been that we have had to temporarily remove many of the interactive activities from the museum gallery. These resources, including family activity packs, puzzles and the book trolley are an important way in which we help families who are not confident or regular museum visitors to feel welcome and at home. Removing interactives, however temporarily, feels a bit like a step back 20 years, so as we start to plan for the summer, Gravel Hunters gives us the flexibility to offer families an outdoor interactive activity, or one for them to take and try at home.

Feedback on the activities has been very positive, but measured purely in terms of participant numbers, the immediate impact of the Gravel Hunters project may seem relatively modest. Funders, stakeholders, and indeed we ourselves are often used to judging the success of a project on the hundreds or even thousands of people who joined in. That is not to say there is no place for a bustling museum or a busy fossil festival—we miss them and cannot wait for it to be safe for them to return. What this has impressed on us is that by clearly demonstrating how our public engagement work is planned and targeted to reach those whose face greatest disadvantage, we can feel confident that it is having the greatest impact. Earth science is a fantastic way for people to engage with nature and understand their natural environment, and we want to make it a place for everyone.

Further Information

You can find out more about the Gravel Hunters resources here:
https://www.museums.cam.ac.uk/index.php/school-sessions/gravel-hunters

The role of geological collections in effecting social change is the subject of a more comprehensive paper by Liz Hide in issue 11-5 of Geological Curator, accessed via https://www.geocurator.org/journal.

Herne Bay's Museum: Curation and Conservation of Historic Collections of Pleistocene Mammalian Fossils and Palaeolithic Artefacts

Pete Knowles, The Seaside Museum, Herne Bay

The Seaside Museum in Herne Bay, Kent, has recently been gifted two large historic collections of Pleistocene Mammalian Fossils and Palaeolithic artefacts. In 2019 the museum was awarded a grant from the Quaternary Research Association (QRA) Geoconservation Award, to help with upgrading its facilities to house, conserve and curate these collections which are of local and national significance.

The museum is currently run by a trust which was set up in 2015 after Canterbury City Council, who had run it at its present site since 1996, relinquished its financial commitment. The museum is now almost entirely run by volunteers, there is no longer any professional specialist curation within the local museum group (Canterbury, Whitstable, Herne Bay).

The Palaeolithic collection predominantly consists of two large historic collections, that of Dr Tom Bowes who was for many years the local GP and instrumental in establishing the first town museum in 1932, and a non-local collection from John Gilchrist Wilson of Birchington. The Bowes collection is from sites within the east Kent Stour fluvial archive, whilst the Wilson collection is a lithic type collection from national and international sites. Curation of the collections is ongoing, but work to date has identified that it contains upwards of 370 Palaeolithic implements, of which at least 207 are from sites of the east Kent Stour's fluvial archive.

The collection includes:

- Fordwich Pit (Chequer's Wood and Old Park SSSI): crude stone-struck pointed hand axes, large unabraded and rolled ovate hand axes, small ovate hand axes and flake tools, large biconical cores possibly of Clactonian type. A twisted cordate hand axe in exceptionally mint condition;
- Sturry Pit SSSI: numerous small, pointed hand axes and flake tools, one extremely large sub-cordate hand axe, and a number of previously unrecognised twisted ovate hand axes;
- Reculver (Thanet Coast SSSI): fresh unabraded small pointed sub-cordate hand axes noted from fresh fall, an extremely large prepared core;
- Canterbury: A fine example of a Bout Coupé hand axe, of unknown provenance and a previously unrecognised assemblage containing ficron and cleaver handaxes.

The Pleistocene material includes several straight-tusked elephant jaws, recovered from local cliff falls at Hampton in the first half of the 20th century but, unfortunately, documentation associated with these finds is poor to non-existent. From foreshore sites near the old Herne Bay pier there are the pelvis, a pair of tusks, and upper and lower jaws from straight-tusked elephants, various mammoth and elephant teeth and various auroch bones. Rhinoceros teeth and scapula from Westbere (within the Stour valley) are also present in the collection. There are also other Pleistocene mammal fossils and *Homo sapiens* remains from various Kent localities (Verrals Pit, Aylesford; Baker's Hole SSSI/Scheduled Monument, Northfleet; and Swanscombe National Nature Reserve); and other non-local comparative material such

as rhinoceros teeth from Kent's Cavern SSSI and Scheduled Monument, Torquay.

The grant from the QRA enabled the museum to purchase racking to store the lithic material and Pleistocene fossils safely. A photographic copy stand was also purchased in order that all the material can be satisfactorily recorded. The remaining funds are to be used to restore one of the original wooden archival cabinets and purchase baize and Plastazote foam to line the drawers, which will eventually house the remains of Bowes' enigmatic collection of palaeoliths from the Stour high terrace at Fordwich. Unfortunately, this work is still on hold due to the COVID-19 pandemic.

Two public engagement events were held before the pandemic took hold, these were In October 2019 (general public) and February 2020 (Canterbury Young Archaeologists Club). The events titled '*People and Beasts of the Ice Ages*', enabled visitors to see a larger part of the collection than would normally be on display. This included fossils of large mammals and flint implements from different terrace levels of the Stour that represent the material culture of different hominin species. These events were very well received, and more are planned.

The Palaeolithic collection is now being used as a resource for a doctoral research project at Durham University by museum curator Pete Knowles. This research seeks to establish whether there is evidence for cultural patterning in the Early and Middle Palaeolithic hand axe technologies visible in the artefacts from the Stour gravels. This collection may be pivotal in that understanding. This research has already identified a previously unknown assemblage of Ficron and Cleaver hand axes from Canterbury, which could radically change the understanding of the artefact record in the Stour fluvial archive.

Stour Valley Palaeolithic Sites

Top: **Volunteer curator Pete Knowles at the Seaside Museum Herne Bay. Photo by Dr Helen Wickstead, Kingston University.**

Right: **Major Palaeolithic sites in the Stour Valley. Based upon Ordnance Survey data, © Crown copyright and database rights 2021 Ordnance Survey (100025252).**

It is hoped that this research could further contribute to the correlation and integration of the Middle Pleistocene fluvial river systems of the south-east of England into a coherent chrono-stratigraphic framework.

These collections together represent a valuable resource and for this reason it is imperative that the collection stays intact and remains in Herne Bay. The grant from the QRA has significantly improved the situation. The public engagement day that was planned for spring 2020 will be rescheduled as soon as COVID-19 conditions allow. Requests to study the collection are welcomed and can be made directly to the museum via the museum website.

For further information, please visit: http://theseasidemuseumhernebay.org

***Top left*: Racking housing the large Pleistocene fossils, funded by QRA. Photo by Dr Helen Wickstead, Kingston University.**

***Left*: Massive sub-cordate hand axe collected by Dr Tom Armstrong Bowes from Whatmer Hall gravel pit, Sturry. Photo by Pete Knowles.**

***Inset*: Part of the October 2019 exhibition – '*People and Beasts of the Ice Ages*'. Photo by Dr Helen Wickstead, Kingston University.**

Let's Circus and the Rock Showman

Steve Cousins, Earth Scientist and Ringmaster, Let's Circus

Geology and Circus are not your regular everyday bedfellows, but there is now a team of creatives and scientists to bring these two specialisms together. Working with partners from museum, conservation, education and event backgrounds to excite the public with Earth heritage, *Let's Circus* is not your average STEM (science, technology, engineering and mathematics) team. Based in Newcastle upon Tyne, they are at the coalface of public engagement as they deliver outdoor events and venue-based outreach across the UK.

Geology and circus - what's that about?

It is about combining visual, physical theatre with sometimes invisible scientific concepts. Some science communicators re-enact the fossilisation process through multicoloured layers of sand or plasticine, whilst I walk across the tops of champagne bottles to give a sense of how precarious that process is. We find creative, entertaining ways that will engage the public. Recently we brainstormed how to communicate visuals of Early Solar System reconstruction without animation, special effects or screens. We found that turning on the Candy Floss machine provided the protoplanetary disc analogy and showed how molten solids condense for accretion. It will come as no surprise that the kids loved it. We may not have the BBC's CGI department or the dulcet tones of Prof. Brian Cox, but a spoonful of sugar helped the metaphor go down!

Artwork of The Rock Showman's Booth © Helen Averley

Left: **Rock Showman Logo.**

Below: **Let's Circus as the first ever circus to the Isle of Barra © Let's Circus.**

All images © Let's Circus unless otherwise stated.

Why mix circus with science communication?

As an art form, circus reaches a genuinely diverse audience where all ages, abilities, languages and cultures can appreciate unique physical skills together. It is a popular format that can be dressed in many ways to tell a story. We used this to advantage in our 2019 Let's Circus production *It's About Time*. This hour-long, international, family circus show was themed around the Climate Emergency, with the narrative disguised as a Time Travel romp until the closing 15 minutes where the metaphor became clear. People need space for enjoyment, as much as they need stimuli for contemplation—Circus is a great medium for both.

Where do you find artists who can deliver science and circus?

It is a pretty rare mix, and the truth is we are always looking! Sometimes people come fully formed in both, sometimes we develop one of their talents. Our team's core creative is my wife Helen Averley who is a circus artist with a master's degree in Anthropology of Art. Her art direction is fantastic. We often direct outdoor entertainers as science communicators as their engagement skills are so developed through the nature of their workplace.

Do you perform in a Big Top?

Yes, we have three boutique Big Tops that can house full circus performances for our larger projects. Most of our science communication work takes place in micro-venues such as The Rock Showman's Booth, which is a beautifully illustrated museum come art gallery come theatre. Visually stunning both inside and out, Helen's artwork combines an aesthetic of Victorian-era miner's banners and Showman's wagons with a strong environmental message. The interior combines a timeline of Earth History and Museum-style infographics and was developed with support from The Geologists' Association's Curry Fund and Arts Council England. It is a real curiosity cabinet and a great starter point for public engagement.

Is what you do science or art?

What is the difference? Each thrives when humans make creative leaps. We design our activities around the point where science and art meet. Our educational outputs are designed to foster the public's creativity and lateral thinking. We attempt to overcome the prejudice *'but they're just rocks!'*, by building an individual's confidence in exploring new knowledge. Using peer-reviewed scientific

content, hands-on performance and activities stimulates the imagination of our audience. We offer free candy floss to anyone who can define a stratigraphic boundary between science and art!

What kind of activities does The Rock Showman's Booth provide?

The venue is a micro-museum, classroom, art gallery and functioning home for our Earth science and environmental outreach activities. As a performance venue it houses our show *'The Greatest Show Unearthed'*, a 45-minute circus-theatre production that tells the story of life, extinction and evolution. We use it as an outreach venue at festivals and public places where it is a part of our public facing '*Dino-Dig'* and *'Fossil Fun'* hands-on activities. We also work within museums, schools and venues as a visitor experience and curriculum engagement activity. We have gone from carrying dozens of obscure circus props and costumes across the UK, to carrying hundreds of rocks, fossils and natural history artefacts instead!

How have you adapted to the COVID world?

The events industry has taken a massive hit, so most of our focus has been on new digital directions and taking Geoheritage to social media in different ways. We have curated and hosted some exciting film and live-broadcast events with partners such as Museums Northumberland and The Common Room of the Great North. These have allowed us to play with stunning heritage venues in creative and mutually beneficial ways. Despite closures, we are continuing to engage both live and digital audiences by adapting to the new conditions that we face. After all, if anyone should be good at jumping through hoops, it's The Circus!

You're working on Mobile Phone GPS activated Geotours - what's that about?

Working with Shetland Geopark we are creating a Geo-located walking tour around Sumburgh Head. This will be an interactive podcast fieldtrip where the public can take a guided tour at their leisure, with the GPS of their phone triggering the narrative as they walk through programmed marker points. We are also exploring this kind of technology for use in academia, where COVID has stopped many fieldtrips from taking place.

Where can we find your live event work?

We are '*The Circus that runs away to join you!*', our Earth Heritage works are similarly peripatetic and take us everywhere. We have always loved Palaeozoic and Proterozoic locations but move with the times. A lot of our 2021 projects will be in North East England, as well as our digital Shetland work. There is a lot of grass-roots energy going into Earth Heritage in this part of the UK right now, with a number of committed and experienced public engagers working together. It is great to be involved with Will Watts at Hidden Horizons, Liam Herringshaw of Yorkshire Fossil Festival, Byron Blessed from Fossils-UK and Roger Osborne at Whitby Museum. Soon this will launch publicly as the YorkshireCoast.Rocks campaign and website, boosting a strong local legacy of public engagement with Earth Heritage.

Is the Rock Showman a novelty act or serious Earth scientist?

You decide, I don't mind! I hope that I can engage academics, enthusiasts and newcomers with my style of work. As a science communicator my content is thoroughly researched and rehearsed, and every day I am peer and public reviewed. My constant challenge is to make factual content unique, quirky and interesting, and for it to lift the engagement level of a wider public. If the balance of tricks, juggling, costumes and dad jokes add to the experience of learning, then perhaps there's wisdom in foolish behaviour after all. I'll work with all the tools that I've got!

Top Left: **Let's Circus presents *The Greatest Show Unearthed* © Woodhorn Museum & Let's Circus.**

Top Right: **Let's Circus team on the Isle of Harris.**

Middle left: **The Rock Showman's Booth—a theatre, classroom, gallery and cabinet of curiosities.**

Middle right: **The rare combination of variety entertainment, planetary geology and dad jokes © Woodhorn Museum & Let's Circus.**

Bottom: **Welcome to The Rock Showman's Booth.**

Further information

For information on The Rock Showman: https://rockshowman.co/

For information on Let's Circus: http://www.letscircus.com/

Coming soon: www.YorkshireCoast.rocks

The Ballantrae Complex promoted in short film

Stuart Graham, NatureScot

One of the world's best preserved Ophiolite Complexes has been portrayed in a short geological film. The Ballantrae Complex in south-west Scotland has exposures of oceanic crust that has been pushed to the surface during the Ordovician period as Scotland and England drifted together.

Communities in the Stinchar Valley in south-west Scotland identified the complicated geology of the Ballantrae Complex as a topic they would like to know more about. Initially guided walks led by experts were proposed but COVID-19 restrictions meant a different approach was needed.

A film featuring local historical landmarks and revealing the geology that lies beneath them was identified as a solution that would have a lasting legacy. The short video shared on social media aims to encourage more people to learn about the rocks that make the landscape around them.

The *PLACE in the Biosphere* project aims to encourage people to be curious, take a closer look at their surroundings, appreciate the natural and cultural heritage assets in their countryside and tell the story of their place to a wider audience.

The film was produced with support from the National Lottery Heritage Fund as part of the Great Place Scheme. Managed by Southern Uplands Partnership, the project involves communities in three distinct landscapes within the Galloway and Southern Ayrshire UNESCO Biosphere: the Borgue Peninsula; the Wigtownshire Moors; and the Stinchar Valley.

The film has been published on the Galloway and South Ayrshire Biosphere facebook page **https://fb.watch/3qfSZEwjlz/** and on Youtube **https://youtu.be/ygl-jRTAzuU** and has already had a few thousand viewings.

A view along the coastline at Ballantrae on the South Ayrshire coast. This area provides the evidence of an obducted ophiolite complex comprising a fragment of Iapetus Ocean crust and underlying mantle. This happened during the Caledonian Orogeny when a slice of ocean floor was detached and then accreted to the Scottish landmass as the Iapetus closed.

Photos by Stuart Graham.

A note from the author:

”I was delighted when Nic Coombey at the Biosphere Project asked me to get involved. I had first visited the Ballantrae Complex as a geology student 30 years previously and was delighted to have the opportunity to both appear in and narrate the film. It was great to work with Calum Ansell, the film producer and the crew at Ferann Alba. The film whilst only 5 minutes long combines some classic geology with artistic photography which Calum achieved through use of drone footage. It really shows off the area at its best.”

Ballantrae,

a poem by Stuart Graham

Ghost castle watches smuggler's coast
where catch is Sawney's brand
or contraband on this, the
coast of the hidden secrets.

Secrets that should be buried deep,
yet we cannot see the wood for the trees,
where ocean floor crests the hill
with Ordovician obduction

and pillow lavas bulge with excitement
as serpentinite slithers inland
with jasper red eyes
to nestle with the trilobites.

(Sawney Bean was a notorious cave dwelling Cannibal from the 16th Century)

Ordovician-age pillow lavas on the Ayrshire coast south of Ballantrae. These together with other elements of the obducted ophiolite including serpentinite, jasper, and fossil-bearing deep water sediments have played an important role internationally in understanding ophiolite generation and obduction.

Camp Siluria revisited

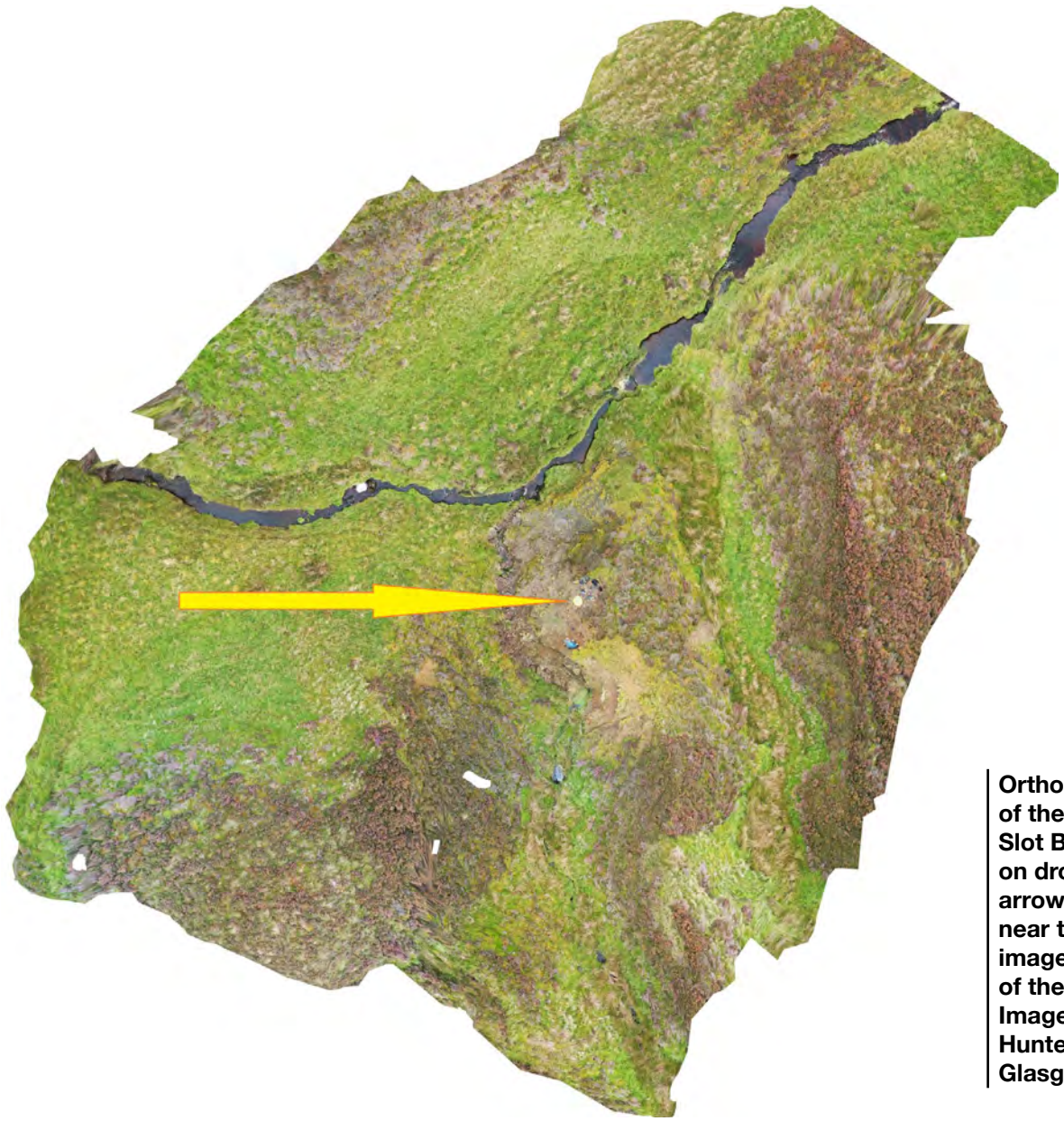
Gary Hoare, Council Member of the Geological Society of Glasgow & **Neil Clark,** President of the Geological Society of Glasgow and Curator of Palaeontology, The Hunterian, University of Glasgow with a contribution from **Jane Reeves**, University of Manchester.

> ***"The Work of Gary Hoare and Neil Clark at a site of global significance, and of considerable historic importance from the perspective of early vertebrate research, highlights the importance of amateur and professional researcher collaboration. It also demonstrates the value of the Site of Special Scientific Interest (SSSI) designation which has for decades helped safeguard the locality for research."***
>
> Colin MacFadyen, NatureScot.

As an amateur collector and researcher with an avid interest in all things fossil, Gary has become interested in the history of palaeontological discovery in Scotland. Knowing of the famous *Camp Siluria* of the late 1800s and early 1900s organised by the Geological Society of Glasgow that looked into the Silurian fossil fish localities of Scotland, he felt it was time for a contemporary look at these sites to elucidate their geological context, help with the site management, and provide fresh specimens to inform current research.

Silurian fish bed localities that contain complete and abundant fossil fish are rare globally, but Scotland has provided us with quite a few from the inliers around Lesmahagow in South Lanarkshire and Muirkirk in East Ayrshire. They were first discovered in the late 1800s and visited by Dr J R S Hunter-Selkirk who first hoisted the *Camp Siluria* flag (see further reading). Dr Hunter-Selkirk

Colourised photograph of *Camp Siluria* participants at an unknown site in the Lesmahagow Inlier (c. 1882) to collect fossil fish in the Logan Water. Three of the party would prepare breakfast whilst the other three discussed the day's work ahead. The party would have included Dr JRS Hunter-Selkirk who may be the person seated left. Image courtesy of The Hunterian, University of Glasgow.



Orthomozaic of a portion of the Blood Moss and Slot Burn SSSI based on drone images. The arrowed yellow circle near the centre of the image marks the location of the 'fish beds'. Image courtesy of The Hunterian, University of Glasgow.

The value of opening up historic sites and renewed collecting

The fossil fish found at these locations are some of the most important specimens for understanding the early evolution of vertebrates. These small, but amazing, fossils exhibit an unusual mix of character traits, including features that may be the first steps in the evolution of bone, hinting that they are critical for reconstructing this major event in vertebrate history. Sadly, many of the species are poorly known from only a handful of fossils, or from fossils that are incomplete, so it is difficult to express just how exciting and vital the prospect of collecting new material from these localities is! New specimens will not only give us better understanding of these enigmatic organisms, but potentially they will unlock a pool of new data that will help in answering some fundamental questions about our (very) ancient ancestors.

Jane Reeves
(a PhD research student at the University of Manchester who is studying the fossil fish *Lasanius*)

***Birkenia elegans*, an example of the kind of fish that has turned up at one of the *Camp Siluria* localities in recent times. Fish like this will help better understanding of these early fish. The specimen was collected from Birkenhead Burn, Lesmahagow, and is in the collections of The Hunterian, Glasgow (GLAHM V8384). Image courtesy of The Hunterian, University of Glasgow.**

was a 19th century collector who was inspired by the collections of William Hunter to build his own collection which he called the 'Braidwood Collection' (much of which is now in the Glasgow Museums' collections). *Camp Siluria* was named in honour of Roderick Murchison who had visited Lesmahagow and studied the collection of Robert Slimon (who brought the fossils from Lesmahagow to Murchison's attention) in the 1850s. Murchison mentioned the fossils in his book *Siluria* in 1859 (3rd edition) which is why the camp was named after the book. Organised by David Nimmo (a member of the Geological Society of Glasgow since 1898), Dr Hunter-Selkirk and other members of the Geological Society of Glasgow camped at the various sites to collect the fossils in the late 1800s to early 1900s.

According to Peter MacNair (Scottish naturalist and geologist Curator of the Kelvingrove Art Gallery and Museum, and past President of the Geological Society of Glasgow) who co-organised some of the later *Camp Siluria* expeditions, the daily routine was to open the tent and inspect the weather at around 5am, then the stove was lit for breakfast of bacon and eggs. While three of the campers dealt with breakfast, the remaining three were usually deep in thought or pondering over maps for the day's digging. After breakfast the party had a morning dip in a large pool in the stream followed by a run through the heather back to camp. After several hours of hammering, chiselling and collecting, "a halt must be called for dinner. So somewhat exhausted we retrace our steps to the tent and begin our midday meal. After this, tobacco is produced and lying on the grass we enter into discussions more or less profoundly paleontological and stratigraphical." (From MacNair's publication of 1905).

It is with thoughts of the early palaeontological pioneers that a current research project looking into the Silurian fish beds is being conducted. The most outstanding of these sites have been designated as SSSIs many years ago and have been safeguarded from development. The current study is looking at improving our understanding of the lithological relationships and geological context, as well as providing detailed analysis of the future potential of the sites and fresh material for research. Perhaps in a less intrusive manner than that conducted in MacNair's day with notebooks, mobile phones and drones rather than explosives, picks and ponies. The first of the current SSSI sites to be cleaned up and recorded is the famous fossil site at Slot Burn (also known as Seggholm), within Blood Moss and Slot Burn SSSI near Muirkirk, in Ayrshire, that was first discovered by Arthur Macconochie and David Tait (appointed collectors for the British Geological Survey) in about 1897. Although it was not part of the original *Camp Siluria* sites, it is considered a critical site in this current project.

Apart from the usual small hammers and chisels used to collect mostly from the scree, soil and overgrowth had to be removed from the rock faces using shovels and brushes to allow a detailed sedimentological log of the exposed sections to be made. The section at Slot Burn had not been looked at from a geological point of view since the celebrated fossil fish expert Alec Ritchie undertook his PhD project looking at the fish beds back in the 1960s. Now a Senior Research Fellow in palaeontology at the Australian Museum, Sydney, Dr Ritchie has expressed his close interest in the outcome of this project, and strongly suggested “getting as much written up as possible”. In contrast with recording projects of the past, photographs can be taken using mobile phones and later stitched together electronically to produce continuous sections. What is significantly different from previous studies is that the locality was also photographed aerially using a drone for context; a technique that also offers considerable value as a site management tool.

This project is in its early days, so it is hoped that there will be a lot more information to be gleaned from comparative studies of the various Silurian ‘fish beds’. So far, only the Slot Burn has been looked at in detail with images and sedimentary logs that can be compared with those taken nearly 60 years ago. Three-dimensional imagery based on drone flights over the sites can help with the evaluation of natural erosion or the effects of collecting in future years. This, in conjunction

Refreshed rock outcrop at the Blood Moss and Slot Burn SSSI with the lead author for scale. This work, facilitated by NatureScot, was supported by the landowner and was an exemplar of the SSSI consent process in action being undertaken entirely in the spirit of the Scottish Fossil Code. Photo by Neil Clark, The Hunterian, University of Glasgow.

with an assessment of the physical extent of the 'fish beds', could feed directly into a future site management plan.

One of the inevitable byproducts of a study to look at the Silurian 'fish beds' is that there will be a number of fishy remains found. These remains help to identify levels within the log of the sediments where fish occur and help provide an insight into the palaeoenvironment at the time of deposition. Sometimes, these remains are of great use and provide us with a greater understanding of the organisms themselves. As part of this project, fossils that have already been shared with researchers have helped to elucidate and interpret the structure of the preserved elements of fish such as *Lasanius*. As these fossils are rare and important, the significant pieces are to be offered to museums with a strong natural history component to their collections (such as The Hunterian in Glasgow which already has a substantial collection of Silurian fish from the area).

With very few exceptions, Silurian fish from places outside of Scotland are fragmentary remains. They provide us with a rare insight into the evolution of non-marine vertebrates, their biomechanics and palaeoecology. At the time they were first discovered in Scotland, they were thought to be the earliest vertebrates. Advances in our knowledge through discoveries in North America and China, the early evolution of vertebrates has been pushed back through the Ordovician to the Cambrian Period, but Scotland is still significant in our understanding of these elusive and aesthetic animals.

As Dr Hunter-Selkirk said in his 1885 publication, "I hope and trust the flag of *Siluria* will in times come to fly in various districts of Scotland, and not be the solitary one in the land either, for I doubt not that some enthusiastic geologists will ere long follow our example, and experience the joys and pleasures of an extended camping out on or near these investigations". This project may not be exactly what Hunter-Selkirk had in mind, but it is hoped to be conducted in the same spirit of adventure and discovery.

Further Reading

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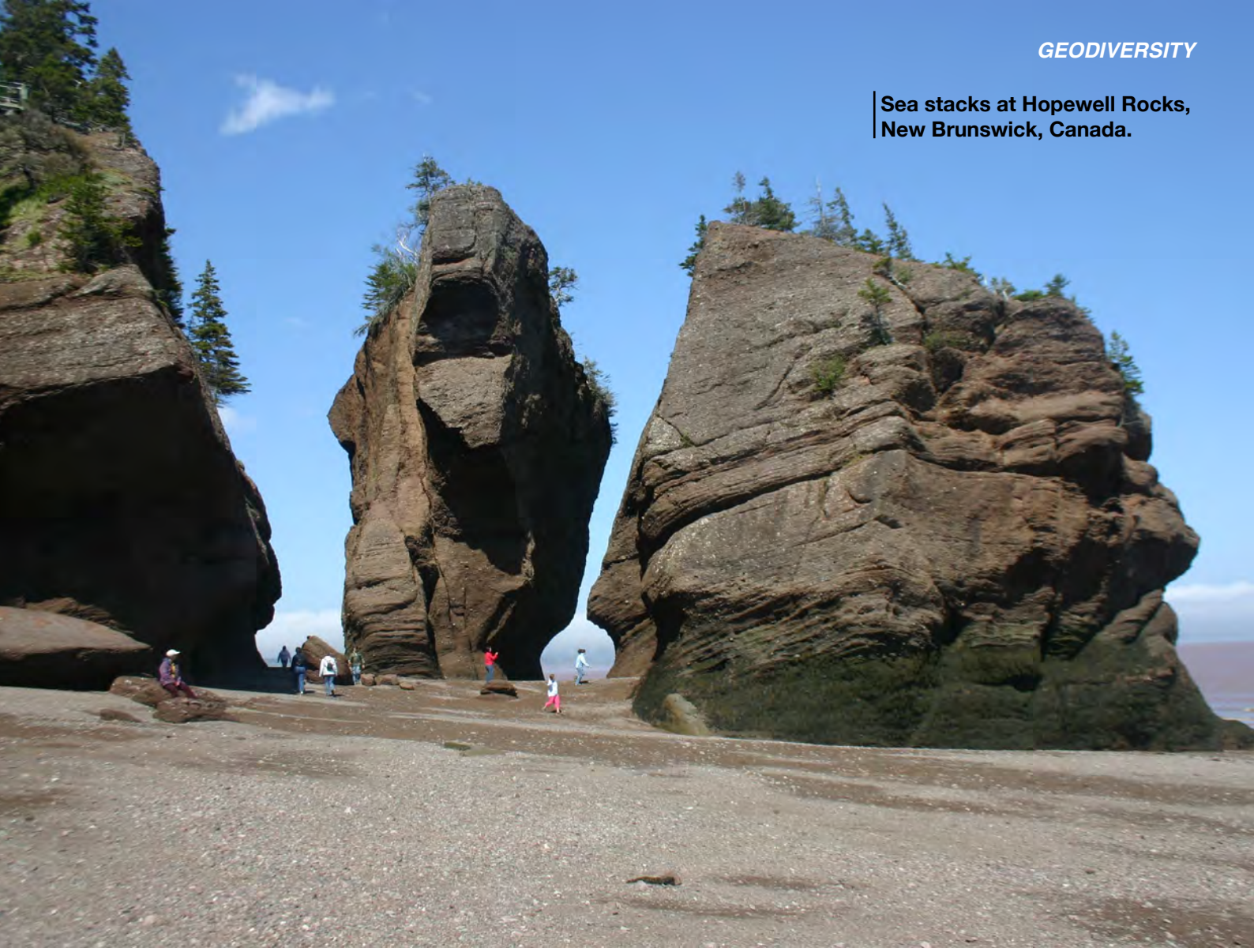
International Geodiversity Day supported by UNESCO's Executive Board

Murray Gray, Queen Mary University of London

On May 22, 2020, when there was publicity surrounding the day being International Biodiversity Day, Zbigniew Zwoliński (Adam Mickiewicz University, Poland) and I independently wrote emails to José Brilha (University of Minho, Portugal) suggesting that it would be a good idea to try to establish an International Geodiversity Day (IGD). This was on the eve of the Oxford Geoheritage Virtual Conference (OxGVC) being organised by Jack Matthews (Oxford University Natural History Museum, UK) and colleagues. Subsequently, José, Jack, Zbigniew and I prepared a brief proposal, which was put to the 600 conference delegates from over 60 countries who agreed to support it.

The United Nations General Assembly and its specialised agencies, including UNESCO, designate 'International Days' to mark important aspects for society. Each international day is intended to act as a springboard for awareness-raising actions related to the theme of the day, with the involvement of governments, the public and private sectors, NGOs, the media, schools and universities and, more generally, citizens.

Geotourists in Iceland watching the Strokkur geyser erupting. Photos by Murray Gray.



Sea stacks at Hopewell Rocks, New Brunswick, Canada.

The four of us then set about the process of taking forward a proposal to establish an International Geodiversity Day. We decided that the first step should be to approach geoscience and nature conservation organisations and individuals around the world seeking letters of support for this initiative. This brought in over 100 letters including ones from the International Union for the Conservation of Nature (IUCN) and the International Union of Geological Sciences (IUGS). Since IUGS is an organisation affiliated to UNESCO we asked it to forward the proposal and the letters of support to UNESCO requesting that it support the proposal. UNESCO is the only UN organization with a mandate to support research and capacity in the geosciences.

In November 2020, UNESCO's Earth Sciences and Geo-hazards Risk Reduction Section acknowledged the proposal and a new phase was started. With the support of its staff, the draft text of a future resolution was prepared, together with a concept note to explain the proposal to UNESCO's Member States. Since geodiversity is not a well understood idea, it was necessary not only to explain the concept in simple language but also to outline its importance for society. We also knew we had to demonstrate how an annual celebration of geodiversity is consistent with UNESCO's mandate, strategy and policy. We therefore ensured that the IGD document was aligned with current UNESCO policy and other international efforts to combat, for example, climate change, increasing pollution of land, water and air, loss of biodiversity, changes in land cover and land use, reduced water supply, and a decrease in ecosystem services.

The International Geodiversity Day proposal was discussed during the 211th Session of UNESCO's Executive Board held online from 7–21 April 2021, less than one year after the Oxford Conference.

The original co-sponsors of the IGD paper were Portugal and the UK but during the period running up to the Executive Board and during it, it garnered support from over 70 countries ranging in size from China and Russia to Andorra and Monaco, and including several African (e.g. Burundi, Madagascar, Gabon) and South American (e.g. Brazil, Colombia, Uruguay) countries. In a statement, the UK Delegation to UNESCO argued that "…while we are diverse nations and places, we are united by our dependence on the extraordinarily rich and diverse geology beneath us".

At the Executive Board the proposal was unanimously supported and recommended for approval at the 41st Session of UNESCO's General Conference in November 2021. It is expected that it will be confirmed there and, if so, we can all expect to celebrate the 1st International Geodiversity Day on 6th October 2022.

Why 6th October? First, we were looking for a date in spring or autumn to allow field activities with a chance of reasonable weather in both hemispheres. Secondly, October was the month in which the first known document was published where the term 'geodiversity' was used in its current sense by Chris Sharples in Tasmania in October 1993. Finally, the 6th was the first October date without any other International Day.

We chose to call it International Geodiversity Day, rather than, say, International Geoheritage Day, as geodiversity is a more inclusive concept and thus gives organisations and individuals around the world flexibility to organise activities most suited to local circumstances. Some may focus on geodiversity and how this benefits local communities, others will promote geoheritage and geoconservation and many will probably focus on geotourism or geoducation. The establishment of an International Geodiversity Day will enable geoscientists in countries/regions currently without geoconservation policies or legislation to go to their governments and argue the point that since the international community recognises the importance of geodiversity and geoheritage, why doesn't their country/region do so as well?

An impressive website is available at www.geodiversityday.org which will be updated with news and ideas on how to celebrate the day. We call on the whole geoscience community to support this initiative, which will be an excellent opportunity to raise awareness of geology as a subject, how society benefits from geodiversity and the need for geoconservation and sustainable resource management worldwide.

Acknowledgments

The development of this process was only possible with the help of all participants at the Oxford Geoheritage Virtual Conference, all supporting organisations, countries, and individuals, and Kristof Vandenberghe and Özlem Adiyaman Lopes of UNESCO's Earth Sciences and Geo-hazards Risk Reduction Section

Further Reading

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An overview of the activities and achievements of Strathclyde Geoconservation Group, 2003–2021

Margaret Greene, Strathclyde Geoconservation Group

Strathclyde Geoconservation Group was established in March 2003 as Strathclyde RIGS (Regionally Important Geological and Geomorphological Sites) and since then the group has achieved much in the promotion of west central Scotland's local geodiversity. This has extended from interpreting sites to working in partnerships with a variety of stakeholders seeking positive outcomes for local geodiversity with the delivery of geodiversity audits and the undertaking of geodiversity action planning. This is their story to date.

Colin MacFadyen, NatureScot

Strathclyde Geoconservation Group (SGG), formerly Strathclyde RIGS (Regionally Important Geological and Geomorphological Sites) was established in March 2003. SGG's outset ambition of identifying local sites for conservation and interpretation was seized by members of the Geological Society of Glasgow (GSG), some of whom were also members of the West of Scotland branch of the Open University Geological Society. The initial area covered by SGG was huge, stretching from Argyll to the Solway Firth but settled at 11 local authorities as groups came into being in both Argyll and Dumfries & Galloway. Currently the local authority areas included are: Glasgow, East Dunbartonshire, West Dunbartonshire, Renfrewshire, East Renfrewshire, Inverclyde, North

Exposures of Carboniferous rock supporting biodiversity and providing a picturesque view in the historic Rouken Glen Park, 7 km south-east of Glasgow city centre. SGG in 2008 produced a leaflet on the geological interests of the area which has been reprinted by East Renfrewshire Council as part of a suite of leaflets describing aspects of this Edwardian park. Photo by Margaret Greene.

Lanarkshire, South Lanarkshire, North Ayrshire, South Ayrshire and East Ayrshire. This area of Scotland encompasses a rich and diverse tapestry of geological and geomorphological features bounded to the north and south by the Highland Boundary Fault and Southern Upland Fault respectively. SGG's focus on the identification, assessment and, where possible, interpretation of sites of geological or geomorphological importance for the general public, has become its principal aim reflecting the focus of development of RIGS in Scotland. More generally the aim of the SGG has been to register sites with the appropriate local authorities, in order that they may be given a degree of safeguard and are conserved through incorporation within local plans; the sites being assessed initially using established UK RIGS criteria.

Ardmore Point, near Cardross on the Clyde, was the ideal inaugural site to interpret for the non-specialist public, comprising a convenient circular walk with superb geodiversity set in a landscape with stunning views. Features include an unconformity between Upper and Lower Old Red Sandstone with sandstone and conglomerate lithologies and a superb example of a Holocene raised beach. Other text-book features include an anticline, syncline, and faulting with slickensides. SGG members rose to some challenges as they worked; investigating and writing up the site for a leaflet, liaising with site owners, the local authority and many others. Not an easy set of tasks as it turned out but enormously rewarding!

A number of other sites formed the focus of leaflet preparation including interpretation of the spectacular Lower Carboniferous sedimentary geology of Campsie Glen, the Highland Boundary Fault on the banks of Loch Lomond at Balmaha, the volcano of Dumbarton Rock and the building stone diversity of Glasgow University and Glasgow city centre. With each project the SGG met the challenges of leaflet writing and working with site owners and local authorities, learning to appreciate

One of three interpretive panels funded by East Dunbartonshire Council that SGG helped produce. The panel is designed to stimulate interest and awareness of the geodiversity of an area which has been pivotal in its cultural and industrial development. Photo by Maggie McCallum.

The Craigie Linn waterfall at Gleniffer Braes. SGG's links with local authorities can take different turns: during 2011 the group was involved in a geological display in Paisley Museum (Renfrewshire Council) about the Gleniffer Braes, a landscape fashioned from Carboniferous basalt lavas, near Paisley. This was part of the exhibition '*In Tannahill's Footsteps*' celebrating of work of early 19th Century poet Robert Tannahill, who drew inspiration from the rugged Braes. Photo © BGS.

and consider the diversity of practice in terms of site designations at local level. Our leaflet collection may be found on the GSG website at https://geologyglasgow.org.uk/sites/ardmore-point/.

An important contributing partner in the development of local geodiversity sites in Scotland has been the British Geological Survey (BGS). The BGS carried out a Geodiversity audit of East Dunbartonshire Council, published in 2010, with most of the local sites identified by members of SGG being included in the BGS audit. Sites identified in the audit for East Dunbartonshire Council have subsequently formed the basis of the Council's Local Geodiversity Action Plan (See https://www.eastdunbarton.gov.uk/residents/planning/planning-policy/natural-and-historic-environment/geodiversity-audit-east), its website underlining the importance of geology and geomorphology as part of both natural and cultural heritage. Collaborative work with East Dunbartonshire resulted in three interpretation boards providing insights into the local geology.

SGG's participation in geodiversity auditing extended to identification of local geodiversity sites within existing Local Nature Conservation Sites of neighbouring West Dunbartonshire Council in 2012. It also had a significant input to the BGS audit for Glasgow Council in 2013 which led to the designation of the city's 'locally important geodiversity sites'.

Further to the south and west SGG's activities in North Ayrshire included an interest in the historic and scenic coastal site of Portencross. Here several sites were identified on the foreshore during 2014 that became the focus of a geology walk guide produced in partnership with a charitable company known as the Friends of Portencross Castle. An important site for potential reappraisal of the geology of this coastline, a former SSSI, is one of the network of geodiversity sites captured in this coastal network.

In more recent years SGG's Portencross network, along with a number of other local geodiversity sites, has been offered to North Ayrshire Council for inclusion in its Local Plan. Inverclyde Council has also been furnished with a list of sites and currently SGG are in the process of supplying Renfrewshire Council with a list of geodiversity sites in their area.

SGG also has the privilege of involvement with the geologically and historically important Fossil Grove in Glasgow, being part of a steering group to save the building, that covers the fossil trees, from permanent closure. This remarkable stand of fossil trees is also an SSSI but SGG designated

Glasgow Necropolis, located on a glacially moulded hill formed from a dolerite sill of Permian age, close to the Cathedral and one of the old city's highest points. SGG's leaflet provides geological information on a selection of monuments including an old quarry worked for road cobbles, and in the construction of the Necropolis walls. Photo by Margaret Greene.

Strathclyde Geoconservation Group's postcard on Glasgow tenements at Battlefield on the south side of the Clyde. The reverse carries a short description about the red- and blonde-coloured sandstone used in their construction. The residents in these tenements are familiar with the fact that the blonde tenements are older than the red—but not that the rock is too! The blonde sandstone is of Carboniferous age sourced locally whereas the red sandstone is of Permian age and has been 'imported' from Ayrshire and Dumfries. © Strathclyde Geoconservation Group.

the adjacent quarry as a RIGS site which was subsequently incorporated into the Glasgow Council geodiversity audit. SGG's promotional flier for the site has been replaced by a more detailed leaflet, now reworked into a booklet with more detailed information about one of the first conserved sites in the global context.

As with many geoconservation groups output depends on the hard work and dedication of its volunteers. Two friends of SGG (ex BGS) have carried out numerous site assessments in North Lanarkshire, east of Glasgow—81 no less—and these have been adopted as Sites of Importance for Nature Conservation, and in conjunction with the Biodiversity officer in North Lanarkshire, a Geodiversity Action Plan has been drawn up. The same two indefatigable retired geologists have now begun an assessment of sites in South Lanarkshire, south-east of Glasgow, and to the west around Falkirk.

Working with others is also key to the success of SGG's activities and a good example has been with Clyde and Avon Valley Landscape Partnership (CAVLP) in their project to develop a 'Shaping our Landscape' Geological Trail. This was based on a commissioned audit of geological sites undertaken by BGS. An exhibition at New Lanark World Heritage site, which is part of the trail

project, has emphasised the clear and demonstrable linkages between the featured geology of the area and local history, industry and culture. SGG's promotional activity, which demonstrates how an area's geodiversity underpins and links multiple interests, is an excellent demonstration of Scotland's Geodiversity Charter in action.

The latest publications by SGG consist of a leaflet '*A Geological Trail of Glasgow Necropolis*', covering the geology of 20 of the monuments at this city centre location that also encompasses an old quarry, and a suite of A5 fliers briefly describing the geology of a number of easily accessible areas within 'Strathclyde's' boundaries. The present focus of SGG includes reengaging with the sites already designated in local audits to establish how they are faring and encourage the general public to visit them. There is also a move toward taking a number of the sites which have been included in local authority audits, such as those for Glasgow and East Dunbartonshire and assess them as being suitable for access by the general public. To this end a number of short descriptions such as those previously produced will (hopefully) be accessible via the Glasgow Geological Society's website.

Given the restrictions in travel we have all been subjected to there is hopefully fresh interest in what local sites have to offer and a keenness to learn more about the geodiversity contained therein. Our region has a rich and varied geodiversity that tells incredible stories of our past and which can help us understand the present and be used to inform our future It will be our continuing aim to promote the sites and bring these stories, to the attention of the public for education and enjoyment and in doing so help conserve our remarkable geoheritage.

We would like to thank all the volunteer members of Strathclyde Geoconservation Group for all their hard work over the years and to our partners in local authorities and elsewhere that share a vision in the promotion and conservation of geodiversity. Strathclyde Geoconservation Group's significant achievements over the years have been down to the welcome effort of those willing to offer a hand at events, walks and exhibitions and to engage with the general public of all ages helping them to find out about their local geology and why it is important.

For further information please visit:
https://geologyglasgow.org.uk/geoconservation/strathclyde-geoconservation/

Shapes of shells and forms: a fossil conservation strategy in the North West Highlands

F.S. Dunn & J.J. Matthews, Oxford University Museum of Natural History, University of Oxford, **E. Panciroli**, Oxford University Museum of Natural History, University of Oxford & National Museums Scotland and **L.A. Parry**, Department of Earth Sciences, University of Oxford.

Nestled in the North West Highlands UNESCO Global Geopark, near Allt nan Uamh, within the Ben More Assynt Site of Special Scientific Interest (SSSI), are outcrops of rock that record a remarkable period in Earth History. The Pipe Rock Member of the Eriboll Formation dates to the early Cambrian Period (more than half a billion years ago), a time which saw the rapid diversification of the groups of animals we find stomping, swimming or scuttling today. Most of the fossils in this locality are trace fossils – burrows, as seen in the photograph, or trackways - recording the behaviour of these ancient animals as they moved through sediment. Studying these fossils, we can recognise similarities to analogous traces left by living groups of living animals. However, things are far less clear when it comes to the only body-fossils in the area. They belong to a strange organism called *Spatangopsis*, shown in another photograph, which remains a scientific mystery to this day. As such, they require further scientific study, but, how best do we balance the aims of scientific research with geoconservation?

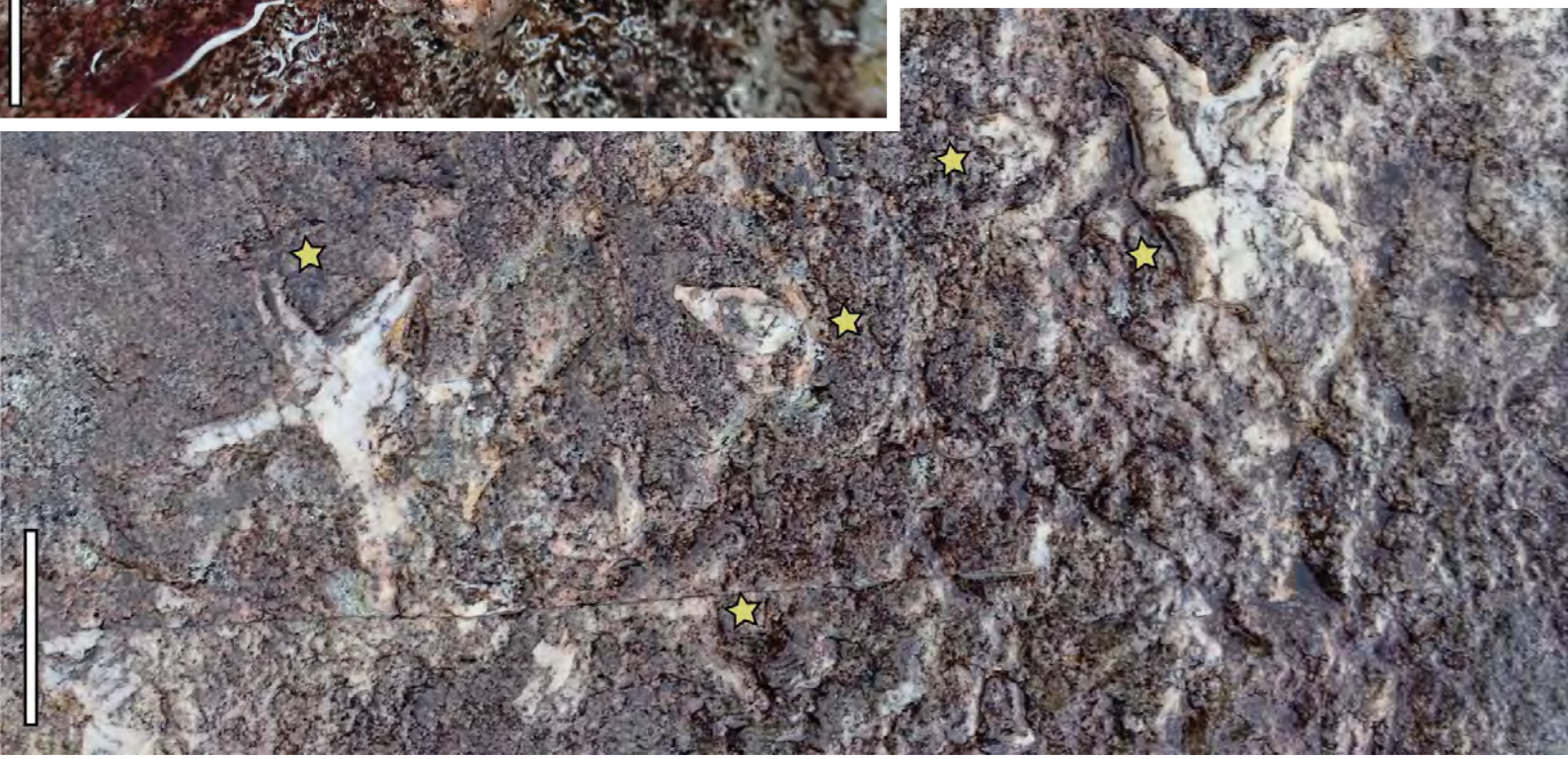
There are approximately 30 specimens of *Spatangopsis* all found in a single area, in the middle of a large quartzite bedding plane, and preserved in life position. This fossil may not look like very much, but it is scientifically significant. The species itself is extremely rare, being known only from this single site, while the genus has only been described from two other sites in Mongolia and Sweden. More significant, though, is the

Trace fossil from the Cambrian age Pipe Rock Member, Eriboll Formation, in the North West Highlands. The organism which created this fossil burrowed through many layers of sediment. Scale bar = 5cm.

All photos by F.S. Dunn unless otherwise stated.

Left: **A single specimen of *Spatangopsis*, showing its unusual anatomy. *Spatangopsis* has a peculiar five-fold symmetry that is only otherwise seen today in starfish, although *Spatangopsis* is not thought to be closely related to living starfish! Scale bar = 5cm**

Below: **A group of *Spatangopsis* fossils (indicated by stars), showing the close spatial relationship and highlighting potential problems with excavation of this this particular specimens. Scale bar = 5cm**



age of the rocks the fossils are found in. Cambrian age rocks record fossil assemblages teeming with animals which we recognise as closely related to living groups, but the fossil assemblages of the Ediacaran Period—immediately preceding the Cambrian—are strange and unfamiliar, full of giant fronds and slithering beasts that lacked a head. Our understanding of the transition away from these alien seas is hotly contested because the earliest Cambrian fossil record is biased towards the preservation of hard parts (shells or scales) and away from the soft parts which are often crucial in determining the nature of these fossils. Therefore, the Scottish specimens of *Spatangopsis* provide a unique insight into this remarkable transition. They are both scientifically significant and contribute to a culturally significant landscape, and therefore require a conservation strategy to protect them.

There is already a small number of partial specimens of *Spatangopsis* held in the Hunterian Museum, Glasgow, but the examples left *in situ* in many cases show anatomical features not exhibited by the museum collection. Furthermore, we can see that the Scottish *Spatangopsis* material is preserved in three dimensions (they are not compressed or flattened) and so could be studied using techniques like CT scanning, which uses X-rays to penetrate host rock and reveal the entire fossil organism. Such techniques cannot be applied to fossils *in situ.* Excavation may therefore seem the most sensible strategy and, indeed, is fairly typical in these cases. Excavation ensures that the specimens are housed in secure and appropriate conditions and safeguards them for future generations of both scientists and museum goers.

However, there is something lost by excavation and that is the conservation of the site itself. It is already within a UNESCO Global Geopark and is within a landscape used in part for public enjoyment, so to remove these specimens from the locality may seem slightly self-defeating. The area in which the fossils are found is within an SSSI. However, in this particular case the designation does not specifically protect the fossils themselves but it is hoped that would-be collectors of these rarities would, in the spirit of the Fossil Code, leave them well alone. These specimens are not in immediate danger from weathering or rock fall, and the nature of the assemblage as a tightly packed cluster means that there is a real risk they could be damaged during excavation itself.

Alternatives to excavation, then, may be more appropriate. Casting is a non-destructive technique used to create replicas of significant fossils or sites, and may provide an alternative strategy. It has been used with great success in other conservation sites with similarly preserved fossils (e.g. Mistaken Point UNESCO World Heritage Site and the Discovery UNESCO Global Geopark, both of Newfoundland, Canada) (See Dunn *et al*., 2019 in further reading). It involves pouring silicone rubber over the fossils to create an inverse mould, waiting for it to set, and then peeling it off. Depending on the size of the area of investigation, this process can take between half a day and two days, after which the mould can be transported back to the lab, and cement replicas can be made and painted to look like the original host rock. Lab-based studies of casts allow for specimens to be lit from any angle; essential when studying low-relief material and a method that led to the discovery of new specimens and features within Ediacaran material.

The Inchnadamp Bone cave and the dry river bed of the Allt nan Uamh river, Inchnadamph NNR, within the Northwest Highlands Geopark. This is the landscape context of the *Spatangopsis* fossil locality. Photo by Lorne Gill, NatureScot.

Casting the *Spatangopsis* locality would give us a snapshot of the area, providing a measure of security against damage from future natural or human impacts, and a reference point against which to monitor the integrity of the site. Meanwhile, the costs and benefits of collection can continue to be weighed appropriately. A further advantage of casting this fossil site is that many replica casts can be made from a single master mould, meaning that the *Spatangopsis* material could be displayed in local museums for the host communities and visitors to access and enjoy. The single biggest conservational benefit of casting is that by leaving the fossils *in situ,* the site remains intact. By accessioning casts, researchers are able to study them without repeatedly visiting the original locality, which may reduce footfall on the fossils' sites and reduce associated erosional risks. However, it should be noted that casting is not without its risks. Failure to properly prepare the rubber, or casting in poor weather conditions can lead to the mix failing to set, leaving an unsightly mess that is difficult to clean and that obscures fine-scale palaeontological details.

Ultimately, we must continually wrestle with two potentially competing aims: to conserve the landscape means keeping these fossils *in situ*, but to conserve the fossils and realise their scientific significance means excavation of the specimens. In this case, the fossils are rare, of a significant age and meaningful analyses (with a high probability of success) can only be carried out on excavated material. Together, these arguments make a strong case for the eventual collection of material. Weighing up the broader conservation of the landscape may mean that only a few specimens from the margins of the assemblage are collected, but in this instance conservation of the fossils requires their removal. Other cases are not so clear cut. Scientists and conservationists must come together to produce a conservation strategy that serves, as in George Crabbe's poem, both the mountain and the slate:

"It is a lonely place, and at the side
Rises a mountain rock in rugged pride;
And in that rock are shapes of shells and forms
Of creatures in old worlds, and nameless worms".

Further Reading

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In and out of the deep freeze - Part 2 (Pitstone Quarry SSSI, Marsworth)

Nicholas Pierpoint, Geologists' Association, **Eleanor Brown**, Natural England, **Neil Adams**, University of Leicester, **Mark Vallance, Leo Keedy** and **Rodney Sims**, all Berks, Bucks & Oxon Wildlife Trust

As the impact of national lockdown restrictions have had a bearing on conservation activity, the team presently engaged with enhancing the geological heritage at College Lake Nature Reserve, have endeavoured to maintain the momentum of this project and want to share news of our progress.

In the Spring of 2019 (*EH* 51) we described the opportunity to open up a geological section to augment the visitor attraction and broaden the appeal of College Lake (aka Pitstone Quarry, Marsworth). The 65-hectare site is located in the Aylesbury Vale district of Buckinghamshire and managed as a nature reserve by Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT). Importantly the site has a SSSI designation for its Quaternary geology. Significantly the sedimentary evidence from College Lake and the Marsworth area has helped constrain a series of warm and cold periods from the Middle and Late Pleistocene MIS 5–7.

The BBOWT, in partnership with local geologists, the Geologists' Association (GA), Quaternary Research Association (QRA) and Natural England (NE) have worked collaboratively to promote the geological heritage at College Lake. The story of the industrial activity started in 1937 as Tunnel Portland Cement Company began quarrying chalk at Pitstone Quarry, with production peaking at approximately 950,000 tonnes per year in the mid-1970s, which continued until 1991.

The test pit, dug in August 2018, was used to help understand how the poorly consolidated material would behave once exposed.

All photos by Nicholas Pierpoint unless otherwise stated.

Top: **The cleaned section of involutions, approximately 8m in length with a vertical section of 1.8m, in November 2020.**

Middle: **The new section, in February 2020, behind the BBOWT team: Leo Keedy, Rodney Sims and Liz Child.**

Below: **The new interpretation panel in February 2021. Photo by Leo Keedy.**

The College Lake Nature Reserve is what remains of Quarry 3, and it was during the quarrying of the chalk that quarry workers came across some very different rocks and sediments cut into chalk. These were ice age (Pleistocene) river channels, which contained many large fossils, and periglacial slope deposits.

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

To understand how a recently cleaned section of poorly consolidated material behaves once exposed to the elements, a test pit was dug early in the summer of 2018 with NE consent. Observations were made over a 9-month period assessing how quickly the face degraded through weathering or vegetation growth. The results were very encouraging, so preparation was made to open a section of involutions approximately 8 m in length with a vertical section of 1.8 m.

In August 2019, with funding secured from the GA Curry Fund and QRA Geoconservation and Outreach Funds, and consents in place the physical work could commence, once the fledglings had departed. The vegetation was cut back and mechanical excavation followed to open up the section. The immediate site was cleared and prepared with a graded path suitable for mobility scooter access. This is something we should routinely consider during the planning phase of any geoconservation project. Erecting fencing and a bench, as well as a new interpretation panel were the next tasks. All the work was completed with the exception of the interpretation panel prior to the March 2020 lockdown. However, using the communications tools of the time (Zoom), the interpretation panel format and content were agreed. Fabrication of the panel was completed in early 2021 and it has now been installed. A formal opening of the area will take place once lockdown rules permit, later in 2021 we hope.

The next stage includes monitoring the section and understanding the nature of the maintenance required. This can present significant challenges in poorly consolidated sediments so understanding best practice and sharing experience is vital. Further tasks include utilising the detailed documentation written by Neil Adams during a placement with NE during his PhD studentship in September 2019. It provides a detailed insight into the geological understanding and heritage of the site, which is a valuable resource for the BBOWT to expand their Earth heritage interpretation at College Lake.

Further Reading

Murton, J.B., Bowen, D.Q., Candy, I., Catt, J.A., Currant, A., Evans, J.G., Frogley, M.R., Green, C.P., Keen, D.H., Kerney, M.P., Parish, D., Penkman, K., Schreve, D.C., Taylor, S., Toms, P.S., Worsley, P., and York, L.L. (2015) Middle and Late Pleistocene environmental history of the Marsworth area, south-central England. *Proceedings of the Geologists' Association*, **126**, 18–49. https://doi.org/10.1016/j.pgeola.2014.11.003.

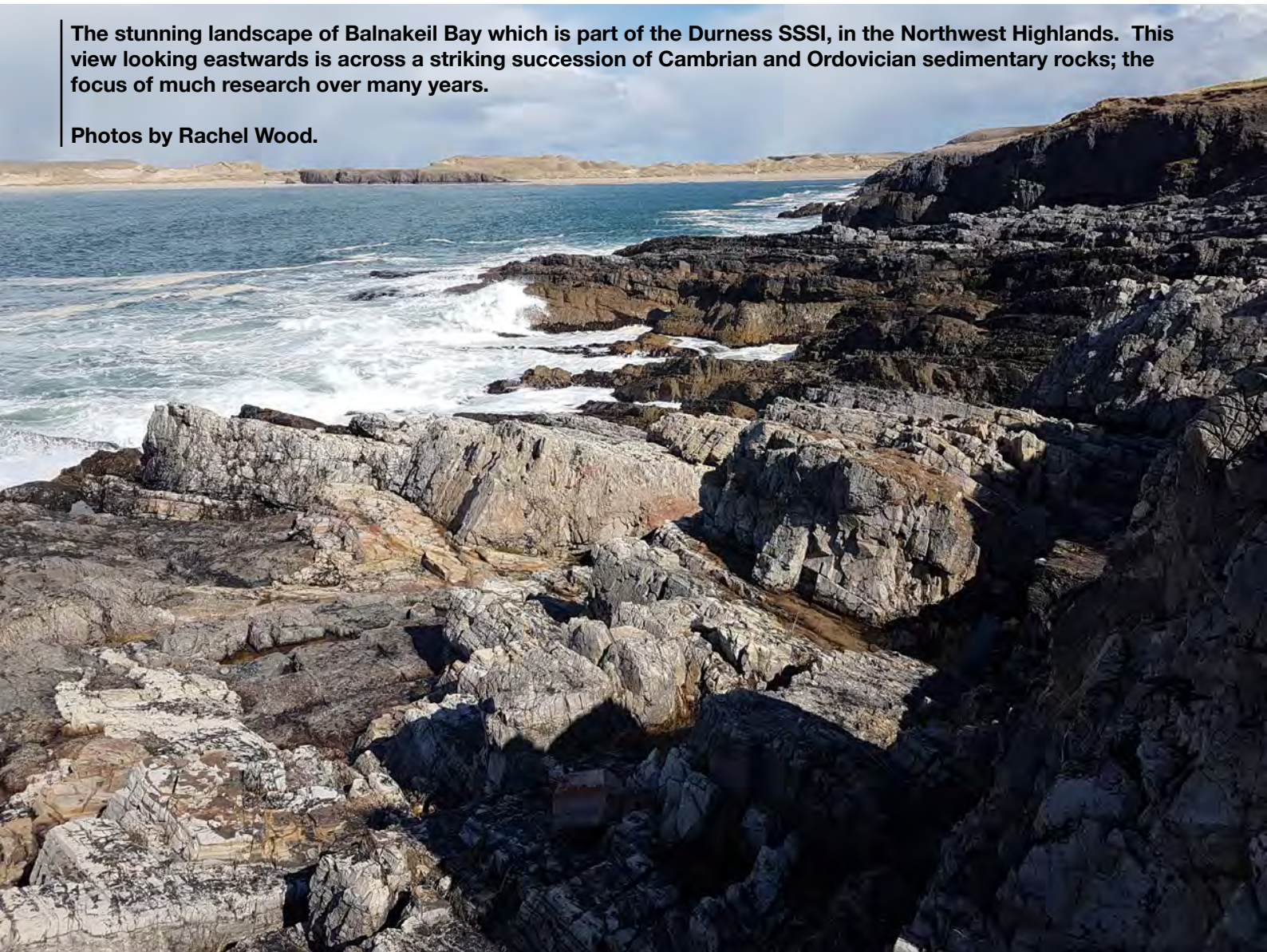
Pierpoint, N., Brown, E., Vallance, M., Keedy, L., and Sims, R. (2019) Opening up the deep freeze at College Lake (Pitstone Quarry SSSI). *Earth Heritage*, **51**, 20–22.

Sustainable Geological Sampling: furthering best practice guidance

Rachel Wood, Chair of Carbonate Geoscience, University of Edinburgh

Our landscape is part of an extraordinary natural capital for all to enjoy, a unique interplay between geodiversity and biodiversity. This is particularly true of many geological sites, which are embedded within some of most beautiful, but fragile, landscapes of the UK. These landscapes are also strikingly diverse—ranging from the eroding soft, sea cliffs of southern England, to the hills, mountains and escarpments of our interior, to the rugged coastlines of NW Scotland.

Our landscape is a heritage that is precious and irreplaceable, but it is also a resource. The history of nearly 3 billion years of evolution of our islands is written here. As new techniques become available which allow Earth system processes to be explored in more detail, geoscientists will wish to return repeatedly to these rocks to extract samples in order to gain further insight into this history. This raises the urgent need to develop sampling methods that are both sensitive and sustainable and, moreover, bespoke for each locality.



The stunning landscape of Balnakeil Bay which is part of the Durness SSSI, in the Northwest Highlands. This view looking eastwards is across a striking succession of Cambrian and Ordovician sedimentary rocks; the focus of much research over many years.

Photos by Rachel Wood.

Karstic surfaces developing at Balnakeil Bay in Durness SSSI site in the Northwest Highlands. The naturally-fractured areas of outcrop offer opportunities for the removal of small rock samples by hand without the need for hammering. This outcrop, although sampled for research purposes, is unmarked in that process.

Much has been written of the quite devastating effect of inappropriate sampling, particularly the irresponsible drilling of holes into rocks (coring), which has disfigured geological features. When carried out properly, the visual impact is minimal, but sadly in many areas the 1989 Code of Conduct for Rock Coring and also the Scottish Core Code have been ignored. Not only have small-scale geological structures such as prominent rock surfaces been defaced, but whole outcrops have been damaged severely by the cumulative effect of successive coring or by the destructive search for valuable fossil specimens. This has taken place even in classic geological sections within statutory protected areas—Sites of Special Scientific Interest (SSSI) an issue highlighted in *Earth Heritage* previously, for example in Issue 27 in 2007.

Destructive and disfiguring sampling practices are totally unnecessary to further geological knowledge and research. There are many methods to sample in such a way that no one will ever know that a geologist has passed through. Indeed, little has changed to alter the message of the Geologists' Association since they first published *A Code for Geological Fieldwork* in 1975.

Securing necessary permissions

Before visiting a locality, we must fully involve authorities and landowners to gain permission to access geological localities. This should also involve explanation of the need for sampling and a sharing of research goals.

Considering the unique features of a locality

When approaching sampling, a geologist should first consider the unique aesthetic features of any given locality: these must be preserved at all costs. For example, are there prominent rock surfaces that will remain for many decades, or geomorphological features such as karst that add to the visual beauty of the landscape? These must surely remain untouched. Particular care must be taken not to take samples from any surfaces visible from site entrances or from the approaches to a natural exposure.

How to sample sensitively and sustainably

After initial site assessment, a geologist should then look for hidden areas of the outcrops that are not easily visible. These may often be naturally fractured rocks that are becoming loose via weathering processes but which are still essentially *in situ*. Such areas can be more easily sampled, as they often offer small samples removable by hand without the use of a geological hammer. Indeed, sample removal from these hidden areas should be totally unnoticeable (as illustrated). Samples should be taken only of the size needed, and no more than the number needed. If coring is absolutely necessary, closely spaced patterns that might detract from the site should never be used, and most importantly always break off the end of the plug and use this to fill the hole and fix this with a small amount of cement so that no boreholes are visible after sampling.

Outreach—involving the community

We should never forget that not only are geological localities part of our collective heritage, they are also parts of a landscape that has particular value and meaning for local communities. As visiting geologists we should always endeavour to find ways of communicating the excitement of our research, and its wider relevance, to communities to complement this natural capital. Chance conversations on the outcrops, talks in village halls, or to special interest groups or local schools, and guided walks, can all create a more integrated engagement.

The trick is to try and maintain the profile of best practice guidance and ensure promotion of the thoughtful application of careful and sensitive sampling. We have to continually demonstrate that scientific research is not incompatible in a world where our landscape is increasingly treasured as a resource for the well-being of all.

Further Reading

Code for fieldwork: Geological fieldwork code – Scotland – the home of geology: scottishgeology.com

Scottish Core Code: https://www.nature.scot/landforms-and-geology/protecting-our-geodiversity/codes-researchers-and-collectors/scottish-core-code

Geologists' Association's Fieldwork Code: https://geologistsassociation.org.uk/newgawpsite/wp-content/uploads/2017/07/Code-for-fieldwork-combined.pdf

Geologists' Association's rock core code of conduct: https://geologistsassociation.org.uk/newgawpsite/wp-content/uploads/2017/07/GARockCoringGuide.pdf

Natural England's responsible collecting guidance: http://publications.naturalengland.org.uk/publication/1644830?category=1768835

The *Explore* trail guides of Herefordshire and Worcestershire

Sue Knox, Herefordshire & Worcestershire Earth Heritage Trust

Herefordshire and Worcestershire Earth Heritage Trust (H&WEHT) has been working to promote the protection, conservation, improvement and education of Earth Heritage, mainly within the two named counties, since 1996. Local trail guides published over the last 25 years have been a mainstay of the Trust's public outreach work and provided much-needed income.

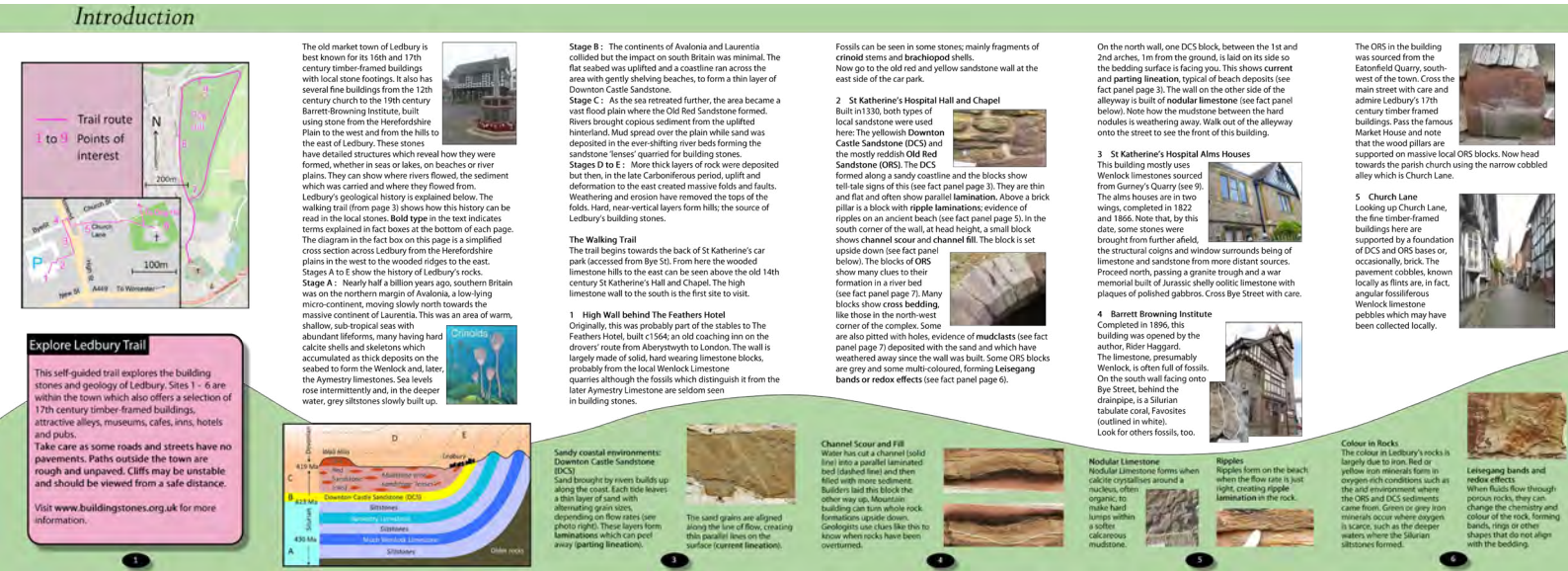
The Trust arose out of a nationwide initiative to designate and protect locally important sites of geological interest as Regionally Important Geological and Geomorphological Sites (RIGS) and was one of the founder RIGS groups carrying out this work at a county level. The Trust has been at the forefront of new developments ever since, including the development of Geodiversity Action Plans and the inception of many innovative walking trails.

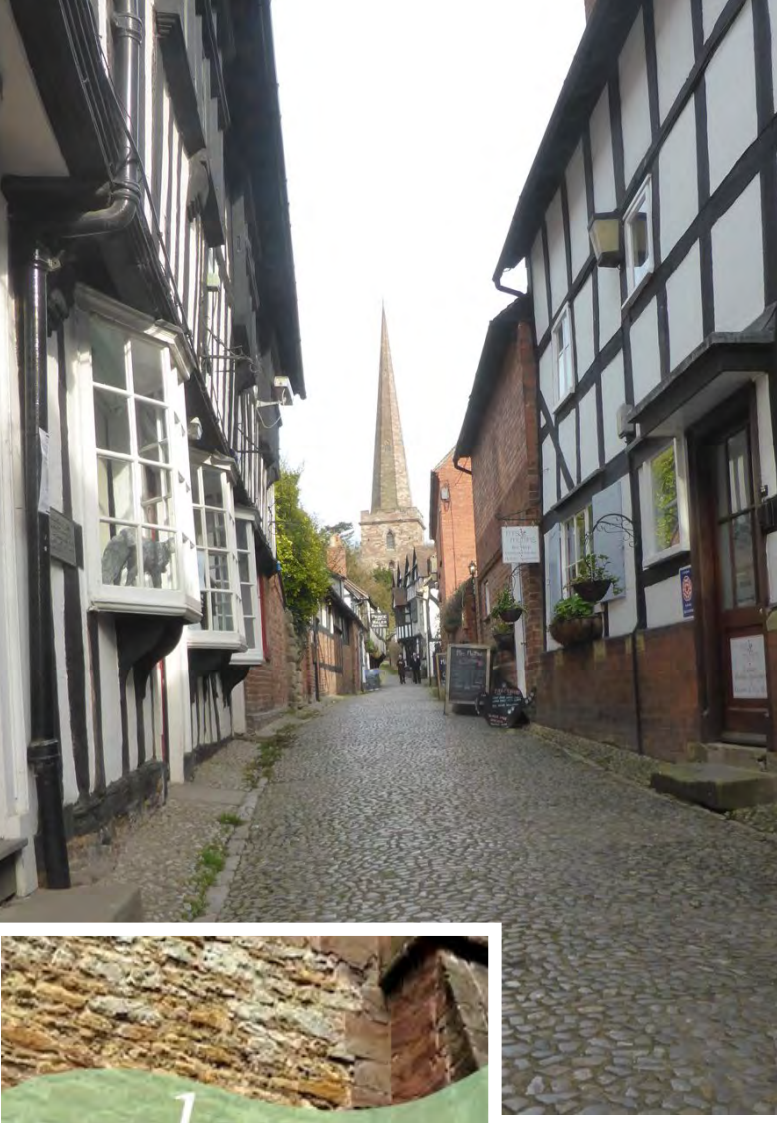
Top: **A view across the Malvern Hills; ancient rocks form part of the amazing landscapes of Herefordshire and Worcestershire. Photo by Mike Brooks.**

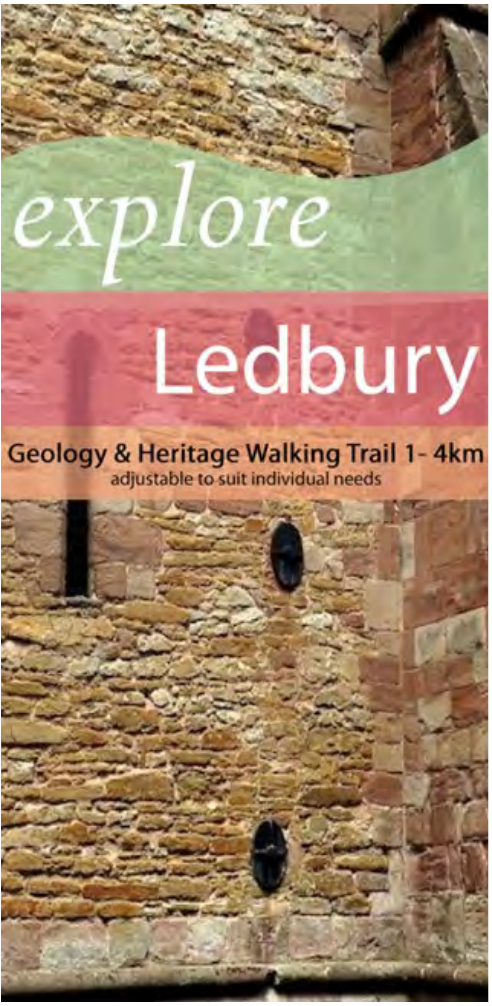
Middle: **A scene by the River Severn where relatively recent glacial deposits can be explored. Photo by Mike Brooks.**

Below: **The fold-out laminated *Explore* Guide format.**

All photos by H&WEHT unless otherwise stated.







Top: **Church Street, Ledbury features in the new *Explore Ledbury* Guide.**

Left: Explore Ledbury **is a 1–4km Geology and Heritage walking trail around this delightful market town.**

H&WEHT has worked tirelessly on a range of truly varied projects over the years to inform and engage both those with professional knowledge of Earth Sciences and Geology, or those with a general or lay interest in the subject. Well-presented information can raise in many people a curiosity about the landscape around them and encourage them to become more informed about what they see on a good day out, be that in a historic townscape or walking across the stunning countryside of Herefordshire and Worcestershire.

To this end, 20 years ago, H&WEHT decided to produce a series of *Explore* Guides which would inform the enthusiast or casual walker about this geologically special area of the country where many geological periods are represented. The story of geological time is written into the landscape, from the ancient rocks of the Malvern Hills to the more recent glacial and river deposits of the Avon, Severn and Wye valleys. The laminated, fold-out Explore guides have consistently explained clearly exactly what is seen and how and when the rocks and landscapes were formed.

From the very first publications, *Explore Goodrich Castle* and *Explore Symonds Yat*, all of these popular Guides have included a sketch map and directions with diagrams and photographs to describe what is encountered along the way. The guides are divided into different categories so that the reader knows exactly what to expect: Building Stones; Building Stones and Landscape; Geology and Heritage; Geology, River and Landscape or Landscape and Geology. Some of the Guides can also be enjoyed by cyclists or car drivers, covering a larger distance.

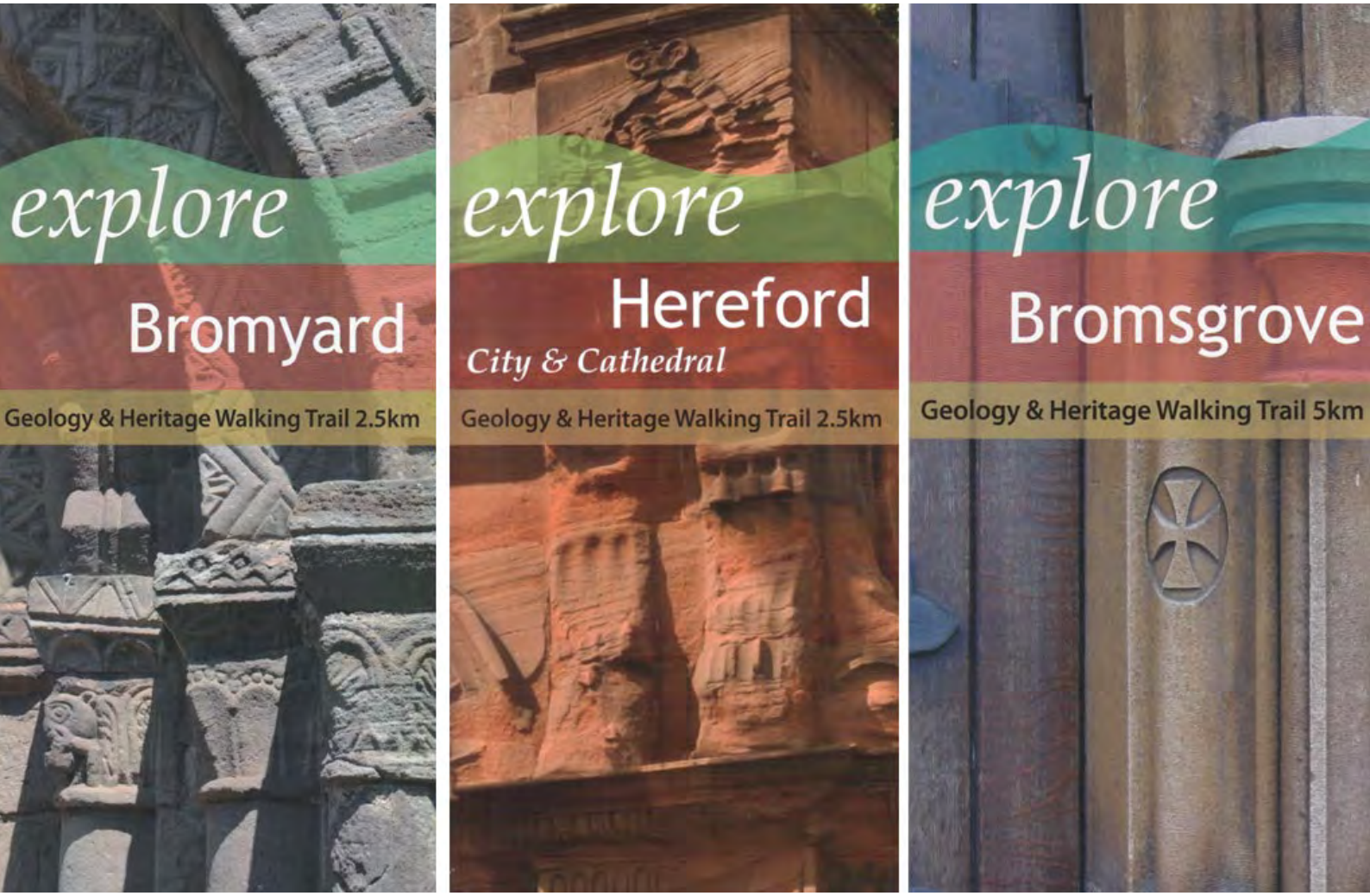
15 *Explore* Guides take the traveler around Worcestershire and 11 Guides are available for Herefordshire. The latest of these and the 26th in the series is a Geology and Heritage walking trail around the delightful market town of Ledbury in Herefordshire, explaining the buildings and the stories behind their stones with an option to

visit quarry sites, along public footpaths, just outside the town. The Ledbury Guide is a legacy from H&WEHT's *A Thousand Years of Building with Stone* project which came to an end in 2017 but which continues to inform stone use and its replacement in buildings across the two counties (see http://www.buildingstones.org.uk/ for the complete database and map).

Also informed by this major project are 4 other Geology and Heritage walking trails to *Explore Malvern Spouts and Stones, Explore Bromyard, Explore Bromsgrove* and to *Explore Hereford City and Cathedral*. These all have a new and updated style but continue the tried-and-tested format of clear and informative text and pictures established by the previous trails. The *Explore* Guides are available from: www.earthheritagetrust.org/shop/ along with the 2019 second edition guide book of the long-established, permanent, long distance walking trail called *The Geopark Way*, consisting of 17 day walks and covering 107 miles in total, starting from Bridgnorth in Shropshire, through Worcestershire and Herefordshire to its end point at Gloucester Cathedral.

To find out about the fascinating projects H&WEHT is currently working on, even through the last year of lockdowns and Covid 19 restrictions, go to www.earthheritagetrust.org where you can also discover more about this extremely active and committed Trust over the last quarter century.

Some of the new format *Explore* Guides written during the major data-gathering project *A Thousand Years of Building with Stone* (2013-2017).



Thorndon Ice Age Wall renewed

Ian Mercer, GeoEssex geoconservation steering group & Chairman, Essex Rock & Mineral Society

Thorndon Country Park near Brentwood is the busiest country park and visitor centre in Essex. In 2011, Gerald Lucy, with other members of Essex Rock and Mineral Society, with assistance from Essex County Council, dug into the edge of a disused gravel pit in the middle of the park to create a geoconservation 'wall'. It revealed the geological layers originally described by Dines and Edmunds in the Romford sheet Memoir of 1925 (page 28) when the pit was still being dug.

Almost ten years after that first geoconservation wall was made it was still in remarkably good condition considering its crunchy rock nature; however, it was in need of a good clean and scrape. A three-ton digger did the trick. In just a few hours, the section was deepened, lengthened, made vertical to protect it from the elements and furnished with a drainage channel.

Left: **The wall before renovation.**

Below: **The wall being dug by ERMS members in 2011.**

All photos by Ian and Ros Mercer.

The Pebble Wall

Evidence of the Ice Age Story

Topsoil layer

Organic bits join with sand and clay to make soil.

Freeze-thaw pebble bed

Flint pebbles in sand.

Bed disturbed by freeze-thaw action in deep permafrost -

Many pebbles were broken when the water inside the pebble froze.

Pebbles were left at all angles.

Base of layer is contorted where the bed sank into the wet silty-clay below.

Freeze-thaw sludge deposit

Silty-clay with a few flint pebbles.

A sludge formed from the silty clay of the much older Claygate Beds.

Tongues of sludge gradually slid down slope from Brentwood hill by freeze-thaw action.

Pebbles came from glacial melt water.

River bed - 450,000 years ago

Rounded flint pebbles with sand.

Meltwater brought sand and pebbles from the ice sheet at Brentwood.

Pebbles choked the channels to make gravel bars.

Sand layers were deposited as currents slowed.

The signboard for the cleaned-up section at Thorndon Park. The 'wall' is 2 metres high.

The lower sand-bar and flint-cobble layer of 450,000 year-old Anglian glacial outwash has yielded Rhaxella Chert from the Yorkshire Jurassic sequence, plus a small block of 'Millstone Grit'-type arkose. These erratics indicate glacial transport down to Brentwood, where the ice front occasionally issued summer outwash across the high-level Warley Gravel, redistributing it south across the Land of the Fanns fenland area and into the diverted Thames.

The succeeding layers are of soliflucted Claygate Beds—a tough sandy clay—and pebbly sands with frost-shattered 'potlid' flints, many of them subvertical. There is also a black palaeosol layer. A thin modern soil tops the section to provide an enlightening exposure of climate change in violent action.

With a grant from the Land of the Fanns Landscape Partnership Scheme, a lottery-funded Community Action Fund, Ros and Ian Mercer, on behalf of ERMS, arranged for renewal of the wall plus a new signboard, together with the re-siting of a Jurassic fossil tree and signboard outside the park's visitor centre. This fossil pine stump had been part of the display at the old Passmore Edwards Museum in east London. With the expansion of Greater London, the museum was sadly closed and the Essex Field Club collection was transferred, eventually, to the EFC Centre at Pitsea. The fossil tree, however, was donated to the Country Park, where it resided in the garden and gradually gathered moss.

A clean-up and re-siting on a new plinth with a new signboard has revealed to the public that the fossil tree was very similar to the surrounding woodland pines and that dinosaurs, that once trod between the Jurassic trees, were living on the edge of an island which is now buried 330 m (1000 ft) beneath the park. Yes, Essex had the dinosaurs.

Explore Essex
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The grant also covers the cost of redesigning and printing an updated 'Pebble Walk' trail guide which explains the geology and landscape of the parkland and tells the intriguing story of a flint pebble. Further information will appear on the ERMS website at www.erms.org

Thorndon Country Park North Visitor Centre is ten minutes' drive south of Brentwood. The new wall is a further ten minutes' walk into the forested park. The car park and visitor centre are situated on the Claygate Beds.

Top: **the fossil tree in the garden.**

Left: **the tree after reinstatement.**

The Smugglers Trail of Thanet - a guided walk along part of the UK's longest chalk coastline

Richard and Tina Hubbard, GeoConservation Kent

The chalk shore platform around the Thanet Coast in Kent is designated as a Special Area of Conservation (SAC), whilst most of the foreshore above Mean Low Water is a Site of Special Scientific Interest (SSSI). All the authorities with a legal responsibility for the coast have worked together since 2001 on a management scheme for the marine site designations, whilst Thanet District Council, the largest foreshore owner, works with Natural England on the management of the wildlife and habitats of the coast covered by the SSSI designation. Located on the longest continuous stretch of coastal chalk habitat in the country, Thanet has some of the best wildlife sites in Europe.

The Thanet Coast, including Pegwell Bay, has long been associated with the chalk cliffs, caves, reefs and sandy bays—not to mention its smugglers—and is nationally important for its geology: the chalk stacks and arches. It also became a Marine Conservation Zone (MCZ) in November 2013, when specific features were protected. This included additional protection for the beautiful stalked jellyfish (*Haliclystus* sp.) found in the abundant rockpools. The importance of the habitats for marine life, coastal plants and bird life, especially the migratory and over-wintering birds, has resulted in a

The broad chalk reef forming the shore platform around Whiteness Point. Note the numerous natural caves, arches and sea stacks within the soft, white chalk cliffs. Please note, Google images are pictorial and should not be used for navigation. © Google.

All photos by Tina Hubbard unless otherwise stated.

The unusual chalk shore platform in Whiteness Bay (the central bay of the previous image) exposes the Barrois Sponge Bed which developed as a mineralised fossil hardground. It records a time of swirling bottom currents when very little if any chalk ooze accumulated on the seabed. It was a time of relatively low sea level within the overall Thanet chalk sequence. The hardground forms the boundary between the Broadstairs Chalk below and Margate Chalk above. Note the 18th century smugglers' caves in the white chalk cliffs forming the distant headland.

number of nature conservation designations which are now collectively known as the North East Kent Marine Protected Area (NEKMPA, which includes the birding SPA/Ramsar site designations), (http://thanetcoast.org.uk/about-us/nature-designations/).

Tony Child, Thanet Coast Officer, says, "During the lockdown when coronavirus access restrictions prevented us from running our usual public events, we ran several virtual Seashore Safaris. Short films were produced by Thanet Coast Project volunteers to show some of the marine creatures found in the tidal rock pools. The films allow the viewer to 'rockpool' from home and see some of our diverse and fascinating foreshore life. Many thanks to Greg Bessant for taking the lead in filming and production, and for support from the project team".

The virtual Seashore Safaris can be found at http://www.thanetcoast.org.uk/learning/informal-zone/. This site also has a new booklet to help families explore the chalk foreshore and learn about the marine life either during a Seashore Safari (public event) or by themselves inspired by the virtual Seashore Safari films. This work has been supported by the National Lottery Heritage Fund as part of the *Guardians of the Deep* project.

Tony Child added, "Thankfully, we are back to a full programme of public events this summer with 11 days organised for July and August. In addition to our Seashore Safaris, there are two interpretation activities. Firstly, as the chalk reefs provide such a perfect substrate for algal communities, we will be organising a walk through rockpools and along the shore to discover various seaweeds, their uses and properties. Ian Tittley, formerly Natural History Museum, Kent Field Club & Kent Wildlife Trust, will lead a *Seaweeds and their Secrets* walk. Secondly, there will be a chance to join Richard Hubbard on a new walk to explore the geology and fossils as we take a step back in time and discover the way our coastline reveals the evidence of life in the oceans over 80 million years ago".

On behalf of GeoConservation Kent, (https://www.geoconservationkent.org.uk/), and with funding support from the Geologists' Association's Curry Fund, Richard Hubbard and Geoff Downer have recently published *The Smugglers Trail. Geology of the Thanet Coastline from Broadstairs to Cliftonville*. The aim of the guidebook is to enthuse as wide an audience as possible. The geological story is told by the continuous chalk cliffs and shore platform reefs where visitors can see more than they might have imagined. Visitors will walk up and down Thanet's 'mini alpine' mountain (Thanet

Anticline) whilst enjoying the natural environment and learning a little about the colourful social history with a brandy smuggler or two! As well as learning about unusual seabed creatures, giant ammonites and the teeth of the huge shell-crushing shark *Ptychodus*, visitors will see how the Victorian geologists first used distinctive marker beds of black flint nodules and orange siliceous sponges to determine the conditions on the seabed some 85 million years ago.

The Smugglers Trail guided walk is suitable for the whole family and a great way to experience and interpret the special chalk shore platform environment in seven of Thanet's beautiful bays. The Smugglers Trail guides the visitor along a leisurely 4-hour walk on the shore platform taking in the social history, with a description of the natural environment and an engaging explanation of the Cretaceous Chalk geology. For those limited by time, there is a 2-hour Highlights Tour to visit and enjoy the key sights. The Smugglers Trail guidebook can be purchased through GeoConservation Kent, online through the GA Shop website (https:/geologistsassociation.org.uk/shop/) and through the Thanet Coast Project and Visit Thanet. Written for the whole family, it aims to explain and illustrate the marvellous coastal geology whilst spending a great day out on the beach.

In the words of the Seashore Code, "*Respect our coastline and protect yourself and others. Enjoy our shore platform and beaches and leave only your footprints in the sand*". Please stay away from unstable chalk cliffs and use a camera only when exploring the chalk boulders and reefs. Please feel free to pick up any of the loose-lying common fossils such as the famous heart-shaped sea urchin *Micraster*, distinctive police-helmet-shaped sea urchin *Echinocorys*, the spherical pea-sized calcareous sponges and the bullet-shaped belemnites. Rarer finds such as giant ammonites and fossil fish should be reported along with their location to thanet.coast@thanet.gov.uk. The protected chalk reef habitats of Thanet's splendid shore platform are a natural treasure and provide a memorable experience for one and all.

http://thanetcoast.org.uk/factfile/thanet-coastal-codes/fossil-code/

Midsummer sunset over Botany Bay. A family enjoying their chalk walk.

Earth Heritage in print

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

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

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

For many of us, the opportunity to reconnect with our local natural environment has been an important part of lockdown over the last year. Getting out to look for rocks, fossils and minerals, and learning about the landscape around us are powerful ways to encourage and inspire the next generation of Earth scientists. Gravel Hunters gets families out and looking for gravel on their drive, in car parks, or, in this case, in a sack of gravel bought from the builders' merchant. Sponge fossils, and echinoid fragments (see inset image taken by Liz Hide) are relatively common in some flint gravels. Photo by Nicola Skipper.

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