

Earth Heritage

The Geological and Landscape Conservation Magazine



**Aerial Revolution:
Geo-Conservation
Takes to the Sky**

ISSUE **59**
Summer 2023

**Scottish Geology
Trust outreach
initiatives**

**The Peak District
GeoWalk**

**England's first
online building
stones database**

**The Fen Edge
Trail**



Cover: Trow Gill: a photo of the vertical-sided dry glacial meltwater channel, on the route from Clapham to Ingleborough peak taken from a drone. Find out more about how drones are contributing to geoconservation on p.19. Photo by Geckoella Ltd

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EDITORIAL

Welcome to the summer edition of *Earth Heritage*. Although a slightly slimmer edition than usual, there is still plenty of interest and a few ideas for your summer, whether you prefer exploring geology through reading or walking.

Within the Outcrops section Dave Stone explores the value of an inclusive definition of nature, quoting the Scottish Biodiversity Strategy to 2045. This uses, as its definition of nature: '*Nature includes biodiversity, geodiversity and the natural elements of our landscapes and seascapes. It encompasses all the underpinning features and forces that have continued since the Earth was formed from summit to seabed including rocks, landforms, soils and processes like weather systems.*' – a welcome step forward in presenting a holistic view of nature. Another important opportunity for geodiversity is found in the *Environment Improvement Plan 2023* (which applies to England) with Goal 10 of the plan emphasising the importance of geological sites.

Under publications we provide a link to the much-awaited Natural England publication *Geoconservation Principles and Practice* which is now available to download. This publication supports practical geoconservation and provides generic site management guidance and new and updated case studies showing the practical application of this guidance. We have reviews of *The River and the Rock: River Potholes of Wales* and of the 2023 edition of *The Old Red Sandstone* by Hugh Miller, which is published as two volumes, one containing the original text and the other a 'critical study' of the work by Ralph O'Connor and Michael Taylor.

Within our main articles Jamie Foster discusses the use of drones to monitor geological features, reproducing some spectacular images from recent SSSI monitoring work. Our second main article focusses on the outreach activities of the Scottish Geology Trust and their 'Geology Does...' campaign. Much of the rest of this issue focuses on geo trails, a perfect excuse to go out into the countryside this summer. The new online publication by Albert Benghiat and Martin Whiteley takes you on a journey through the spectacular scenery of the Peak District, describing the geology of the area as you follow a circular walking trail. The route is split into 14 sections, each with their own walking guide and detailed description of the geology. Similarly, The Fen Edge Trail takes you on a 'journey across a landscape and time'. Many of the walks which describe the geology, landscape and historic importance of the area, are already available to download. More work and more volunteers are needed to complete the trail, eventually it will cover over 300 miles within 50 walks. Brian Whalley and Duncan Hawley add to this theme with their thoughts on how to develop a geo trail for the Waddesley area of Sheffield. If you are thinking of exploring any of these trails, please do familiarise yourself with the principles in the refreshed Countryside Code for England and Wales.

As ever, please do get in touch with one of the editors if you have an idea for a future article.



Hannah Townley, Editor

The value of an inclusive definition of nature

Geodiversity is an intrinsic part of nature and ecosystems, comprising the abiotic, non-living parts of the natural environment. It is important in and of itself, giving an understanding of the history of Earth and the evolution of life. It also underpins and helps us understand the character of landscapes, the natural processes that shape them, and their associated habitats and species. Geodiversity and geoconservation have been part of statutory nature conservation in Great Britain since 1949 and a key element of the work of all the UK statutory nature conservation bodies.

High-level plans and policy documents dealing with nature conservation often include policies and plans for nature, with geodiversity and landscape inherently included in these alongside biodiversity. But without a clear and inclusive definition of nature, which explicitly incorporates geodiversity and landscape, there is a risk that the dominance of biodiversity may lead to the role that geodiversity and landscape play in nature conservation and recovery being overlooked.

Recognising the opportunities and benefits that a comprehensive definition of nature can provide in delivering a more integrated approach to nature conservation and recovery, the Chief Scientists' Group of the statutory nature conservation bodies have recently expressed support for the use of 'an inclusive definition of nature' in their work. This means a definition of nature that explicitly recognises geodiversity and landscape alongside biodiversity.

A good example of an inclusive definition of nature is presented in the 'Scottish Biodiversity Strategy to 2045'. This uses, as its definition of nature: 'Nature includes biodiversity, geodiversity and the natural elements of our landscapes and seascapes. It encompasses all the underpinning features and forces that have continued since the Earth was formed from summit to seabed including rocks, landforms, soils and processes like weather systems.'

This inclusive definition of nature, with geodiversity, landscape and seascape all specifically mentioned, is a very welcome step forward in presenting a holistic view of nature that recognises these fundamental elements of the environment, providing a positive basis for adopting an integrated approach to nature conservation and recovery.

**By Dave Stone, Chief Scientist,
Joint Nature Conservation Committee**

Limestone pavement, showing one aspect of the relationship between biodiversity and geodiversity. Photo by Michael Dempster



John Durham: Geological landscapes

I primarily paint geological landscapes, producing contemporary paintings which focus on revealing the underlying structures of some of my favourite places.

My passion for the natural environment and understanding of geodiversity as a fundamental part of nature, underpinning the structures of these landscapes and the natural processes that shape them, is the inspiration for my art.

I use colour and form to explore iconic landscapes, by means of vibrant colours and tints to illustrate the composition of these geologically interesting sites.

The result is work that is colourful and informative and seeks to lay bare the inner beauty of its subjects.

I am a regular participant at Herts Open Studios and his paintings have been exhibited at many local exhibitions. Further afield I have exhibited at museums and galleries in London, Norfolk, Peterborough and Nuneaton. Please visit my website for further information and view other examples of my work.

By John Durham



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Environment Improvement Plan 2023 – an opportunity for geodiversity...

Earlier this year the Government's Environment Improvement Plan (EIP) 2023 was launched. EIP 2023 applies to England and is the first revision of the 25 Year Improvement Plan (YEP) which, in 2018, established a vision for quarter-of-a-century of action to help the natural world regain and retain its good health. EIP 2023 reinforces this vision setting out the plan to deliver across the original 10 goals, and crucially, it has strengthened the visibility and opportunity for geodiversity as part of this shared ambition for the natural environment.

Goal 10 - Enhancing beauty, heritage and engagement with the natural environment

establishes a clear commitment to 'conserve and enhance the natural, geological, and cultural diversity of our landscapes, and protect our historic and natural environment for the benefit and enjoyment of future generations' and recognises that 'England has many important geological sites that have considerable scientific, educational and heritage value'.

The importance of the recently designated Black Country UNESCO Global Geopark and Saltwells National Nature Reserve, particularly the connection between geoheritage, industrial heritage, place, and community that they bring, is reflected in a continued commitment '...to provide opportunities for people to experience geoheritage through our network of National Nature Reserves' alongside support for UNESCO Global Geoparks, Biosphere Reserves and World Heritage Sites.

More widely, the target to restore 75% of protected sites to favourable condition by 2042 encompasses England's 4,128 Sites of Special Scientific Interest (SSSIs) which includes 1,200 geological SSSIs. Progress towards this target is measured by a number of indicators including the 'G2 Indicator - condition of heritage features including designated geological sites and scheduled monuments'. This has established a comprehensive monitoring programme for geological SSSIs, which will identify the actions and resources need to achieve this target.

We mustn't underestimate how important the ambition of the Environment Improvement Plan 2023 is: it is a shared plan, across government, for the natural environment. There is a strong emphasis on environmental protection and improvement, and in particular, the importance and benefit of nature to people. The explicit inclusion and recognition of the value of geoheritage and the need for its conservation and enhancement, gives strength and opportunity for geodiversity and geoconservation. Now, more than ever, it is critical for the geological community to demonstrate how geodiversity benefits from and contributes to achieving these ambitious goals for nature's recovery.

By Jonathan Larwood, Natural England

 HM Government

Environmental Improvement Plan 2023

First revision of the 25 Year Environment Plan



<https://www.gov.uk/government/publications/environmental-improvement-plan>

Siccar Point UNESCO World Heritage Application Update

We have received the very disappointing news that our bid to get Siccar Point onto the UK Tentative List to apply for UNESCO World heritage status did not get on the short list for consideration in the current round. Feedback was generally positive and there was clear recognition of the site as a place of scientific historical importance as the “birthplace of geology”, but that the tangible attributes of the site were not sufficient to convey and demonstrate potential Outstanding Universal Value. Perhaps we would have been successful if, just like Hutton took his friends, we could have taken the assessment panel to visit Siccar Point and they could have appreciated and understood the clarity and stunning evidence for “deep time” and heard the words of Hutton “we find no vestige of a beginning, no prospect of an end” with the evidence before them.

What next? We remain very positive and would like to achieve something special for Hutton’s tercentenary in 2026. We certainly won’t give up on UNESCO World Heritage status, but we will look at other options. We know there is support from Scottish Borders Council, the South of Scotland Enterprise,

and the local community in Cockburnspath to improve awareness. We can build on the inclusion of Siccar Point in the International Union of Geological Sciences’ list of Geological Heritage Sites which recognises its international scientific relevance as one of the world’s most important global sites. We could also consider working toward UNESCO Global Geopark status.

Undertaking the creation of a Geopark would entail essential local community buy-in and support. Core to such a development would be promoting and celebrating the site’s substantial contribution to geological science and raising awareness of James Hutton and his Earth-changing genius. Ideas include developing improving access to Siccar Point, a Hutton museum/visitor centre in the nearby village of Cockburnspath, improvement of the footpath links to Cockburnspath and the Southern Uplands Way and also to the Berwickshire Coastal Path and the John Muir link. These are some of the exciting ideas, the realisation of which, could bring the world to Siccar the site having brought the world to science.

By Robert Gatliff (Edinburgh Geological Society and the Scottish Geology Trust) & Colin Campbell (CEO The Hutton Institute)



An unusual view of Siccar Point that highlights the challenges of engineering an access to the coastal platform and unconformity. This may involve a set of steps down the grassy cliffs taking away the need to grip a dodgy rope or grab the barbed wire fence! Recognised as a very Special Site of Scientific Interest, on a particular scenic coastline, care will be fundamental to ensure sensitive and appropriate access solutions. Interpreting Siccar Point, its role in the development of science and issues with difficult access to the site have been raised in previous issue of *Earth Heritage* for example see issue 42, 2014.

© Colin MacFadyen/NatureScot

Raising the profile of Skye's dinosaur heritage

On Friday April 28 and Saturday April 29 2023, the Royal Society of Edinburgh hosted an event at Sabhal Mor Ostaig, the Gaelic college on the Isle of Skye. Entitled 'Islands: Past', the two-day event gathered speakers who presented talks to the public on the history and culture of the Hebrides. The event featured Skye's geological heritage with Professor Steve Brusatte, palaeontologist at the University of Edinburgh, giving a Friday evening public keynote address on the island's Jurassic-aged fossil dinosaurs. More information on the event is here: <https://rse.org.uk/whats-on/event/islands-past-skye/> and recordings of the talks are available at the RSE's YouTube page: <https://www.youtube.com/@TheRoyalSocietyofEdinburgh>

Below: In addition to the Royal Society event Professor Brusatte presented a workshop for children at a primary school on Skye with his wife Anne who has authored the new children's book on Scottish dinosaurs entitled 'Dugie the Dinosaur'. Image provided by Steve Brusatte



Refreshed Countryside Code

Shaun the Sheep has become the new champion of the Countryside Code which applies to England and Wales.

The campaign encourages people to ‘respect, protect and enjoy’ the countryside. Primarily aimed at children and families, there are animated guides starring Shaun and his friends on how to protect the countryside and enjoy it safely. The principles of the code are:

Respect everyone

- be considerate to those living in, working in and enjoying the countryside
- leave gates and property as you find them
- do not block access to gateways or driveways when parking
- be nice, say hello, share the space
- follow local signs and keep to marked paths unless wider access is available

Protect the environment

- take your litter home – leave no trace of your visit
- do not light fires and only have BBQs where signs say you can
- always keep dogs under control and in sight
- dog poo – bag it and bin it in any public waste bin or take it home
- care for nature – do not cause damage or disturbance

Enjoy the outdoors

- check your route and local conditions
- plan your adventure – know what to expect and what you can do
- enjoy your visit, have fun, make a memory

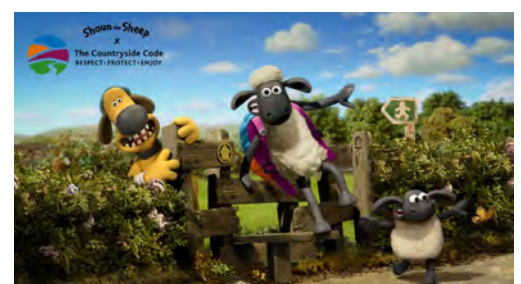
This refreshed Countryside Code follows research from Natural England’s Children’s People and Nature survey which revealed that 80% of children and young people agreed that looking after the environment was important to them, and 83% said they wanted to do more to look after nature and wildlife. The principles in the code will help children to understand how to care for the countryside.

By Hannah Townley, Natural England



https://www.nationaltrail.co.uk/en_GB/countrysidecode/

<https://www.gov.uk/government/collections/people-and-nature-survey-for-england#children-survey-data>



The beach at Auchmithie is peppered with highly attractive eroded cobbles and pebbles from the surrounding cliffs of Devonian conglomerate. A handful of pebbles in the hand tell numerous incredible stories of their origin painting a picture of erupting volcanoes to vast mountains and colliding continents. Find out more about how the Scottish Geology Trust are developing a series of outreach activities on p 23. Image by Katie Strang



Geoconservation: Principles and practice

EVANS, D., BROWN, E., LARWOOD, J., PROSSER, C., SILVA, B., TOWNLEY, H and WETHERELL, A. 2023. Geoconservation: principles and practice. Natural England General Publication NE802, Natural England. ISBN 978-1-78367-390-2

Natural England has recently published *Geoconservation: Principles and practice*. This handbook revises and updates the previous publication *Geoconservation a guide to good practice*. Much of the contents will be familiar with the publication divided into sections by type of site as previously but with revised text and diagrams and both new and updated case studies.

This publication explores the principles and practice of geoconservation, drawing on the practical experience gained by Natural England, its predecessor bodies and many of its partners and stakeholders. It sets out why geoconservation matters, who benefits, and how sites are selected and monitored. Its focus is the principles and practice of delivering geoconservation on the ground. It explores the threats which arise, approaches to site management, and the positive opportunities to deliver geoconservation which sometimes occur through development proposals or land use change.

Supporting practical geoconservation is at the heart of this publication and a wide range of real case studies are used to illustrate interventions which have been successful in conserving, enhancing and promoting geoheritage sites and some which have not.

One new case study discusses how geodiversity and biodiversity can be managed together, using Swaddywell Nature Reserve near Peterborough as an example. Here several locations around the site are actively managed to show different aspects of the Lincolnshire Limestone as part of a geological trail. Keeping these faces free of vegetation also provides important habitat for mining insects. Other areas towards the centre of the pit are more actively managed for the habitats and species they support.

Although primarily aimed at supporting geoconservation and nature recovery in England, the principles, practice and case studies set out here should also be of relevance to anyone anywhere interested in or involved with conserving, recovering or enhancing geodiversity and geoheritage.

It is available to download as the full publication (100Mb) or in three parts (between 30Mb and 70 Mb each) from the access to evidence catalogue, see [Geoconservation: Principles and practice - NE802 \(nepubprod.appspot.com\)](https://nepubprod.appspot.com)

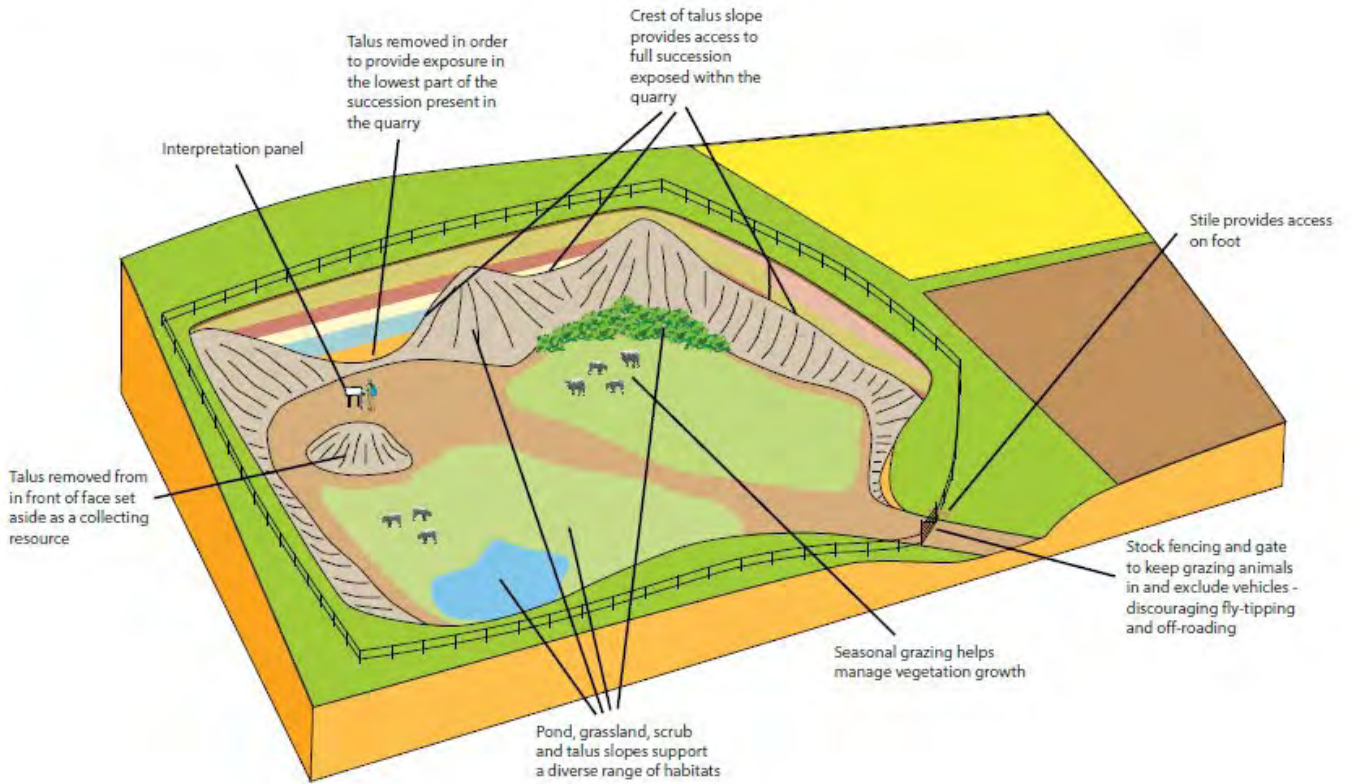
Hannah Townley, Natural England



**Geoconservation:
principles and practice**



3.2e: Small urban and rural quarries managed to enhance geodiversity and biodiversity features (ED)



One of the new site management diagrams, showing some options for managing geodiversity and biodiversity together. © Natural England



One of the locations on the geology trail at Swaddywell. Here the boardwalk gives access the geological exposures when water levels are high. Photo by Colin Prosser

The River and the Rock: River Potholes of Wales

The River and the Rock: River Potholes of Wales by Dewi Roberts, Stephen Tooth and Hywel Griffiths. Gwas Garreg Galch (2022). 160pp. ISBN: 9781845278878. £22.00

The River and the Rock: River Potholes of Wales starts by looking at the science behind potholes - what geomorphological processes are involved in their formation and the link to wider fluvial features such as waterfalls, rapids and gorges. This is done through a mix of informative diagrams and plenty of illustrated examples. The second section covers the ecology of potholes, but with a particular slant on how the morphological diversity of the potholes provides a variety of habitats. Depending on their size and shape or the type of any trapped sediment, the pothole can be a home to a wide range of fish, amphibians and insects – another classic example of geodiversity underpinning biodiversity!

The book then discusses the close relationship between humans and rivers and the fascination we have with potholes. Many travel writers and poets have described the scenery and the many myths and legends associated with our rivers in Wales. The Afon Conwy is said to be the home of a mythical creature called the Afanc which has been described as a crocodile, giant beaver or a dwarf! The thrashing of the Afanc in the waters of the Conwy was believed to have led to frequent flooding downstream. The story ends with a local maiden enticing the Afanc from the river for the best blacksmith in Wales to bound the creature in iron chains before two oxen pulled it all the way up to



THE RIVER AND THE ROCK

RIVER POTHoles OF WALES

DEWI ROBERTS • STEPHEN TOOTH • HYWEL GRIFFITHS





The Fairy Glen, Afon Conwy by Stewart Campbell

the flanks of Yr Wyddfa (Snowdon). As if that wasn't enough, such was the effort required by the oxen that the eye of one ox popped out and its tears formed Pwll Llygad yr Ych (pool of the eye of the ox)!

The second half of the book highlights some international examples before going on to discuss the physical and mental health benefits of potholes and suggestions of some Welsh potholes to visit. The physical health benefits of walking along rivers and gorges, or wild swimming, may be obvious but there is growing understanding that nature can provide even greater benefits as all our senses come into play. The play of the light, the sound of the river, smell and even taste of water spray and the touch of sculpted, smoothed surfaces can create a special experience.

The River and the Rock: River Potholes of Wales is an excellent and sometimes thought-provoking book which is well-illustrated with excellent photographs and diagrams. There is also a handy glossary and a section on further reading. It is a pity, though, that there is no explicit mention of geoconservation! Many of the iconic potholes, gorges and waterfalls in the book occur within GCR sites and SSSI and highlighting the importance of site protection would have been a useful addition.

Raymond Roberts, Natural Resources Wales

Further reading:

Gregory, K.J. (ed.) (1997) *Fluvial Geomorphology of Great Britain*. Chapman & Hall, 348pp.

Williams, D.D. & Duigan, C. (eds) (2009) *The Rivers of Wales*. Backhuys Publishers, Leiden, 336pp.

Bringing Hugh Miller's *The Old Red Sandstone* to a new generation of readers

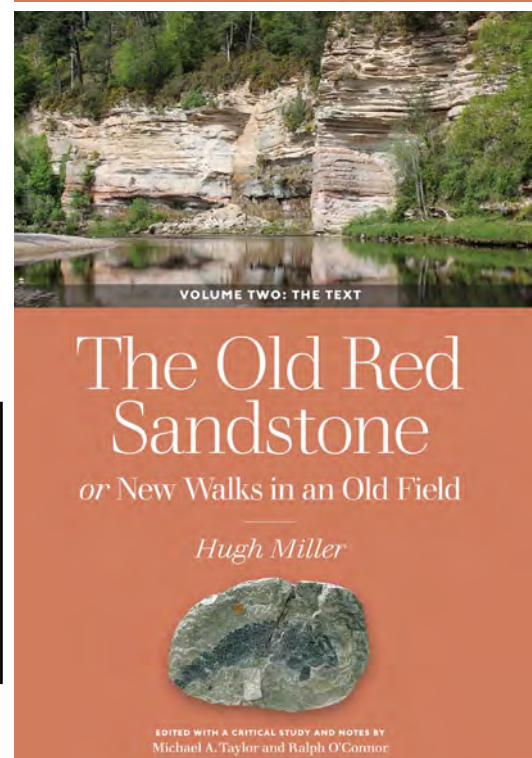
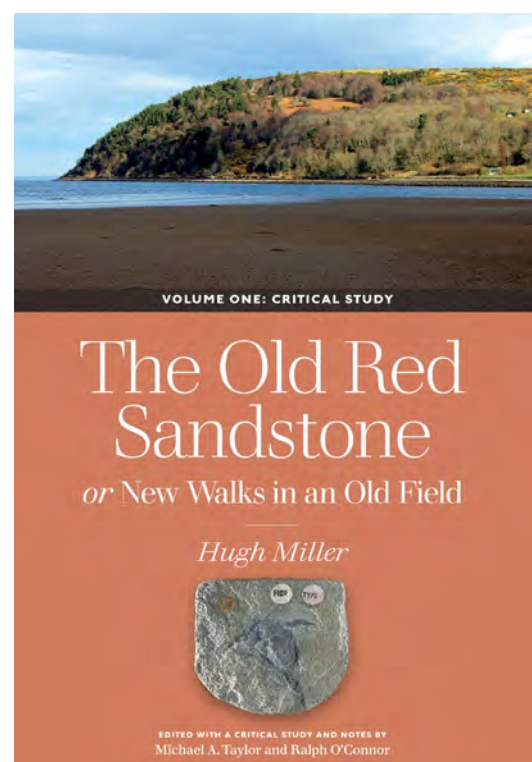
Hugh Miller (2023) *The Old Red Sandstone*, reprint of 1841 first edition, edited by Michael A. Taylor and Ralph O'Connor, with *A critical study of Hugh Miller's The Old Red Sandstone, 1838–1920* [2 volumes, National Museums Scotland – Publishing, Edinburgh]. ISBN 978 1 91062 25 8. The book is published by NMS Enterprises Limited. For further information on this publication please contact: publishing@nms.ac.uk

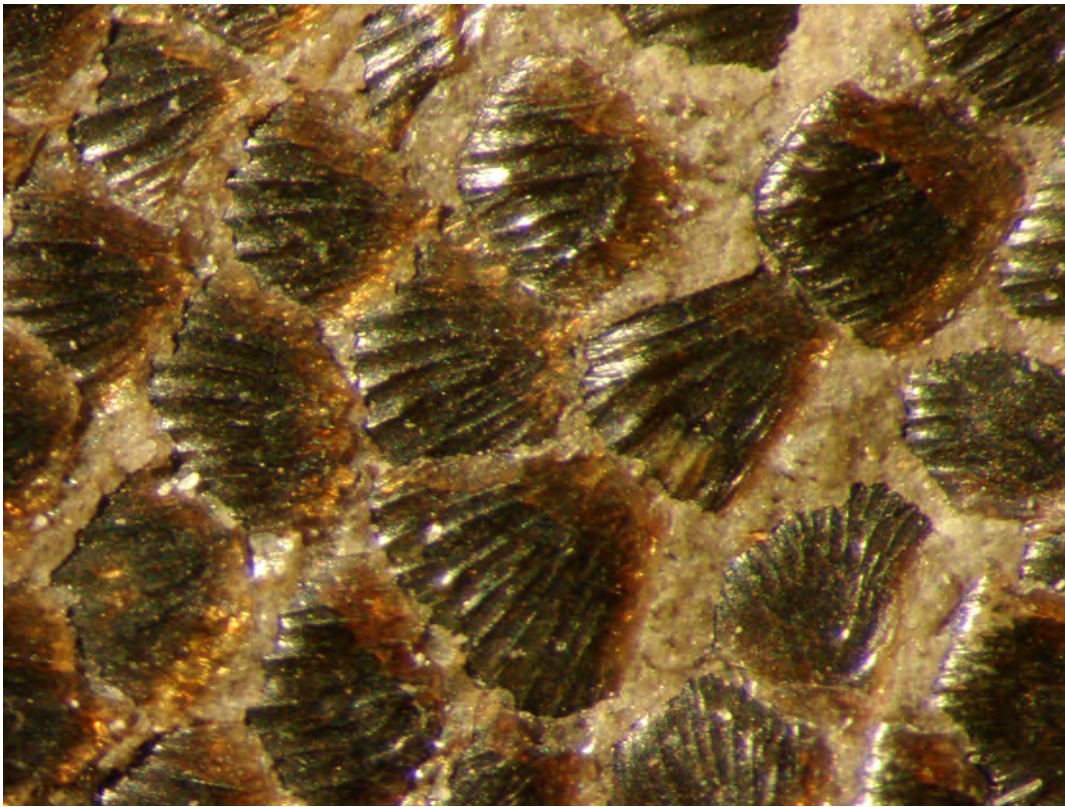
The 2023 edition of *The Old Red Sandstone* is the first truly new one for a century. It is in two main parts: a facsimile reprint of Miller's original first edition of 1841, with explanatory notes added, and a book-length 'Critical Study' of Miller's work by the authors Ralph O'Connor and Michael Taylor. Ralph O'Connor's expertise lies in history and English literature, with Celtic languages and culture, and Michael Taylor's in palaeontology and museums, with an overlap in the history of geology. This seemingly odd combination was just what was needed to tackle this highly idiosyncratic book, in a project that stretched over fifteen years, on and off.

The Old Red Sandstone is commonly said to be based on articles in the Edinburgh newspaper *The Witness*, which Miller started editing in 1840. But it was no simple reprint. Our analysis shows that much of the book was completely new and much of the rest was heavily reorganised and modified. What seems a chaotic muddle, which hops from fossil fishes to fairies, from self-improvement to the meaning and end of Creation, turns out to be a highly-structured and creative work of controlled argument.

Annotating the book for modern readers, to explain the once-contemporary and now sometimes baffling references, has forced us to examine it in detail, and sometimes rethink our ideas. Miller comes over as quite a gradualist in terms of the sequence of life through geological time. He is commonly held to be a catastrophist, but this turns out to be an optical illusion, so to speak, caused by the way in which he writes about scenes of past life exactly like different scenes in a theatre, with the curtain

The front covers of Volume 1 and Volume 2 of the new two-volume reprint of Hugh Miller's *The Old Red Sandstone*, edited and with an accompanying critical study by Michael Taylor and Ralph O'Connor. The cover of volume one which is the Critical Study, illustrating the South Sutor, a prominent landmark and viewpoint, and Miller's famous fossil fish site seen from Cromarty, together with a fossil fish from Miller's collection. Another of Miller's fossil finds augments the cover imagery of volume two which pictures the Old Red Sandstone exposed in the gorge of the River Findhorn near Sluie, as described in Miller's book. Photo by Ralph O'Connor





Miller wrote of the scales of *Rhadinacanthus* (a Middle Devonian fish): 'when examined with a glass, the body appears as if covered with scallops. It seems a piece of exquisite shell-work, such as we sometimes see on the walls of a grotto' (p.91). *Rhadinacanthus longispinus*, Middle Old Red Sandstone, Gamrie (Gardenstown), Banffshire, James Powrie Coll., scales c. 0.8–1mm long. NMS G.1891.92.338. Photograph kindly provided by, and the copyright of, Jan den Blaauwen

rising and falling for each scene. The authors also examine the sequence of strata then attributed to the Old Red Sandstone and how it differs from today's understanding.

Like Miller himself, the authors ended up down several irresistible but still illuminating diversions. William Buckland's discovery of both Miller's writing, and the first known glacial site in Scotland, at Closeburn in Dumfriesshire, en route to the 1840 Glasgow meeting of the British Association for the Advancement of Science, turned out to be an accident of his social calendar and – perhaps – a liking for Walter Scott novels. At the meeting, Buckland and Roderick Murchison praised Miller's work to the skies. But, in contrast to common belief, Miller was not there (as the late Mahala Andrews first spotted). Nor did he go on the subsequent glacial tour of the Highlands with Buckland and the fossil-fish-and-glacial-specialist Louis Agassiz. This has considerable consequences for understanding Miller's contemporary fame, and his evolving relationships with other scientists, as shown in the successive editions of Miller's book.

Most of Miller's collection is, of course, held by National Museums Scotland, and the authors emphasise the scientific importance, for taxonomy and research, of those fossils which Miller illustrated in his book. An appendix by Andrew Ross and Michael Taylor, curator and research associate at NMS, considers the provenance of these specimens. The fossils (or at least the ones traceable today) are also included in a new section of colour illustrations of specimens, portraits, maps, paintings and prints. Several microphotographs of fossil fish scales by Jan den Blaauwen help to show exactly why Miller's enthusing over their beauty captivated so many people. Miller's fossils had enormous cultural significance as well, ultimately influencing the poet Tennyson in such works as *In Memoriam*.

The Old Red Sandstone in fact became one of the best-selling science books of its mid-Victorian era, high in the league table with such works as *On the Origin of Species* – and, like that book, written for everybody. At least forty-seven thousand copies of *The Old Red Sandstone* were sold in the United Kingdom and its empire (and still more in the United States) from 1841 to the time the Everyman edition of 1922 went out of print. This was very good going for a book that originally cost six and a

half shillings when it came out, soon upped to 7s 6d. In decimal terms, 7s 6d is 38p, which might not seem much until one realises that money was worth more than a hundred times as much as it is now.

And who bought it? The authors look at its readers – and borrowers – over the years. On the more formally scientific side of matters, for every Agassiz who was sniffy about Miller, the authors found a Christian Pander, or Richard Owen, or Thomas Huxley, or Ramsay Traquair of the Royal Scottish Museum, respectfully impressed by his work (and saddened that Miller didn't become a full-time palaeontologist). On the more amateur front, Miller's enthusiasm for fossils and geology, and his writing, influenced many in all walks of life. The modern writer James Robertson has contributed a preface on what Miller means to him. His many forerunners whom the authors have collected, male and female alike, number Poet Laureates and prime ministers, bakers and lawyers, artists and philanthropists, nature-writers and farmers, professors and Catholic priests, many prompted to go fish-hunting in the rocks of Cromarty and Eathie, and in their own neighbourhoods, in a wave of geotourism in Scotland, and further afield in the Old Red Sandstone of the Welsh Marches.

Michael Taylor, Research Associate, National Museums Scotland &
Ralph O'Connor, University of Aberdeen



A fossil fish from the Middle Devonian fossiliferous horizons at Cromarty, on Scotland's east coast, found by Miller and illustrated in *The Old Red Sandstone*. The specimen, in the care of the National Museums Scotland, is still labelled by Miller, 'First specimen of *Diplacanthus* ever found'. Nodule 9.7cm long. NMS G.1953.4.4. © National Museums Scotland

A photo of Rheinstor, in Bradford Dale, point 2 on the Peak District Trail. Read a review of the Trail on p. 36. Photo by Helen Moat



Aerial Revolution: Geo-Conservation Takes to the Sky

Jamie Foster, Geckoella Ltd

The proliferation of small unmanned aerial vehicles (sUAVs), or drones, as a surveying method within the conservation sector has grown rapidly in recent years. This is partly due to the increasing public accessibility of drones, and the evolution of drone technology itself allowing for a diverse range of data to be readily collected from standard aerial photography and videography to more advanced techniques such as thermal imaging, multispectral imaging, photogrammetry and LiDAR. Fundamentally, the demand for cost-effective and time-efficient solutions to conservation challenges remains a primary factor driving the increased use of drones as a modern surveying technique.

Drones evolved from military applications such as reconnaissance, however since the mid-2000s and the development of small unmanned aerial vehicles, they have been recognised as powerful environmental monitoring tools. The applications of drones in conservation are varied, however Geckoella (a geological and ecological consultancy based in South West England) practices a hybrid approach to using drones in their day-to-day monitoring, where drones are used alongside a traditional boots-on-the-ground approach by geological or ecological specialists.

Since 2020, Geckoella has been working with Natural England to carry out monitoring surveys of geological and geomorphological SSSIs. In this time, over one-hundred Geological Conservation Review sites have been assessed, over 30% of which have been monitored using drones. This aerial monitoring technique has been used across England from the Lizard Peninsula in Cornwall to the rugged Yorkshire Dales, and has been applied to a diverse range of GCR types including karst landscapes, coastal



Limestone Pavements of the Great Scar Limestone Group at Harry Hallam's Moss, on the western flank of Ingleborough SSSI. The terraced landscape is pitted with dolines and scarred by dry valleys. All images by Geckoella Ltd



Twisleton Pastures, a glacial valley on the flank of Ingleborough SSSI. Gods Bridge seen in the centre-right

geomorphology sites, mass movement features and finite palaeontological interests, to name a few. Not only do drones provide us with the opportunity to document the condition of important geological outcrops, whether they are exposed at the top of a cliff face or on the opposite side of a flooded quarry, but we also get a unique aerial perspective of the feature in the context of the wider geological and geographical setting. This is especially important in sites such as the West Dorset Coast SSSI, where local outcrops are part of a much broader geological picture - the Dorset and East Devon Coast World Heritage Site.

Some geological sites are very large, and when it comes to monitoring them, their scale can be challenging. An example of such a site is Ingleborough SSSI in Yorkshire. Covering over 5,200 ha, Ingleborough is considered Britain's finest karst landscape with outstanding examples of dolines, shakeholes, gorges and erratics. However, traversing such a site for monitoring purpose is difficult. Drones on the other hand can cover large areas with ease, cutting down the time required to spend on site and potentially opening up the surveyors' time to focus on more detailed outcrops which demand a trained eye. In addition, modern technologies such as automated flight routes and 'waypoints' allow surveys to be standardised.

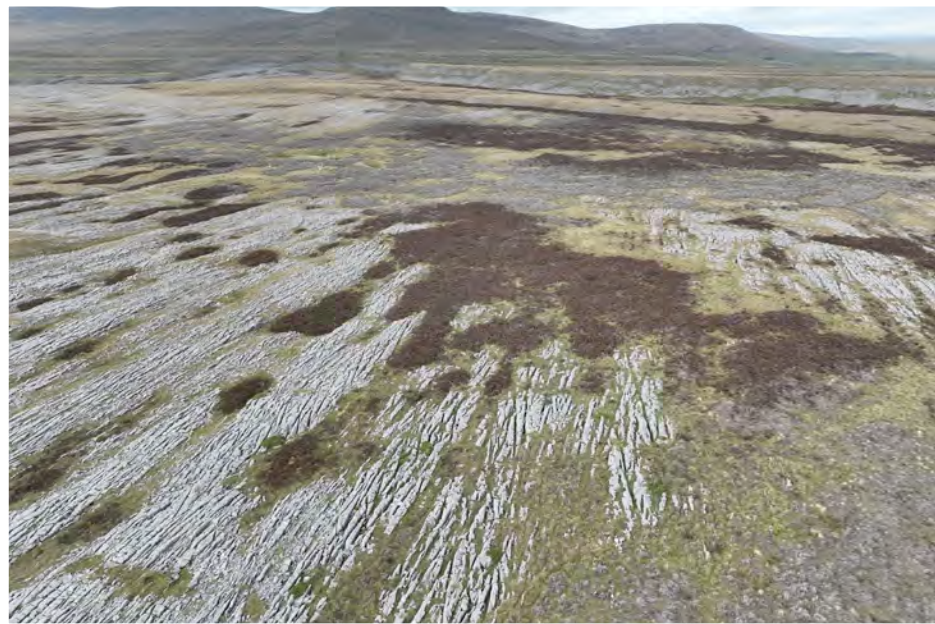
Recently, Geckoella has had the opportunity to work with local authorities regarding the application of aerial monitoring of cliff erosion within a section of the Blue Anchor to Lilstock Coast SSSI near Watchet, Somerset. The coast here exposes exceptional outcrops of Lower Lias (lowest Jurassic) limestones and shales faulted against late Triassic red mudstones laced with striking white and pink gypsum veins. Since early 2022, a series of aerial surveys have been conducted to collect photographic and video records of the stages of coastal erosion, in addition to producing repeated high-resolution orthomosaic maps and 3D photogrammetric models. The drone surveys themselves were successful in helping to inform local authorities who are working to manage the impacts on public infrastructure including nearby roads and houses. Given the nature of the situation, drones offered a means of recording the site without placing geologists in a highly unstable and active landslip zone. This aerial monitoring programme has also produced a detailed insight into the failure characteristics of the late Triassic and early Jurassic strata on the Somerset coast.

Where sites are difficult to access, for example, flooded quarries, waterlogged ground, tidal inlets, dense vegetation or rough karst terrain, then drones really come into their element. In early March

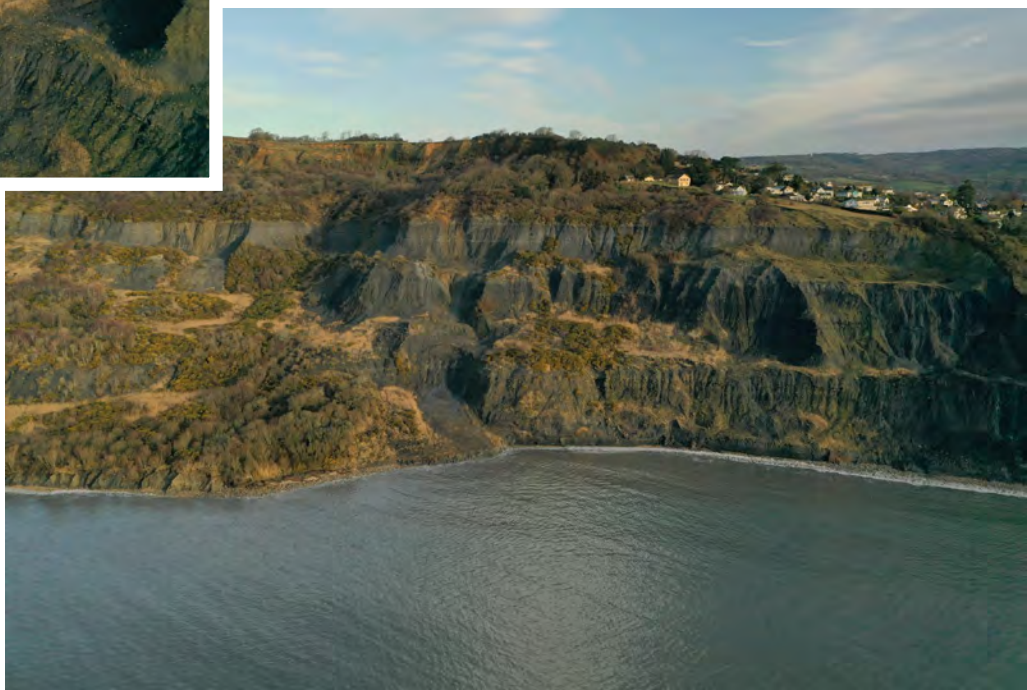


Above: Trow Gill: a vertical-sided dry glacial meltwater channel, on the route from Clapham to Ingleborough peak

Right: Extensive limestone pavements near Moughton, east of Horton-in-Ribblesdale



Black Ven, a large active mass movement complex, hosting slumped and weathered Lower Lias stratigraphy succeeded by the Cretaceous Upper Greensand Formation, an oblique view can be seen in the left image and a front-on-view below



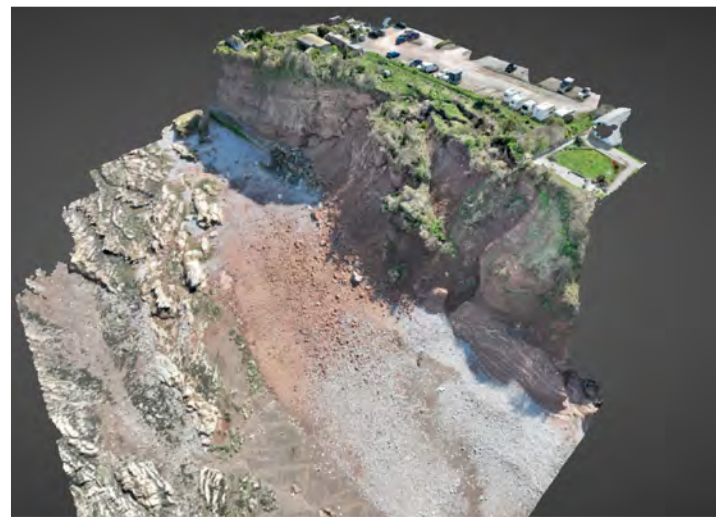
2022, Geckoella employed the use of drones to inspect the condition of Black Ven – a famous active landslip complex on Dorset’s Jurassic Coast. Recent heavy rainfall and active mudslides meant the site itself was too dangerous to enter on foot, therefore drones were used to inspect the site and look for any signs of damage to the SSSI, such as unauthorised fossil collection.

As with any survey technique, utilising drones also presents its own challenges. First and foremost, weather is a day-to-day pressure on drone surveying, especially in the UK. At best, high winds can make controlling a drone difficult, and reduce the flight time. At worst, extreme winds can de-stabilise a drone and force it out of the air. Few commercial drones are water resistant, therefore the onboard sensors and electronics can become vulnerable in the rain. Temperature is a less obvious hazard: high temperatures can cause overheating sensors and have a detrimental impact on the condition of the batteries. Lower temperatures, especially when combined with high humidity, can cause water to precipitate onto the drone’s propellers and freeze, making the drone unstable and potentially causing a crash.

Geckoella monitors both geological and ecological sites with drones, naturally there are environmental considerations to be made before taking flight such as avoiding particularly sensitive areas, modifying flight elevation to avoid disturbing wildlife and reducing the length of time spent flying. As an example, breeding, wading and overwintering birds can be sensitive to drones and territorial birds such as gulls and peregrine falcons will attack drones if they perceive them as a threat.

As drones become increasingly accessible, legislation is being continually revised and reinforced. It is a fact that where and how a drone may be flown can be heavily restricted. However, these restrictions are generally designed to ensure the safety of the public, aircraft and wildlife in addition to ensuring responsible drone operations. These regulations also demand a certain level of competency (including understanding and complying with the Civil Aviation Authority Drone Code). Unfortunately, drones are not always used responsibly, and reports of unregistered and irresponsible drone operators are commonplace. This in turn can impact heavily on the public perception of drones, with the possible result that people may be hesitant when it comes to utilising the full potential that drones can offer.

The current applications for drones in geological conservation are endless, and the future is looking promising. By adding drones as an additional specialist tool to a geologist’s toolkit, we can begin to record, monitor and access important sites like never before.



Left: A plan view (left) and a 3D photogrammetric model of the same area (above) of the recent coastal landslip activity in Watchet, Somerset. The cliffs here are comprised entirely of red mudstones laced with pinkish-white alabaster of the Mercia Mudstone Group. A series of these models have been generated over the last year, allowing us to track the cliff collapse in 4D

Scottish Geology Trust outreach initiatives

Katie Strang, Angus Miller and Bob Holdsworth, Scottish Geology Trust

The Scottish Geology Trust is a new charitable organisation, launched in 2020, with the key objective of inspiring people everywhere to understand, love and care for Scotland's geological heritage. It has the ambition to becoming a leading voice that represents and demonstrates support for the promotion and protection of Earth sciences in Scotland. Since its inception the Trust has embarked upon a series of outreach events that celebrate Scotland's geology and its importance.

What tells
Scotland's story,
from Deep Time
to today?

Geology does



scottishgeologytrust.org

Aiming to reconnect people with geology

Leading up to the Trust's formation there was growing concern and recognition, amongst Earth scientists and other geodiversity enthusiasts and stakeholders, that despite the role and value of Scotland's geological heritage and its exceptional education potential, there were signs of people becoming disconnected with the subject. A particularly good example of this disconnect being the declining number of geology graduates. Additionally, despite the potential of the *Curriculum for Excellence*, most Scottish students are neither exposed to nor learn very much about Scottish geology at school. Concerning indicators remain that the subject risks drifting into obscurity just at a time when understanding Earth processes has never been more important to society.

In the nation that is home to the 'birthplace of geology' this came as an unwelcome and deeply concerning eye-opener, especially given that Scotland's unique character and long history of scholarship, innovation and industry are rooted, quite literally, in the rocks that lie beneath our feet and under the sea. These rocks have directly influenced our landscapes, biodiversity, built heritage and industry, and are intrinsically linked with our distinct cultures and sense of place. Scotland's hidden stories span over 3 billion years of Earth's history, and they are waiting to be discovered. Over the last few years, the Scottish Geology Trust have been

An example of the Scottish Geology Trust's 'Geology does' campaign that utilises the well-known Calanais Standing Stones, a globally significant Neolithic monument on the Isle of Lewis. An image of the iconic stone structure, that many people can relate to and are familiar with, attracts public attention together with the provocative question and answer combination. An accompanying message then expands on the 'Geology does' answer to reveal the fact that Scotland's rocks capture and can reveal a story of 3 billion years of change. Calanais Standing Stones image is by Andy Wasley

busy telling these stories and encouraging everyone to learn about our geological past. Scotland's rocks have the potential to change the way you look at the world, and will be a critical testing ground for our ambitions to aid the effort to tackle climate change.

Scottish Geology Festival

The Scottish Geology Festival is our keystone annual activity that promotes Scottish geology through a small army of grass-root volunteers. Over the last three years we have seen a remarkable number of events organized across the length and breadth of Scotland and beyond. The festival aims to work with partners to offer a varied programme that helps explain why Scotland's landscape is so unique and alluring. From exploring Edinburgh's extinct volcanoes, to encountering evidence of ancient tropical seas and coral reefs around the Forth, from discovering exceptionally preserved 400 million year old plant fossils in Aberdeenshire, to learning about the scouring ice sheets which carved out our rugged highland landscapes – the diversity of our geology and its influence on society is beautifully reflected in the wide range of events we see during the Festival.

Using the Festival, we are keen to help bring different people and organisations together to share ideas, develop long-lasting and meaningful partnerships, inspire new ways of collaborating, and to encourage interdisciplinary learning and discourse around the importance of Scotland's geology. We strive to be accessible in our engagement, recognising the importance of reaching and engaging with diverse audiences and people from under-represented and disadvantaged backgrounds.

Each year sees a packed programme of events organised by dedicated volunteers, including individuals, community groups and local geological societies, and larger institutions like universities and museums. There's a broad range of activities including online talks, guided walks, geo-



Left: The beach at Auchmithie, Angus, on Scotland's east coast, one of the many venues hosting events as part of the Scottish Geology Festival. The pebbles, forming much of the beach, have been eroded from underlying Devonian rock that is comprised of conglomerate beds evident in the surrounding cliffs forming the spectacular backdrop. Each pebble (see above) has a story to tell of the geology comprising the Devonian landscape and their transport in vast Mississippi-sized river system that flowed across vast parts of the land over 370 million years ago, numerous incredible stories of their origin. Photos by Katie Strang

poetry, boat trips, beach pebble events, geological exhibitions and much, much more. We work with local organizations and groups to facilitate co-production of resources, including displays of local geological finds, to allow a legacy of meaningful material to be shared and disseminated further throughout these communities. For example, this year will see us return to Auchmithie village, in Angus on Scotland's east coast, to partner with the Auchmithie HAAR (Heritage Arts Auchmithie Residents) group for the 3rd year running, as part of their annual heritage event dedicated to sharing the history of their village. Working with a fantastic team of locals, the Trust and our amazing volunteers are delighted to be able to add a geological perspective to their celebrations - the impressive conglomerate cliffs, which now shelter the tiny harbour, are brimming with tales of 400 million year old Mississippi-sized rivers and powerful flash floods.

This year's festival will run from the 1st September to 8th October. If you would like to get involved, and we would very much like you to consider this, then please email Dr Katie Strang on engagement@scottishgeologytrust.org

'Geology does' campaign

Using the truly remarkably and inspiring geology of Scotland, we also have ambitions to promote an interest and awareness of geology and the geosciences more generally to the public, business, other stakeholders and also government. This has been exemplified by the launch in November 2022 of our highly successful social media campaign, 'Geology does...'. The campaign is centered on a series of eye-catching images overlain by simple question and answer combinations that are designed to provoke people's interest. Each image highlights an environmental, cultural, economic or social aspect or theme that people can relate to. 'Geology does', is the response to each and every question accompanied by a more detailed explanation that reveals the fundamental role, value and significance of geology in for example how we know about deep time. Other topics include geo-

An oxbow lake in the The Medwin Water, part of The River Clyde Meanders Site of Special Scientific Interest (SSSI) and GCR site. The Medwin Water, a tributary to the Clyde, is very active with a complex history of both progressive channel migration, and sudden change through meander bend cut-offs. On-going monitoring of this site, combined with a very detailed historical record of channel migration (from maps and aerial photographs), has great potential to further our understanding of floodplain history and alluvial stratigraphy. A publically available interactive map-based database will make it easier for everyone to find out about this and other Scottish geosites including Local Geodiversity Sites, SSSIs and remaining unprotected GCR sites, to enable anyone to report damage to, or the deteriorating condition of any geosite. Image by Angus Miller



engineering and how geology influences our built heritage and biodiversity. In the future, we intend to further develop this campaign creating new themes and resources for teachers and educators. The full campaign can be viewed here <https://www.scottishgeologytrust.org/geology-does/>

To find out how you can share and get involved in the “Geology does..” campaign, please contact Dr Angus Miller, SGT Vice-chair and Geology Does Project Manager, at angus@scottishgeologytrust.org.

Geosites

The ambitious new Geosites project which launched this year, gets right to the very heart of the Trust’s aims. It is designed to create an active and passionate community of local people who are involved directly in the promotion and conservation of the multitude of world-class geological sites that exist across Scotland.

Scotland has a wide range of sites that are important for geology and geomorphology at a national or local level and are variously designated as Sites of Scientific Interest (SSSI), Geological Conservation Review (GCR) sites or Local Nature Conservation Sites (Local Geodiversity Sites - LGS). Together, these ‘geosites’ represent Scotland’s world-class geodiversity, containing the evidence of geological processes of the past and present, important fossils and minerals and demonstrate the fundamental links between geology, processes, landscape, people and nature.

Over the next 3-5 years, the Trust plans to work with NatureScot and other partners to develop a fully accessible interactive map-based database that makes it easy for everyone to find out about Scotland’s geosites, and for anyone to report damage to, or the deteriorating condition of any site. We see this as a ‘citizen science’ project that meaningfully engages volunteers across Scotland, contributes to conservation and provides a springboard for further engagement by communities with their local geology. The pilot phase runs over this summer, involving volunteers visiting up to 100 sites, recording key information, taking photographs and noting any conservation concerns. If you would like to be involved then please contact Dr Angus Miller, SGT Vice-chair and Geosites Project Manager, at angus@scottishgeologytrust.org.

Scottish geology round table

Our ambitions to become a strong voice for Scotland’s geology are further demonstrated by the Trust’s recent proposal to set up and facilitate the Scottish geology round table. This will be an informal forum where organisations can share and discuss their aspirations and concerns for geology in the context of Scotland. The intention is to bring together organisations who have a vested interest in Scottish geology and promote collaborations that benefit all parties and efficiently raise the profile of Scottish geology and its importance to society. If you or your organisation would like to participate then please contact secretary@scottishgeologytrust.org.

Making progress through support and dedication

The breadth of activities in which the Trust is involved would not be possible without the support of our dedicated Trustees, members and volunteers, all of whom are fundamental to the work we do. We hope that this glimpse into a few of the Trust’s key activities illustrates how we are beginning to make significant progress, and create real impacts, as we strive to become a strong voice for Scotland’s geology and to inspire future generations of geoscientists. If you would like to become a member or support the work of the Trust please visit <https://www.scottishgeologytrust.org/support-us/>.

England's first online building stones database

Hannah Townley, Natural England

Historic England launched a new online database of the stones that define the rich diversity of our country's buildings in early June 2023. The Building Stones Database for England brings together information on over 4,000 types of building stones, their uses and sources, in a searchable online GIS map explorer.

You can browse the geological map, search by postcode, address or place name or look for a specific building stone, representative buildings or structures made with each stone type. The database identifies important indigenous building stones, where they were extracted and potential sources for repairs and new construction.

Historic England has led the development of the comprehensive new database, working with the British Geological Survey, local geologists, historic building experts and volunteers.

The database is accompanied by a series of 45 highly illustrated regional guides covering different areas of the country. From Roman walls to Norman churches, workers cottages to imposing town halls, the guides highlight local buildings, the stone used in their construction and the underlying geology which has helped shaped the distinct character of an area.

Just under half the country's listed buildings (49%) are made from stone and it is a key material in many more. It also features heavily in conservation areas and historic high streets, as well as in thousands of unlisted buildings and structures.

Clara Willett, Senior Building Conservation Advisor at Historic England, said:

'England's diverse geology has given rise to a huge variety of building stones, which in turn has helped shape our historic landscape – from cottages to grand castles, industrial mills to bridges.

Before modern transport, buildings were constructed with locally available building stones, which commonly reflect the area's geology. This has helped create the character and distinctiveness of our towns, villages and rural landscapes.

The need for a database was identified following research which revealed that - despite the importance of stone to England's historic environment - there was no comprehensive catalogue to help match stones used in a building to their source.

Historic buildings are generally best repaired with the same type of stone used in their construction. Understanding the properties and performance of the original stone helps to determine the replacement. Like-for-like repair avoids further damage caused by incompatibility, as well as being important for a visual match.'



<https://historicengland.org.uk/building-stones-england>

St Paul's Cathedral, London. Building Stones: Portland Stone including Jordans Basebed variety and some Weldon Stone



Roman wall at Hardknott, Cumbria. Building stones: Various igneous building stones



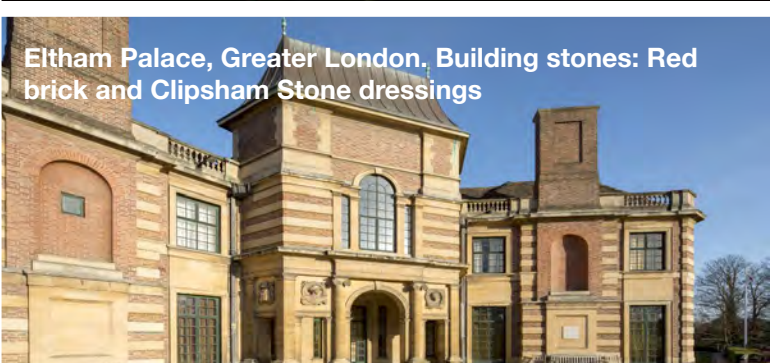
Llanyblodwel Bridge, Shropshire. Building stone: Cefn-Y-Fedw Sandstone



Portland and Bath Stone dressings on the Royal Brighton Pavilion, East Sussex



Hardwick Hall, Derbyshire. Building Stone: Grenoside Sandstone



Eltham Palace, Greater London. Building stones: Red brick and Clipsham Stone dressings



Trinity Methodist Chapel, Newlyn, Cornwall. Building stones: Coursed killas with granite dressings, painted rubble, dry Delabole Slate hipped roof



High Street St. Martin's, Stamford Conservation Area, Lincolnshire Building stone: Lincolnshire Limestone

All photos © Historic England Archive

The Fen Edge Trail



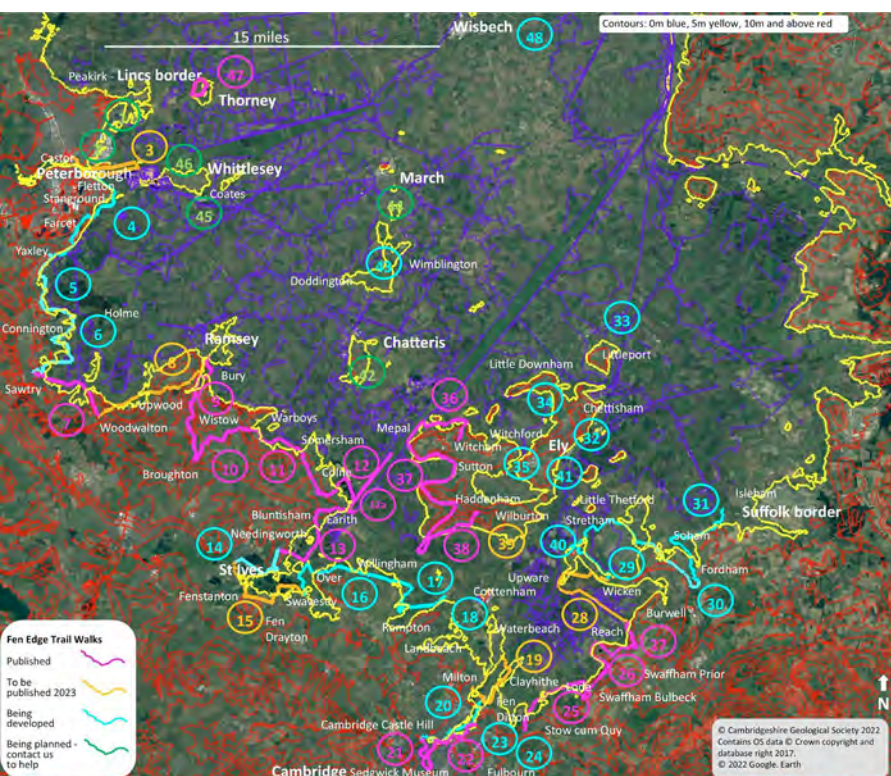
Chris Donnelly, Cambridgeshire Geological Society Fen Edge Trail team

Described as a ‘journey across a landscape and time’, this Trail is a series of walks, each with its own (6 page) guide that includes maps and descriptions of local geology and landscape as well as the usual practical advice. In addition, the guides, which are published on our website as free downloads contain historical, ecological and land use information related to the local landscape. People undertaking the walks not only see the landscape in a different light but also learn more about local history and culture and their links to geology – from building stones and water supply to why settlements and local industries are where they are. The value of the Fen Edge Trail to Cambridgeshire Geological Society (CGS) is that it brings an understanding of local geology (which most people know little about) to the attention of anyone taking one of the walks, who may be attracted by more familiar topics such as history or wildlife. This also helps to introduce the idea of geoconservation and encourages people to learn more.

In Cambridgeshire, the effect of geology on the landscape can be easily seen in the Chalk hills in the south but there was a mistaken impression that there was ‘no geology’ further north in the Fens! CGS therefore set out to show how geology still influences the landscape in an area dramatically

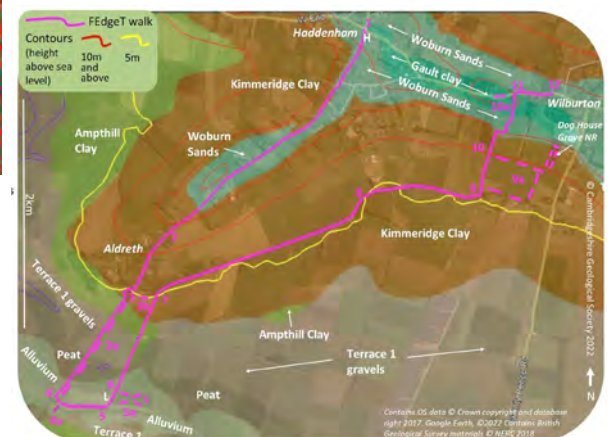
changed by man over the last few hundred years: the Fen Edge Trail was born. It takes people on a journey around a mostly unappreciated landscape and reveals the links to recent cultural and natural history as well as the geological stories from ‘deep time’.

In an area often regarded as very ‘flat’, each slight change in altitude (if you can call it that) provides clues to the local landscape heritage and its associated development, not least in the locations of the cathedral cities of Ely and Peterborough and the fen edge



Above: Latest map of walks © Cambridgeshire Geological Society, contains OS data © Crown copyright and database right 2017. © 2022 Google Earth

Right: Geology map of walk on the Isle of Ely. Contains OS data © Crown copyright and database right 2017, © Google Earth, © 2022 contains British Geological Survey materials © NERC 2018





**Left: Boat on Burwell Lode. ©
Cambridgeshire Geological Society**

**Below: Lime Kilns at Isleham ©
Cambridgeshire Geological Society**



crossing point that became the world famous city of Cambridge. Just as significant, however, is the history of what were once relatively remote settlements in places such as Ramsey, Wisbech, Chatteris, Thorney, Whittlesey and March, all with a fundamental relationship to their geology. The Trail roughly follows the 5 metre contour around the edge of the Cambridgeshire Fens and the larger 'islands', exploring what was, not long ago, the edge of an extensive, wild and complex wetland in a huge, shallow basin surrounded by chalk, clay, sandstone and limestone hills, some with a covering of glacial deposits.

The East Anglian Fens are loved by a few people, undervalued by many and misunderstood by most. Currently a 'hot topic' in terms of climate change issues (including carbon loss, potential flooding and changes in farming practice), the Fens are also becoming better known for their biodiversity restoration projects, their rich archaeological heritage and the research into their unique Quaternary geology. When Cambridgeshire Geological Society started to get more involved in local geoconservation several years ago, this large area of low-lying land that covers much of the county was recognised as being far more interesting than generally assumed, particularly from a geological point of view. The county holds most of the southern 'peat fens', with the rest in Norfolk, Suffolk, and Lincolnshire. The northern part of Cambridgeshire also has a large area of 'silt fen'. However, the Holocene deposits of the Fens are much more complex than this simple division into (surface) peat and silt suggests. Peat has, erroneously, been regarded by many as just a 'soil' but, although there are peat soils (containing degraded peat), there is still a significant amount of 'preserved' peat buried beneath, often below layers of clay, silt and sand. As more cores through the deep fenland deposits are taken, an environmental record of the last 10,000 years or so comes to life, leading to an intriguing record of freshwater marshes, salt marshes, extensive meres, tidal channels, raised bogs and wooded 'carrs' amidst an ever changing pattern of water channels. All this lies upon and between a complex, and often confusing, collection of Pleistocene deposits including river gravels of the Nene, Great Ouse and Cam, and the enigmatic 'March gravels'. Features such as periglacial basins, ice-pushed ridges, spring lines and 'fossil' river beds (roddons) add to the story.

The isn't just about the Quaternary, however. Starting in the north west of the county on the Lincolnshire border and finishing in the south east at the Suffolk border, the first couple of walks cross Jurassic limestones whilst the last few take you over the Cretaceous Chalk and between the two are plenty of fossil-rich Jurassic clays, the Woburn Sands 'greensand' and the classic Corallian reef limestone of Upware. All are reflected in the building stones along the Trail and there are even

a few Local Geological Sites en route - such as ‘clunch’ pits, coprolite pits, limekilns, brick kilns, chalk springs and a very famous ‘sedge fen’. The Trail also passes some superb wildlife areas including Fen Drayton Lakes and Ouse Fen (both RSPB), Wicken Fen (National Trust), the Great Fen (the Wildlife Trust Bedfordshire, Cambridgeshire & Northamptonshire and Natural England) and the famous Ouse Washes. People that feature in local history on the Trail include Oliver Cromwell, Charles Darwin, King Cnut, John Clare, Cornelius Vermuyden, Capability Brown, Boudica, Hereward the Wake ... the list is endless.

So far, a team of about 30 people have helped collect information for the walks with several taking on the job of putting the information together for at least one of the Walk Guides. Volunteers have included members of partner organisations such as an archaeology group, a heritage group, a community group, a wildlife group, a village society, a walking group and local museums whilst others have been historians or just fenland enthusiasts. Our latest collaboration has been with a creative arts community group. Several members of CGS have also researched some of the walks as well as providing the geological information for all the walks. By working with volunteers who have different interests, CGS has been able to share its geological knowledge and enable ‘non-geologists’ to explore their local earth history:

‘I really enjoyed developing new routes in the company of an amateur geologist. He opened my eyes to what had been going on in the Fen Basin and its hinterland.’ Mike, local archaeology group member.

‘I can’t tell you when I first started walking some of the walks on the Trail but all I know is that a journey of learning and adventure has followed, each footstep echoing a piece of history and a deeper understanding of the environment that surrounds me.’ Paul M, ‘fenland coddiwompler’ (wanderer).

‘Between Yaxley and Stilton, the geology map shows that the trail crosses a finger of limestone. It’s only on foot that you really detect any difference from the surrounding clay. But it was



Above: View to Ely Cathedral from the Sutton ridge.
© Cambridgeshire Geological Society



Left: The New Bedford Drain (Ouse Washes) at Earith.
© Peter Daldorph

The Fen Edge Trail
The 'island' of Thorney
2.3 miles (3.8 km)

In partnership with
Thorney Society and Thorney Museum



'In 1135 William of Malmesbury wrote that Thorney was "a little paradise... ..delightful as heaven itself". I agree!'

Dot, Thorney Society & Thorney Museum



The route: 'an iconic fen island – monks, marshes and a model village'

Thorney, the 'Isle of Thorns', was a fen island surrounded by marshes until the drainage projects of the 17th century. It has been known since the 7th century for its major **Benedictine Abbey**; the large Abbey church remains impressive, even though much of it was lost in the 16th century. The **Victorian village** is of the characteristic local brick and is famous for being a 'model village', built in the 19th century under the Duke of Bedford's ownership. The **Thorney Museum** is housed in the **Bedford Hall** and has plenty of information on the local history. This walk is a good introduction to the geology of the northern part of the Cambridgeshire Fens, including silt from extensive **tidal marshes** and **ancient river beds** (roddons), the **River Terrace Gravels of the Nene** and the complex **'March' Gravels**. The latter created the island itself, raising it above the low fenland; these gravels also form the islands of Whittlesey, March and Chatteris. Not far from the City of Peterborough, this easy walk takes you through an **historic fenland village** and quiet countryside with plenty of wildlife, giving a taste of the **iconic landscape of the Fens**.



Photos: 3.1f The windmill; 9.1f Small footbridge across drain; 8.2f Footpath through arable fields; 1.1f St Mary and St Botolph Church; 13.1f Bedford Hall holding the Museum; 4.2f The Thornev River; 9.2f Cattle in the Cricket Field; 2.2f Village sign.

Left: Front page of a Walk Guide. © Cambridgeshire Geological Society

Below: Windmill at Wicken Fen. © Cambridgeshire Geological Society



enough to set me exploring the jagged scar nearby where I think limestone was quarried, and to speculate on the location of the lime kilns which gave their name to Limekiln Lane, linking to the clay pits on Ermine Street in Stilton's North End where bricks were once made.' Paul S, local heritage group chair.

'The border surrounding the Fens is a treasure trove of landscape features, history and wildlife. The most welcome aspect of the Fen Edge Trail is that it brings all of these into focus when following a specially curated trail. Those who enjoy these trails will see and understand the subtle landscape changes driven by the geology underneath. Being the sliver of land between the boggy fen and the wooded upland, the human story goes back far into pre-history. Unique habitats are opened up to the walker through the seasons. Easy to see why the Fen Edge Trail is my passion.'

Reg, ex Chair CGS and CGS Geosites team.

Just after the first Walk Guide was published in April 2018, the nature writer Patrick Barkham joined us to walk some of the Trail. He enjoyed his walks as described in his write-up, published in The Guardian - 'Weirder than any other landscape: a wild walk in the Fens'. Since then, 16 more walks have been published, 6 more are due soon and the remaining 27 are underway (more volunteers welcome!). If you are over this way and have time, do explore this little known area, not just for the wide open skies but for some surprisingly pleasant views and a unique landscape heritage.



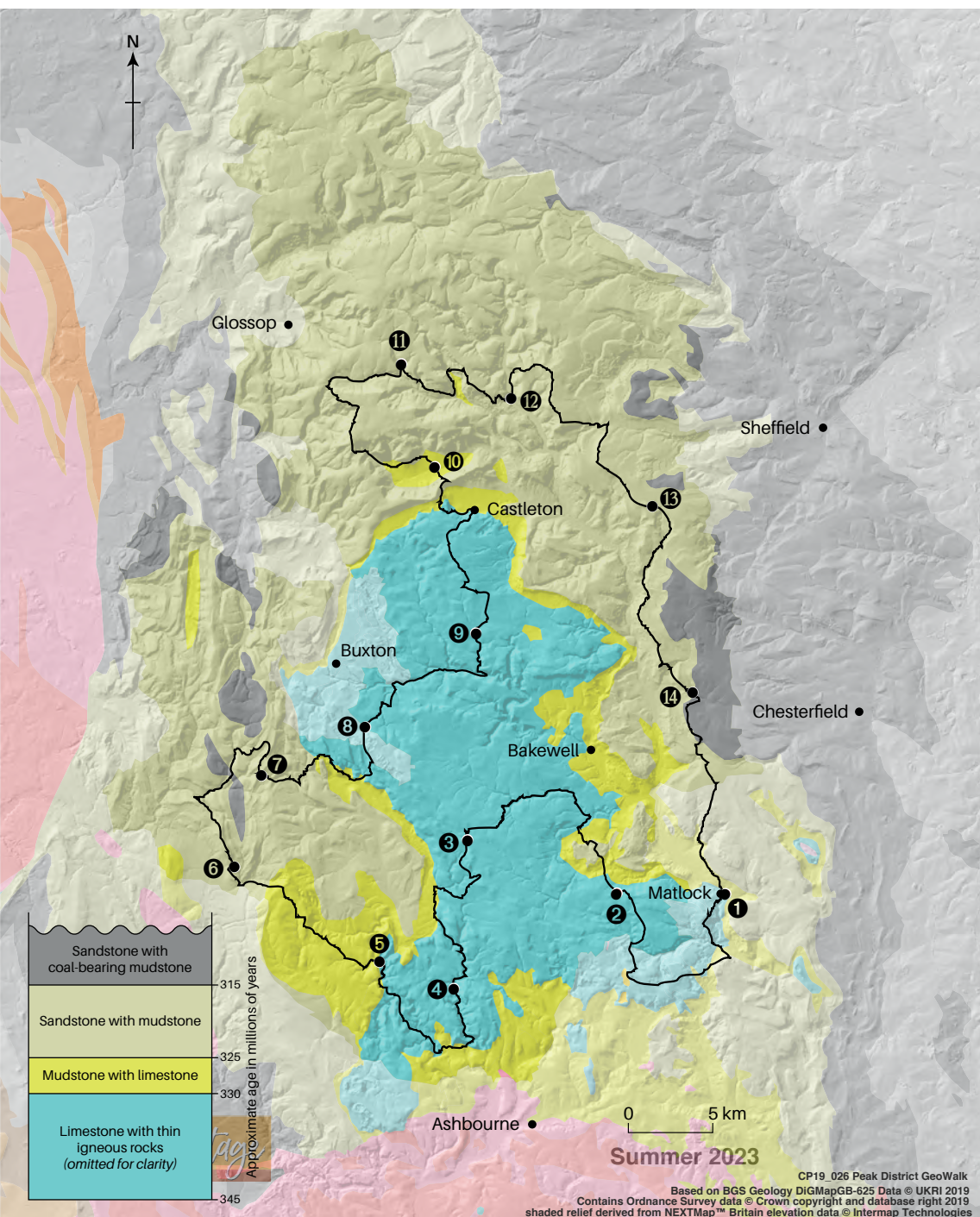
<http://www.fenedgetrail.org/overview> @FenEdgeTrail
www.cambsgeology.org @CambsGeology

The Peak District GeoWalk is up and running...

Albert Benghiat & Martin Whiteley, Originators of The Peak District GeoWalk



A new long-distance geowalk has been launched recently, this one exploring the various rocks and landforms of the Peak District. The Peak District GeoWalk, unlike similar offerings such as The Geopark Way and The Coast-to-Coast Walk: Rocks & Scenery, is supported by a free, web-based guide describing the 215-kilometre circular walk that is mainly within the boundary of the Peak District National Park. It is also the first guide that superimposes the route on BGS geological maps and thus allows the walker to know more about the ground that they are covering.



The Peak District GeoWalk follows existing roads, public/ permissive footpaths and open access land through both the White Peak (mainly Carboniferous limestone terrain) and the Dark Peak (overlying sandstones). Some may see the entire circuit as a challenge to be undertaken as a continuous multi-day walk, whilst others will prefer to access shorter sections and enjoy a stroll for a few hours.

Route on a simplified geology and hill-shaded relief map, with Walk Section numbers
Based on BGS Geology DiGMapGB-625 Data
© UKRI 2019 Contains Ordnance Survey data
© Crown copyright and database right 2019 shaded relief derived

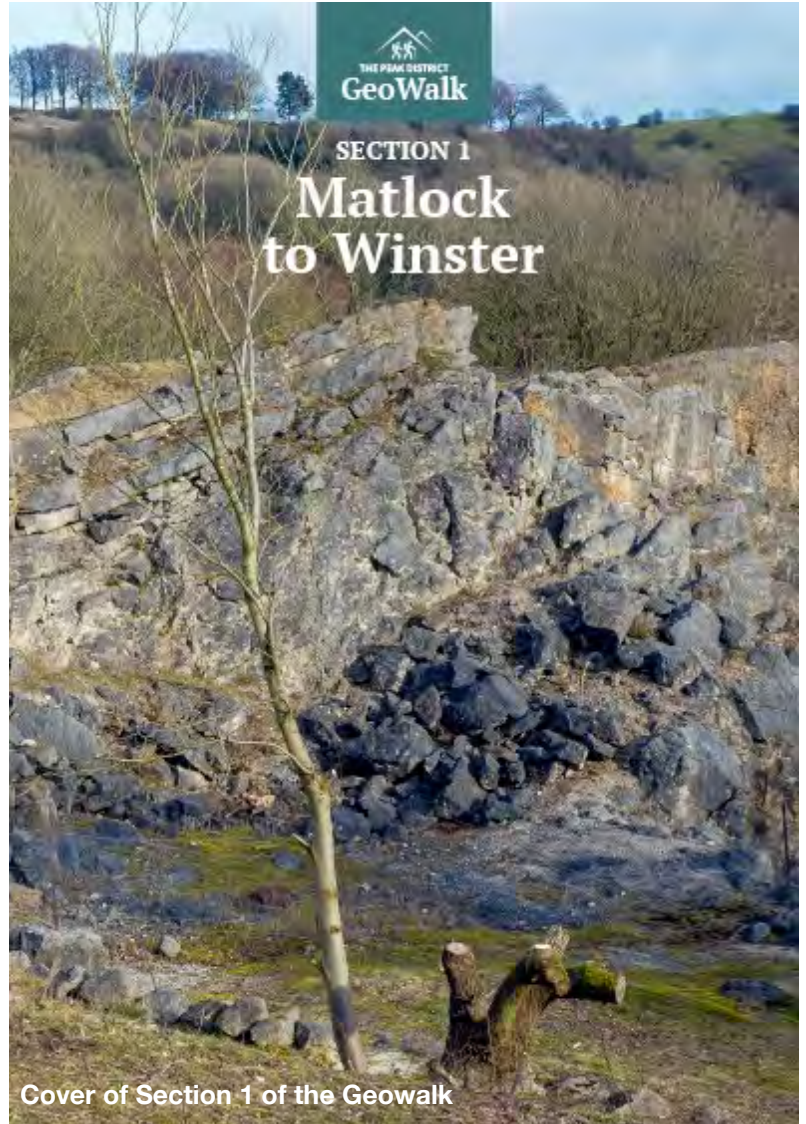
All photos by Martin Whiteley and Albert Benghiat unless otherwise stated

For convenience the walk is divided into 14 sections that are numbered sequentially in a clockwise direction from a starting point in Matlock. Each Walk Section is approximately 15 km in length and they can be accessed easily (and often by public transport) at many convenient locations.

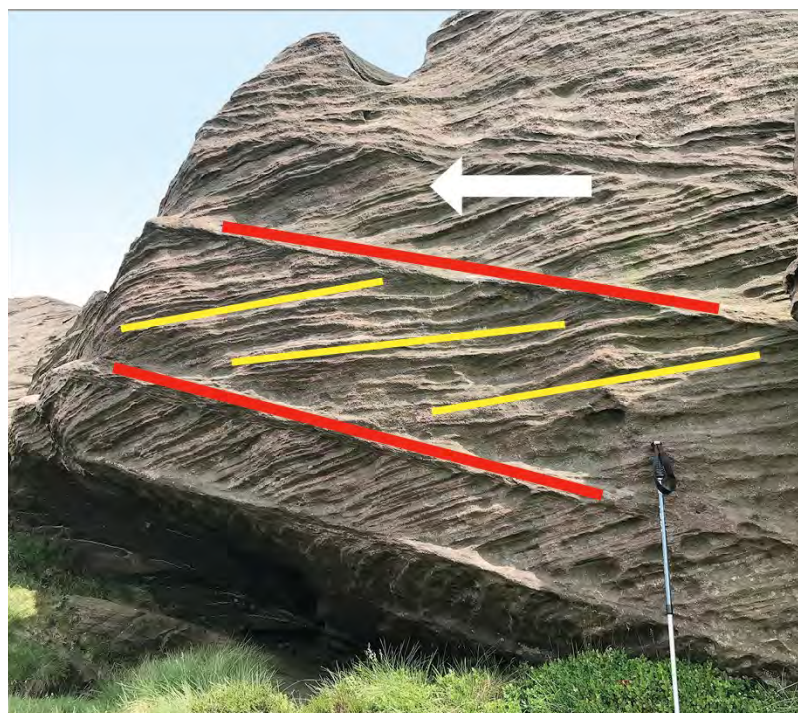
The website (www.peakdistrictgeowalk.org) provides practical advice about the walk and a gentle introduction to the geology of the area, recognising that the target audiences are walkers who may simply want to know something about the local scenery. More detailed information is available in the 14 Walk Sections; each one includes a route map and, for those who prefer, there are also written instructions for navigating. This narrative is combined with photographs and some insight into the various rock exposures, wonderful views and spectacular landforms that are seen during the course of the walk.

Each Walk Section is a pdf file, approximately 4-5 Mb in size and comprising 8 to 11 pages of content – convenient for reading as a printout or on a smartphone en route. These and the accompanying GPX route files are available as free downloads.

One of the advantages of committing the guide to a website, rather than a book, is that it can be easily expanded or revised. Another is that it is potentially more user-friendly, because nobody will begrudge trashing a few printed pages on a rain-sodden walk when the alternative might have meant reducing an expensive book to pulp. And for those who prefer accessing their information digitally, everything can be accessed from your smartphone.



Cover of Section 1 of the Geowalk



One of the photographs from the guide that helps explain the cross-bedding seen in a gritstone tor.
Photo © Martin Whitely and Albert Benghiat

Thorpe Cloud from Dovedale.
Photo by J. Harrauld



Further reading:

The Peak District GeoWalk (2023). Devised and written by Albert Benghiat & Martin Whiteley. Free-to-access website and digital file downloads via www.peakdistrictgeowalk.org

The Geopark Way (2nd edition 2018). Devised, written and published by Herefordshire & Worcestershire Earth Heritage Trust. ISBN: 978-0-9558390-7-8

The Coast-to-Coast Walk: Rocks & Scenery (2017). Written by Barry Butler & John Gunner, published by 2QT Ltd. ISBN: 978-1-9120145-2-1

High Tor and Riber Castle from Masson Hill. Photo by M. Whiteley





Peak District Geowalk Review

Tom Moat, formerly Natural England

Having lived in the Peak District for 23 years, I'm familiar with the wealth of geodiversity on offer hereabouts. But to my mind, the Peak's geo-treasures haven't had the exposure to a wider public as they deserve. So, I was excited to hear about the new Peak District Geo-walk. Right off the bat, I will say this web-based walking guide is mightily impressive, portraying local geology in a way that will appeal to expert and layman alike.

Starting and finishing in Derbyshire's County Town, Matlock, this grand tour comprises a 14-stretch circular route encompassing the area's main stratigraphical, mineralogical, and geomorphological features. I would be hard-pressed to improve on the choice, perhaps except for a slight detour to take the final stages of the route a little east into the Coal Measures. On the way though, the route magically manages to tick off nearly all the area's star sites and simultaneously demonstrate how geology underpins the distinctive landscapes, culture, and nature of Britain's first National Park.

Throughout, walking directions are practical and easy to follow, replete with map references, elevation, walk lengths, potential risks and pleasingly, where the weary rock-hound may find refreshments! Descriptions of the geology and landscape are equally accessible and well-supported by photos, geological maps and cross-sections. Background sections on the geological history and processes are also a useful addition to get more from the walks. I was particularly impressed that the key academic references included each have a precis of their contents, de-mystifying as well as adding depth.

The online format clearly lends itself to regular updates and additions, so with that in mind, I found myself hoping future sections might be added covering for example stratigraphy, geomorphology, or an in-depth look at the gritstones to match the excellent section on Dinantian limestones. Future updates might also add a glossary linked to the terms highlighted in the text, although that would be the icing on an already impressively made cake! This is a well-designed route that will no doubt contribute to the broader recognition of the geological delights of Britain's Peak District.

Curating the Rocks and Relief of local, post-industrial, landscapes: an example from Sheffield

W. Brian Whalley, Sheffield University & **Duncan Hawley**, Sheffield-based independent researcher and education advisor

Earth heritage is about geological and landscape conservation. The geology is evident in the geomorphological landscape and, as Tooth, Griffiths and Roberts show in *EH 58*, geomorphology is the ground over which people walk. Heritage is also about sharing artefacts with the public that are often found in museums but also as monuments, sculptures, literature and the arts. Sharing all these attributes should relate to a wide variety of audiences with diverse interests, from specialists to casual visitors. In this article we outline a curation of several Earth heritage localities of the Wadsley area, northwest of Sheffield, by linking the Carboniferous geology to the geomorphology and the economics of the 19th, 20th and 21st Centuries.

Names and Places

We tend to use names, of places, people or companies, as pegs on which to hang knowledge, or versions of knowledge. The time-related linkages between these pegs produces heritage. Our curation of some Earth heritage sites in the Wadsley area of north Sheffield, presented here, starts to explore places and people with its post-industrial scenery.

In this article we start to explore some geomorphological features that can only be explained in terms of capitalism courtesy of local entrepreneurs, as well as exploitation of solid geology.

There is a need to engage more effectively with a range of non-specialist audiences, including schoolchildren and citizen scientists following Tooth, Griffiths and Roberts (*EH 58*) and to support the interest of local societies in their environment. We would advocate the inclusion of Sheffield Museums at Weston Park (geology) and Kelham Island (industry and technology), as well as the Botanic Gardens, in a discussion about visualisation and interpretation of the Earth and its heritage in South Yorkshire.

We suggest that Earth sciences could be made more accessible to the public at large by exploring how 'heritage' means all sorts of past, present and future linkages between geology, extractive industries and landscape change, perhaps viewed as part of the 'anthropocene'. Leaving the validity of this concept to the pub or wine bar, there is no doubt that 'anthropocene' is now well established in the public awareness of environments. We have started to think how we might make the public more aware of these interrelationships by looking at our own 'patch' and where some aspects of geoheritage and folk memory are being eroded from public consciousness.

Wadsely and the Common

We are hoping to link several geosites of scientific interest based on geology or geomorphology that can serve various purposes such as research, conservation, education, tourism, and sustainable development (Suzuki and Takagi 2018) and have recently finished a reconnaissance for a small geoheritage project in our neighbourhood. We now bring together some of our thoughts about the 'geosites' we might include, what we might say about them and in how much detail. How do we present the sites and in what order might a visitor view them? How big might the party be and are there mobility problems? This is quite a list but there are some overall observations before we get too carried away in our enthusiasms, not least in recording contributions from Earth scientists of the past. In other words, rather than a visit to a geosite we want to consider a related collection of sites, the *heritage assets* and how we build in *interpretative devices* to reach a wide *audience* (Slack 2021).

Our 'patch' is Wadsley and Loxley Commons, northwest of Sheffield. We want to make the geology and scenery part of the 'local story', as does Alan Gardner make Alderley Edge part of his local patch on the Bunter Sandstones (remaining thus in our geological folk memory rather than Sherwood Sandstone Group). Wadsley lacks an equivalent of Garner's *The Weirdstone of Brisingamen: A Tale of Alderley*, although traditionally Loxley is the birthplace of Robin Hood. The geology of the Loxley-Wadsey area is Coal Measures rather than Sherwood Sandstone (formerly Bunter) but we trust you get the connection. In other words, we are story telling between sites as part of the plot. Story telling is not just to a lay audience but also to professionals, to see if the story is geologically/geomorphologically and historically consistent for creating 'storylines' of explanation. The landscape of the Sheffield area is an interplay between the observed, and walked upon, geology and landscape.

An Initial Storyboard for a walk on Wadsley and Loxley Common

The following is a storyboard for a project

1. We start in the Long Lane car park looking south west towards the high moors of the Peak District on the eastern flank of the Derbyshire dome. We note the distant skyline is remarkably consistent in altitude for much its length, except for an occasional interruption by a tor. This view helps explain the simple geology as an eastward dip – the skyline being the north-south 'run' of the rock strata, introducing the concept of strike. By way of demonstration, hand orientation can mimic the strike and dip.
2. Long Lane descends in a series of steps, beyond the location of an old gibbet, down the Loxley Valley. These can also be traced as corresponding lines on the hillside across the valley. Are these geological, structural or erosive benches?

Walking southeast along Loxley Edge, which is much smaller than the main gritstone edges of Stanage and Bamford to the west, reveals slumped and rotated blocks of the Loxley Edge Rock of the Lower Coal Measures. The dip here is to the east. What caused the rock to break up like this and scatter down this slope? Periglacial conditions causing a 'shatter and slide' process offers a possible explanation. There is compelling evidence that these blocks were quarried as building stone for the first hospital in Sheffield, The Royal Infirmary, constructed between 1794 and 1797 (SAGT 2015). This landmark building, Grade II listed, was closed in 1980 and is now used as offices.

Looking west from near the Long Lane car park, towards the 'Coach and Horses' 'gritstone' tor. All photos by W. Brian Whalley CC BY-SA 4.0 2023 unless otherwise stated



3. With the 'lowland' heath (at about 240 m asl) behind us we walk to the 'trig' point. However, the view, as elsewhere in the area, is obscured by growth of trees, mainly birches that have grown in the last 50 years. Although notionally managed by Sheffield City Council, there is need for landscape curation to regain the view; there was a trig (triangulation) point established here. The photo below shows an information board erected (2022) near the trig point. Mining and quarrying ('coal, stone, iron ore and ganister') is mentioned under 'heritage' and the 'geology' mentions that 'sandstone is a hard rock formed millions of years ago from sand at the bottom of ancient rivers'.



Slumped blocks of Loxley Edge Rock at Loxley Edge, looking northwest. The west-facing slope is now densely covered in secondary birch woods. The general easterly dip of the in-situ (solid) geology can be seen in the large bedding plane on the right of the photo. The jumble of blocks in the centre and left are displaced



Information board (one of two identical) on Wadsley and Loxley Common, erected in 2022, concentrating on the wildlife

The *Wadsley and Loxley Commoners* (WALC, founded in 1983) is a local conservation group that hosts talks, including one on the local cottage industry of pen and pocket knife manufacture in the small workshops of ‘little mester’ cutlers, attached to houses and pubs (Orwell referred to these as ‘little bosses’). A careful search reveals scattered evidence that some grindstones were made from the Loxley Edge Rock, although production was limited as the coarse texture made them much less favourable than sandstones from other locations around Sheffield (Lewis and Rees, 1926).

4. We reach another small overlook at the top of a quarry where the stone was quarried in 1847 for the Wicker Arches viaduct that carried the new railway from Manchester into Sheffield. It should be possible to see down the Don Valley to where the Wicker Arches still stand, but the view here is once more restricted by tree growth and so also is the sight that arrested William Cobbet (Leeder, 2020, p 235) ‘so that we saw the iron furnaces in all the horrible everlasting splendour of their everlasting blaze’. In our conversation, Duncan remarks on the present-day quiet compared with the forge hammers of his youth. The Don valley, with its constrained watercourse was once the site for many small forges. The industrial activities were enhanced with the coal-fired steam-powered devices. Abbey Forged Products, in nearby Beeley Wood, continues the tradition, with forging and services for the energy, defence and aerospace industries.

George Orwell and Sheffield

George Orwell described the working town in 1936 when he visited to research his book ‘The Road to Wigan Pier’. His diaries note: “It seems to me, by daylight, one of the most appalling places I have ever seen. In whichever direction you look you see the same landscape of monstrous chimneys pouring forth smoke which is sometimes black and sometimes of a rosy tint said to be due to sulphur... everywhere streets of mean little houses blackened by smoke run up at sharp angles, paved with cobbles which are purposely set unevenly to give horses etc, a grip [and] In the central slummy part of the town are the small workshops of the ‘little bosses’, i.e. smaller employers who are making chiefly cutlery.” (Orwell diaries, 3.3.36)

Since Orwell’s visit ‘The Steel City’ has been transformed and is now ranked as the UK’s greenest city, although the centre itself ranks low in the green space hierarchy. Today perhaps, visitors might stay and acquaint themselves with links between the industrial past and post-industrial present in a smoke-free environment.



5. A little further, under the hummocky heaps of quarry spoil and sub-surface, lies an abandoned ganister mine. Ganister is a seat-earth that lay beneath a coal-forming forest whose trees extracted most of the nutrients to leave a very high silica-content. It was used to make refractory bricks that lined the furnaces in steel-making. The rock was ground to a paste and moulded into bricks. Ganister was an important geological contribution to steel-making in Sheffield. During World War 1, Sheffield geologist Prof. W.G. Fearnside assessed local ganister resources to ensure that a high level of steel production could be maintained for the British war effort. Many remains of ganister adit mines and trial diggings can be found on Wadsley Common and in the surrounding district.
6. In 1873 an excavation at the then newly-built Middlewood Hospital uncovered a 'fossil forest'. It was described by Henry Clifton Sorby and the asymmetry of the *Lepidodendron* stumps prompted him to be the first to suggest a Coal Measures palaeo-wind direction. Originally protected with a cover (like Glasgow's Fossil Grove), neglect and exposure to the elements caused severe weathering of the stumps. After the hospital closed in the 1990s, a rescue excavation created a concrete cast of the stumps. To preserve the specimens, the site was then backfilled. The cast and a display board by the Sheffield Area Geology Trust was placed nearby. A similar specimen can be seen in the Sheffield Botanic Gardens in its 'Evolution garden'.
7. Finally, we visited a children's play park where a 'fish' had been constructed. As yet, we know nothing about the sculpture.



A ganister mill, used for grinding rock to paste, at Kelham Island Museum. Nearby is a Bessemer converter with aspects of steel making, used to manufacture items such as knives, cutlery and a multitude of Sheffield tools (The Hawley Collection, on display inside the museum)

Small specimen (cm scale) of *Stigmaria ficoides* rootstock, Upper Carboniferous, found locally in garden soil about 300m from Wadsley Fossil Forest



Wadsley Fossil Forest, interpretation board and cast of *Lepidodendron* stump



Implementation of the storyline

This list of geosite assets is preliminary but it shows how a storyline can be brought together to explain the scenery in space and geological as well as industrial-archaeology time, to address a variety of audiences.

Tooth, Griffiths and Price suggest that 'At many UK landscape attractions, ... information is commonly simplistic, dated, erroneous, or absent altogether. Outdoor signboards weather rapidly and are easily damaged but not always replaced'. In our 'Wadsley patch' we are pleased that the fossil forest sign and the 'Fish' remain unvandalised. However, there are still places on the common that have received scant, if any, geological input. Our task is to build in and integrates these components and weld them into a coherent storyline about the Wadsley environs over the last 150 years. Mobile technologies should help this endeavour. We would welcome discussion about using or producing apps and the material. Although this project is still in the planning stage, we shall explore a variety of ways to present the 'trail' educationally within a more general heritage remit.

Earth heritage in a wider context

Charlotte Higgins has recently written:

Amid the highly variegated landscape of museums in Britain, there is a growing awareness that museums can no longer offer a singular, lofty, purportedly neutral view. Unless, that is, they are content to be mistrusted by, or understood as irrelevant to, some of the communities around



A sculpture expressing elements of Carboniferous flora and fauna, including what appears to be a fish, lycopod tree trunks and a giant arthropod (*Arthropleura*), in Wadsley Park children's playground. No information is provided alongside the sculpture but nevertheless it makes good point in the storyline

them. Equally, since there is no such thing as a “neutral” curatorial position, there is a growing realisation that museums should be more honest about their own intellectual processes, and more generous about sharing their power (that of amassing, keeping, selecting and displaying objects) with those outside their walls.

Our storyline is a start in linking traditional geological geosites to the human-modified geomorphology of the area. Together with records from social and political history and heritage preserved in museums of various kinds, we believe that an accessible Earth heritage trail can be developed. Local storyboards tend to concentrate on the living natural history rather than the underlying earth, although there will be, as we have found in Wadsley, interests in local industrial and social history. Earth heritage should bring all these aspects together for locals and visitors alike. Advances in mobile technologies allow, using assisted imagery and audio tracks, the development of an expanding resource base. We aim to involve communities largely unaware of their local Earth heritage by producing an outdoor museum.

Further reading:

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- Tooth, S., Griffiths, H. and Roberts, D. (2023).** Where is the geomorphology in diversity? *Earth Heritage*, 58, 28-32



Earth Heritage in print

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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.

Three Cliffs Bay, Gower Peninsula by John Durham.

John Durham paints geological landscapes which focus on revealing the underlying structures of some of his favourite places. His understanding of geodiversity as a fundamental part of nature, underpinning the structures of these landscapes and the natural processes that shape them, is the inspiration for his art. Find out more on p5.

