

GEOSCIENTIST

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The Fellowship Magazine of the Geological Society of London

🐦 @geoscientistmag

[ANNOUNCING THE 'YEAR
OF SPACE' FOR 2021!]

MOUNTAIN EXHUMATION UNDER THE MIDNIGHT SUN

Anna Bidgood reports on the challenges
of field work in north-east Greenland

ARMoured DINOSAURS

Susannah Maidment describes
the first north-African stegosaur

ATTENBOROUGH

Sir David on the importance
of Williams Smith's work

2°C WORLD

Geoscience has an essential role
to play, reports Mike Stephenson



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Lyell Meeting 2019

Carbon: geochemical and palaeobiological perspectives

28 June 2019

The Geological Society, Burlington House



The fundamental building block of life as we know it, carbon, is critical to the Earth system. Traditionally biological and chemical approaches to understanding carbon dynamics in the geological past have been considered in relative isolation.

For the 2019 Lyell Meeting we will bring together a broad spectrum of scientists that address the big picture of carbon

in the Earth system, drawing on expertise in palaeontology, geochemistry, palaeobotany, atmospheric processes, deep-Earth processes, and anthropogenic impacts.

This meeting seeks to foster conversation between these disparate communities to facilitate a more holistic approach to considering carbon, and how it cycles between Earth's organic and inorganic reservoirs.

Call for Abstracts

We invite oral and poster abstract submissions for the meeting, and these should be sent in a Word document to katherina.steinmetz@geolsoc.org.uk by 30 April 2019. Abstracts should be approximately 250 words and include a title and acknowledgement of authors and their affiliations.

Convenors:

Barry Lomax (Nottingham University)
WT Fraser (Oxford Brookes University)

Further information:

For further information about the conference please contact:

Katherina Steinmetz, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J 0BG
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E: katherina.steinmetz@geolsoc.org.uk

Web: www.geolsoc.org.uk/lyell19



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sea ice off the north-east coast of Greenland
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ONLINE SPECIAL

A MODEL SOCIETY

Douglas Palmer highlights
the 200th anniversary of the
Cambridge Philosophical
Society, a society founded by
a trio of geologists and modelled
on the Geological Society
of London







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The Petroleum Group is the Geological Society's Specialist Group dedicated to petroleum exploration and production. Our primary aim is to advance the study and understanding of petroleum geoscience through the organisation of cutting-edge conferences, workshops and publications, and where possible bring together industry and academia. We also seek to collaborate with other groups and organisations where mutual interests overlap.

Since the Group started in 1983, we have convened over 280 meetings, produced 59 Geological Society Special Publications and 25 Petroleum Geoscience thematic sets – quite an archive of reference material, all of which is available through the Lyell Collection. Past meeting abstract books and resources, information on our busy 2019 programme and much more can be viewed at www.geolsoc.org.uk/petroleum.

The Petroleum Group Committee currently has 22 members drawn from industry and academia, including our PhD student representative. Companies such as Shell, BP, Halliburton, Badley-Ashton and Sound Energy; and the Universities of Liverpool, Heriot Watt & Leeds are represented. We seek to maintain a broad committee, drawing on a range of experiences to ensure we cater for the needs of our community. New committee members are welcomed each year, with a call for applications before September.

We strive to remain relevant to changing times within our industry by ensuring our meeting topics are at the forefront of geoscience innovation and technology. We also aim to ensure that early career geoscientists are represented on the committee and that we will continue to provide cutting edge geoscience through the energy transition.


You don't have to be a member of the committee to contribute. We welcome your ideas and proposals for future conferences, or your participation as a convenor. Meeting attendance counts towards your CPD; important if you are considering Chartership. To find out more about becoming a member of the Petroleum Group or the committee, please contact Sarah Woodcock at: sarah.woodcock@geolsoc.org.uk

Follow us on:   






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www.geolsoc.org.uk/petroleum



THE MICROPALAEONTOLOGICAL SOCIETY AGM BIOSTRATIGRAPHY: A 21ST CENTURY SCIENCE

13-14 NOVEMBER, 2019 | BRITISH GEOLOGICAL SURVEY, KEYWORTH, UK





On day one, join us for a showcase of the applications of data science, machine learning and automation to biostratigraphy. Data science is changing our everyday lives and will drive increased efficiency and insight in many aspects of geoscience, including biostratigraphy. Topics for discussion will include machine assisted interpretation of microfossil data in terms of biozone/age and palaeoenvironments; data extraction and synthesis; automation of microfossil identification.


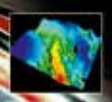
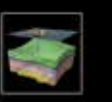
Day two will include open sessions of short (c. 15 minute) talks and dedicated poster sessions. These sessions are open to any topic related to micropalaeontology.


CONVENERS: **Jim Riding** - BGS | **Mike Simmons** - Halliburton

For more information, to register, or submit an abstract please visit
<https://www.tmsoc.org/tmsoc2019/>

REGISTRATION CLOSING 23RD OCTOBER; ABSTRACT SUBMISSION DEADLINE 13TH SEPTEMBER











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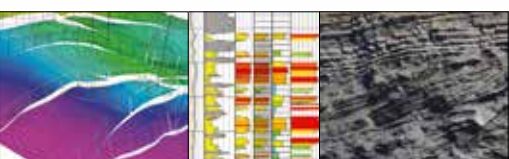
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Capturing Geoscience in Geomodels

26-27 June 2019
Robert Gordon University, Aberdeen




Over recent years the construction of 3D static and dynamic reservoir models has become increasingly complex. With the availability of extensive tools and technology it is important not to forget the objective of the modelling process.

As we develop our hydrocarbon fields it is essential that 3D Static Models be built with fit-for-purpose geological models, honouring the geological, geophysical and petrophysical data that they are created from.


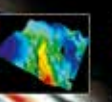
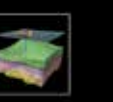
This two-day conference will explore how geoscience information should be used to best effect, and how to identify when geoscience data may no longer add value. Sessions will include the following themes:


- Data integration: seismic, well log, sedimentological, core dynamic data and beyond
- Capturing conceptual geology in reservoir modelling for different settings and depositional environments
- Scale: geology vs model vs data
- Uncertainty: dealing with geological uncertainty in modelling and understanding its benefits and limitations
- Embracing new modelling technology and approaches.

For further information please contact:
Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.
Tel: +44 (0)20 7434 9944 Web: <https://www.geolsoc.org.uk/PG-Geomodels>






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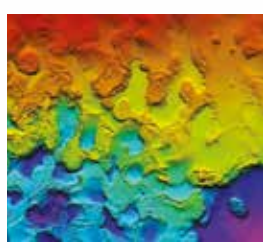
Clare Bond
University of Aberdeen

Christina Von Nicolai
BP

Call for Abstracts – Deadline: 28 June 2019

Salt Tectonics: Understanding Rocks that Flow

29-31 October 2019
The Geological Society, Burlington House, Piccadilly, London



The complex behavioural and rheological characteristics of salt can strongly influence the structural and stratigraphic evolution of a basin. With many of the largest hydrocarbon provinces existing within salt-related basins understanding of the processes involved in salt tectonics has important scientific and economic implications for geological research and hydrocarbon exploration.



Modern high-resolution 3D seismic data with improved imaging of salt structures in combination with more advanced physical and numerical modelling techniques revolutionises the way we see salt tectonics and the role of salt structures.

This three-day international conference aims to bring together leading academic and industry geoscientists to discuss new techniques and case studies, and to capture an up to date assessment of our understanding of salt tectonic processes including:

- Geographical case studies; e.g. North Sea, Gulf of Mexico, Persian Gulf, Campos Basin
- Salt tectonics in extensional and contractional settings
- Halokinetic sequence stratigraphy
- Analytical methods of interpreting salt in seismic data
- Physical and numerical modelling of salt tectonics
- Implications of salt tectonics for hydrocarbon exploration.

Call for Abstracts:
Please submit talk or poster abstract to sarah.woodcock@geolsoc.org.uk by 28 June 2019.

For further information please contact:
Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.
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“GEOLOGY IS AN OPAQUE SUBJECT TO MANY. WE MUST PERSIST IN CLARIFYING ITS SIGNIFICANCE TO SOCIETY”

FROM THE EDITOR'S DESK:

Geology the Obscure

People are fascinated by geology. But few *really* know what geology is. At least, that's been my general impression from chatting with friends and non-geologist colleagues over the years. People are enthralled by volcanoes and earthquakes—understandably so—but I'm not sure many grasp exactly what the study and practise of geology involves, beyond identifying rock types.

At times I've even found that many scientists trained in the broader Earth and atmospheric science disciplines have only a little awareness of the close links between geology, climate science, sustainability, energy, ecology and the like.

In conversations with non-Earth scientists, I've noticed that few fully appreciate the geologist's part in creating the climate crisis or the essential role we have in attempting to fix it. As Mike Stephenson writes on page 24, when it comes to decarbonisation “geoscience has a lot to offer, but we as a community need to better organise and influence—to make sure the voice of geoscience is heard”. Many also seem unaware of the importance of geology for sourcing the raw materials needed to supply our infrastructure and technologies, or the geologist's role in waste management, land contamination or water security.

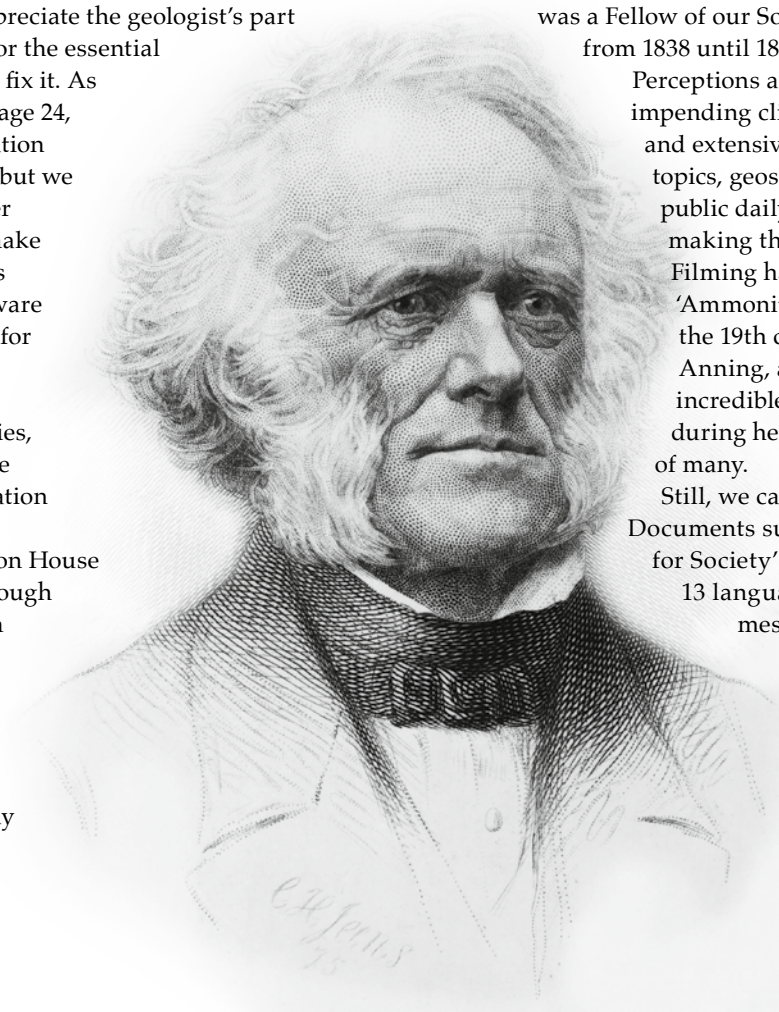
In a recent visit to Burlington House (page 27), Sir David Attenborough noted that the average person on the street has likely never heard of William Smith, ‘Father of English Geology’. Yet, Smith's fossil collection, which sits in a somewhat understated display in London's Natural History

Museum, represents the very foundation stones of stratigraphy—a science that has helped revolutionise our understanding of this planet's workings.

It was recently announced that notebooks belonging to Sir Charles Lyell have been consigned for sale. This heftily priced (over £1.4 million) collection could be sold to an overseas buyer. Thankfully, Arts Minister, Michael Ellis, has put a hold on the sale of the notebooks in a bid to keep this important archive in the UK. But, I wonder how many in the general public are familiar with Lyell? He was a huge inspiration and mentor to Sir Charles Darwin, and the notebooks apparently contain transcribed correspondence between the two, yet I've found that few people realise Darwin was a geologist (and, indeed, was a Fellow of our Society, serving as Secretary from 1838 until 1841).

Perceptions are shifting. In light of the impending climate and biodiversity crises, and extensive media coverage of these topics, geoscience is communicated to the public daily. Historical figures are even making their way onto the silver screen. Filming has begun on the movie ‘Ammonite’, which stars Kate Winslet as the 19th century fossil hunter, Mary Anning, and will bring the tale of an incredible palaeontologist, undervalued during her own life, into the homes of many.

Still, we can't rely on the media alone. Documents such as the Society's ‘Geology for Society’ paper (now translated into 13 languages) help disseminate the message to a broader population, but also as individuals we must not miss opportunities to extol the benefits and importance of our science to society at large.



Sir Charles Lyell (1797-1875)

SOCIETY NEWS

Research grants 2019

The Research Grants Committee met on 8 March and considered 28 applications from Fellows and non-Fellows spanning early career and established researchers. Council approved the award of 21 Society grants totalling £29,550 and the Robert Scott Memorial Award of £2,000 to one applicant. The Society is very grateful for the contributions made by the Jeremy Willson Charitable Trust and the Robert Scott Memorial Award.

(A full list of winners is posted online. *Editor*.)

New e-journal



The Library can now provide Fellows with offsite online access to the journal *Soil and Sediment Contamination*, from vol.6 (1997) onwards, which includes volumes published as *the Journal of Soil Contamination*. This international peer-reviewed publication focuses on soil and sediment contamination from a number of different sources, including offsite and in situ remediation techniques, strategies for assessing health effects and hazards, and tips for dealing with everyday regulatory and legal issues.

Ask the Library for an OpenAthens login, if you don't have one and visit the Virtual Library webpages or the Library catalogue to discover the Library's collections of e-journals and e-books.

Society Discussion Group 2019

Meetings of the Geological Society Discussion Group are 18.30 for 19.00, when dinner is served. Attendance is open to all members of the Society. For up to date information concerning topics for discussion and speakers, please go to W: www.geolsoc.org.uk/Groups-and-Networks/Specialist-Groups/Geological-Society-Discussion-Group.

- 11 June - The Athenaeum, Pall Mall
- 18 September - The King's Head, Mayfair
- 23 October - Bumpkins Restaurant, South Kensington

Please contact David Riach for more information and to make a reservation.

E: david.riach@geolsoc.org.uk

Discover the EurGeol App

The European Federation of Geologists has launched the new EurGeol App, an electronic tool that offers European Geologist title holders many useful services and provides a public directory of all title holders. You can discover more about the app through this video: <https://youtu.be/b7pAGPKNaDQ>



PUBLIC LECTURE SERIES

Did the Earth move for you? From slow slip to Great Earthquakes

Speaker: Rebecca Bell, Imperial College London

Location: Burlington House, London

Date: 12 June

Programme

- ◆ **Afternoon talk:** 14:30 Tea & Coffee; 15:00 Lecture begins; 16:00 Event ends
- ◆ **Evening talk:** 17:30 Tea & Coffee; 18:00 Lecture begins; 19:00 Reception

Further Information

Please visit www.geolsoc.org.uk/gsslondonlectures19. Tickets are now available on Eventbrite.co.uk and will work on a first come first serve basis. The lectures will be available to watch livestreamed at both the 3pm and 6pm lecture. To watch, please check the lecture webpage for the link.

Contact: The Geological Society, Burlington House, Piccadilly, London W1J 0BG T: +44 (0) 20 7434 9944
E: conference@geolsoc.org.uk

Office closures

The Society (London and Bath) will be closed all day on Thursday 18 July for staff training.

Enterprise Membership

In recognition of the importance of engaging with start-up and smaller companies working in the Earth science industry, the Geological Society have announced a new **Enterprise** category, as an extension of its existing Corporate Membership Programme. For a contribution of £500+VAT, companies with up to 10 employees and an annual turnover of under £2 million can join the Geological Society as Enterprise members.

Please contact the Development Team:

T: + 44 (0) 20 7434 9944

E: development@geolsoc.org.uk

**What your society is doing
at home and abroad**



Beyond Earth...

We are delighted to announce that 2021 will be the Geological Society's themed 'Year of Space', write Flo Bullough & Megan O'Donnell.

The thematic year programme, as set by the Society's Science Committee, aims to raise the profile of geoscience, promote public engagement, and provide exciting, informative and inspiring themes around which to frame our education, outreach, conferences, publications, meetings and other activities throughout the year.

The Year of Space will see the Society direct its gaze upwards, beyond the earth beneath our feet, towards the lesser explored corners of our universe. Space science seeks to answer some of life's biggest questions—why are we here, how did life evolve, and are we alone? To answer these questions, space and planetary scientists search for clues in the rocks, dust, gas and other matter that help them understand the formation and development of planets, moons, stars and perhaps other life in our universe. Space also offers scientists a novel platform from which to study Earth; using remote sensing and satellite technology to obtain high-resolution spatial and temporal data detailing our planet's state and rate of change.

Space science relies on the observation and measurement of many characteristics largely un-observable with the naked eye, the ability to deal with long timescales, and to visualise interconnected systems at vast scales—a trio of skills honed by geoscientists in the study of internal planetary processes, rock systems beneath our feet and the landscapes we see all around us. Exploring space offers us the ability to expand our horizons; conduct fieldwork, take samples, measure and observe at the very limit of our capabilities.

From the rocky matter of meteorites, comets and asteroids, to the search for extra-terrestrial life, and the study of the planetary systems that could support it—the geosciences underpin much of present-day space science. Two ongoing NASA research expeditions to Mars have geological aims at the core of their missions. The NASA Curiosity rover analyses rock, dust and soil samples to determine the structure and chemistry of Martian rocks in the quest to find evidence that suggests the planet could have supported life, and the NASA InSight lander uses geophysical techniques such as seismology, measurements of heat flow and precision GPS tracking to better understand and monitor the planet's internal structure and physical characteristics. Excitingly, InSight is thought to have heard its first Marsquake on 6th April 2019,

which suggests there may be more to the tectonic activity of other planets than we currently understand!

Geoscientists are also interested in the metal and mineral resources in asteroids, the search for Earth-like exoplanets (habitable bodies beyond our Solar System), the study of non-rocky planets like Jupiter and Saturn, and ultimately traces of early life on our planet and others. With so much still unknown, every day of space exploration provides never before seen data for scientists to digest and analyse. The joint Japan Aerospace Exploration Agency (JAXA) and European Space Agency (ESA) Bepi-Columbo mission to Mercury, launched in 2018 and expected to land in late 2025, will collect data about the planet's magnetosphere, giving us insights into the composition of the planet's core.

2021 will see two more field missions to Mars from NASA and ESA, scheduled to land on the planet in February and March of that year, boasting drilling capabilities to take deeper geological samples than have ever been achieved before. The China Mars program is also planning a test mission for 2021 that will lay the groundwork for the first martian samples to be brought back to Earth. Alongside a year of exploration firsts, we look forward to highlighting and celebrating the contributions of the geosciences to our exploration and understanding of the science beyond Earth.

Get Involved!

We are looking to run activities during the **Year of Space** to celebrate and explore the relationship between space and geoscience, and we want to hear **your** ideas and proposals for:

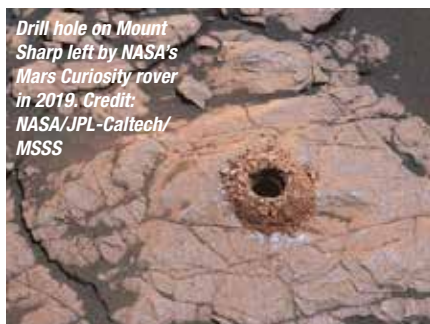
- Meetings and conferences
- Education and outreach activities
- Public engagement initiatives

We are aiming to run a diverse programme of events that will showcase the variety of links between geoscience and space, which could include exhibitions, presentations, scientific conferences, resources for teachers and science communicators, artistic collaborations, and more! You can also continue to submit ideas and proposals for the 2020 Year of Life.

Email outreach@geolsoc.org.uk to discuss your ideas with us.

See our website for past examples and details of how to propose an event. Or email conference@geolsoc.org.uk.

Drill hole on Mount Sharp left by NASA's Mars Curiosity rover in 2019. Credit: NASA/JPL-Caltech/MSSS

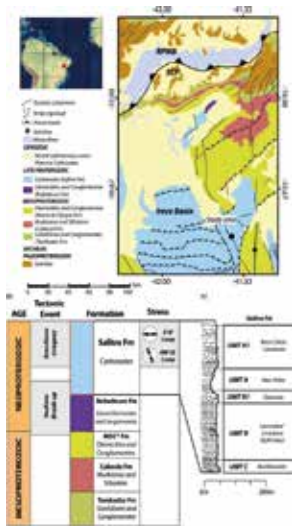


Latest news from the Publishing House

Linking natural fractures to karst cave development: a case study combining drone imagery, a natural cave network and numerical modelling

By Quinten Boersma, Rahul Prabhakaran, Francisco Hilario Bezerra and Giovanni Bertotti

In carbonate rocks, channelized fluid flow through fracture conduits can result in the development of large and connected karst networks. These cavity systems have been found in multiple hydrocarbon and geothermal reservoirs, and are often associated with high-permeability zones, but also pose significant challenges in drilling and reservoir management. Here, we expand on the observed interplay between fractures, fluid flow and large cave systems, using outcrop analysis, drone imagery and fluid-flow modelling.



► Read the full abstract and paper in the Lyell Collection

<https://pg.lyellcollection.org/content/early/2019/04/09/petgeo2018-151>

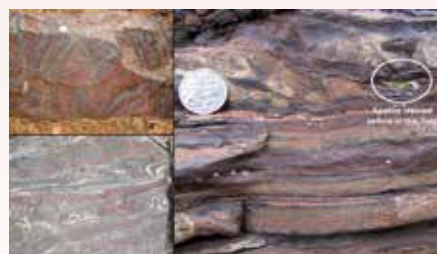
Fossil biomass preserved as graphitic carbon in a late Paleoproterozoic banded iron formation metamorphosed at more than 550°C

By Dominic Papineau, Bradley T. De Gregorio, James Sagar, Richard Thorogate, Jianhua Wang, Larry Nittler, David A. Kilcoyne, Hubertus Marbach, Martin Drost and Geoff Thornton

Metamorphism is thought to destroy microfossils, partly through devolatilization and graphitization of biogenic organic matter. However, the extent to which there is a loss of molecular, elemental and isotope signatures from biomass during high-temperature metamorphism is not clearly established. We report on graphitic structures inside and coating apatite grains from the c. 1850 Ma Michigamme silicate banded iron formation from Michigan, metamorphosed above 550°C. Traces of N, S, O, H, Ca and Fe are preserved in this graphitic carbon and X-ray spectra show traces of aliphatic groups. Graphitic carbon has an expanded lattice around 3.6 Å, forms microscopic concentrically-layered and radiating polygonal flakes and has homogeneous $\delta^{13}\text{C}$ values around -22‰, identical to bulk analyses ...

continue reading in the Lyell Collection

► <https://jgs.lyellcollection.org/content/early/2019/03/12/jgs2018-097>



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Geoscience Jobs is the official jobs platform for the Geological Society. Whether you are searching for a new role, or in a managerial position keen to advertise a new vacancy, you will be able to access and use jobs.geolsoc.org.uk knowing it is tailored to a broad spectrum of specialist earth science professions. Managed for the Geological Society of London by Century One, Geoscience Jobs is an essential resource for any earth science professional looking for the next step in their career.



The broader picture

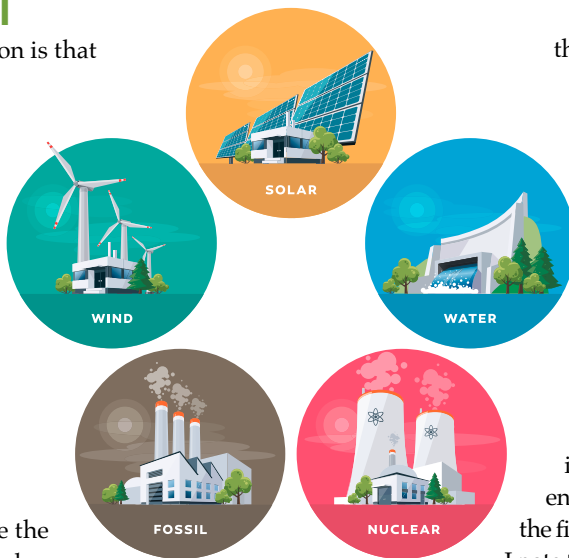
The Society should support geologists in every sector, argues **Larry Thomas**

The article by Mike Simmons (Speaking up for geoscience. *Geoscientist* 28(11), 9, 2018) highlighted the relationship between academic and commercial viewpoints in relation to energy requirements. The petroleum industry has a high profile and still has an active group within the Society. The coal industry has not. The Coal Geology Group alas is no more, in part due to the reduction, and in some cases the abandonment of coal exploration and mining in western Europe, so that the Society has no voice in this sector of industry.

Embedded coal

The general perception is that the use of fossil fuels is one of pollution and a contributor to environmental damage. Whilst this is historically true in many areas, the undeniable fact is that coal currently provides 39% of global electricity generation. Many countries do not have the finance and/or technology, and in some cases the inclination, to reduce or halt the use of coal. Many lack the knowhow and, more significantly, the funding to undertake renewable energy projects.

The role of the geologist is a double-edged sword. On the one hand their identification and determination of the geological character of coal deposits is appreciated by Governments and shareholders of mining companies, but they can be vilified by protest groups and environmentalists for simply doing their job.



Notable strides

It is important to realise that in the last 30 years, vast improvements have been made in coal mining and coal cleaning technologies. Additionally, conditions are placed on the geologist, for example, to consider whether coal seams with a sulphur content >1% should be mined or left in the ground. Geological reporting now is accompanied by hydrogeological analysis and geotechnical appraisal of any prospect, and all asset determinations are made according to international standards. Such improvements have been accompanied by the design and construction of modern power plants that control SO_x, NO_x and particulate emissions.

The industry and their geologists must communicate with others, whilst respecting confidentiality agreements, both within the geological sphere and the public at large, to explain the balance between fossil fuel extraction and the impact on the environment, as well as the financial ramifications.

I note that 2019 is the 'Year of Carbon'. It is essential that the Society responds to the needs and viewpoints of academia and industry, producing an even-handed approach to presentations and discussions on the use of fossil fuels. There will be geologists in all the industries producing fossil fuels—let the Society recognise them and their contribution to global energy needs.

The Society is our voice in geosciences not only in the UK, but worldwide, so let's hear it for all sectors of the profession.

Dr Larry Thomas, C.Geol, C.Eng, FIMMM, FGS; Director, Dargo Associates Ltd.; e-mail: lpdargo@gmail.com

SOAPBOX CALLING!

Soapbox is open to contributions from all Fellows. You can always write a letter to the Editor, of course, but perhaps you feel you need more space?

If you can write it entertainingly in **500 words**, the Editor would like to hear from you. Email your piece, and a self-portrait, to amy.whitchurch@geolsoc.org.uk. Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

Pictures should be of print quality – please take photographs on the largest setting on your camera, with a plain background.

Precedence will always be given to more topical contributions. Any one contributor may not appear more often than once per volume (once every 12 months).

“THE INDUSTRY AND THEIR GEOLOGISTS MUST COMMUNICATE... THE BALANCE BETWEEN FOSSIL FUEL EXTRACTION AND THE IMPACT ON THE ENVIRONMENT, AS WELL AS THE FINANCIAL RAMIFICATIONS”

DR LARRY THOMAS

PROBING CONTINENTAL SUBDUCTION IN EAST GREENLAND



Icebergs drifting under the midnight sun, night-time polar bear watches and wading through frozen rivers are all part of the Greenland field experience, reports **Anna Bidgood**

Surrounding the settlement of Ittoqqortoormiit, at the mouth of Scoresby Sund in North-East Greenland, is the Liverpool Land Terrain—a geological terrain that records evidence of subduction to ultra-high pressures (depths of over 100km). Such ancient ‘ultra-high-pressure terrains’ are typically found exhumed within mountain belts and provide a direct record of a poorly understood process: the subduction of continental crust.

Located in a steeply mountainous area within the Arctic Circle, Liverpool Land terrain is inaccessible even by the standards of ultra-high-pressure terrains and is therefore particularly understudied. The combination of excellent geology combined with a mountaineering challenge was part of the motivation for

organising an Oxford University expedition to the region during the summer of 2018. We wanted to reconstruct the metamorphic and structural history of this geological unit and collect samples for petrological work, to archive with the geological survey of Denmark. Ultimately, we want to understand how buoyant continental crust, which typically resists subduction, can be forced to depths of over 100km beneath Earth’s surface.

A Glacial Landscape

The settlement of Ittoqqortoormiit is home to approximately 450 people and was originally a hunting settlement. The only permanent settlement in the region, it was founded in 1925 by the Danish explorer and administrator, Ejnar Mikkelsen, who saw an opportunity to re-colonise a rich hunting area (where the population had



*Scoresby Sund
settlement*

died out in the 1900's) and, in the process, decrease the hunting pressure farther south on Greenland's east coast. The fjord system known as Scoresby Sund (named after the English whaler and ice-navigator, William Scoresby) is one of the largest and longest fjord systems in the world, with the longest fjord extending at least 350km inland. Indeed, recent research suggests that this fjord system may extend under the enveloping ice, right across Greenland to the west coast, thus effectively dividing this enormous Arctic island into two!

Our team consisted of two geologists from the University of Oxford (myself and Jamie Lucas), an arctic botanist and mountaineer (Nigel Bidgood), a geographer (Peter Shuttleworth) and mountaineer (Nils Devynck). Many of our team have visited Greenland before for mountaineering expeditions and

geological fieldwork and are familiar with the kinds of challenges involved with working in large-scale glacial landscapes. Nevertheless, estimating the distances that can realistically be covered each day when trekking always proves difficult. As per any expedition, we modified and changed our plan on arrival into Greenland to account for weather, terrain and polar bears.

The journey

The boat journey from Constable Point across Hurry Inlet was relatively short and relied on my navigation skills using a 1:250,000 scale map with 100m contours, whilst trying not to get seasick or lose any maps to the wind. Luckily only one map was lost, and we were set down on the western side of the field area with a plan to backpack east onto the 'plateau', where

we would be in an ideal position to move around the proposed research area.

On landing, we looked at the terrain sloping steeply to the east up to a high point of 700m with dismay. The steep, unstable glacial landscape was deeply incised by rivers that formed great canyons and ravines filled with hard-compacted snow and thick ice. Long, frozen lakes feed the rivers and miles of boulder fields provided no place to camp. We soon realised that tackling this terrain with 35kg backpacks was out of the question and instead embarked on a four-day detour, to approach our field area from the south and east.

Back-up plan

Our back-up plan turned out to be an amazing backpacking route. We were blessed with incredible views of the ►

mountains and could take in the sheer vastness of Scoresby Sund. We followed the remarkable coastline complete with an abandoned Greenlandic hunting settlement (somewhat sadly named Kap Hope) and a hunters' musk ox graveyard. As well as introducing us to the varied boulder geology and some interesting outcrops, the route took us along sandy beaches littered with icebergs and flanked by cliffs of snow.

Incised rivers outpoured to the fjord all the way along the coast, sometimes forming a small boulder-dammed lake at their mouth, allowing for an easy crossing. At other times, the 15m cliffs down to the river forced us to wade into the sea and cross the river mouth in the sea—an exhilarating experience. At the mouth of the glacial Jaetteelv River in the Jættadal Valley, we turned inland and painfully crossed a muddy (Triassic) bog where the difference between the solid and sinking ground, to this day, leaves me baffled.

At 70 degrees north on the east coast of Greenland, polar bears are a serious consideration. This is not a denning area, but it is a popular hunting ground for polar bears and humans alike, due to the huge fjord systems and abundant marine life. Each team member was woken twice a night to do two one-hour bear watches. This experience was made more pleasant by the midnight sun,

which glowed from its hiding place behind the mountains. We opted for two one-hour watches, rather than a single two-hour one, due to the night hours being very cold indeed—I wore five layers including a down jacket and an extra, large down jacket of one of the other team members over the top of everything I owned! During the first night, many mist-enshrouded icebergs were blown into the fjord which, combined with the midnight sun, made the watch a truly magical experience.

Complex geology

After our four-day detour, we arrived at the frozen Tværelv River, which runs down from the southernmost of the Tvaerdal lakes and marks the entrance to our field area. The terrain dramatically changed to either an unstable boulder field with a flora dominated by small, intensely-coloured arctic flowers and birch “trees” that peeped out from between boulders or small flush meadows at the base of steep sided, snow-covered mountains and periglacial landscapes. Access to the plateau every day meant crossing the boulders and rivers, which made for slow progress. Our ascent of Kronen (a 1140-m-high peak) took us up a steeply

inclined boulder field onto a wide, gently sloping summit ridge covered in periglacial stone polygons. Over the next few days, we saw migmatites (of mafic and metasedimentary origin), eclogites (high pressure mafic rocks), gneisses (granitic origin) and peridotites (mostly dunites with purple chromium garnets).

Eastwards from our basecamp the terrain and geology changed as we headed into metasedimentary migmatites containing strongly metamorphosed marbles, amphibolites, and quartzites. To access these rocks, we had to cross a braided glacial river system, spanning about 1.5 km with over 10 to 20 channels depending on the time of day. The ice-cold water and strong current made crossing the channels more difficult than you would expect from a river of its size and proved rather painful when the blood rushed back to your feet!

A building point

The samples I collected cover a huge range of rock types, mirroring the similarly huge range of pressures and temperatures this terrain must have experienced in the past. The samples could provide some interesting information petrologically when studied under the microscope. The



The team above the braided glacial river plain running into the fjord below (credit: Peter Shuttleworth)



Crossing the river in the fjord

relationships between these rocks in the field provides crucial context for this type of study. Unfortunately, the limited time and difficult terrain meant that we were unable to study the contact between these rock types in detail and we were also unable to access the northern end of the field area at all.

However, the preliminary results from this field season provide us with a good building point for future trips. We now know that backpacking in and out of the region is possible. Although, the extra equipment required for polar bear protection and the weight of the rock samples makes this a challenge—one that pragmatically may lead to the use of helicopter transfers into and out of the study area next time!

Anna Bidgood is a PhD student at Oxford University and was a 2018 recipient of the Geological Society of London's Mike Coward Fund; e-mail: anna.bidgood@univ.ox.ac.uk

ACKNOWLEDGEMENT

This expedition was made possible due to the generous support from the Mike Coward Fund of the Geological Society of London, the Gino Watkins Memorial trust, The Oxford University Exploration Club and the Irvine Fund, for which we are hugely thankful.



Photo of the field area looking north from the plane. The deep incised valley is the Tvaerdal Valley and the snow-covered glacier on the right the Jaettadal



The journey along the coast



Polar bear watch and icebergs in the midnight sun (credit: Peter Shuttleworth)

NORTH AFRICA'S FIRST STEGOSAURIAN DINOSAUR



*Sophie, the world's most complete Stegosaurus,
on display at the Natural History Museum*



Susannah Maidment describes how the first stegosaur discovered in north Africa pushes back the timing of diversification of the armoured dinosaurs

S ometime in the summer of 2016, then working at the University of Brighton, I opened my inbox to an email from a colleague who is a sauropod dinosaur expert and works in the US. He had been sent some photos of dinosaur bones from the Middle Atlas Mountains of Morocco that were being sold by a commercial fossil dealer. The bones were described as sauropod dinosaur, but my colleague had his doubts, and he was right. As soon as I opened the photos, it was clear that they were from a stegosaur.

Stegosaurs are one of the most iconic dinosaurs. With two rows of bony plates extending along the back, and two pairs of fearsome spikes at the end of the tail, *Stegosaurus* is well-known to seven-year olds everywhere. Despite their popular appeal, however, stegosaurs are very rare as fossils. It was only with the Natural History Museum of London's acquisition, in 2013, of the world's most complete *Stegosaurus* (known as Sophie) that we learned really basic aspects of their anatomy, like how many vertebrae there were in the spinal column and how many plates there were along the back.

New species

Stegosaur fossils are known from North America, Europe, China and southern Africa, but none were previously known from north Africa. Consequently, I was extremely excited to see these bones from Morocco, and immediately suspected that they probably represented an entirely new genus and species of stegosaur—one that nobody had ever seen before.

Later that day, Professor Paul Barrett, dinosaur researcher at the Natural History Museum (NHM), contacted me with the same images. He had been sent them too, was equally as excited, and was determined to purchase the specimens for the museum. He was successful and the bones arrived at the NHM in Autumn

2016. As Paul and I began to study them, it became clear that we were right. Although the specimen comprised just a few vertebrae, an upper arm bone and a spike, we could clearly see features unknown in any other stegosaur: we had a new genus and species on our hands.

Fossil excavation for the commercial market in Morocco is quite common and is often carried out by farmers who have no formal scientific training. As a result, important contextual information about how and where the specimen was found is usually lacking. The only information we had about our new stegosaur was that it was from the Jurassic of Boulemane—a town in the Middle Atlas Mountains.

We looked into the literature to try to narrow down the discovery location, and therefore age, of the animal. Jurassic rocks in the area around Boulemane are predominantly marine, but the Bathonian strata are terrestrial, and dinosaur fossils have been reported in them since the 1940s. If the specimen was Bathonian, this made it even more special: it would represent not only the first stegosaur from north Africa, but the oldest definitive stegosaur from anywhere in the world. The only way to be sure where the specimen came from, however, was to go to Morocco and try to track down the original discovery location.

Moroccan excursion

In September 2018, funded by the Geological Society's Garwood Fund, I travelled to Morocco to attempt to do just that. I was accompanied on the trip by David and Allison Ward, Scientific Associates at the NHM who have been collecting fossils in Morocco for over 20 years and have a network of useful contacts whom we could draw upon to help us out. Most important of these contacts is Moha Segauui, a fossil dealer who also runs guided geological tours, and has been guiding fieldtrips for UK palaeobiologists and geologists for many ►

► years. Moha acted as our guide and translator for the trip, and also proved a very reliable source of wisdom and advice.

Our first aim was to meet with Professor Driss Ouarhache, a sedimentologist and stratigrapher at the Université Sidi Mohamed Ben Abdellah in Fes. Driss is an authority on the sediments of the Boulemane area and he guided us through the stratigraphy. The El Mers Group is divided into three formations: The El Mers 1, 2 and 3. The El Mers 1 comprises shallow marine and intertidal facies overlain by terrestrial red beds, while the El Mers 2 and 3 represent shallow marine deposits. Driss showed us a rippled sandstone bedding plane in the El Mers 1 covered in sauropod footprints.

Having explored the stratigraphy and depositional environments of the El Mers Group, we headed south to Er Rich, to meet the fossil dealers who sold the fossils to the NHM—people the Wards know well. The dealers were extremely helpful and offered to take us to the village where the specimen excavators lived. The next morning we

followed the fossil dealers north from our hotel in Midelt to a small village just outside of Boulemane, which we reached by a dirt road. The dealers introduced us to a farmer, who offered us tea and then accompanied us to another farm some distance from the village where the farmer who had excavated the fossils lived. The land next to the house was badlands cut into red beds, extremely similar to those of the El Mers 1 Formation that Driss had shown us on the other side of Boulemane. As the farmer guided us up and down the valleys, I noted abundant bone washing out. There were also numerous large pits from where bones had been excavated. The farmer explained that he collected most of the fragmentary material from drainages, where it washed out, and also excavated larger bones. We returned to the village to a lunch of turmeric goat and very sweet tea.

The following day I returned to the badlands and was able to study the stratigraphy and depositional environments in more detail, again receiving excellent hospitality in the form

of grilled chicken and tea for lunch. The sediments exposed are all terrestrial, and appear to have been deposited by rivers and on floodplains, consistent with our interpretation that these represent the El Mers 1 Formation. The lower part of the section comprises green silts interbedded with thin calcareous sandstones, which I interpret as overbank deposits, while the upper part consists of red mudstones with rootlets and thicker channel sandstones, which represent floodplain palaeosols and river channels. Dinosaur fossils are found in a distinct unit at the top of the green silts. This unit is mottled orange, and contains abundant charcoal and jarosite (a sulfate mineral), and the matrix of the NHM stegosaur specimens matches this unit. The El Mers 1 Formation has been reliably dated to the Bathonian based on biostratigraphy, and we collected some sediment samples in an attempt to confirm that.

Oldest on record

The trip was a huge success. I was able



From left to right: David Ward, Moha Segauji, Allison Ward and Driss Ouarhache

to relocate the discovery site of north Africa's first stegosaur and confirm that it is also the oldest definitive stegosaur in the fossil record. We have now analysed its evolutionary relationships, and we find that the species is more closely related to European stegosaurs than to the two stegosaur genera currently known from southern Africa. The age of the species also pushes back the radiation of the armoured dinosaurs into the Early Jurassic, hinting at a huge diversity of these animals that we have yet to sample.

Furthermore, we have now finalised a Memorandum of Understanding between the Natural History Museum and Université Sidi Mohamed Ben Abdellah, so that Driss and I can work together in the future to excavate dinosaurs from the site, working with the farmers. We hope that in the long term we will be able to house the specimens that we find in Morocco and prevent the commercial

sale of further material, preserving the scientific heritage of the area and inspiring future generations of Moroccan children and adults alike.

Susannah Maidment is a Researcher in the Department of Earth Sciences at the Natural History Museum, London and was a 2018 recipient of the Geological Society of London's Edmund Johnson Garwood Fund



The El Mers 1 Formation at the discovery site



A sauropod hind foot (pes) print on a rippled sandstone bedding plane in the El Mers 1 Formation



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New Publications

William Smith's Fossils Reunited

By: Peter Wigley (Editor) with Jill Darrell, Diana Clements and Hugh Torrens



With a Foreword by Sir David Attenborough, William Smith's Fossils Reunited is intended both for the William Smith enthusiast and also for those with a more general interest in the work of this remarkable pioneering geologist. The fossil illustrations and maps in this exquisite volume are aesthetically pleasing in their own right and demonstrate the extraordinary skill of early nineteenth-century engravers and map makers.

View more at: www.geolsoc.org.uk/WSFR

Glaciated Margins: The Sedimentary and Geophysical Archive



Edited by: D. P. Le Heron, K. A. Hogan, E. R. Phillips, M. Huuse, M. E. Busfield and A. G. C. Graham

Understanding the sedimentary and geophysical archive of glaciated margins is a complex task that requires integration and analysis of disparate sedimentological and geophysical data. Their analysis is vital for understanding the dynamics of past ice sheets and how they interact with their neighbouring marine basins, on timescales that cannot be captured by observations of the cryosphere today

View more at: www.geolsoc.org.uk/SP475

Metamorphic Geology: Microscale to Mountain Belts



Edited by: S. Ferrero, P. Lanari, P. Goncalves and E. G. Grosch

In Earth evolution, mountain belts are the loci of crustal growth, reworking and recycling. These crustal-scale processes are unravelled through microscale investigations of textures and mineral assemblages of metamorphic rocks. Multiple episodes of metamorphism, re-equilibration and deformation, however, generally produce a complex and tightly interwoven pattern of microstructures and assemblages.

View more at: www.geolsoc.org.uk/SP478

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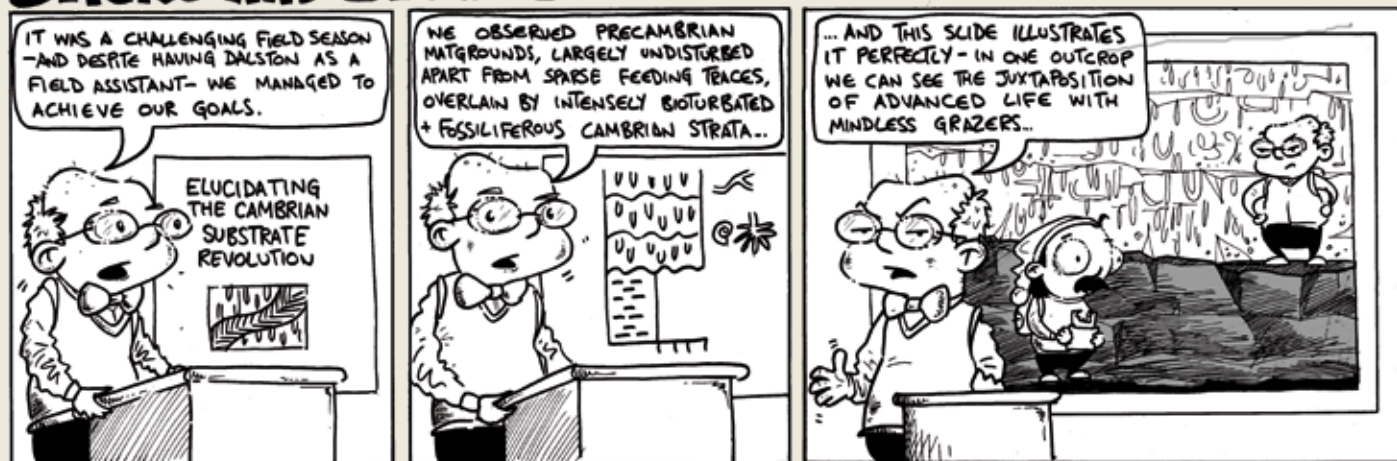
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Image credit: Staple Tor © Wayne Brittle

ENDORSED TRAINING/CPD AND EVENTS

MEETING	DATE	VENUE AND DETAILS
The Engineering Geology of Contaminated Land	4 Jun	Conference Venue: Burlington House, London W: https://www.geolsoc.org.uk/CLG-EG-Eng-Geol-of-Con-Land
Geo-conservation	11 Jun	Lecture Venue: The Birmingham & Midlands Institute W: https://www.geolsoc.org.uk/WMRG-Geo-conservation
South West: Deep Basement Excavation	13 Jun	Lecture Venue: Ley Arms, Kenn, Devon W: https://www.geolsoc.org.uk/SWRG-Deep-Basement-Excavation
CPD Course for Teachers of A-level Geology	13-14 Jun	CPD course Venue: University of Liverpool W: https://www.geolsoc.org.uk/Uni-of-Liverpool-CPD-Course-Alevel-Geology-Teachers
Lakeland Rocks: Tropical seas, raging deserts and ice ages	16-19 Jun	CPD course, field trip Venue: Higham Hall College, Cumbria W: https://www.geolsoc.org.uk/Higham-Hall-Lakeland-Rocks_Jun19
Petroleum Group 30th Annual Dinner	20 Jun	Social event Venue: Natural History Museum, London W: https://www.geolsoc.org.uk/PG-Annual-Dinner-2019
Capturing Geoscience in Geomodels	26-27 Jun	Conference Venue: Robert Gordon University, Aberdeen W: https://www.geolsoc.org.uk/PG-Geomodels
The Blue Carbon Meeting	28 Jun	Conference Venue: Royal Society of Edinburgh W: https://www.geolsoc.org.uk/MSG-Blue-Carbon-Meeting-2019
The Lyell Meeting 2019	28 Jun	Conference Venue: Burlington House, London W: https://www.geolsoc.org.uk/GSL-Lyell-Meeting-2019

STICKS AND STONES



A STALKING HORSE IN THE ELECTION?

Dear Editor, The Elections to Council notification (*Geoscientist*, March 2019) reminds us that under Regulation R/G/11 Council may reduce the number of President-designate candidates for the eventual vote to two. I find this alarming as it allows Council to debar any properly-proposed Fellow from the election without informing Fellows of his/her name or sponsors. In effect it says "we do not trust the Fellows to make an informed choice".

Even in the case of only two valid nominations, all that Council has to do is propose one further candidate (a stalking horse?) and

can then debar the unfortunate third nominee whom they deem unacceptable. This is almost carte-blanche for Council to select their own nomination.

This approach is at best anachronistic and at worst potentially corrupting; those Fellows sufficiently interested to read the supporting statements from two candidates must surely be capable of reading a third and of putting a tick in one of three boxes rather than two.

DAVID JAMES (FGS)

A STALKING HORSE IN THE ELECTION? - REPLY

In response to David James' letter of 2nd March, I have a degree of sympathy with his view. The regulation he cites (R/G/11) states that Council 'shall consider all nominations of the President-designate and *will* vote to reduce the list to two candidates of equal standing.' (my own italics). Accordingly in this case, Council had no option but to act as they did and as they have done so at other times in the past.

Council could, under different circumstances, act as David suggests and nominate their own stalking horse to undermine and indeed corrupt the whole process. However, we are not a political party and as I repeatedly remind Council, they are the conscience of the Society and are charged as trustees to act ethically in its best interests. That said, that regulation does leave the door open for mischief and, as with other aspects of our by-laws and regulations is probably overdue for a comprehensive review.

I shall raise the matter at the next meeting of Council.

NICK ROGERS, PRESIDENT OF THE GEOLOGICAL SOCIETY OF LONDON (FGS)



Volcanism and climate

Dear Editor, Further investigations into the Anthropocene period are needed in geoscience. Our planet has never before been populated by 7.5 billion people, yet the regional and global contributions to a warming and cooling climate by natural processes—such as volcanism—compared to anthropogenic greenhouse gases are poorly constrained.

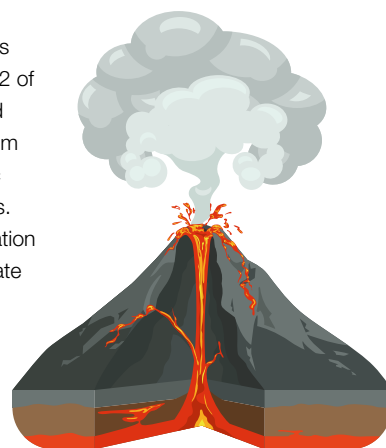
Variations in Earth's orbit and solar radiation are first-order drivers of climate, influencing interglacial and glacial cycles, monsoons and seasonal changes. However, volcanism also influences climate and can contribute significantly to natural variations, having both a warming and cooling effect.

NASA satellites first became available for tracking volcanic eruption clouds in the early 1980s. This led, for example, to recognition that the El Chichón stratospheric cloud from the April 1982 eruption circled the globe in 21 days. Submarine volcanism is more difficult to track. In the early 2000s, the ARGO global array of almost 4,000 ocean profiling

floats to a depth of 2,000 m was established, primarily to observe ocean temperature, salinity and currents. However, this array has also provided a much-improved means of identifying possible submarine volcanic eruptions, such as the October 2011 to March 2012 El Hierro eruption in the Canary Archipelago.

In 2019, the Past Global Changes (PAGES) project is launching stage 2 of its Volcanic Impacts on Climate and Society (VICS) program, with one aim of providing information on volcanic forcing for climate modelling studies. The project will provide vital information on the role of volcanism in the climate system.

WYSS YIM (FGS)



Microbial mats—always ‘waiting in the wings’?

Dear Editor, The Bell Island succession (Caroline Mascord, *Geoscientist* **29** (2), 12-17, March 2019) records the later throes of the Cambrian Substrate Revolution (CSR), during which the dominant Proterozoic benthic life-forms—microbial mats—were superseded by burrowers, grazers and filter-feeders. In part this was due to mat predation and disruption by these newly-evolved metazoans; but the wrinkled bedding surfaces, characteristic of the mats, occasionally reappear in the stratigraphic record, implying that the microbial biomes have since ‘waited in the wings’ in order to exploit conditions inimical to benthic macro-faunas. The aftermath of the Permian global mass extinction, finds microbial mats widely developed in early Triassic shallow marine environments, typically between fair weather and storm-wave base.

A local ecological crisis, with a similar outcome, is recorded in the Ludfordian (late Silurian) of the Welsh Basin. Progressive shallowing and restriction, coupled with the increasing frequency of storm-event deposition saw the inverse of the CSR—a counter-revolution. The basin-wide Ludfordian massive siltstones, associated with pervasive bioturbation by benthic marine burrowers, were progressively replaced

by an alternation of microbially wrinkled micaceous shaly siltstones and graded or hummocky cross stratified (HCS) tempestites. The associated, impoverished, shelly macro-fauna very largely consists of washed-in (extra-basinal) death assemblages. Hence the shallow marine basin appears to have slowly evolved into a storm-influenced, ‘Proterozoic’ state.

The mat-forming microbial biomes are still with us, providing the uniformitarian explanation for the fossil wrinkles. Yet these latter seemingly faded from the post-Jurassic stratigraphic record. Has the global environment become increasingly benign, pushing the mat-forming biomes into the harsh marginal marine and continental environments that more rarely feature in the stratigraphic record, or are wrinkles simply being overlooked? Their common association with HCS suggests that post-Triassic strata with such bedforms would be a good starting point for a search.

ROBIN BAILEY (FGS)

(The full letter and accompanying references are published online. *Editor*.)

Whose geology is it anyway? – Reply

Dear Editor, Peter Styles’s article ‘Whose geology is it anyway?’ (*Geoscientist* **28** (9), 9, 2018) reminded me of a paper published more than 25 years ago, which I believe is the nearest we have to an explanation of the extraordinary nature of the ownership of English mineral rights. This paper is to be found in *Trans. Instn. Min. Metall.* (Sect A: Min. Industry) 100 May-August 1991. pp A73-A83. Honey R.M. Outline of mining law of England, Scotland and Wales.

Having worked on the nature of mineral rights abroad, I did not

encounter any country with such a Byzantine legal structure for ownership of mineral and mining rights, particularly with regard to the status quo prevailing in Cornwall, Devon, The Forest of Dean and the Hundreds of the High Peak, plus the Wapentake of Wirksworth. Perhaps this reflects the antiquity of some of the legal provisions, which must predate most if not all existing legal codes concerning mineral rights.

ROBERT C JONES (FGS)

Geology at Aber lives on

Dear Editor, Many Fellows will remember that a couple of decades ago Geology at Aberystwyth University was set to decline. Yet it lives on, vigorously, with its diaspora spread throughout academia, institutions and industry. The Society News in March’s *Geoscientist*, for example, shows that several Aber graduates and postgraduates are officers of the Geological Society: Vice President Nick Reynolds; Secretaries Kate Royce and Rob Strachan; and *Geoscientist* Editorial Board member Tony Harris. Conspicuously, not one but both presidential nominees Jonathan Craig and Mike Daly are Aber old-boys!

It’s great to see Aberystwyth’s ongoing contribution to the Geological Society and the geoscience community.

BILL FITCHES (FGS) & TIM PALMER (FGS)



William Smith's Fossils Reunited



Whilst we might wonder why it has taken so long for William Smith's historically important writings to become available again, we should just be very

grateful that this has now happened with the publication of *William Smith's Fossils Reunited*. In this the 250th anniversary of Smith's birth and the bicentenary year of Smith's *annus horribilis*—his incarceration for debt in 1819—his two most important works, *Strata Identified by Organized Fossils* and *A Stratigraphical System of Organized Fossils* etc. have been republished together and with considerable 'added value'. For the latter we have to thank the editor, Peter Wigley, his team and the publishers for a book with such high production values and reasonable price. A key element to the success of this new edition is the identification of Smith's original fossils, and the updating of their taxonomy and excellent photographic reproduction by Jill Darell and Diana Clements of the Natural History Museum. The tragedy is that it took Smith's financial difficulties, bankruptcy and sale of his fossil collection to the British Museum to ensure their long-term survival.

Whilst today we are used to high-quality and detailed images of fossils, the visual impact and verisimilitude of the 200-year-old, originally hand-coloured images is remarkable. Any geologist with some knowledge of English fossils can recognize them. Another tragedy for Smith was that relatively few copies of his works were sold and the series was never completed, consequently they did not become as widely known as they deserved to be.

As we can now appreciate, Smith was incredibly lucky to have met James Sowerby, his engraver, publisher and something of a kindred spirit. Sowerby certainly seems to have indulged some of Smith's less-practical ideas, such as printing the fossil illustrations on paper coloured to match that of their stratigraphical unit as seen on his map. As a result, the definition and appearance of fossil printed on dark paper, such as the greenish-blue Greensand is not as good as those on paler coloured papers.

To fully appreciate William Smith's *Fossils Reunited* you need to own a copy and browse the full extent and depth of its scholarship, which this short review has barely touched upon.

Reviewed by: **Douglas Palmer**

WILLIAM SMITH'S FOSSILS REUNITED

by Peter Wigley (ed) with Jill Darrell, Diana Clements & Hugh Torrens, 2019. Published by: The Dolan Charitable Trust & Halgrove Publishing (hbk.) 160 pp. ISBN: 9780857043375

List price: £34.99 W: www.halsgrove.com or <https://www.geolsoc.org.uk/WSFR>

Petroleum Geology of the Black Sea



If you are looking for a one-stop-shop to get yourself up to speed with the geology and hydrocarbon prospectivity of the enigmatic and relatively unexplored

Black Sea, then this not a bad place to start. Deep-water exploration drilling started less than 20 years ago and has averaged approximately one well per year. It has been hindered by the cost of access and of maintaining sufficient activity levels to justify an expensive mobile drilling rig. Recent potential commercial successes at the Domino gas field (2012) in Romania and Polshkov High (2016) in Bulgaria have thrown the deep-water Black Sea into the spotlight.

The knowledgeable editors are involved in no less than 5 of the 16 papers, which after an introduction are split into a smorgasbord of crustal structure and tectonics, igneous geochemistry, hydrocarbon plays, petroleum systems and source rocks, upper Miocene and Holocene stratigraphy and papers on the petroleum potential of the eastern Black Sea and deep-water exploration.

As a reader knowing almost nothing about the area, I would have benefited greatly from a plate tectonic summary paper including evidence from earthquake data, subsidence history, magnetics and crustal geophysics. Indeed, the first paper concerning the crustal structure of the Mid Black Sea High would have then made a nice compliment and later papers on the evolution of the Pontides, as well as

Cretaceous volcanic and intrusive rocks might have sat in a larger overall context. Nevertheless, there is plenty of interesting material here if you already have the knowledge, or the patience, to fit it all together.

Papers on the Istria Depression and Cretaceous sedimentation and deep-water plays in the western Black Sea, followed by several papers on source rock deposition, are highly relevant at a time when there is significant industry and governmental/regulatory activity and interest. Later papers concern subsea canyons developed during the Messinian sea-level fall, a study of Holocene sediments for source rock potential, and an interesting description of the petroleum potential of the Rioni Basin at the Georgian margin of the Black Sea.

The volume concludes with a succinct history of deep-water exploration and play types in the Black Sea. Wells are expensive, and several have failed due to inability to predict reservoir presence and quality. Not unlike the Eastern Mediterranean, after discovery of large biogenic gas accumulations (i.e. Domino), the thermogenic systems remain to be proven and play concepts are yet to be tested systematically.

Reviewed by: **David Latin**

PETROLEUM GEOLOGY OF THE BLACK SEA

by M.D. Simmons, G.C. Tari and A.I. Okay (eds) 2018. Published by The Geological Society, SP 464, 484 pp. (hbk.) ISBN: 9781786203588.

List price: £ 120.00 Fellow's price: £ 60.00 W: <https://www.geolsoc.org.uk/SP464>

The Life Scientific: Explorers



BBC Radio 4 has, for the past seven years, broadcast *The Life Scientific*, Professor Jim Al-Khalili weekly talking with a leading British scientist about their life and work.

Delving into the scientist's inspiration and motivation, they discuss how this work has affected humankind. People who know well the interviewee and their work contribute insights. Since the first (11 October, 2011) interview of Paul Nurse, winner of the Nobel Prize and President



of the Royal Society, there have been 176 episodes, all available as podcasts on the BBC's website.

In *The Life Scientific: Explorers*, the BBC has moved into print. The result is a fascinating and very readable book. Rather than transcribe past interviews verbatim, Anna Buckley (the series' producer) has taken highlights from selected interviews and interwoven them with autobiographical information provided by the scientist. Each chapter commences with a sidebar detailing where the scientist grew up, to whom they are married, and their job title. It provides less mundane stuff too, such as their inspirations (parental encouragement; a visit to Pompeii; hearing a radio advert saying "Astronaut Wanted"). Advice to aspiring scientists is presented, such as "persist" (palaeontologist Richard Fortey), "don't let men do all the talking" (astrophysicist Lucie Green) and "follow your passion" (volcanologist Hazel Rymel).

One interviewee noted that science can be a lonely endeavour. However, several of them have done much to bring their science to the layman, and so have wide contact with others. Astronomer Chris Lintott ("I take the 'Citizen' in Citizen Science very seriously") has involved the public in classifying the shapes of galaxies, while lichenologist Pat Wolseley has engaged with people nationwide in a project using lichen to monitor air pollution.

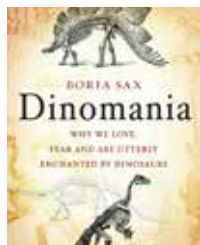
This book strikes just the right balance between insights into the interviewees' lives and talk of their work. True, I sometimes I found myself wishing to know more about the science; but in these Google-infested days, such information is readily available. At other times, I knew that no amount of reading would enlighten me greatly, the science being so alien to my experience. Such was pretty much the case, for example, with the work of mathematician Marcus du Sautoy, who explores symmetry and has mathematically modelled a shape symmetrical in 196,883 dimensions. However, I enjoyed reading about his work demonstrating the role of mathematics in Mozart's music. I would recommend this book not only to seasoned scientists, but also to aspiring young people looking for inspiration and motivation.

Reviewed by: **Brent Wilson**

THE LIFE SCIENTIFIC: EXPLORERS

by Anna Buckley (with a foreword by Jim Al-Khalili), 2018. Published by: Weidenfeld and Nicolson, 321 pp. (hbk.) ISBN: 9781474607483 List Price: £18.99
W: www.weidenfeldandnicolson.co.uk

Dinomania: Why We Love, Fear and Are Utterly Enchanted by Dinosaurs



This book is, essentially, a human social history of dinosaurs from the turn of the eighteenth century to date—that is, since Mary Anning was extracting fossils, including dinosaur bones, from Dorset. The text contains much about dinosaur-related issues, along with numerous flash-backs linking them variously with dragons and myth/legend, and with what we presume was the real world some tens of millions of years ago. The book starts with dragon bones and moves on, via Crystal Palace and Jurassic Park, and totems of modernity, to our seemingly dinocentric world.

The pictures in the book are excellent. The first is a superb dragon by Matthaus Merian (1748), others include an astonishing Neolithic petroglyph—how could people then have known what a sauropod dinosaur might have looked like?—and works by Hieronymous Bosch and Henry de la Beche. At the other end of (human) time are mid-twentieth century murals, posters for films and exhibitions, and examples of twenty-first century palaeoart by Jan Sovak, Carl Buell, for example.

Apart from the pictures, *sensu stricto*, the book contains numerous word pictures drawn from different cultural sources. All are interesting because they are so various, and some are as good as a picture (but use very much less than a thousand words). The author also discusses several relevant geological issues—the cause(s) of the end-Cretaceous mass extinction, for instance—but not in huge detail. Such discussion is sufficient, however, to show that Sax has a good understanding of many of the subject's facets.

The book's principal tenet is that "we cannot help but think of dinosaurs as, in some sense, contemporaneous". Perhaps that is partly because, as is noted, dinosaurs were discovered at about the time that widespread belief in dragons, devils and angels was ending. Perhaps the human mind needs to believe in the existence of powerful, potentially untameable, species,

and dinosaurs, which are terrifying but live entirely in another dimension, fill the gap nicely.

Having thought on the matter extensively since reading the book, I don't know whether Sax has answered the questions implied in the title. Whether he has or not, doesn't matter at all. The book is fascinating and well worth owning. The text is interesting and informative, and the pictures (all 128) add huge amounts to what is said. The book is not intended to be about dinosaurs, per se. Rather, it is about human interactions with human perceptions of dinosaurs.

Reviewed by: **Jeremy Joseph**

DINOMANIA: WHY WE LOVE, FEAR AND ARE UTTERLY ENCHANTED BY DINOSAURS

by Boria Sax, 2018. Published by: Reaktion Books, London, UK. (hbk.) 264 pp. ISBN: 978-1-78914-004-0
List Price: £20.00 W: www.reaktionbooks.co.uk

BOOKS FOR REVIEW

Please contact amy.whitchurch@geolsoc.org.uk if you would like to supply a review. You will be invited to keep the review copy. See a full up-to-date list at www.geolsoc.org.uk/reviews

- ◆ **NEW AVAILABLE! The Role of Women in the History of Geology**, by C.V. Burek & B. Higgs (eds), Geological Society SP 281 2007, 342 pp. hbk.
**Re-issued to mark the centenary of female Fellows
- ◆ **NEW! Hydromagmatic Processes and Platinum-Group Element Deposits in Layered Intrusions** by Alan Boudreau, Cambridge University Press 2019, 275 pp. hbk.
- ◆ **NEW! Aeolian Geomorphology: A New Introduction** by Ian Livingstone & Andrew Warren (eds), Wiley Blackwell 2019, 318pp. hbk.
- ◆ **NEW! Paleozoic Plays of NW Europe** by A.A. Monaghan et al. (eds), Geological Society SP 471, 398 pp. hbk.
- ◆ **NEW! Reconstructing Archaeological Sites: Understanding the Geoarchaeological Matrix** By Panagiotis (Takis) Karkanas & Paul Goldberg, Wiley Blackwell 2019, 279 pp. hbk
- ◆ **NEW! Fluvial Meanders and their Sedimentary Products in the Rock Record** by Massimiliano Ghinassi et al. (eds), Wiley Blackwell 2019, 592 pp. hbk
- ◆ **Martian Gullies and their Earth Analogues** by S.J. Conway, J.L. Carrivick, P.A. Carling, T. de Haas and T.N. Harris (Eds), GSL SP467 2019, 434 pp. hbk
- ◆ **A Practical Guide to Rock Microstructure (2nd Edition)** by Ron H. Vernon, Cambridge University Press 2018, 431 pp. hbk.
- ◆ **Development of Volcanic Gas Reservoirs: The Theory, Key Technologies and Practice of Hydrocarbon Development** by Qiquan Ran, Dong Ren & Yongjun Wang, Elsevier (Petroleum Industry Press, Gulf Professional Publishing) 2019, 1066pp. pbk.

Geoscience and the two-degree world

Michael Stephenson reports on the 2019 Bryan Lovell meeting, where geoscientists, social scientists and policy makers met to offer geological solutions to the 'well below 2°C' objective agreed at the COP21 conference in Paris

At the 2015 United Nations international climate change conference in Paris (COP21), 195 countries committed to limit global warming to well below 2°C compared to pre-industrial levels. But current plans and pace of progress are still far from sufficient to achieve it. The Bryan Lovell Meeting (<https://www.geolsoc.org.uk/GSL-Bryan-Lovell-2019>), held in London in January 2019, brought together delegates from across the world to discuss geological decarbonisation—or ways that geoscience and the subsurface can contribute to global efforts to keep global warming well below 2°C.

The specific objective of the meeting was to examine the role that geoscience and the subsurface could play in decarbonising electricity production, industry, transport and heating to meet UK and international climate change targets. These technologies vary from direct decarbonisation of electricity production, through carbon capture and storage (CCS), to direct substitution of domestic heating by geothermal, but also include more ambitious technologies, such as bioenergy and carbon capture and storage (BECCS), that aim to achieve negative emissions. The supply of geological materials that we'll need in the future to sustain the electrification of the vehicle fleet and other low-carbon technology was also discussed. The conclusion of one hundred delegates gathered in Burlington House was that geoscience has a lot to offer, but that we as a community need to better organise and influence—to make sure the voice of geoscience is heard.

Subsurface heat store

Several talks focussed on the ground as a heat store. Much progress is being made in Germany by teams led by Ingo Sass (Technische Universität Darmstadt) and Sebastian Bauer (Christian-Albrechts-University Kiel). In Germany, about 50% of total energy demand is due to heating as well as cooling, but geological heat storage in the urban subsurface could help in storing solar thermal energy and industrial surplus heat to smooth out supply and demand through the year, from summer to winter.

“GEOSCIENCE HAS A LOT TO OFFER, BUT WE AS A COMMUNITY NEED TO BETTER ORGANISE AND INFLUENCE—TO MAKE SURE THE VOICE OF GEOSCIENCE IS HEARD”

CCS

Perhaps most discussion time was dedicated to carbon capture and storage. Several speakers, including Martin Blunt (Imperial College London) and Jon Gibbins (University of Sheffield), discussed its implementation, concluding that safe, long-term storage of carbon dioxide in the subsurface is possible with careful site characterization, injection design and monitoring. They also noted that it is current commercial arrangements, not technical difficulties that are holding back large-scale implementation. Whatever the finances, it's likely that the expertise and knowledge of the oil-and-gas companies will be central to a CCS industry roll out.

Clair Gough of the Tyndall Centre (University of Manchester) talked about a variant of CCS explaining how

capture and storage (BECCS) has become central to achieving the goal of limiting global average temperature rise to 1.5 C. However, Gough concluded that bringing together modern biomass energy systems with CCS at scales large enough to contribute to negative emissions at a global level goes well beyond technical and scientific challenges.

Raw materials

A good part of the conference was given over to the raw materials we'll need to power and facilitate decarbonisation, for example, materials for batteries for electric cars. Karen Hanghøj (EIT Raw Materials) explained how the key to getting the raw materials we'll need for the energy transition will be a better understanding of the 'circular economy'. That is, bringing raw materials into the loop in a sustainable way, keeping materials in the loop for as long as



possible, and minimizing waste at all stages.

Frances Wall (University of Exeter) pointed out that however well we recycle and re-use, we'll continue to need to mine materials that are part of solar cells, wind turbines, electric cars, fuel cells and nuclear power stations, simply to meet growing demands and sustain burgeoning populations.

Social context

For me, the most interesting talk was one by the social scientist Benjamin Sovacool (University of Sussex) who explained the historical context of energy transitions. This echoed my own opening comments of the conference where I noted how geological science, resources and their distribution were part of the

'carbonisation' energy transition that we call the industrial revolution—and that 'decarbonisation' will also need a deep understanding of the subsurface for heat storage, geothermal, CCS and other technologies. Indeed, a talk by Charlotte Adams (Durham University) focussed on the value that the abandoned coal mines of the industrial revolution could have in bringing heat to homes in areas important to the UK's industrial past.

Sovacool's message was that transitions can be excruciatingly slow, but that if you get conditions right, they can be faster. Perhaps geoscience can help to make the fossil-to-renewables transition faster? To make that happen, we need to step up our research in a concerted way, organise and speak as a group to influence government, industry and the science funders.

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DISTANT THUNDER

Equal opportunities

As geologist and science writer Nina Morgan discovers, when it comes to a universal welcome, the Geologists' Association were pioneers in the field

Right from its foundation in 1858, any and all with an interest in geology—whether professional or amateur—were welcome to join the ranks of the Geologists' Association (GA), irrespective of age, gender or social class. Women and children both featured among the early membership. The youngest to join, one W. Pye, was just 7 when his father gave him a GA Life Membership in 1862.

Along with lectures, or 'indoor meetings', field trips have always been an important GA activity. The first GA field meetings, or 'excursions to places of geological interest', took place in 1860. Three were held in that year, to Folkstone, Maidstone and Charlton, and the GA annual report for 1860 recorded that: "These excursions gave great satisfaction to members." Buoyed up by their success, the GA General Committee then decided to continue organising more.

In his presidential address in 1909, the GA President from 1908 to 1910, Professor William Whitehead Watts [1860-1947] noted that "It is the excursions which mark off the Association from other bodies, attract to it its large membership, form the link between town and country, and knit together its members in closer friendship than is the case in any other institution."

Females in the field

Although the first GA excursions seem to have been attended only by men, they were open to women too. As Professor Thomas Rupert Jones [1819-1911], President of the GA from 1879 to 1881 noted in his opening address to the 1880-1881 session, "Women,

as well as men, can be Geologists as far as their strength for travel, and opportunities among domestic affairs will allow... Doubtless for many ladies it is hard to tramp about on Geological Excursions over rough roads, hillsides, hedges, ditches and seaside rocks wand shingle."

But this, he emphasized was no reason to exclude women from field trips. To accommodate their needs, he suggested: "Let special Excursion-lines be planned so that we may have the pleasure and advantage of female society."

While there is no evidence that the special excursions suggested by Professor Jones were ever carried out, women in the GA soon joined the field trips nevertheless. The first few female GA members were spotted on field excursions as early as 1861. However, women were not commonly seen as participants on GA field trips until 1870. But, said Jones: "Since then they have often graced the outings with their presence."

The GA Carreck archive, a photographic archive coordinated and curated by GA member Marjorie Carreck [1928-2017; GA Archivist from 1955-2010] that documents GA field activities from the 1890s to the present, shows many women—often very fashionably dressed!—examining rocks alongside their male colleagues.

An adornment

Women also played an important role in the GA indoor meetings. "In the Meetings of the Association," Jones noted, "the female element is an adornment and a social pleasure. As in Universities (now-a-days) and Colleges, as in the British Association, and the Archaeological and Social-Science Congresses, so in our Association, how greatly would the scientific meetings and outings lose if the ladies were absent! ...Who requires to be reminded of the intellectual powers and persistent

energy of the well-educated woman? We can readily speak of the Lady Members of the Association as types of good thinking women, able and willing to know about the Earth as the Earth, and to learn from other persons, as well as from books, what has been gathered of such knowledge, and what is being thought of old and new notions thereon. The pleasant influence of ladies at the Meetings is universally felt. Women can attend Geological Meetings without hurt to their sensitiveness. Geology, though one of the most comprehensive, is one of the most plain of Sciences."

Although expressed in language that may seem patronising to modern ears—the GA's early welcome to women was clearly genuine, and as evidenced by its membership profile today, is clearly ongoing.

End notes: Sources for this vignette include: Address at the opening of the session, 1880-81 by Prof. T. Rupert Jones *Proc. Geol. Assoc.* **7** pp 1 & 43-44; G.S. Sweeting, *The Geologists Association – 1858-1958*, Benham and Company Ltd, 1958; Norman Carreck, Marjorie Carreck, *GA Magazine*, **16**, no 4, 2017, pp. 30-31; The Carreck Archive is available at <https://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/archives/GeologistsAssociation/>



Photograph digitised from the Geologists' Association Carreck Archive, reproduced with permission of the British Geological Survey

* **Nina Morgan** is a geologist and science writer based near Oxford. Her latest book, *The Geology of Oxford Gravestones*, is available via www.gravestonegeology.uk



Stratigraphical foundations

A William Smith birthday cake, chocolate ammonites and an appearance by Sir David Attenborough. Sarah Day and Amy Whitchurch report on the launch party for "William Smith's Fossils Reunited".

On the eve of William Smith's 250th birthday, Fellows and friends gathered in Burlington House, Piccadilly to celebrate the launch of the new book *William Smith's Fossils Reunited*. Edited by Peter Wigley and colleagues, the book combines two of Smith's seminal, unfinished publications—*Strata Identified by Organized Fossils* and *A Stratigraphical System of Organized Fossils*. Placed within the context of newer work, the manuscripts are republished together with stunning engravings by the illustrator and naturalist, James Sowerby, as well as new photographs of fossils from Smith's Collection.

After a welcome from Peter Dolan, the evening's proceedings kicked off with an introduction from the Society's President, Nick Rogers, who welcomed guests to the 'spiritual home' of geoscience. Peter Wigley then described how he, together with Jill Darrell, Diana Clements and Hugh Torrens, set about scanning and digitising Smith's two original manuscripts, using image processing techniques to breathe new life into the plates. The team attempted to match each of the illustrations from Smith and Sowerby's work to the original specimens from Smith's collection, which is now housed at the Natural History Museum in South Kensington. And, using Smith's careful notes, collected during his days roaming the English countryside, the team were able to locate each of the fossil specimens on copies of Smith's own geological maps. Smith's life was not an easy one and financial difficulties meant he ended up in debtors' prison before he could complete these tasks himself. It is fitting that 250 years after his birth, Peter Wigley and colleagues, aided by modern technology, can now help close that chapter for him.

In his speech, Sir David Attenborough—author of the book's foreword—mused on how the average person has likely never heard of William Smith, yet his work helped found one of the most important natural sciences. Indeed, Sir David noted that Smith's fossil collection, sitting in display cabinets in West London, represents the very foundation stones of the science of stratigraphy.

We were lucky enough to steal a few precious moments with Sir David during which we asked him why he felt William Smith's work was so important. Describing William Smith as 'one of the great founders' of geology, he noted that the new book, a 'marvellous document', must have been 'thrilling' to produce; particularly the search for corresponding specimens at the Natural History Museum to match the images in Smith's book.

On the significance of geology and the history of science to our lives now, he said, 'Science is the most important thing that any child can learn. It's the foundation of our lives and our understanding of the world. But equally importantly, our lives and our world view are shaped by science, and we are beginning to understand where we stand in that world view.'

'If you know about science and geology and you know about what's happening to the world, you are in a better position to understand the gravity of the situation that we find ourselves in.'

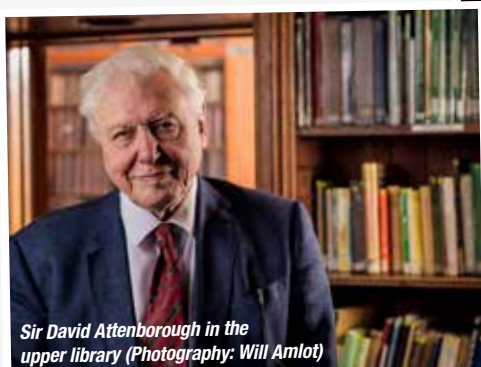
'We know from science and geology that the world is not static, that it's always changing. We are now beginning to realise that it is changing at an astonishing, terrifying rate. If you know anything about geology and anything about palaeontology, you recognise that we are living in extraordinary times. We ought to be aware of that and aware of the responsibility we have. And that's why geology is so important.'

Well said, Sir David.

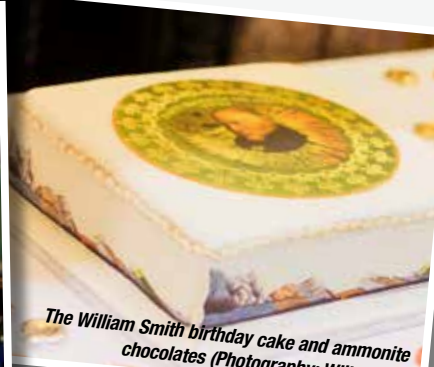
After toasting William Smith, his birthday cake was cut and enjoyed, ammonite-shaped chocolates were distributed, and the book launch celebrations carried on late into the evening.

Sarah Day, Head of Media Relations & Outreach and Amy Whitchurch, Editor Geoscientist magazine

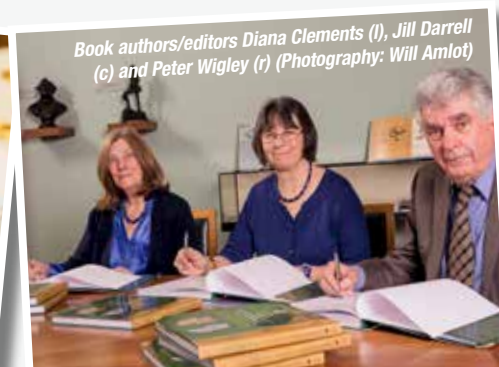
Read a review of "William Smith's Fossil Reunited" on page 22 and order a copy of the book here: <https://www.geolsoc.org.uk/WSFR>. To read more about the event, which was co-hosted by the Geological Society of London and the Dolan Charitable Trust, view additional photographs and listen to our interview with Sir David Attenborough in full, please visit the Geological Society of London blog: <https://blog.geolsoc.org.uk/>



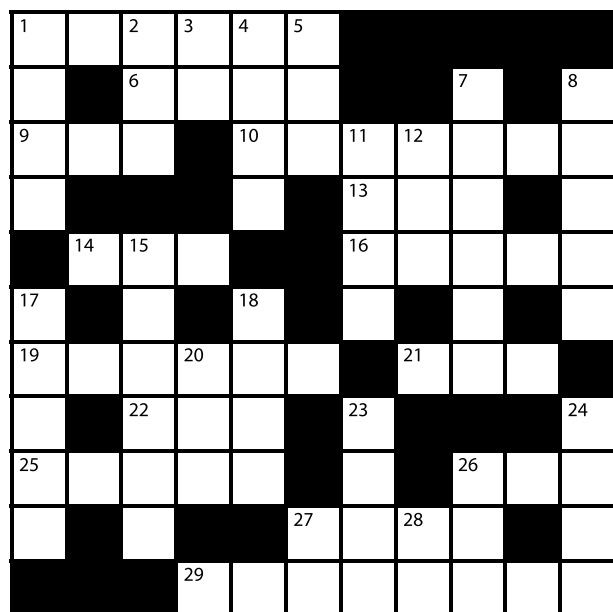
Sir David Attenborough in the upper library (Photography: Will Amlot)



The William Smith birthday cake and ammonite chocolates (Photography: Will Amlot)



Book authors/editors Diana Clements (l), Jill Darrell (c) and Peter Wigley (r) (Photography: Will Amlot)



Across

- 1** Barren region with little precipitation (6)
6 The 'A' in UAE (4)
9 A type of bread associated with curry (3)
10 _ 1ac, arid region of Chile and Peru (7)
13 Cantonment in the Punjab famous for its gardens (3)
14/27D _ _ Khali: the empty quarter (3,2)
16 1970's computer company named after a position in the game of Go (5)
19 Upupa epops (6)
21 Stimulant plant native to the Arabian Peninsula and Horn of Africa (3)
22 The jack of clubs especially in the game of loo (3)
25 Location of part of 24d 1ac (5)
26 State capital of Akwa Ibom (3)
27 American Association for the Advancement of Science (4)
29 1ac, mostly in Botswana (8)

Down

- 1** Coastal landform also found in 1ac (4)
2 Indigenous people of the 29ac 1ac (3)
3 One of the four elements named after the town of Ytterby (2)
4 Royal Australian Air Force (4)
5 Banned metal-based marine antifoulant (3)
7 The world's largest hot 1ac (6)
8 The vast place; a 1ac noted for its fogs (5)
11 Where there is a will, there is ... (1,3)
12 Carnivore of the family Felidae (3)
15 Imaginary place of perfection (6)
17 Orange red skin paint extracted from the leaves of an Amazonian vine (5)
18 Legendary plant extract used to induce euphoria (4)
20 Hard sub-stratum often found in a 1ac (3)
23 Massive example of 1d (4)
24 Generally cold 1ac on the Silk Road (4)
26 Country where the saguaro cactus is found (3)
27 See 14a
28 Unit of electric charge equivalent to 3600 coulombs (1-1)

By Bindweed

Solutions May | **Across:** 1 Mbeya 5 hews 8 samp 10 aa 12 rock 13 margin 16 LTT 17 Marie Tharp 20 Somerville 22 AVO 24 Anning 26 Cell 28 Al 29 Azar 31 SCSI 32 Op art **Down:** 1 Mary 2 Esc 3 yak 4 Am 6 Earth 7 wagtail 9 Pm 11 snipe 14 Altair 15 micron 18 almanac 19 Assam 21 evils 23 flat 25 Ga 26 cap 27 era 30 zo

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OBITUARY Martin Harold Phillips Bott (1926-2018)

Martin was born in 1926 in Stoke-on-Trent, Staffordshire.

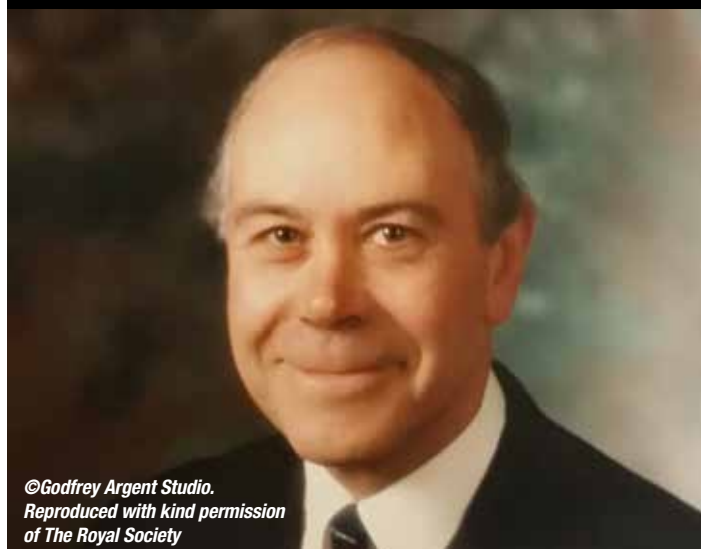
He was educated at Clayesmore School in Dorset and Magdalene College, Cambridge. After military service in the Royal Signals in East Africa, where he climbed Mount Kilimanjaro, Martin took up a scholarship at Cambridge where he initially read Mathematics before switching to Natural Science.

In 1949 he joined the Cambridge Spitzbergen Expedition, climbing glacier-covered mountains and developing his passion for geology from field work and the collection of fossils. He received a D.Phil from Cambridge in 1954 for his work on gravity and magnetic anomalies in the Northern Pennines, supervised by Brian Harland. Martin spent his entire career at the University of Durham, being promoted to a Personal Chair in Geophysics in 1966 and serving as Head of Department (1970-3, 1976-82). He retired in 1988, but remained research active, and was elevated to Emeritus Professor in 1991 and awarded the Chancellors Medal in 2014.

Geophysics

Martin's expertise was in geophysics, especially potential field observations, theory and interpretation. He acquired gravity and magnetic data onshore and offshore UK, and developed forward and inverse

Renowned field-based geophysicist noted for his work on gravity and magnetic anomalies and their geological interpretation



methods for the geological interpretation of gravity and magnetic anomalies. His earliest research focused on the northern Pennines, Cornwall, the Irish Sea, the Iceland-Faeroes Rise and the UK continental shelf and slope. He demonstrated how geophysics could be used to address important geological problems, such as the mechanism of granite emplacement, mountain building and sedimentary basin formation.

In 1970, Martin spent a sabbatical term at the Lamont-Doherty Geological Observatory of Columbia University, where he developed his interests in regional crust and upper mantle structure and the driving mechanisms of plate tectonics. His subsequent research focused on the formation processes of

basins and rifted continental margins, tectonic stress within the lithosphere and the application of finite element methods to compute fault deformation.

Teaching & honours

Martin once said that his students were the main stimulus of his own research. He supervised more than 45 PhD students on a range of projects in geology, geophysics and mathematical computing. He was instrumental in setting up a MSc course in Advanced Geophysics and an Honours course in Geology and Geophysics at Durham, which trained generations of students in exploration geophysics. His success is reflected in his students, many of whom have gone on to leadership positions in industry, government and academia.

In recognition of his

distinguished achievements, Martin received many awards and honours, including the Clough Medal of the Edinburgh Geological Society, and the Murchison and Wollaston Medals of the Geological Society of London. In 1977, he was elected a Fellow of the Royal Society.

Legacy

Martin's interests encompassed much more than geophysics. He was an avid mountaineer summiting all the peaks of the Monros, the Nuttalls and the Wainwrights in the British Isles. Along with his wife Joyce, Martin was a keen gardener. And for more than 5 decades he was an active member of St. Nicholas Church, Durham. His knowledge of the bible was extensive and he saw no conflict between his enduring Christian faith and his science.

Martin passed away on Saturday 20 October, 2018. He will be remembered by all who knew him as a humble, modest and gentle man. Perhaps his greatest legacy is his 154 journal publications and lucidly written and beautifully illustrated book "The interior of the Earth". He leaves behind his wife, Joyce, children Andrew, Nicholas and Jacqueline, and 6 grandchildren. He will be greatly missed.

► By Tony Watts and Nick Kusznir

HELP YOUR OBITUARIST The Society operates a scheme for Fellows to deposit biographical material. The object is to assist obituarists by providing contacts, dates and other information, and thus ensure that Fellows' lives are accorded appropriate and accurate commemoration. Please send your CV and a photograph to Amy Whitchurch at the Society.

OBITUARY Ian Morven Simpson (1922-2018)

Dr Ian Morven Simpson FGS, known to all as Morven, was born in Edinburgh in 1922, son of Dr John Baird Simpson, District Geologist in the Geological Survey in Scotland¹.

Morven's early education was based in Edinburgh, at George Heriot's School and as an undergraduate student in Chemistry at the University of Edinburgh. His undergraduate career was interrupted by World War II, and when he resumed after the war, he switched to studying Geology. He graduated top of his class, with first class honours, but usually added, with a twinkle in his eye, that there were only 4 geology students in his year, and two of those spoke very little English. Nevertheless, it was a good enough result to get him an appointment at the University of Glasgow as an assistant lecturer in Geology, and as a PhD student with Prof T.N. George, working on the Carboniferous Limestones of Ireland. In 1951 Morven completed his PhD and secured a position in the Geology Department at the University of Manchester, where he spent the rest of his working life.

Gifted teacher

He quickly gained an enviable reputation as a teacher, in the lecture theatre, laboratory and in the field, and started what turned into a lifetime research partnership, and deep friendship, with Dr Fred Broadhurst. Together they published many papers on the Carboniferous of Northern England, both

A gifted teacher and gentle intellectual giant with expertise in the Carboniferous of Northern England



clastics and carbonates, usually managing one day a week in the field, notably in and around Castleton, in the Peak District.

Morven was a gifted teacher, and one who became a role model to many who themselves went on to teach. To any student with a reasonable geological question, spontaneous or prepared, his default response was "Well now, what do you think?". Delivered reassuringly with his gentle, educated Scots accent this was a pedagogic masterstroke. For those with Morven's modesty, the response avoided the temptation to showcase his own knowledge and instead opened the door to the greatest educational treasure-house of all—getting the student to think, analyse, articulate and discuss. It was an

immediate conversation-starter where the knowledgeable one became tutor rather than expert, and it would reassure the student that this was no waste of his time. In the field it was a priceless gambit. In a group it could spark a collaborative response where others would crowd around ... goodies were being given out and here was stuff for notebooks. There was always a story of some sort contrived and delivered by this gentle intellectual giant.

Extramural classes

Morven retired in 1983, but he continued teaching extramural classes and writing geological guides. His last appearance in public was at the Geological Society, at Burlington House, in 2013, when he

handed back to the Society, for safe keeping, the Lyell Medal that his father had been awarded in 1954 (see footnote 1).

He died on November 19, 2018, six years after losing his wife of 65 years, Janette. He is survived by his son, Graeme, also a geologist, daughter Jennifer, five grandchildren and six great grandchildren.

► By Graeme Simpson, with contributions from Dr John Pollard and Prof Gordon Walkden

¹ <https://www.geolsoc.org.uk/Geoscientist/Archive/May-2013/John-Baird-Simpson>

The Society notes with sadness the passing of:

Barber, Peter Marriott
Blanche, James Bruce
Bott, Martin Harold Phillips
Bradshaw, Reginald
Broecker, Wallace *
Burke, Kevin Charles Anthony *
Butler, Raymond John Thomas *
Clayton, Keith *
Cornes, Barbara Charlotte *
Herries-Davies, Gordon L *
Huckerby, John Andrew *
Ireland, Richard *
Jobbins, Alan *
Kempton, Nicholas Hugh
Simpson, Ian Morven
Simpson, Peter Robert *
Westhead, Robert Keith
Whyatt, Stephen John *
Whitham, Andrew Gordon

In the interests of recording Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. Bold, recent additions to the list; * Fellows for whom no obituarist has been commissioned; § biographical material lodged with the Society.

If you would like to contribute an obituary, please email amy.whitchurch@geolsoc.org.uk to be commissioned.

Deceased Fellows for whom no obituary is forthcoming have their names and dates recorded in a Roll of Honour at www.geolsoc.org.uk/obituaries.

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Reflecting the high-quality technical content, 50% of the audience is G&G, with 20% of the audience identifying themselves as C-level executives.

This year the PESGB has received over 90 high quality abstract submissions which will form a diverse and relevant technical program. Submissions have once again come from across the industry spectrum and include oil companies, service companies and academia. All the main prospective regions of Africa will be considered.

We are looking forward to papers on, recent discoveries and forthcoming wells in Africa, including high impact and play-opening wells presented by their Operators. Technical overviews of basins hosting licences rounds will provide a unique opportunity to fast track your technical knowledge ahead of bid deadlines. A range of submissions provide an overview of technical workflows that set the standard for industry best practice. Once again the conference will be the "go to" for Africa E&P activity and in-depth geological understanding of the continent.

60%

of attendees were Presidents / VP /
Directors / Exploration Managers /
Senior Explorationists / Chief / Senior
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Over 250

companies represented at Africa 2017



29%

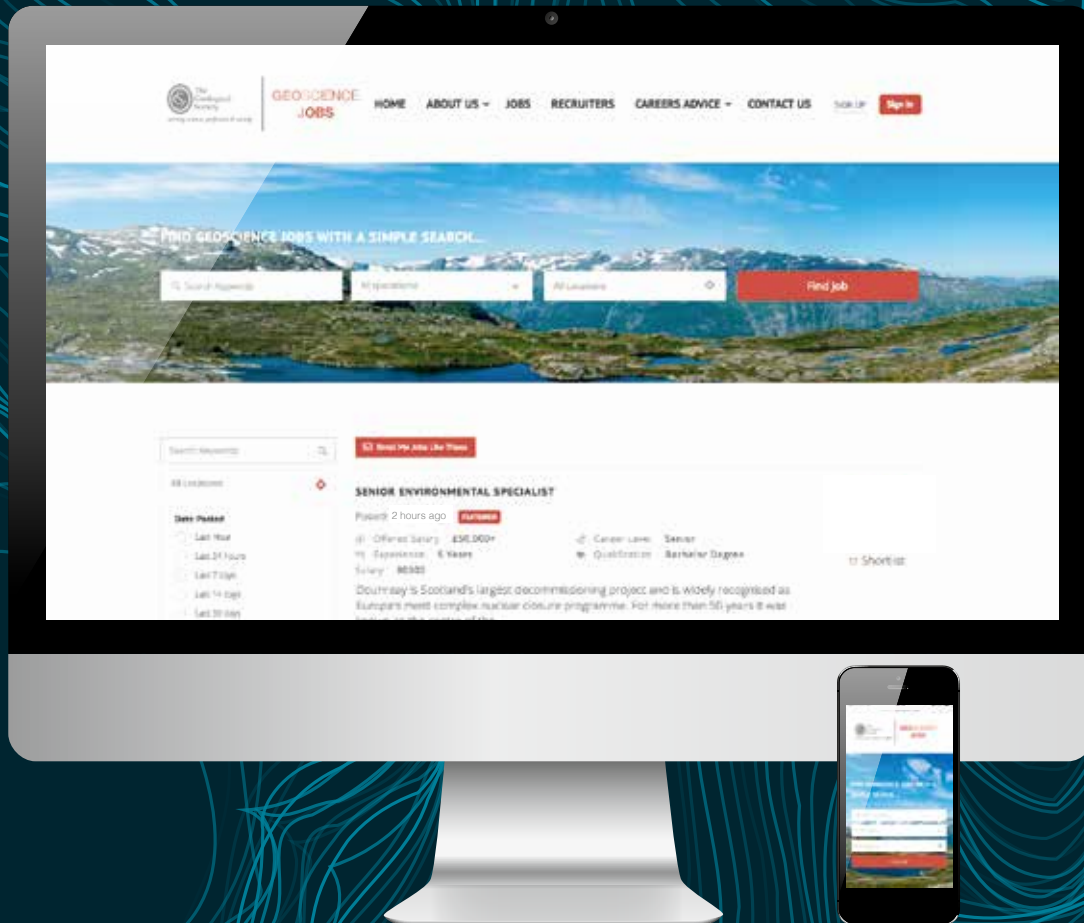
of the audience was
international with representation
from: Comoros, Mozambique,
Sierra Leone, South Africa,
Namibia, Guinea, Congo,
Madagascar, Gabon, Nigeria,
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