GEOSCIENTIST

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The Fellowship Magazine of the Geological Society of London

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CAMBRIAN SUBSTRATE REVOLUTION

Catherine Mascord on the importance of shallow burrowers for seafloor oxygenation

ILL-FATED EREBUS
Douglas Palmer considers the doomed Franklin Expedition

GEOSCIENCE IN COURT
Alastair Ruffell and colleagues on the expansion of geoforensics

DE-RISK GEOLOGY
John Beswick ponders exploration and reputations

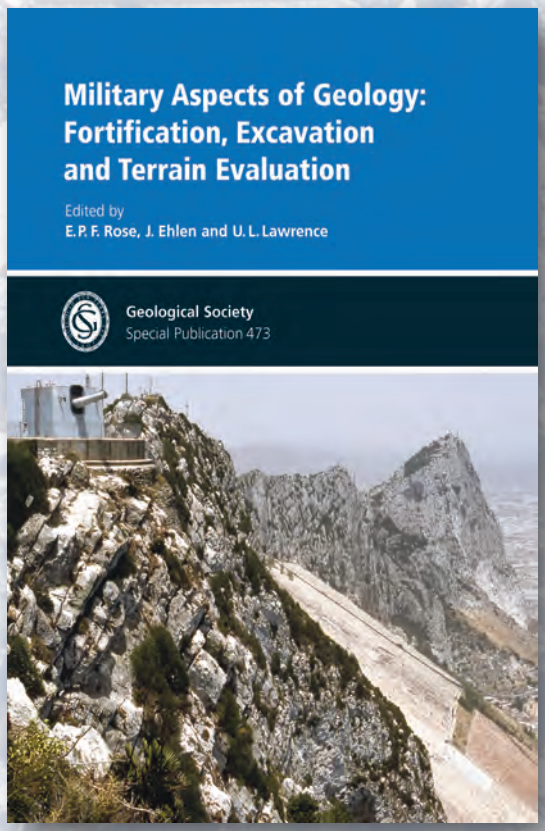
The Geological Society

serving science, profession & society

New Title Alert

Military Aspects of Geology: Fortification, Excavation and Terrain Evaluation

Edited by E. P. F. Rose, J. Ehlen and U. L. Lawrence



NEW

314 pages
Hardback
List price: £ 110
Fellow's price: £ 55
Other societies price: £ 66

This book complements the Geological Society's Special Publication 362: Military Aspects of Hydrogeology. Generated under the auspices of the Society's History of Geology and Engineering Groups, it contains papers from authors in the UK, USA, Germany and Austria. Substantial papers describe some innovative engineering activities, influenced by geology, undertaken by the armed forces of the opposing nations in World War I. These activities were reactivated and developed in World War II. Examples include trenching from World War I, tunnelling and quarrying from both wars, and the use of geologists to aid German coastal fortification and Allied aerial photographic interpretation in World War II. The extensive introduction and other chapters reveal that 'military geology' has a longer history. These chapters relate to pre-twentieth century coastal fortification in the UK and the USA; conflict in the American Civil War; long-term 'going' assessments for German forces; tunnel repair after wartime route denial in Hong Kong; and tunnel detection after recent insurgent improvisation in Iraq.

Find out more online at: www.geolsoc.org.uk/SP473

Or call to purchase a copy + 44 (0) 1225 445 046

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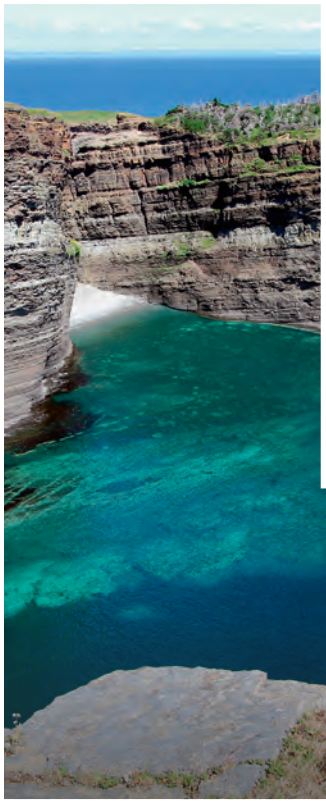
Cover image: Rocky cliffs along the George Nomore Walking Trail, Bell Island, Newfoundland



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ON THE COVER:

FEATURES

REGULARS

Latest news from the **Publishing House**

Mantle plumes and mantle dynamics in the Wilson cycle

By Philip J. Heron

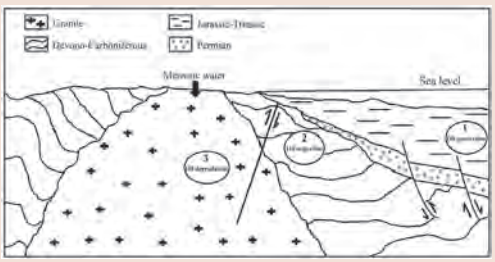
This review discusses the thermal evolution of the mantle following large-scale tectonic activities such as continental collision and continental rifting. About 300 myr ago, continental material amalgamated through the large-scale subduction of oceanic seafloor, marking the termination of one or more oceanic basins (e.g. Wilson cycles) and the formation of the supercontinent Pangaea. The present day location of the continents is due to the rifting apart of Pangaea, with the dispersal of the supercontinent being characterized by increased volcanic activity linked to the generation of deep mantle plumes. The discussion presented here investigates theories regarding the thermal evolution of the mantle (e.g. mantle temperatures and sub-continental plumes) following the formation of a supercontinent. Rifting, orogenesis and mass eruptions from large igneous provinces change the landscape of the lithosphere, whereas processes related to the initiation and termination of oceanic subduction have a profound impact on deep mantle reservoirs and thermal upwelling through the modification of mantle flow. Upwelling and downwelling in mantle convection are dynamically linked and can influence processes from the crust to the core, placing the Wilson cycle and the evolution of oceans at the forefront of our dynamic Earth.

➤ **Read full abstract and paper in the Lyell Collection**
http://sp.lyellcollection.org/content/early/2018/11/16/SP470.18

The geochemistry of oil in Cornish granites

By Mas'ud Baba, John Parnell and Stephen Bowden

Oil residues in Variscan granites in Cornwall, SW England, preserve biomarker data which indicate an origin from marine source rocks. The biomarkers also indicate a thermal maturity that excludes an origin from the Devono-Carboniferous rocks intruded by the granites, but is similar to that of Jurassic-sourced oil to the east in the Wessex Basin. A suite of five different samples from the South Crofty tin mine are variably biodegraded, implying alteration after emplacement of oil in the granite. These characteristics are compatible with models for updip flow of fluids from offshore Mesozoic sediments into older granite topographical highs.



➤ **Read full paper in the Lyell Collection**
http://pg.lyellcollection.org/content/early/2018/12/19/petgeo2018-053

> GEOSCIENTISTS ARE HELPING TO PUT THE RIGOUR BACK INTO FORENSIC SCIENCE

FROM THE EDITOR'S DESK:

Geoscience in the dock

Over the past few decades, forensic science has experienced something of a crisis. In numerous high-profile cases, people convicted of serious crimes were exonerated years later due, in part, to flawed forensic evidence.

The severity of the problem was highlighted in a highly critical 2009 US National Research Council report that called for an overhaul of the entire system. More recently, a 2016 report from the US President's Council of Advisors on Science and Technology emphasised the need to establish forensic methods as valid and reliable, while a 2018 UK Forensic Science Regulator document stressed that only reliable evidence is admissible in court. Most of the concerns centre on techniques like DNA, bitemark and hair analyses, but the problems cast a dark shadow over the whole field.

What does all this have to do with geology? Well, the geosciences have a small but important role to play in forensic science. As highlighted in a Meeting Report on page 26 of this issue, an ever-expanding range of geoscientific and archaeological approaches are used in forensics, and the geoscience community is engaged in the robust testing of these techniques and their application to crime scenes.

For example, recent research has shown that LiDAR is effective for identifying clandestine graves because pulsed laser light can penetrate undergrowth to image recently disturbed ground (Corcoran *et al., Forensic Sci. Internat.* 2018). Work is also on-going to test the suitability of geophysical methods for detecting and characterising graves in the sub-surface (Pringle *et al. J. Forensic Sci.* 2012, 2016). Buried pig cadavers—both naked and wrapped in tarpaulin—are monitored using electrical resistivity measurements and ground-penetrating radar. It seems that the usefulness of the geophysical approaches varies depending on the style of and time since burial. Decomposition fluids from the naked burial generated a low-resistivity anomaly for up to 4 years, but after this time the grave became less clear. The wrapped burial could be detected with ground-penetrating radar, yet the naked burial was difficult to resolve.

Such surveys are site-sensitive and while pigs are commonly used as a proxy for humans, they don't decompose at the same rate. More accurate tests of these geophysical approaches would require a human taphonomy facility (an outdoor centre for research on donated human cadavers) in the UK. There are eight such facilities in the US, one in Australia and one in the Netherlands, but decomposition is highly sensitive to local geology and climate, so findings from abroad can't be easily extrapolated to the UK.

Anna Williams and colleagues argue that these facilities help uphold evidentiary standards, and that the lack of one in the UK puts scientists here at a disadvantage and opens the possibility of criticism in court (Williams *et al., Forensic Sci. Internat.* 2019). They make a compelling case, but the topic is a sensitive one with obvious ethical considerations. The Human Taphonomy Facility for UK Forensic Science is running a survey to gauge public opinion.

(**http://htf4uk.blogspot.com/p/our-survey.html**). Interested Geoscientist readers might want to provide feedback?

Forensic geoscience is a nascent field, but it is clear that a growing and passionate community is dedicated to ensuring that geoscientific techniques can robustly aid criminal investigations.

DR AMY WHITCHURCH, EDITOR - amy.whitchurch@geolsoc.org.uk @geoscientistmag

SOCIETY NEWS

What your society is doing at home and abroad, in London and the regions

Society Awards 2019

The Society is delighted to announce the names of the winners of its medals and funds and offers all its heartiest congratulations. The President's Award winners will be announced at a later date.

The awards will be presented at President's Day on 6 June 2019.

Name	Affiliation	Award
Prof Edward Stolper	Caltech	Wollaston Medal
Prof Nicholas Kusznir	University of Liverpool	Lyell Medal
Prof Marian Holness	University of Cambridge	Murchison Medal
Prof Frances Wall	Camborne School of Mines, University of Exeter	William Smith Medal
Dr Anthony Barber	retired	Prestwich Medal
Dr Nigel Woodcock	University of Cambridge	Dewey Medal
Prof Richard Law	Virginia Tech	Coke Medal
Dr Bramley Murton	National Oceanography Centre	Coke Medal
Mr Colin Day	NERC National Marine Facility, National Oceanography Centre	Distinguished Service Award
Charmouth Heritage Coast Centre		R H Worth Award
Prof Emily Rayfield	University of Bristol	Bigsby Medal
Dr Andrea Cozzi	Eni Upstream & Technical Services	Aberconway Medal
Dr Andrew Parsons	University of Oxford	Wollaston Fund
Dr Sam Giles	University of Birmingham	Lyell Fund
Dr Jonathan Pownall	Australian National University	Murchison Fund
Dr Brendan McCormick Kilbride	University of Cambridge	William Smith Fund

Fellowship Renewals

Every year at this time, we remind Fellows to renew their Fellowship for the current year, or face being struck off—with the subsequent inconvenience of having to re-apply. For the Society, late payment results each year in additional costs and administration. In this economic climate, we must ensure that optimum use is made of Society resources and we rely on the support of Fellows to achieve this. Time is running out for you to renew your Fellowship. To ensure that you continue to support and belong to your professional body, please renew today, preferably online via the website; or you can call Burlington House and ask for the Fellowship Department.

Richard Hughes, Executive Secretary

Mentoring Workshop

This is the final call for people to register for the workshop planned for March 26th at Burlington House. If fewer than 12 have registered by March 11th, the Workshop will be cancelled. Please contact the Chartership Officer (**Chartership@geolsoc.org.uk**) to register your interest and for further information.

Chartered Fellows Elected Feb 2019

CGeol: Kim Michelle Altinkaynak, Christopher Peter Bailey, Bertrand Raymond Burnet, Anil Kumar Chatterj, Oliver Chrisp, Philip William Clare, Samuel John Deeley, Gianluca Dell'Elce, Laura Elsworth, Mario Fornaciari, Maxwell Joseph Foweraker, Malcolm Thomas Graham, Jonathan Allan Hunt, Darren Jones, Marianne Hemmet McGaughy, David Andrew Pollitt.

CSci: Danilo Ricardo Bettosi, Daniela Lagomarsino.

Annual Training Record Form

The annual reporting form for early career geoscientists working towards Chartership can be found at **www.geolsoc.org.uk/Membership/Chartership-and-Professional/Applicants#chartershiptraining**.

Council & OGMs 2019

The dates for meetings of Council and Ordinary General Meetings until June 2020 are as follows:

2019: 17 April, 19 June, 17 September, 20 November.

2020: 5 February, 8 April, 17 June

Notification of Officers 2019/2020

At the Annual General Meeting on 6 June 2019, Fellows will be asked to elect the following members of Council as Officers for 2019/2020:

President
Prof Nick Rogers

Vice-Presidents
Mr John Booth
Mr Nicholas Reynolds
Miss Jessica Smith
Mr John Talbot

Treasurer
Mr Graham Goffey

Secretaries
Prof Katherine Royse
Prof Rob Strachan
Dr Alex Whittaker

Secretary, Foreign & External Affairs
Dr Sarah Gordon

ELECTIONS TO COUNCIL 2019-2020

The October issue of *Geoscientist* invited Fellows to nominate new members of Council for election to succeed those who will be retiring at the Annual General Meeting on 6 June 2019. Subsequent calls were made in the email newsletter.

Three nominations were received for President-designate, which, in accordance with Regulation R/G/11, Council reduced to two. There are seven nominations for the remaining five vacancies. The process for the election of members of Council is set out at section 6 of the Bye-laws. The process for the election of President is set out at section 7.

It is important that Council is representative of the views and diversity of all the Fellowship, so Fellows are urged to participate in the preliminary ballot, which will determine the list for the formal vote at the Annual General Meeting.

This year we have again commissioned the highly respected Electoral Reform Services (ERS) to manage the ballot for Council on behalf of the Society. ERS is the UK's leading independent ballot services provider, and has extensive experience of overseeing ballots for a wide range of organisations.

All Fellows for whom we have an email address should already have received voting information direct from ERS. All other Fellows should have received a postal ballot pack. If you have not heard from ERS via email or post, or would prefer to receive a postal ballot pack, or have any other difficulties casting your vote, please contact Stephanie Jones (**stephanie.jones@geolsoc.org.uk**) at the Society.

Voting closes at 23.59 on Sunday 31 March 2019. Postal ballot forms must be sent to ERS (not to the Society) and must arrive by Sunday 31 March.

ONLY FELLOWS OF THE SOCIETY ARE ELIGIBLE TO VOTE

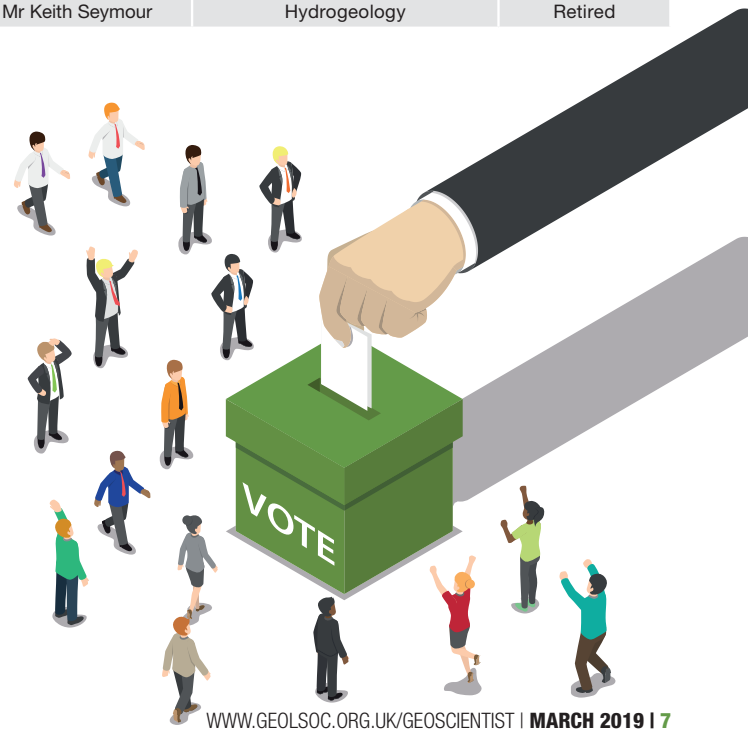
The Council elections are your opportunity to choose who should serve on Council to best represent the interests of all Fellows and to shape the future of the Society. Fellows may wish to make their choices having regard to the area of expertise of the continuing members of Council, which are shown on the tables below. Biographies of members of Council are at **www.geolsoc.org.uk/biographies**.

Continuing members of Council 2019-2020

Name	Expertise	Background
Mr Thomas Backhouse	Risk / Environmental and Geological Hazards	Industry
Dr Andrew Bloodworth	Economic Geology	Government
Mr John Booth	Engineering Geology	Industry
Ms Lesley Dunlop	Geomorphology	Academe
Dr Sarah Gordon	Mining, Meteoritics, Risk	Industry
Mr Graham Goffey	Petroleum Geology	Industry
Prof James Griffiths	Engineering Geology	Academe
Prof Chris King	Geoscience educator	Academe
Prof Bryne Ngwenya	Microbial Geochemistry	Academe
Mr Nik Reynolds	Contaminated land, Geotechnical engineering	Industry
Prof Nick Rogers	Geochemistry	Academe
Prof Katherine Royse	Environmental Geology	Government
Miss Jessica Smith	Engineering Geology	Industry
Dr Helen Smyth	Petroleum Geology	Industry
Prof Robin Strachan	Tectonics, Geochronology	Academe
Mr John Talbot	Geotechnical engineering, Engineering Geology	Retired
Dr Alex Whittaker	Tectonics and Landscape Dynamics	Academe

Members of Council retiring at the Annual General Meeting on 6 June 2019

Name	Expertise	Background
Dr Jason Canning	Petroleum Geology	Industry
Dr Naomi Jordan	Sedimentology, Palaeontology, Palaeoenvironments	Academe
Dr Robert Larter	Marine Geophysics	Government
Dr Colin North	Sedimentology	Academe
Dr Sheila Peacock	Geophysics	Government
Mr Keith Seymour	Hydrogeology	Retired



Supporting Statements

Supporting statements for President-designate nominees

Prof Jonathan Craig

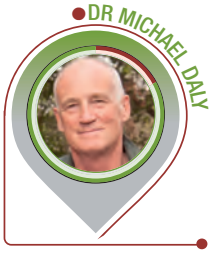
To serve as the President of the Geological Society would be a great honour. I joined the Society in 1979 while still at University and it has always been at the heart of my professional life. I have served on the Corporate Membership and Books Editorial committees, been Chair of the Petroleum Group, edited six Geological Society Special Publications, been awarded the Petroleum Group Medal and currently serve on the Awards committee.

My geoscience career has spanned four decades, initially with Geomorphological Services, Shell and Lasmo and then, since 2000, with the global Energy giant Eni, where I am now the Senior Vice President responsible for global exploration strategy and for the 560 exploration and geoscience staff worldwide. I also have the privilege of holding four Honorary Professorships, at Durham, UCL, Royal Holloway and the University of Jammu in India, and so am actively involved in teaching, publishing and in research. I am a Chartered Geologist.

I am proud of the Society's long tradition of supporting geoscience in both industry and academia, but I am conscious that it faces many challenges. To survive and prosper it needs to modernize, to be relevant, useful and accessible to the next generation of geoscientists, to expand its international profile, be more visible to the Public and to Government and to capitalise on its role as a Professional Body through wider application of accreditation and chartership. Addressing these challenges would be the focus of my Presidency.

Proposer: ***Malcolm Brown***
Supporters: ***John Underhill and Richard Fortey***

Dr Michael Daly

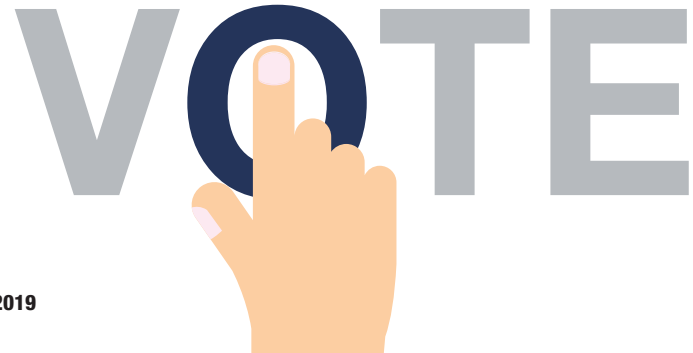


As President I would have three priorities: developing the Society's future by responding to the changing context of geology in the natural sciences; bringing my industrial experience and connections to the Society's significant financial challenges; supporting and challenging the Executive Secretary and team.

Core geological disciplines thrive in the Society and in industry. However, less emphasis is placed on these same disciplines in University curricula, largely to allow room for other subjects included in the Earth and Environmental Sciences. Yet the core disciplines remain essential components of broad, thematic research themes of societal relevance, such as climate change, predicting and mitigating natural hazards, sustainable development and the availability of water, energy and mineral resources. These big themes attract funding and people, and increasingly represent the frontier of natural science research. For the Society to remain relevant and thrive, it needs to embrace these changes while nurturing core disciplines.

I have an industry and academic background. A graduate of UCW Aberystwyth, I spent 10 years as a Survey geologist mapping in central Africa and completed a PhD in tectonics at Leeds. I joined BP in 1986 and in 2014 retired after eight years as head of exploration and a group executive. I am currently a Visiting Professor at Oxford University researching continental tectonics and resource systems, and hold director positions in Tullow Oil and CGG Geoscience. I joined the Society as an undergraduate, have served on Council, co-convened the "Plate Tectonics at 50" conference and co-edited GSL Special Publication 472.

Proposer: ***Dan McKenzie***
Supporters: ***Ceri Powell and Tracey Radford***



Supporting statements for Council nominees

Prof Quentin Crowley

I am an Associate Professor in Isotopes and the Environment and Director of the Centre for the Environment at Trinity College Dublin (TCD), Ireland. I carry out a wide range of geological and environmental research and contribute to relevant policy. I collaborate extensively with institutions and agencies in the UK, Ireland and Europe, particularly the Irish Centre for Research in Applied Geosciences (iCRAG), the BGS, GSI and GSNI.

My research interests include radon, geochemistry of contemporary environmental systems, geochemistry and geochronology of gold and porphyry deposits, detrital minerals in provenance studies, and biominerals as environmental proxies.

Elected FGS in 2006, I was Chief Editor for the Journal of the Geological Society for five years up to 2016, and have served on the Awards, Publications and Science Committees. I therefore offer substantial experience in operations of the Society, particularly of its publications.

I completed my BSc in Geology (1994) and PhD (1997) at University College Galway (now NUIG), followed by post-doctoral research at Keele University and seven years at BGS Keyworth, before joining TCD in 2008.

I am enthusiastic about strengthening the Society's interaction with the geological community on the island of Ireland, fostering geoscience education at all levels, and promoting informed dialogue on environmental issues at a national level.

Proposer: ***John Walsh***
Supporters: ***John Ludden and Michael Young***

Dr Joel Gill

Geoscientists are critical to enabling sustainable and resilient communities, and the Geological Society has an important role in facilitating this. I

am standing for election, as I believe my experience and skills can support effective governance of the Society's work and its purpose of serving society. I am an interdisciplinary geoscientist (BA Natural Sciences; MSc Engineering Geology; PhD Geography - Natural Hazards), working in the BGS international development team and researching hazard dynamics and disasters. My commitment to the social value of geoscience led me to found the charity Geology for Global Development. I have engaged with and listened to the priorities of geoscientists around the world (including hundreds of early-career geoscientists), advocated for geoscience at national and international gatherings (including UN forums), and gained skills and experience in charity governance. I have been an active Fellow since 2012. I sit on the External Relations Committee (2014–), have supported outreach (e.g., Schools Geology Challenge, New Scientist Live) and represented the Society (e.g., Voice of the Future, IUGS Council Meeting 2016). If elected, I look forward to playing an increased role in the life of our Society, ensuring a passionate voice for social geoscience and early-career geoscientists on Council.

Proposer: ***Nic Bilham***
Supporters: ***Iain Stewart and Helen Reeves***

Dr Kathryn Goodenough

I am a Principal Geologist with the British Geological Survey (BGS) in Edinburgh, where I have worked for 18 years. After a PhD studying alkaline igneous rocks in Greenland and a first job in geo-conservation, I joined BGS, initially doing Scottish and international field mapping. I now research the genesis and geodynamic context of mineral deposits, and lead a DFID-funded capacity-building programme that partners BGS with geological surveys in developing countries. Geologists in these countries are in great need of professional networks, and if elected to Council I would like to investigate ways for the Geological Society to collaborate with, and support the professional development of, our colleagues overseas. I am also a strong supporter of the Society's diversity agenda, and particularly interested in ideas to fix the 'leaky pipeline'.

I have been a Fellow of the Geological Society and Chartered Geologist since 2003. I served on the Awards Committee from 2011-2013, and was Secretary of the Volcanic and Magmatic Studies Group from 2002-2009. I have also been a Mineralogical Society Council Member (2007-2009) and General Secretary (2011-2016). I sit on the NERC Peer Review College, and am Chair of the Scientific Advisory Group for the International Continental Drilling Programme.

Proposer: ***Frances Wall***
Supporters: ***Marie Edmonds and Robin Strachan***

Dr Stephen Laubach

Laubach provides decades of experience in the science behind unconventional resources, and a useful non-UK perspective on the challenges of use-oriented and basic geoscience research and science publication relevant to the global transition to a low-carbon economy that will be helpful in guiding Society business. Laubach is a senior research scientist at The University of Texas Bureau of Economic Geology, in Austin, Texas. His research program, funded by industry and the US Department of Energy, includes structural diagenesis, fundamentals of fracture development in rock, fractured and unconventional reservoirs, natural fracture/hydraulic fracture interaction, and microstructural methods in structural geology. He was a member of the AAPG Executive Committee and AAPG Elected Editor from 2010-2013 and has also been involved over many years organizing conferences and publications with the Society of Petroleum Engineers. Laubach has been a Fellow since the mid-1980s. He served as a Co-opted Member of the Petroleum Group Committee of the Geological Society of London from 2008 to 2012 and helped organize GSL conferences on unconventional and on carbonate reservoirs. The latter conference led to Geological Society of London Special Publication 370. His research over the next several years on fractures in Scotland and Wales will allow him to attend meetings in London.

Proposer: ***Peter Eichhubl***
Supporters: ***Ron Steel and Julia Gale***

Mr Andrew Moore

I started out in 1989 with a Geology degree from Kingston Polytechnic. My first job was Engineering Geologist with a contractor immersing me in site investigation fieldwork, logging and reporting. In 1995, I joined the new Environment Agency to pursue an interest in hydrogeological assessments and develop interpretation, risk assessment and regulatory skills. I moved to environmental consultancy in 1998 and managed teams of geoscience professionals. The 90's was a busy period gaining experience and achieving milestones including MSc Engineering Geology (1992), Chartered Geologist (1996) and Chartered Engineer (1999).

I am a Technical Director with WSP UK promoting technical excellence across the Ground Risk Team and supporting clients on ground risk in infrastructure, property and industry sectors. I practise in contaminated land and have professional qualifications including Specialist in Contaminated Land (SiLC), Suitably Qualified Person (SQP) and Qualified Person (QP).

I have served as committee member to the North West Regional Group of the Geological Society for over 20 years and held the posts of Secretary and Chair. I am an active mentor, promote careers events, present lectures and am a scrutineer of candidates for Chartership.

I am a committed geologist in a modern commercial environment, enjoying working with technical people. I strongly believe in supporting early career professionals in their development of sound scientific assessment and the ability to provide clear professional advice. If I were elected as a member of Council, I would like to support and advance the CPD and Chartership processes ensuring that employers recognise the value brought by professional geologists.

Proposer: ***Michael Neden***
Supporters: ***Stephen Jones and Jeff Shuttleworth***

Mrs Sarah Scott

I am a practising hydrogeologist working at the Environment Agency for over 28 years, protecting groundwater resources and quality. I

joined as a Fellow in 2005 and became chartered in 2012. I am standing for Council as I believe hydrogeology and effective regulation will continue to grow in significance for the Society in response to a changing climate.

My current focus concerns the protection of groundwater from oil and gas operations. This means I have a real appreciation of the importance of politics and communication when explaining contentious geoscience in ways relevant to the audience, particularly where emotions are running high. I believe this would be useful experience to bring to Council and help the promotion of geological and hydrogeological understanding in the wider world.

I have served on the Hydrogeological Group Committee for the past 3 years as Treasurer, during which I have streamlined management of the bank account and modernised access to event registration.

I have been accused of turning every family holiday into a field trip. Well, it is true, I am passionate about my subject and about getting other people interested! I would like to use my energy and experience in service of the Council.

Proposer: ***Rolf Farrell***
Supporters: ***Claire Gould and Mark Whiteman***

Ms Gemma Sherwood

I am a Senior Geologist for EDF Energy, working on the construction of Hinkley Point C Nuclear Power Station. I read for a Geology MSci (Bristol University) and later studied for a MSc in Geotechnical Engineering (Birmingham University). I became a Fellow of the Geological Society in 2008, achieving Chartered Geologist status in 2016 and was listed on the RoGEP in 2017. I am proud to have won the Glossop Award in 2017. If elected to Council, I will bring experience in Engineering Geology, Ground Investigation and New Nuclear Build.

I have been on the Western Regional Committee for 5 years; serving 4 years as Programme Coordinator and 2 years as Chairperson, for which I am standing for re-election in 2019. While on the committee, I have restarted our regional heat of the Schools Competition; organised multiple field trips and lectures and promoted entrants for the Early Career Geoscientist award.

I am passionate about promoting STEM subjects, regularly volunteering as a STEM ambassador at schools and science festivals, aiming to promote and encourage Earth Science careers. I believe that I can help Council to realise the Geological Society's Strategy 2017-2027, particularly engaging with schools and stimulating public awareness.

Proposer: ***Victoria Edmonds***
Supporters: ***Louisa McAra and Elizabeth Withington***

Honorary Fellowship

Following a proposal from the External Relations Committee, Council recommends the following candidate for election to Honorary Fellowship at a future Ordinary General Meeting.

Professor Eric Onyango Odada

Professor Odada has a national and international reputation in the field of geoscience and sustainable development. As an Honorary Fellow of the Geological Society, we are confident that Professor Odada would continue this engagement, and be eager to share his perspectives and experience in using geoscience to inform international policy and support society. His advocacy for the role of geoscience in sustainable development, pursuit of excellent environmental change research, and investment in building the capacity of others, strongly align with the values of the Geological Society.

Professor Odada holds a PhD in Applied Geochemistry from Imperial College. He is a Professor of Geology at the University of Nairobi and Regional Director of Global Change Research Programme in Africa. Previously, he served in Kenya as Chief Research Officer, Marine and Freshwater Research Institute and Principal Geologist with the Mines and Geology Department, Ministry of Environment and Natural Resources. He is an ex-member of the United Nations Secretary General Advisory Board on water and sanitation and currently a member of the committee on Freedom and Responsibility in the conduct of science of the International Council of Science. He is a Fellow of the Kenya National Academy of Sciences; World Academy of Art and Science and Geological Society of Kenya. His fundamental endeavour as an Earth scientist has been to study Global Environmental Change as a basic understanding of how the Earth system works. He is currently undertaking a strategic assessment of water resources vulnerability to environmental change, and working with UNEP-GEF on a study of atmospheric deposition of micronutrients in Rivers and Lakes in equatorial Africa.

PUBLIC LECTURE SERIES

Diamond windows into the deep Earth

Speaker: Kate Kiseeva, University College Cork, Ireland; University of Oxford, UK
Location: Burlington House, London
Date: 27 March

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/gsllondonlectures19**. Tickets are now available on **www.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: **Patricia Petrovic,** The Geological Society, Burlington House, Piccadilly, London W1J 0BG
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De-risking UK geology

We cannot let fear of being proved wrong prevent deep geological investigations, argues **John Beswick**

I am prompted to reflect on the interesting article by Nadia Narayan and colleagues (*Geoscientist* 28 (9), 2018) about karst geothermal resources and their potential source of hot water. I am an engineer, but I have been a member of the Geological Society for 40 years or so. During my education and career, I have obtained a lick of geology to justify my membership, but I always feel subordinate to the real geologists. In terms of geothermal energy, however, I am regularly asked about projects that seem attractive on paper based on a geological prognosis, but are still very risky for an investor.

Confusion

Interpretation of deep geology, and particularly hydrogeology, from maps, sections, geophysical data and outcrops usually results in various eloquent prognoses by geologists. However, the more you ask about the detail or the more geologists you ask, nice as they are, the more confused you get. Advising clients on the commercial viability, therefore, in most cases is impossible.

Some potential geothermal resources are focused in buried Carboniferous Limestone areas. If the formations were karstic, a geothermal well might tap significant quantities of hot water that could have a real benefit for some industries that need heat, or for homes and business premises—and at the same time help replace the need for fossil fuels.

Conversely, they may not. In terms of hydrogeology, the actual compared with the prognosis can be very different.

Reputational damage?

The oil-and-gas industry provides some data that are important for understanding the deep geology, but the industry doesn't always focus on areas of interest for geothermal development or other sub-surface interests and is also itself risk averse at times. The UK's deep geology is complex, which prompts the question of why there is now no national investment in more deep-stratigraphy boreholes to give ground truth to all the indirect methods for interpreting deep geology? The last deep stratigraphic borehole was the Winterbourne Kingston in Dorset, drilled in 1976. This begs the question, are the geologists of today frightened of damaging their reputations by pursuing some real exploration in terms of deep drilled and cored boreholes, strategically sited to help untangle some of these conundrums and create a better-quality database?

Of course, this is the probably the bailiwick of the British Geological Survey and other academic institutions, so can they be brave enough to ask for the necessary funds from the various funding agencies, and not just a few bob for a field trip armed with rucksack, hammer and pub guide, that results in a report or paper, but funds for geological exploration that can de-risk some of the key questions about the UK's deep geology? Some of these geologists, a few of whom sit behind computers playing with visualisations, have spent years studying particular topics and may be proved wrong—that may deter the faint hearted! However, the venture is worth it if there are potentially significant commercial benefits on offer that would allow investors to seriously think again about geothermal and other projects.

John Beswick, Director, Marriott Drilling Group;
E: john@marriottdrilling.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).

> "ARE THE GEOLOGISTS OF TODAY FRIGHTENED OF DAMAGING THEIR REPUTATIONS BY PURSUING SOME REAL EXPLORATION…?"
> JOHN BESWICK

THE FOSSILS OF

BELL ISLAND

Rare sunny days showed off the cliff sedimentology, which was not always accessible without a boat. Freshwater Cove, was only accessible by climbing down a stream bed and using an abandoned fence (visible to the left) as a makeshift ladder

Burrowing animals helped kill off ancient seafloor matgrounds. **Catherine Mascord** reports on the role of shallow burrowers with links to the oxygenated surface in initiating this process

On the surface, Bell Island, Newfoundland appears unremarkable in geological terms. The island is relatively flat with few hills or other dramatic geography, and most of the rocky outcrops are limited to the cliffs along the island's coastline.

Throughout much of the early 20th century the island was host to one of the most productive iron ore mines in Canada. Today the mines are decommissioned, but the island's rocks still hold a great deal of scientific interest because they preserve a record of one of the most important events in the history of life on Earth, the Cambrian Substrate Revolution. The revolution saw the transition from a seafloor lined with microbial mats and limited burrowing by animals, to more extensive vertical burrowing, oxygenation of the subsurface and the evolution of the animal-dominated seafloor we know today.

To better understand this record, I spent two weeks of fieldwork, in June 2018, examining the island's geology, using the research funding provided by the Geological Society. From the information gathered during the trip it seems that shallow burrowing animals were key to opening up the ocean substrate to more complex animals.

Subsurface reform

For much of Earth's history life on the marine seafloor was very different to the animal-dominated communities we know today.

A typical healthy, modern seafloor is home to a large number of burrowing organisms. These animals, particularly

The fossils and trace fossils preserved in the Precambrian and Cambrian are very different from one another. Precambrian (Ediacaran) fossils (left) include simple Rangeomorph (frond-like) animals, shallow surface trails and elephant skin textures produced by microbial mats on the sediment surface. By the Cambrian (right) the Rangeomorphs had disappeared, replaced by other, more complex animals such as Trilobites. The trace fossils were also more complex because animals capable of deep burrowing had evolved

those capable of producing deep burrows, are vital for maintaining oxygen levels in the sediment and recycling deposited material, because they mix oxygen and suspended material from the water column into the sediment as they burrow (McIlroy & Logan, *PALAIOS* 1999). However, most burrowing animals did not evolve until the early to mid-Cambrian, about 530 million years ago. The few burrowers around in the Precambrian were rarely capable of burrowing more than a few millimetres into the surface sediment (Gehling, *PALAIOS* 1999; Droser et al., PNAS 2002; Pecoits *et al.*, *Science* 2012).

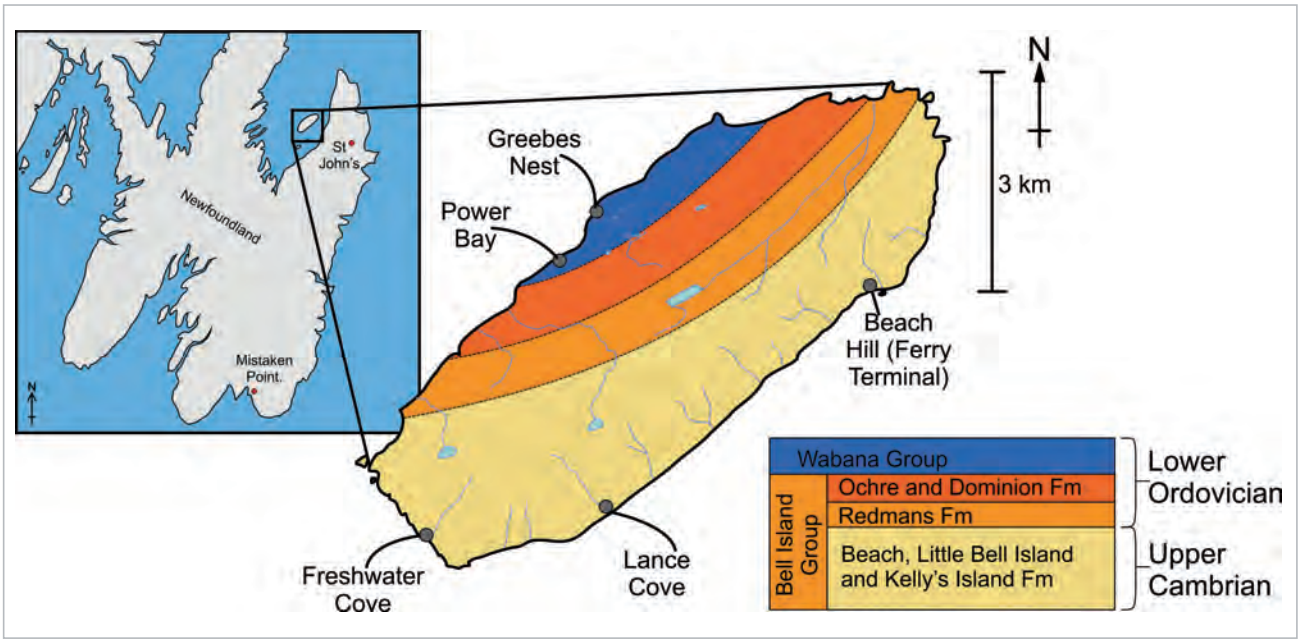
Without the oxygenating effects of burrowing animals, the ancient seafloor was characterised by widespread anoxia (a low oxygen concentration) (McIlroy & Logan, *PALAIOS* 1999) and in the place of animals, the seafloor was blanketed in a community of single-celled organisms known as a microbial matground. Matgrounds are formed when bacteria and other microbes stick themselves, and the host sediment together, using a biological glue (Parsons et al., *Geophys. Res. Lett.* 2016), allowing them to form a cohesive mass on the sediment surface. Despite the microscopic size of their constituents, matgrounds, if left undisturbed, can reach thicknesses of a few cm or more. By gluing themselves together, the bacteria also increase their resistance to erosion and can further facilitate sediment anoxia by limiting sediment mixing by wave action.

Matground traces or microbial-induced sedimentary structures, such as stromatolites, elephant skin fabrics and wrinkle structures, are relatively common in the Precambrian fossil record. However, between 540 and 530 million years ago there was rapid transition from a matground-dominated seafloor to oxygenated, animal-dominated conditions. This transition—the Cambrian Substrate Revolution—is preserved in the fossil record as a rapid decline in fossilised microbial fabrics, and an increase in the number and diversity of trace fossils (Fedonkin, *Paleont. Jour.* 1978; Crimes & Droser, *Ann. Rev. Ecol., Evol. & Syst.* 1992; Jensen, *Int. & Comp. Biology* 2003).

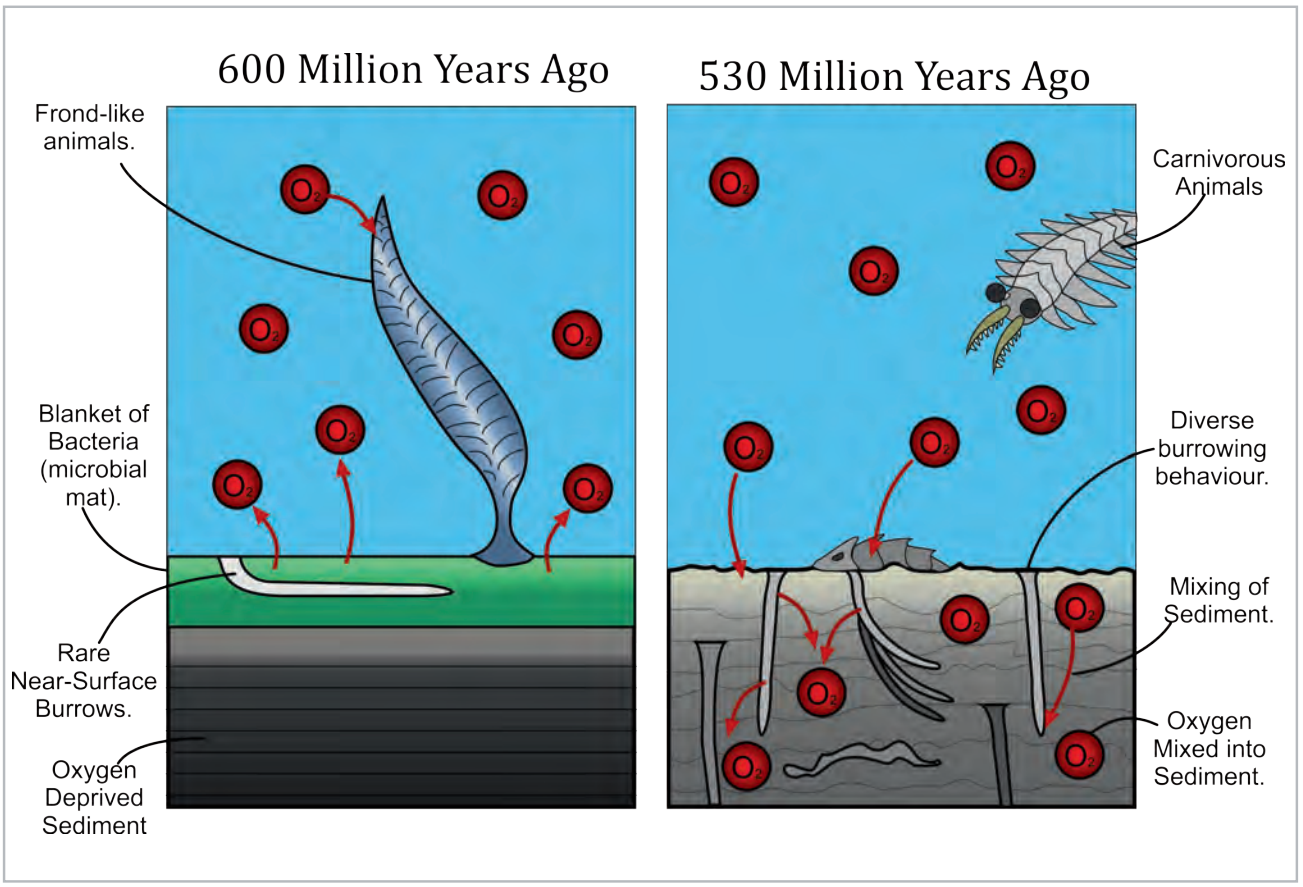
From the late Cambrian and to the present-day, matground communities are rare, limited to anoxic, nutrient-deficient or polluted areas of the sea and lakes, where burrowing animals can't survive in large numbers. This is partly because burrowing animals will break a matground apart as they burrow, and can ▶

feed on the microbes themselves, killing off the microbial community. However, matground-dominated seafloors, and thus the microbial-induced fabrics they create, do see a few resurgences in the fossil record after mass extinctions (Gerbersdorf *et al., J. Soils & Seds.* 2009; Mata & Bottjer, *Geobiology* 2012), most notably after the End-Permian mass-extinction (Feng *et al., Earth Sci. Rev.* 2018; Buatois *et al., Geobiology* 2013), where oceanic oxygen stagnation (Hotinski *et al., Geology* 2001) likely led to a die-off of burrowing animals allowing matgrounds to thrive.

Understanding the mechanisms behind matground resurgence and decline could prove important to future conservation efforts, as global climate change has led to an increase in oceanic dead-zones that may allow matgrounds to regain a foothold today. However, matground resurgence and decline, particularly in the context of the Cambrian Substrate Revolution, is poorly understood. For example, it is unclear how early burrowing animals, which



Located in Northern Newfoundland, Bell Island is part of the Wabana and Bell Island Groups, dating from 490 to 470 million years ago. The geology is based on the published map by King, A.F. (1988).



The change in the seafloor environment from the Precambrian to the Cambrian. In the Precambrian (late Ediacaran 580-540 million years ago) the seafloor was blanketed by a microbial mat, with the few burrowing animals present only able to burrow into the top few millimetres of sediment. By the middle Cambrian (about 510 million years ago), the matgrounds had been replaced by a diverse community of burrowing organisms mixed oxygen and other dissolved material into the sediment

To a sedimentologist the island's coastline holds a wealth of information, with the interlayered sands and muds preserving a record of the ancient tides. It also preserves a history of the island's mining activity with bands of red ironstone, visible at the base of the stack, and rusted equipment and mine outlets dotted along the cliffs

are likely to have lacked many of the more complex adaptations to anoxia, survived in the anoxic sediments of the Precambrian.

Extraordinary interaction

Most of Bell Island is made up of interlayered sandstones, mudstones and thick ironstones, deposited in a shallow sea just after the Cambrian Substrate Revolution, 490 to 470 million years ago, during the Upper Cambrian and into the Early Ordovician. Like many sedimentary rocks deposited in marine environments they preserve ripples and cross bedding produced by wave and current action.

What makes Bell Island important to the understanding of the Cambrian Substrate Revolution is the fossil community it preserves. These fossils are not the shells and bodily remains you would normally think of when fossils are mentioned—indeed, Bell Island has surprisingly few body fossils—instead, the island's rocks are characterised by a diverse community of trace fossils (fossils produced by the behaviour of an organism).

Bell Island's trace fossil communities are unusual because they preserve both complex fossil burrows and microbial-induced sedimentary fabrics in the same succession and on the same bedding planes, recording an ancient community where both complex animals and matgrounds lived together. This rock archive therefore presents a unique opportunity to examine the Cambrian Substrate Revolution because it allows us to study an in-situ interaction between a well-established Precambrian-like matground and relatively complex burrowing animals—something that is rare in nature today.

Field days

Braving the cold rain and high winds of the North Atlantic summer, I found myself spending much of June, 2018, nose pressed against the coastal rocks, hand-lens at the ready, examining ancient trace fossils.

Accommodation on the island was limited for most of our time in Newfoundland, so most days we caught an early morning ferry from the mainland across the short stretch of the Labrador Sea to reach the island. The ferry trips gave us fantastic views of the island and its geology. The island has near-continuous exposure along the coastline, and even from a distance the sedimentary layering of the cliffs was visible, however many of the island's outcrops are inaccessible without a boat.

We identified five main accessible field sites, some with fantastic coastal geography, including rock columns and bedding platforms extending out to sea. At each site we looked at the components of the fossil and trace fossil assemblages (communities of different species), as well as how these assemblages are distributed relative to one another, both in terms of their position in the stratigraphy and their relative locations on the bedding planes.

Fossil assemblages

Broadly speaking, Bell Island's fossils can be divided into three main assemblages (communities): microbial mats, simple shallow-burrowers and complex deep-burrowers. These assemblages may occur alone in a bedding plane or together, particularly in the case of the microbial mats and the shallow-burrowers.

The matgrounds are preserved either as wrinkle structures or as elephant skin fabrics. The two textures can be seen on the same bedding plane and can blend laterally into one another, indicating that they form part of the same matground community. These matgrounds may be crisscrossed by simple surface trails (trace fossils) that rarely penetrate deeper than a few mm into the sediment.

The simple, shallow-burrowing ▶

assemblages are mostly made up of horizontally oriented burrows, which reach a maximum depth of 20 mm. More complex burrows are also present in these assemblages, albeit much rarer. These include U-shaped burrows, and larger, horizontally oriented, branching burrow networks. While the shallow-tier community can occur on its own on a bedding plane, it is more commonly found concentrated around the edge of, or directly beneath, the microbial mats. When in proximity to a matground, these shallow-tier communities form intense bioturbation zones—areas with a high burrow density.

Deeper-tier trace fossils are usually limited to layers well above the sandstones that preserve microbial textures (wrinkle structures and elephant skin fabrics). These deeper-tier communities include simple, horizontally oriented burrows similar to those seen in the shallow-burrowing assemblage, however they also include vertically oriented burrows produced by organisms capable of deep burrowing and producing more complex burrow morphologies. These vertical burrows include simple non-branching forms and complex branching burrows produced by methodological sediment removal.

Essential surface connections

Judging by these initial data, it seems that more complex, deep-tier burrowers were unable to survive in, or were less effective at colonising, matground sediments. So, the Precambrian matgrounds were likely to have initially been invaded by simpler, shallow-tier burrowers. Alternatively, the simple trace fossils we see associated with the matground may have been produced by deeper-tier burrowers that modified their burrowing behaviour in response to the presence of the matground. Either way, the trace fossils indicate that burrowing organisms that remain close to the sediment surface and the oxygenated water column are more likely to survive in, and effectively exploit, matground communities.

Close proximity to the sediment surface may have been the factor that allowed shallow burrowers to survive in the anoxic conditions and break-apart the matgrounds. By maintaining easy access to the oxygenated water column above, these animals could 'dive' into the anoxic sediment for brief periods of time, allowing them to feed before resurfacing for oxygen. They may also have been exploiting 'waste' oxygen produced by photosynthesising microorganisms in the matground itself (Meyer *et al., Palaeo3* 2014). By exploiting near surface oxygen, simpler organisms could have acted as one of the key pioneers in the Cambrian Substrate Revolution, breaking up the microbial sediment and opening up new ecological niches for more complex animals.

Today shallow-tier burrowers may be critical for preventing microbial matgrounds from re-establishing themselves on the modern seafloor as modern climate change continues to affect the global marine environment. ◆

ACKNOWLEDGEMENTS

Many thanks to my supervisors, Dr Liam Herringshaw, Dr Krysia Mazik and Prof Dan Parsons, at the University of Hull, and Dr Duncan McIlroy at the Memorial University of Newfoundland, and to the Geological Society of London for their support via the Elspeth Matthews Fund.

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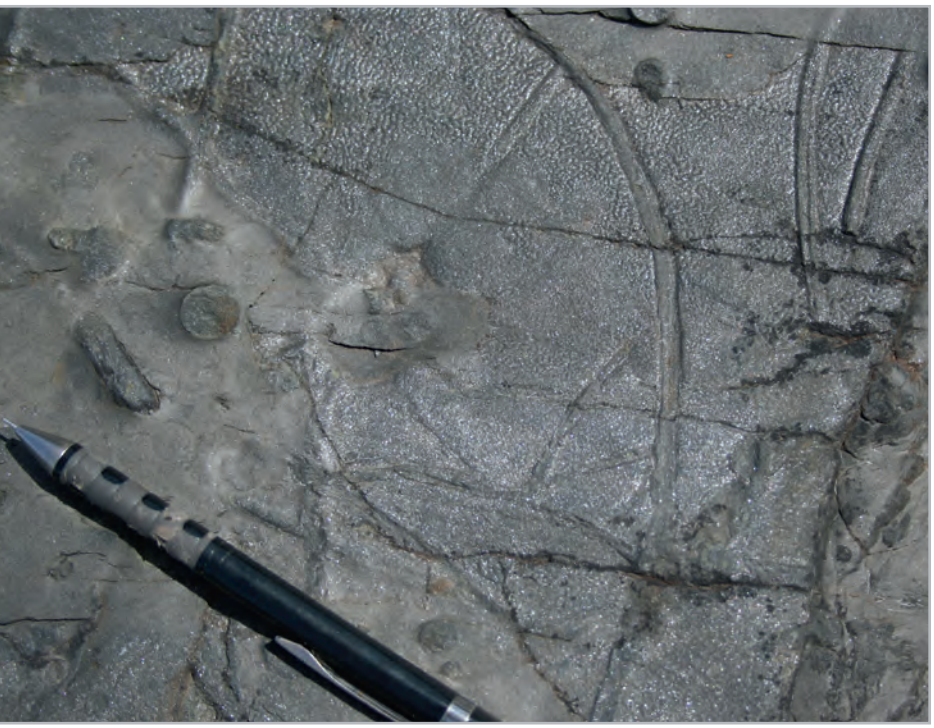
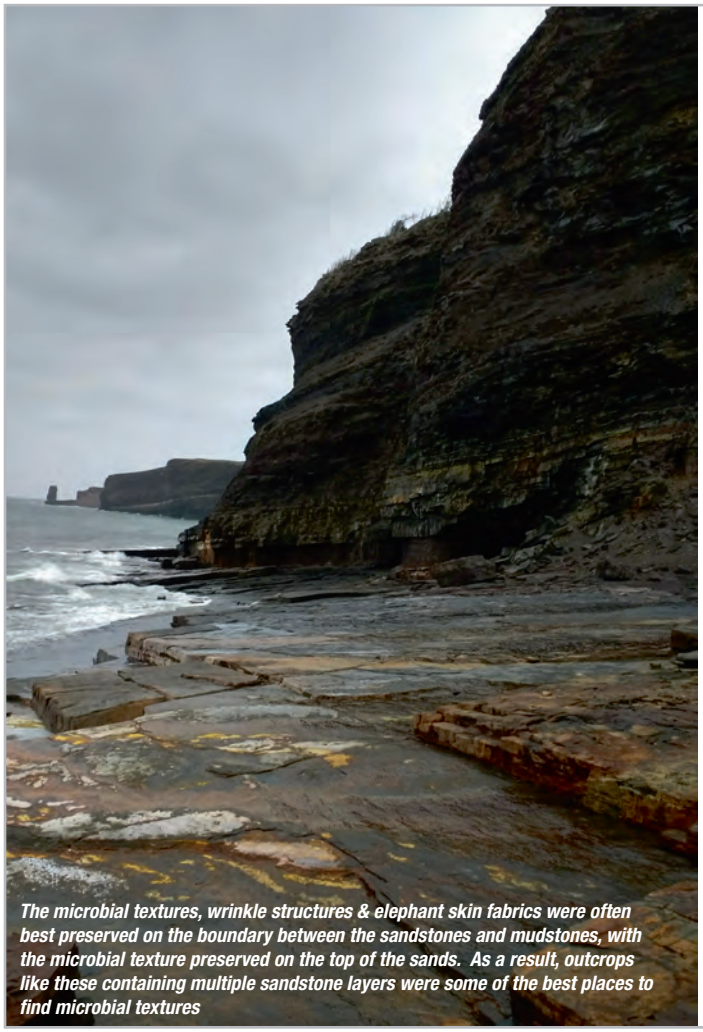
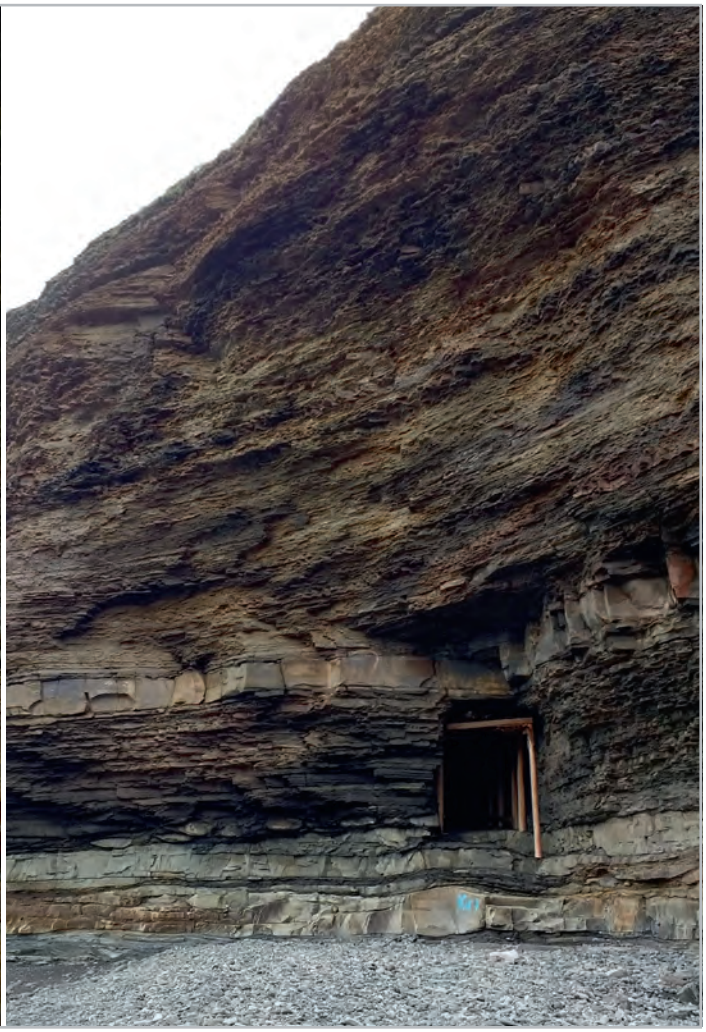


Wrinkle structures, here cross cut by simple fossils trails, (left) and Elephant skin fabrics (right) are microbial-induced sedimentary features produced by the binding of sediment (due to the secretion of a biological glue) and decay of a microbial matground



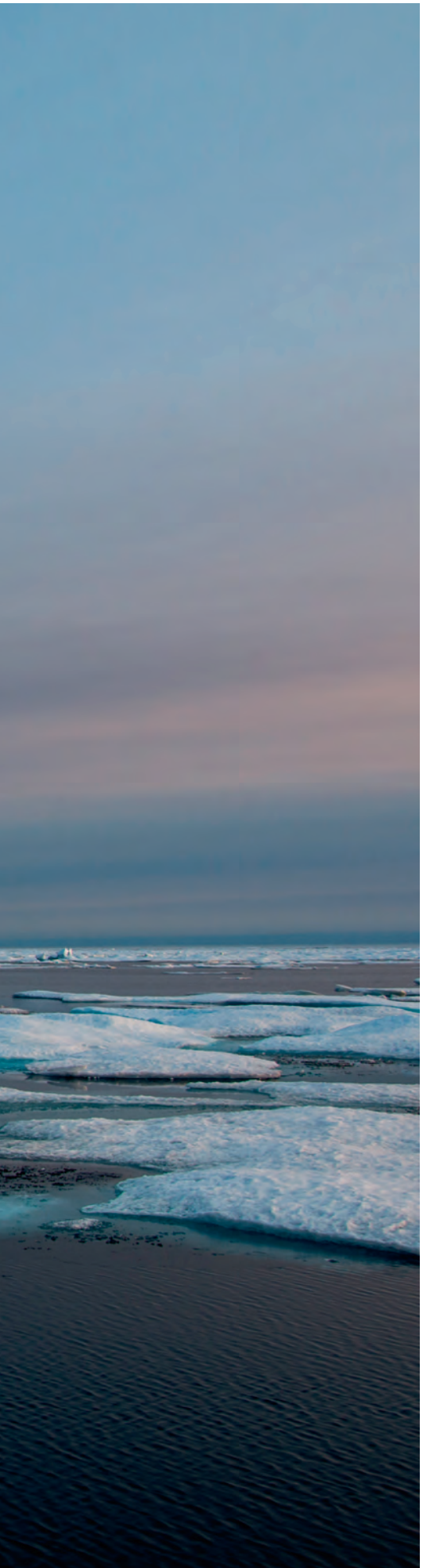


The microbial textures, wrinkle structures & elephant skin fabrics were often best preserved on the boundary between the sandstones and mudstones, with the microbial texture preserved on the top of the sands. As a result, outcrops like these containing multiple sandstone layers were some of the best places to find microbial textures

Even in the overcast and rainy weather typical of the North Atlantic, the near continuous exposure of rock along Bell Island's coastline is apparent from the mainland, with the sandstone-mudstone layering particularly visible on the right of the photograph

INSIGHT FROM CATASTROPHE

Floating ice field in the North-West Passage



Douglas Palmer ponders some of the geological upshots of the doomed Franklin Expedition

Sir John Franklin's ill-fated expedition on HMS *Erebus*, to find the North-West Passage between the Atlantic and Pacific Oceans, has often been in the news—most recently thanks to Michael Palin's new book, '*Erebus*: the story of a ship' (see book review on page 24).

And the story is an extraordinary one. The ship disappeared in 1845. Successive searches throughout the 19th century found artefacts and human remains, but it was not until 2014 that the wreck of HMS *Erebus* was eventually found in cold Arctic waters. While the searches for survivors were initially fruitless, the search parties did discover a number of interesting geological artefacts.

Lady Franklin's Lament

"Alas, she cried, all my life I'll mourn,
Since Franklin seems never to return"

And so she did and so it was. The traditional ballad 'Lady Franklin's lament' was sung from the 1850s onwards to the present, commemorating the loss of Sir John Franklin and 129 seamen. They were the doomed crews of HMS *Erebus* and her sister ship HMS *Terror*, which was also part of the expedition that aimed to navigate the North-West Passage in the Canadian Arctic.

Lady Jane Franklin's determination to find the missing expedition and the offer of a substantial reward of 20,000 pounds for doing so resulted in a succession of search parties. In 1847, under pressure from the press and Lady Franklin, the Admiralty launched a major search from three directions. One led by Admiral John Ross was by sea through the Canadian Arctic Archipelago; another led by Sir John Richardson and John Rae went down the MacKenzie River to the Canadian Arctic coast and the third led by Henry Kellett was from the Pacific through the Bering Strait.

Kellett's mammoth tusk

In 1848, Henry Kellett, captain of HMS *Herald*, had been surveying the Pacific coast of North America. On May 9th the *Herald* left Panama and sailed north through the Bering Strait, reaching Kotzebue Sound, Alaska on September 14th.

Whilst waiting for its depot ship HMS *Plover* to arrive, Kellett and his naturalist, the German-born Berthold Seemann, took the opportunity to explore the nearby frozen ice cliffs of Eschscholtz Bay. Kellett and Seemann were aware that in 1816, a Russian expedition led by Captain Kotzebue had discovered what became Kotzebue Sound and the fossil-bearing ice cliffs of Eschscholtz Bay—named after Kotzebue's naturalist Johann von Eschscholtz. The cliffs had also been investigated in 1826 by a British naval expedition led by Captain Frederick Beechey, an investigation that again turned up the bones of large animals.

Whilst Kellett did not find any trace of Franklin, he did find a spectacular cache of well-preserved mammoth tusks and other bones. As Berthold Seemann later wrote in his published *Narrative of the Voyage of H.M.S. Herald* … 'In 1848 we collected eight tusks of the antediluvian elephant, the largest of which, though broken at the point, was eleven feet six inches long, one foot nine inches in circumference at the base, and weighed 243 lbs. The tusks were accompanied by molar teeth, thigh bones, ribs, and … a great number of … bones, were disinterred.' Altogether, extinct species of mammoth, horse, musk ox and bison were found, along with those of living moose and reindeer species.

Antediluvian beasts

Seemann's 1853 account included comments by the Scottish surgeon and naturalist Sir John Richardson who, along with John Rae, had navigated the Mackenzie River in search of Franklin. Richardson wrote that 'The animals whose osseus remains now engage our attention ranged while living to the shore of an icy sea, and that by some sudden deluge …were swept from their pasture grounds ….we have evidence of diluvial action extending from the *ultima Thule* of the American polar sea so far southwards in the valley of the Mississippi.' This was the common explanation given at the time and was little more than a version of the biblical Flood story.

However, Richardson, like many of his contemporaries realized that such ▶

Illustration of Sir John Franklin's North Arctic exploration. Created by Grandsire and Laly, published on Le Tour du Monde, Paris, 1860

▶ an explanation was becoming increasingly untenable. As he went on ..'I find it difficult, however, to account for the introduction of fossil remains in such quantity…the excellent state of preservation…the recent decay of animal matter shown by the existing odour, quantities of hair found in contact with a mammoth's skull, the occurrence of the outer sheaths of bison horns, and the finding of vertebrae of bovine animals lying in their proper order of sequence, render it probable that entire carcasses were there deposited, and that congelation followed close upon their entombment.'

Within a decade or so there was a revolution in thinking about the antediluvian animals and deposits, which are so common across the landscapes of North America, northern Europe and Asia. A Swiss geologist Louis Agassiz, who had first-hand experience of the effects of glaciation in the Swiss Alps, persuaded British geologists, such as Adam Sedgwick in Cambridge and William Buckland in Oxford, that many features of upland Britain were the result of the action of ice rather than flood waters.

Missing the connection with their supply ship HMS *Plover* and with winter approaching, Captain Kellett was unable to pursue his search for Franklin. HMS *Heritage* returned to England via Hawaii, Hong Kong and South Africa. They arrived back in June 1851 and Captain Kellett dispersed his wonderful finds from the ice cliffs of Eschscholtz Bay to various museums, including the Sedgwick Museum in Cambridge.

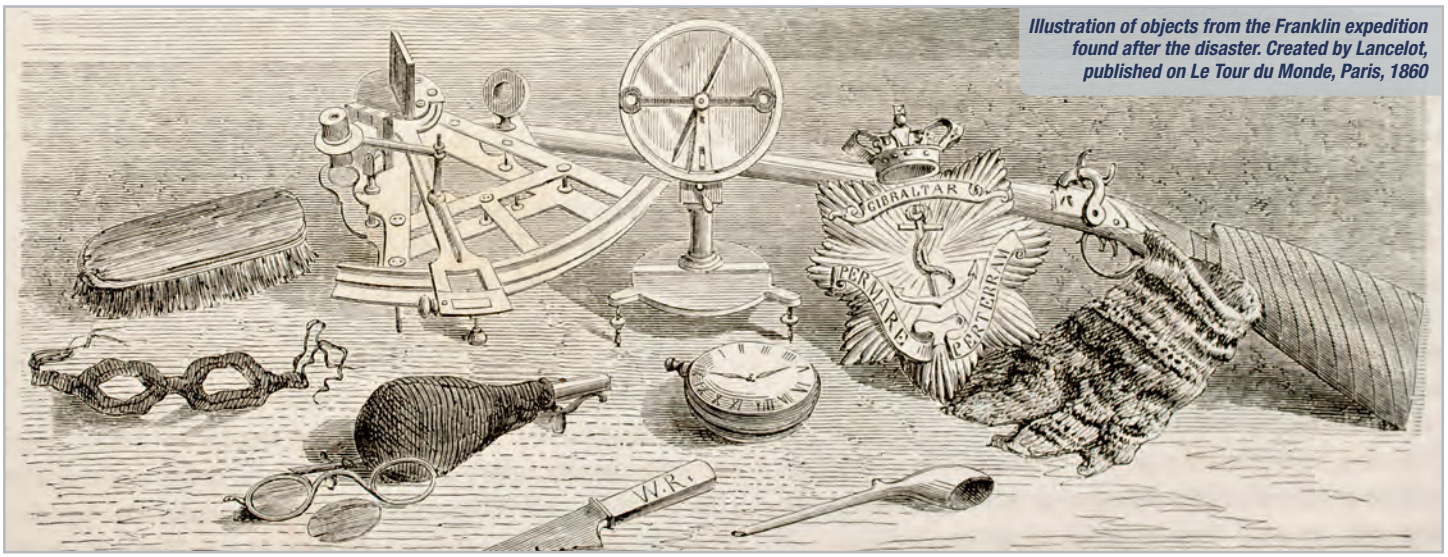


Illustration of objects from the Franklin expedition found after the disaster. Created by Lancelot, published on Le Tour du Monde, Paris, 1860

Finding Franklin today

Eventually, thanks to the combined efforts of the Canadian Coast Guard, Ice Service, Navy, the Government of Nanavut and Parks Canada, along with modern technology, such as sonar and remotely operated vehicles, the wreck of Franklin's ship, HMS *Erebus* was found in 2014 in Victoria Strait offshore from King William Island in the Canadian Arctic Archipelago. Two years later the consortium found HMS *Terror* some distance away in Terror Bay. Divers have recovered large numbers of artefacts, which are now being conserved at a new research facility on King William Island.

Climate Change in the Arctic

The ice cliffs of Eschscholtz Bay and their fossil bones, including Captain Kellett's mammoth tusk, can now be seen as evidence for changing climate within the Ice Age. With lowered sea levels during cold glacials, Asia was connected to North America across the Bering Strait. And, when climates permitted, huge numbers of animals migrated back and forth across this landbridge. At times, animal populations in Alaska were decimated by phases of intense cold and the remains became incorporated into the freezing deposits of the permafrost. Much of that permafrost remains, but is being thawed out by today's rising temperatures.

During the brief summer thaw, melting of the surface of the ice cliffs exposes occasional animal remains that were frozen and preserved in the mud and silt deposits formed during the Ice Age. ◆

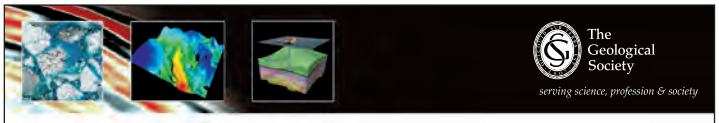
Douglas Palmer is Communications Officer at the Sedgwick Museum of Earth Sciences, Cambridge; e-mail: dp315@cam.ac.uk

FURTHER READING

◆ **Narrative of the voyage of H.M.S. Herald during the years 1845-51** under the command of Captain Henry Kellett, R.N., C.B., by Berthold Seeman. Reeve and Co., London, 1853. 348 pp.

Engraved portrait of Sir John Franklin. Created by Morin and Trichon, published on Le Tour du Monde, Paris, 1860

Kellet's tusk. Held here by Museum staff, the tusk is now on display as part of the Sedgwick Museum's new exhibit on the 'Ice Age'.



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Hydrocarbons in Space and Time

9-11 April 2019

The Geological Society, Burlington House, Piccadilly, London

The global endowment of hydrocarbons is markedly uneven both spatially and temporally. In the 1990s, several key papers recognised that distinct stratigraphic and paleogeographic trends exist and that this knowledge was an important guide to successful exploration. So, what has changed in 30 years?

The industry has moved into new frontiers and basins, drilled deeper, found new plays and gone through a revolution that has brought unconventional resources to the fore. It is therefore timely to consider how our knowledge of the distribution of hydrocarbons in time and space has changed. What new insights have we gained? Can this new understanding be used to be better at predicting new hydrocarbon discoveries?

This 3-day conference will seek to share recent advances and case studies and will be built around four main themes:

- The known global heterogeneity of hydrocarbon resources – including source rocks
- The controls on heterogeneity – including palaeoclimates and geodynamics
- The geological and data science tools to aid prediction
- What our present understanding means for future exploration

Event to be accompanied by a post-conference field trip to the Wessex Basin.

For further information please contact:

Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.
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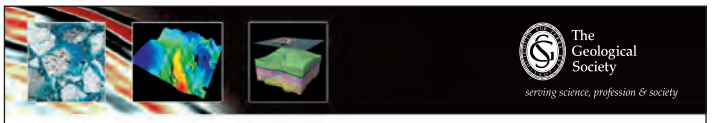

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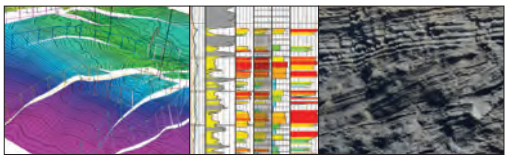
Call for Abstracts – Deadline: 29 March 2019

Capturing Geoscience in Geomodels

26-27 June 2019

Robert Gordon University, Aberdeen



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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.

Call for Abstracts:

Please submit talk or poster abstract to sarah.woodcock@geolsoc.org.uk by 29 March 2019.

For further information please contact:

Sarah Woodcock, The Geological Society, Burlington House, Piccadilly, London W1J 0BG.
Tel: +44 (0)20 7434 9944

PETROLEUM GROUP

At the forefront of petroleum geoscience
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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 to 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.

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

Further information:
For further information about the conference please contact:
Ruth Davey, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J 0BG
T: 0207 434 9944
E: ruth.davey@geolsoc.org.uk
Web: www.geolsoc.org.uk/lyell19
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2019 YEAR OF CARBON

Call for Abstracts

We invite oral and poster abstract submissions for the meeting, and these should be sent in a Word document to ruth.davey@geolsoc.org.uk by 25th March 2019. Abstracts should be approximately 250 words and include a title and acknowledgement of authors and their affiliations.

PETROLEUM GROUP

Petroleum Group Medal & Young Petroleum Geoscientist Award Nominations

Nominations for the Petroleum Group's annual awards are now open.

Petroleum Group Medal Award
The Petroleum Group Medal (formerly Silver Medal) is an annual award presented to individuals with a geoscience background who have made outstanding contributions to the petroleum industry. It can be awarded for excellence in petroleum geoscience and/or management of oil-finding activities. The winner will be presented with the medal at the Petroleum Group Annual Dinner on 20th June 2019.

Early Career Petroleum Geoscientist Award
The Early Career Petroleum Geoscientist Award is an annual award presented to recognise Petroleum Geoscientists in the early stages of their career. Nominees must be within ten years (full time equivalent i.e. it does not have to be consecutive years) of the award of their first degree in geoscience or a cognate subject, and either have already made a significant contribution to the understanding of petroleum geoscience or be an emerging talent who is making a significant impact in the field. Those nominated do not have to be Fellows of the Society. Current Members of the Petroleum Group Committee or the Geological Society Council are not eligible for nomination.

Submissions must be made by 22nd March 2019

For further details please visit the Petroleum Group web pages:
https://www.geolsoc.org.uk/pg_awards **or contact Sarah Woodcock** (sarah.woodcock@geolsoc.org.uk)

At the forefront of petroleum geoscience
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CAN'T FIND YOUR MEETING? VISIT WWW.GEOLSOC.ORG.UK/LISTINGS FULL, ACCURATE, UP-TO-DATE

ENDORSED TRAINING/CPD

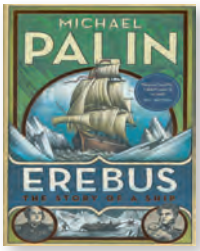
MEETING	DATE	VENUE AND DETAILS
Lapworth's Logs	n/a	Training. 'Lapworth's Logs' is a series of e-courses involving practical exercises of increasing complexity. **Contact:** Michael de Freitas or Andrew Thompson (First Steps Ltd) **E:** office@firststeps-geo.co.uk (mention Lapworth's Logs as the subject)
Geology of Britain: An Overview	25 Feb-1 Mar	CPD course/lecture **Venue:** Green Park Hotel, Pitlochry **E:** annettemcgrath@aol.com **W:** www.geolsoc.org.uk/Higham-Hall-Geology-of-Britain-Course-GPH_Feb19

EVENTS

PLEASE NOTE THAT THERE ARE MANY MORE MEETINGS FOR WHICH WE DO NOT HAVE SPACE. ALWAYS CHECK WITH **WWW.GEOLSOC.ORG.UK/LISTINGS**

MEETING	DATE	VENUE AND DETAILS
Engineering Group: The 2nd Annual Engineering Group's early Careers Evening	13 Mar	**Venue:** Burlington House, London **E:** tom.hall@mottmac.com **W:** www.geolsoc.org.uk/EG-Early-careers-event
The Geoscience and Society Summit	18-21 Mar	**Venue:** Stockholm, Sweden **W:** connect.agu.org/gss/home
The Geological Society Careers and Industry Days	20 Mar	**Venue:** Royal School of Mines, Imperial College London **E:** registrations@geolsoc.org.uk **W:** www.geolsoc.org.uk/careersday18london
9th International Conference on Environment Science and Engineering	20-22 Mar	**Venue:** Leuven, Belgium **W:** http://www.icese.org/

Erebus: The Story of a Ship



Michael Palin's *Erebus* is not only a good read, but also a well-researched account of a remarkable vessel, which helped pioneer the exploration of polar regions in the mid-19th century. Today, H.M.S. *Erebus* is most famous for its tragic loss in the late 1840s, along with its sister ship HMS *Terror*, their 129-strong crews and leader Sir John Franklin, whilst searching for the North West Passage between the Atlantic and Pacific oceans.

However, as Palin vividly recounts, over a four-year period from 1839 to 1843, *Erebus* and *Terror* had successfully taken James Clark Ross and his expedition repeatedly into Antarctic waters from an over-wintering base in Tasmania and brought them safely back to Britain. In our typically British way, Franklin's 'glorious' failure is hugely celebrated, whilst Ross's great scientific achievement is largely ignored. Hopefully, Palin's *Erebus* will help restore the balance.

For geologists it is the Antarctic part of the *Erebus* story that is perhaps of most interest. The 1838 British Association for the Advancement of Science meeting had recognized the need to measure terrestrial magnetism. Scientists such as the astronomer John Herschel [1792-1871] and the soldier-turned-geophysicist Edward Sabine [1788-1883] successfully prevailed upon Lord Melbourne [1779-1848], the prime minister, to support a magnetic survey of Antarctica. For the task, the Admiralty refitted two 'retired' warships, HMS *Erebus* and HMS *Terror*. Known as bomb-ships, their small size, shallow draught and reinforced hulls to withstand the recoil from their armament of siege mortars and cannon, proved well-suited for tackling icy polar seas.

Under the captaincy of James Clark Ross [1800-1862], the aim of the voyage was to help establish a system of magnetic observatories across the southern hemisphere. Scientifically, Ross was supported by his surgeon, Robert McCormick [1800-1890], and the assistant surgeon Joseph Dalton Hooker [1817-1911]. Whilst Hooker was knighted and showered with honours for many subsequent achievements in botany and palaeobotany, McCormick has largely slipped from view. He is mainly remembered for abandoning HMS *Beagle* at Rio de Janiero in 1832, complaining that Captain Fitzroy favoured Darwin and provided him with greater opportunities for collecting.

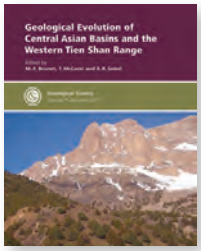
Palin quotes Hooker recounting to his father how McCormick '…takes no interest but in bird shooting and collecting rocks. I am *nolens volens* the Naturalist for which I enjoy no other advantage other than the Captain's cabin, and think myself amply repaid'. Like Darwin, McCormick was an excellent shot. On his return to England, the unfortunate McCormick tried repeatedly for advancement in the Navy and eventually, in 1859 became Deputy Inspector of Hospitals. He even had to privately publish his account of his polar and global seafaring, but this has been republished in recent years (*Voyages of Discovery in Arctic and Antarctic Seas, and Round the World*, by R. McCormick 1884 reprint 2014, Cambridge University Press, 2 vols. ISBN 9781108071710).

Fortunately, Palin resists the temptation to recount the tale as one of his famous '*Ripping Yarns*', but at times it is difficult not to view the ultimately tragic tale of Franklin, *Erebus* and *Terror* as another '*Ripping Yarn*'.

Reviewed by: ***Douglas Palmer***

EREBUS: THE STORY OF A SHIP
by Michael Palin, 2018. Published by: Random House Books, 352 pp. (hbk.) ISBN 978184120.
List Price: £20.00 W: www.penguin.co.uk

Geological Evolution of Central Asian Basins and the Western Tien Shan Range



This volume is made up of 17 papers divided into four sections. Each paper is written to be able to stand alone. The subject area of the volume is large, rugged and remote. The region's location and evolution are explained with respect to the regional tectonic setting of central Asia.

Limited information for this area is available in English, although some translations are available. In addition, access to parts of this area is restricted by either a lack of infrastructure or by conflict. Fortunately, an overview is provided that helps the reader get an overall limited understanding of the geology, tectonics and theory on the evolution of the region, from the Paleozoic to the Quaternary. This introductory paper is followed by several more focused papers that help fill in questions about the geologic history and evolution of select central Asian basins and the western Tien Shan Range, as well as their structural and tectonic setting. Parts of Uzbekistan, Turkmenistan, Kyrgyzstan, Afghanistan and northwestern China, including basins associated with the Caspian and Aral seas, are covered.

The different basins discussed in the volume have undergone varying levels of exploration, mainly for oil or gas. In some areas there has been little or no basin-wide exploration, including field mapping at scales that are helpful to evaluate the potential for oil and gas or mineral exploitation. This reflects the title of the volume and meets the reader's expectations. In addition, some basins have many lithologic complexes that are highly heterogenous over short distances, making accurate mapping difficult. Fortunately, remote sensing data sets, when available, have been useful in large-scale analysis of subsurface and surficial targets. While limited in extent, the volume contains a number of examples of seismic surveys conducted in the region.

Overall, the volume is a helpful general resource for descriptions of the geology, tectonic setting and evolution of select central Asian basins and the western Tien Shan Range.

Reviewed by: ***Robert Anderson***

GEOLOGICAL EVOLUTION OF THE CENTRAL BASINS AND THE WESTERN TIEN SHAN RANGE
by Brunet, M.- F., McCann, T. & Sobel, E.R. (eds), 2017. Published by The Geological Society SP427, 605 pp. (hbk). ISBN: 978-1-86239-738-5
List Price: £120.00 Fellow's Price: £60.00
W: https://www.geolsoc.org.uk/SP427

The Epochs of Nature

This is the first translation into English of this influential text. It was initially published in 1778, and is introduced by the translators and accompanied by a brief essay on Leclerc's life and work. The first thing that strikes me is the literary acrobatics that are performed to avoid a direct collision with the church. The creation story is masterfully examined word-by-word in a valiant attempt to reconcile the science and religion of the day in such a charming way that it would be difficult not to be convinced. This style of thorough investigation, discussion, and persuasion is found throughout *The Epochs of Nature*.

As the first attempt at a geological history of the Earth, and bearing in mind the level of knowledge of the day, this is an impressive feat. Leclerc realises the significance of different rock types and interprets them to be indicative of environmental and sea-level changes. That he correctly deduces that certain marine organisms produce their shells from substances within seawater is quite staggering. Extinct species also appear in the book—before general acceptance of the idea that a species could even become extinct. Everything is supported with extensive notes, letters, and references to museum collections in the justifying notes at the end of the book.

As we now know, there are substantial errors in Leclerc's interpretation of events. This is easy to say now that we have radiometric dating techniques and the theory of plate tectonics, however one can't help but feel that Leclerc was close. If he had gone down the route of cyclicity rather than beginning, middle and end he could have come close to something resembling our modern ideas on Earth's history.

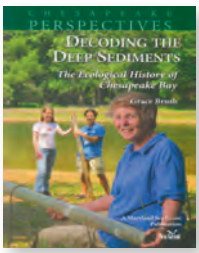
He does lay the foundation for one of our modern ideas: the Anthropocene. Leclerc realised the impact that humans were having on the environment and certainly guessed that we were capable of affecting regional temperatures. Little did he know that the industrial revolution in which he wrote *The Epochs of Nature would* set into motion much greater climatic changes. Yet, his views on brute Nature and civilised Nature hark back to an era of trying to dominate the wilderness, rather than protect it, so perhaps he might have approved of the current situation.

A must-read for those interested in the evolution of scientific thinking, particularly that most complex and interpretive science of the Earth, without which many of us would be out of a job.

Reviewed by: ***Jonathan Scafidi***

THE EPOCHS OF NATURE
by Georges-Louis Leclerc & Le Comte De Buffon, translated and edited by Jan Zalasiewicz, Anne-Sophie Milon & Mateusz Zalasiewicz, with an introduction by Jan Zalasiewicz, Sverker Sörlin, Libby Robin & Jacques Grinevald, 2018. Published by: The University of Chicago Press 190pp (hbk) ISBN: 9780226395432 **List Price: £34.00.**
W: www.press.uchicago.edu/ucp/books/book/chicago/E/bo27847512.html

Decoding the Deep Sediments: The Ecological History of Chesapeake Bay



It was once suggested to me that there are two times when most academics might write reviews: as a graduate student, and towards their career's end, when they show how their lifetime's work fits into the bigger picture of their field's developments. In this short book, aimed at members of the public, Grace Brush looks back on her work on the later Holocene of Chesapeake Bay. This paperback spans her life from the mid-1950s, when she was a graduate student at Harvard University, to her ongoing work.

The estuarine Chesapeake Bay has in post-Colonial times been greatly impacted by human activities on the surrounding land. There is little evidence that the small numbers of pre-Colonial Native Americans caused major changes. Thus, when Europeans arrived in the late 17th century, the land was primarily forested. These forests were cleared for cropland, buildings, firewood, roads, and other needs, such that 20% had been cleared by the 18th century, and 80% by the late 19th century. As the land changed, so did the Bay's estuarine ecosystem.

Grace Brush's work has included mapping the remnant forest types of the Chesapeake drainage basin ("watershed" in American parlance). She and her co-workers identified 18 forest types using indicator species, and documented these forests' relationships with rock and soil substrates. This information proved valuable for interpreting palaeoecological studies of the Bay, which incorporated much evidence from pollen and seeds, as well as other microscopic remains. Work on cores documented the extirpation of the American chestnut in the 1930s and of the American elm more recently. These core studies showed also that the increasing flux of nutrients (especially from sewage and fertilizer) led to an increase in the abundance of diatoms, but this was accompanied by a decrease in their diversity. The foraminifera Elphidium, which favours clear water because it obtains nutrients from chloroplasts derived from consumed diatoms, does not occur in post-Colonial sediment. Populations of polychaete worms (documented using their fossilised jaws) declined dramatically, leading to declines in carnivorous fish species.

Brush's work has contributed to restoration efforts since 1985. This work has been led primarily by appropriate reforestation. It is anticipated that as the water becomes clearer and cleaner, the estuarine ecosystem will gradually reorganise and restore itself.

Brush's monograph concludes with a chapter on the challenges facing women in palaeocological research. She notes especially the problem of juggling research and childcare (and its costs). One wonders if that situation has changed appreciably nowadays.

Reviewed by: ***Brent Wilson***

Decoding the Deep Sediments: The Ecological History of Chesapeake Bay
Grace Brush, 2017. Published by Maryland Sea Grant College, 72 pp. pbk. ISBN 978-0-943676-76-0,
US Price: $12.95 W: https://ww2.mdsg.umd.edu/store/books/cp/

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The long arm of the (geoforensics) law

A recent meeting in London considered both the conventional and unusual applications of geoscience to forensic investigation. Alastair Ruffell, Jamie Pringle and Ruth Morgan discuss the global expansion of forensic geoscience, and how this field is central to keeping geoscience at the forefront of science and public interest.

The term forensic geoscience often draws to mind images of a scientist analysing dirt on a crime suspect's shoes. Important though such analyses are, the field has moved far beyond these humble beginnings and now includes work on spacecraft surfaces, remote sensing of mass graves relating to humanitarian crimes and much more. The Environmental & Criminal Forensics meeting, held at Burlington House, London in December 2018, explored how the regular 'dirt-on-shoes' type analyses have advanced, but also revealed the fascinating widening scope of forensic geology.

Global popularity

The first two meetings on forensic geology took place at Burlington House in the early 2000s and opened many eyes to the uses of geology in serious criminal investigations. The importance and popularity of the field led to the formation of the Forensic Geoscience (specialist) Group (FGG) —with the emphasis now on 'geoscience' to reflect the widening interest and participation in the subject.

Since 2011 The International Union of Geological Sciences (IUGS) has also recognised forensic geology, with the creation of the IUGS Initiative on Forensic Geology (IUGS-IFG) and the two groups are now closely linked.

Scope

Forensic geology emerged in the 19th and 20th centuries with the application of analyses of traces of sand, sediment and soil to criminal investigations. The main questions answered by forensic geologists were in establishing whether a suspect could have been at a crime scene, or their alibi locations, and this type of analysis continues today. However, geoscientific techniques have also long been deployed in the search for buried or sunken items, as well as in the sampling of inorganic materials at crime scenes. Thus, in the last five years, forensic geology has evolved into the application of geoscience techniques to the 'search, scene and sample'. This broadening of definitions and applications was aptly reflected in the presentations at the December 2018 meeting.

Oceans, wildlife and fraud

Geologists have long been involved in oceanography, but less so for forensic applications. A stunning presentation by Agathe Ribéreau-Gayon (University College London) and colleagues discussed the difficulties in searching for human remains on the Atlantic Ocean floor, from a sunken commercial airline flight that tragically crashed in June 2009. The use of geospatial technology to accurately locate the crash site, as well as individual human remains at such great depths depended on accurate oceanographic surveying. A combination of remote sensing techniques meant that remains could be distinguished from the seafloor topography and other debris, and enabled the successful recovery of the remains of many of the victims. The research also highlighted just how little we currently know about the decomposition of human remains in the marine environment compared to the terrestrial. The challenges of working in these 'extreme' environments is further compounded when the complexity of assessing the taphonomic processes and establishing a post-mortem submersion interval (PMSI) in marine environments is addressed. Research in this study sought to establish the key variables in play in this highly variable environment (such as type of clothing, level of trauma pre.- and post- mortem, and activity levels of scavengers) and assess how understanding them better can contribute to an evidence base for establishing a PMSI.

Geoscientific techniques have assisted investigations into wildlife crimes, such as badger baiting or the theft of bird's eggs, since the early 2000s. Typically in such cases, geochemical analyses are used to compare trace materials on equipment used in the crime with traces from the crime scene. However, Kris Wisniewski (Keele University & Staffordshire University) and colleagues showed that geophysical techniques can provide important insights too. They used ground-penetrating radar to plot the location of badger setts and determine which of the setts might have been intentionally—

and illegally—filled in with slurry in an attempt to harm the badgers. Such data has the potential to serve as evidence in an investigation that can build a case that allows crime enforcement officers to prosecute suspects.

Investigations into mineral, metal and rare earth element fraud have increased in past decades, due to the financing of guerrilla warfare, the need for electronics components, and simple stock market manipulation. Examples that come to mind are blood diamonds mined in war zones and then sold to finance an invading army or insurgence, as well as the Bre-X scandal of the 1990s, where Bre-X Minerals Ltd. claimed to have discovered vast gold reserves in Borneo, sending stock prices soaring before the gold samples were found to be falsified. Nelson Eby (UMass, Lowell, USA) and colleagues highlighted this issue in a discussion of the trace element techniques that allow the source for emeralds to be traced, while Laurance Donnelly (IUGS) and colleagues provided a synopsis of the role forensic geology has in such cases.

Drones, faeces and ethics

If the examples above are not enough to convey the widening remit of forensic geology, other presentations at the meeting discussed the use of geodetic and geophysical near-surface surveys to identify not just the location of illegally buried toxic waste, but also the volume and distribution relative to landownership (Alastair Ruffell, Queen's University, and colleagues); the use of drones as a cost-effective approach to aerial photography and remote sensing in the search for clandestine graves (Rykker Evers and Peter Masters, Cranfield University); the use of satellite and aerial image analysis, geophysical surveys and groundwater geochemical analysis to aid the interpretation of signals given by cadaver, or victim recovery dogs in the search for unmarked homicide graves (Laurance Donnelly, IUGS, and colleagues); and the analysis of unusual materials—in one case dog faeces—to establish intelligence in forensic reconstructions (Alastair Ruffell, Queen's university).

> "FORENSIC GEOLOGY HAS EVOLVED INTO THE APPLICATION OF GEOSCIENCE TECHNIQUES TO THE 'SEARCH, SCENE AND SAMPLE'"

Samara Testoni (Federal University of Paraná, Brazil and James Hutton Institute, Scotland) and colleagues described the great advances being made in forensic soil science in Brazil, including the creation of a standard operating procedure, which describes the required steps for collecting and analysing soil samples from crime scenes in Brazil. The analytical procedures involve investigation of the soil's physical, chemical, mineralogical and organic profile.

The talks wrapped up with Lorna Dawson (James Hutton Institute) and colleagues discussing 'geo-ethics' and the essential need for ethics training and accreditation systems for anyone working in the field of forensic geoscience. Lorna presented a white paper outlining the many potential pitfalls in the use of geoforensics from crime scene to court and how a set of guidelines could help prevent potential bias and unethical practices.

Several professional and innovative talks and posters were presented by research students. Their work extends the scientific and global reach of the field and represents the future of forensic geoscience. The visually-impactful poster of Rachael Carew (University College London) and colleagues on 3D Printing in Forensic Archaeology, which even included miniature 3D-printed models of human skeletons, was awarded the Best Student Poster.

Alastair Ruffell (a.ruffell@qub.ac.uk) is a Reader and Jamie Pringle (j.k.pringle@keele.ac.uk) is a Senior Lecturer in Geoscience at Queen's Belfast and Keele, respectively; Ruth Morgan (ruth.morgan@ucl.ac.uk) is Professor of Crime and Forensic Science at University College, London.

DISTANT THUNDER

Pen to paper

Geologist and science writer Nina Morgan provides some advice on how to cure writer's block

Nothing can induce more panic in the heart of many a geologist than the combination of a looming text deadline and the sight of a blank page. If that's you, take heart. You are not alone. Percy Fry Kendall [1856-1936], Professor of Geology at the University of Leeds from 1906-1902, felt exactly the same.

Writing to Herbert E. Wroot [1869-1939], Honorary Secretary of the Yorkshire Geological Society, in October 1928 he confessed:

"While you objurgate I wrestle with my task. I'm sure it is difficult for the practised writer to realise the loathing for the pen that fills the unpractised. I sit down and with many sighs take up the dreaded implement and after scanning the last previous attempt decide that it won't do, so make a fresh start – almost day by day the same irritating round..."

The answer

Kendall's solution? Find a good collaborator. And in this quest, he was lucky enough to team up with Wroot, a writer who joined the staff of the Yorkshire Post in 1920 and contributed a much-loved weekly Nature Lover's Diary, written, as one reader described it "... with charm and exactness ..."

Although interested in natural history, Wroot was not a trained geologist. He had a broad scope of interests in other fields, including history and literature, and published several studies related to the Brontës and edited the publications of the Brontë Society for six years, in the early 20th century. Wroot was also one of the founders of the Yorkshire Dialect Society. He joined the Yorkshire Geological Society in 1909 and was made both Secretary and Editor in 1917. He was celebrated as Secretary for his encouragement of amateur geologists and as Editor for his work to make the academic and professional papers read at the meetings intelligible to the layman.

Perfect pair

In his quest to promote geology for all, Wroot found his ideal geologist and co-author in Kendall. Born in Clerkenwell, Kendall, a studious reader, naturalist and collector, never went to school, but later studied at what is now Imperial College London and the Royal School of Mines. Among his teachers were the geologists Jonathan Sollas [1849-1936] and J.W. Judd [1840-1916], as well as the biologist T.H. Huxley [1825-1895]. In 1891 he became a part-time lecturer at Yorkshire College, Leeds and then, in 1906, Professor of Geology when the College attained full university status.

Academically, Kendall is perhaps best known for his work on glaciology, but he also carried out important research on the Carboniferous Coal Measures, as well as studies of underground water in the Carboniferous Limestone in the Craven Uplands and the source of the River Aire. In addition, he contributed to work on water supplies to villages and towns. He remained at Leeds University until his retirement in 1922. In 1924 he was elected a Fellow of the Royal Society and in 1926 the University of Leeds awarded him an honorary doctorate.

For ten years, from 1912 to 1922 Kendall and Wroot often met on Sunday mornings, when Wroot listened to Kendall discuss his knowledge of the geology of Yorkshire. The upshot, notes Wroot's obituarist in the *Proceedings of the Yorkshire Geological Society*, was that Wroot "came to a better understanding of geology through a knowledge of the life of those who were engaged in it."

Weighing in

The product of these fruitful discussions was a hefty tome, *The Geology of Yorkshire*. The manuscript was completed by 1922, but declined by several English publishers who believed it would be "impossible to make a localised book pay". Rather than allow their work to be wasted, Kendall and Wroot had it printed privately in Vienna in 1924. The book, intended for all interested in the landscape, geology and scenery of Yorkshire, whether amateur, academic or professional geologist, serves both as a geological and a 'tourist' guide to the county. Along with geology, it also features sections such as 'Yorkshire from a railway carriage window' and 'Specimen days in Yorkshire'.

Although it's not clear who actually did all the writing, the fact that this readable book, running to 995 pages and weighing in at nearly 2 kg, came out at all suggests that Kendall really did find the perfect way to conquer writer's block.

End notes: Thanks to Duncan Hawley for drawing my attention to the letter from Kendall to Wroot, which can be found at https://www.bradfordmuseums.org/blog/kendall-wroot-digitization-project/. Other sources for this vignette include the obituaries for Herbert Wroot, which appeared in *Proceedings of the Yorkshire Geological Society*, **24**, 71-75, 1 January 1938 and *Brontë Society Transactions,* **9:4**, 257—259, 1939; a biographical article about Percy Fry Kendall by David Rowe available at www.ypsyork.org/resources/yorkshire-scientists-and-innovatior/kendall; and the obituary of Kendall that appeared in *Nature*, **137**, 692 – 693, 1936.

* **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

Geoscientists in the news and on the move in the UK, Europe and worldwide

West Midlands Regional Group AGM

The West Midlands Regional Group (WMRG) held its annual general meeting in December 2018, at the Birmingham Midland Institute, the current home for the monthly lectures. The committee for 2019 was elected. Stepping down was the chairman, Dan Welch, who served on the committee for six years and had led the group for the past four. 2018 was a very active year for the group with ten evening meetings, four field meetings and a representation with promotional poster at the GA conference at the University of Birmingham.

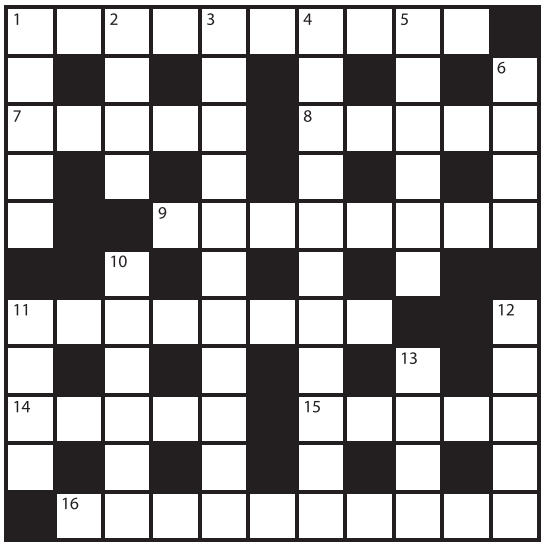
Befittingly, Dan received the very first Certificate of Recognition award from the Geological Society—an award he had proposed at a regional group meeting at Burlington House. The WMRG also awarded him with an inscribed glass memento for his dedicated services.

As his last duty as serving Chairman, Dan had the honour of presenting WMRG awards to the 2019 field trip leaders in recognition of the time and effort taken to plan and lead the widely applauded trips. Receiving the awards were Julie Schroder for leading two walks looking at the building stones of Birmingham city centre, Andrew Harrison for his leadership role examining the Palaeozoic of The West Midlands, and Graham Worton for his leadership around the Wren's Nest Nature Reserve, a site of special scientific interest.

—Ray Pratt, Chairman WMRG

Julie Schroder, Andrew Harrison and Graham Worton receiving their inscribed 2018 field trip leader awards from the WMRG

Dan Welch with his Geological Society Certificate of Recognition and his award for four years' service as WMRG Chairman



Across
1 Rocks forming aquifers worldwide (10)
7 Low-lying water-logged area (5)
8 Ability of a well to produce water (5)
9 An aquifer under pressure (8)
11 Distribution describing the toss of a coin (8)
14 Book size between quarto and octavo (5)
15 - well theory, used to model aquifer boundaries (5)
16 A naiad (5,5)

Down
1 Fish, seaweed and rice (5)
2 He of The Flood (4)
3 Lay one on another as in 15a well theory (11)
4 The action of adding element 8 (11)
5 Of or belonging to deserts (6)
6 Paradise (4)
10 State of needing 4d (6)
11 Opposite of an acid (4)
12 Sounds like a tree growing at the waterline (5)
13 Tree sometimes growing near the waterline (4)

By Bindweed

Solutions February| Across: 1 Ferricrete **7** Chert **8** Beryl **9** Crystals **11** Anorthic **14** Prism **15** Emery **16** Chockstone
Down: 1 Facet **2** Reef **3** Interatomic **4** Ruby Spinels **5** Tarmac **6** Alas **10** Oolith **11** Alps **12** Gryke **13** Zeno

The Society notes with sadness the passing of:

Barber, Peter Marriott
Barnes, Barry *
Blanche, James Bruce *
Bott, Martin Harold Phillips
Cooke, Herbert Basil *
Cornes, Barbara Charlotte *
Dobson, Margaret *
Ireland, Richard *
Kempton, Nicholas Hugh
Lambert, John F *
Manning, Aubrey
Moores, Eldridge *
Okada, Hakuyu
Shrimpton, Godfrey *
Simpson, Ian Morven
Veevers, John James
White, Owen *
Whyatt, Stephen John *

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. The most recent additions to the list are in shown in bold. Fellows for whom no obituarist has yet been commissioned are marked with an asterisk (*). The symbol § indicates that biographical material has been lodged with the Society.

If you would like to contribute an obituary, please email amy.whitchurch@geolsoc.org.uk to be commissioned. You can read the guidance for authors at www.geolsoc.org.uk/obituaries. To save yourself unnecessary work, please do not write anything until you have received a commissioning letter.

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.

Help your obituarist

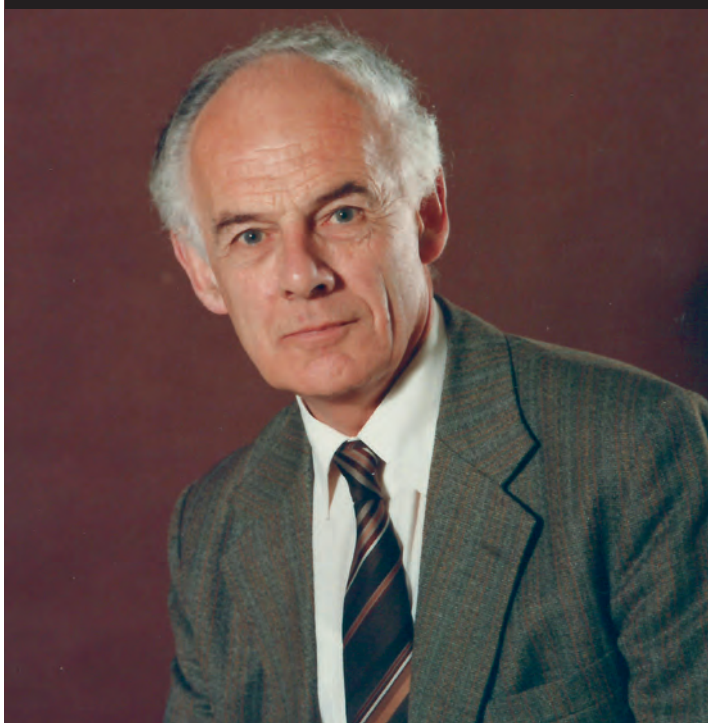
The Society operates a scheme for Fellows to deposit biographical material. The object is to assist obituarists by providing contacts, dates and other information, and thus ensure that Fellows' lives are accorded appropriate accurate commemoration. Please send your CV, publications list and a photograph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

Staff matters

Angela Edwards, Facilities Manager, **Janine Benn**, Fellowship Secretary, and **Will Foreman**, Education Assistant, left the Society last month. The Society wishes them all well for the future and thanks them for their valuable contribution to its work over the years.

OBITUARY Leslie Illing 1920-2018

Pioneer of modern carbonate sedimentology who joined his father's firm and worked with many other greats on the dolomitization problem



Leslie was born in November 1920 in Wimbledon. He attended the City of London Freemen's School, Ashtead and Epson College. He studied geology at Sydney Sussex College Cambridge, but his studies were interrupted by the war when he served in the Royal Air Force. Later he spent two terms at the Royal School of Mines, before returning to finish his studies at Cambridge with First Class Honours in 1947.

Bahamas

He joined Seismic Services Corporation, Venezuela and during a survey of the Bahamas collected bottom samples at each shot point—the material for his future PhD studies at Cambridge with Maurice Black, which he completed in 1949.

Leslie's work on the Bahamas, together with that of Newell and Purdy and that of Robert Ginsburg in Florida Bay and the reef tract, lead to a surge in interest in carbonate sediments and the interpretation of ancient carbonate sequences.

After completion of his PhD, Leslie joined Pemex (Petroleos Mexicanos) and studied the Tambara limestone of Poza Rica, Mexico. Later, he studied the Cretaceous sequence of Guarico Venezuela for Caracas Petroleum and the Paleozoic carbonate sequences of Western Canada for Shell. He argued the change from limestone to dolomite in the Mississippian rocks was produced by movements of fluids through a chain of reefs. He thus introduced the concept of dolomitization by escaping compaction waters.

V C Illing & Partners

In 1960, Leslie, with his wife and four sons, returned to the UK to join his father's company V.C. Illing & Partners and assumed control of its management in 1968. Here he continued his work on carbonate sequences. Among other surveys, together with J.C.M. Taylor, Leslie made a comprehensive survey of the Zechstein carbonates of the North Sea for BP.

In the 1960s Leslie, John Taylor and Roger McQueen investigated, together with Alan Wells and Vic Colter of Shell, the modern dolomitization in the saline intertidal-flat deposits of Qatar, Persian/Arabian Gulf. The association of dolomite and evaporite was reminiscent of many of the rocks Leslie had studied previously: the Mississippian of Western Canada, the Jurassic of Mexico and the Middle East, the Cretaceous of Guatemala and the Tertiary rocks of Libya.

The reduction of exploration by oil companies, after the collapse of oil prices, led to V.C. Illing and Partners closing in 1987.

PESGB

In addition to his consulting and research work, Leslie was a keen supporter of the Petroleum Exploration Society of Great Britain (PESGB). He served on its committee, was its Chairman in 1975 and represented the society on the Organising Committee of the first two North Sea Geological Conferences of 1974 and 1980. Together with the late Douglas Hobson (his father's old colleague), he edited the proceedings of the latter. The Society honoured him by making him an honorary member.

Leslie was a quietly spoken, very kind, courteous person, always willing to listen critically to new ideas. He had a formidable task following such an eminent father, but he did this with great success. Leslie must be considered, in view of his Bahaman and Persian/Arabian Gulf work, as one of the pioneers of modern carbonate sedimentology whose work led to a more sophisticated interpretation of ancient carbonate sequences. His death in January 2018 was preceded by that of his wife Edith in 2017 and he is survived by four sons, four grandchildren and one great grandchild.

➤ By Graham Evans

(The full original piece can be read online. Editor)

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The PESGB's national public outreach initiative

PESGB

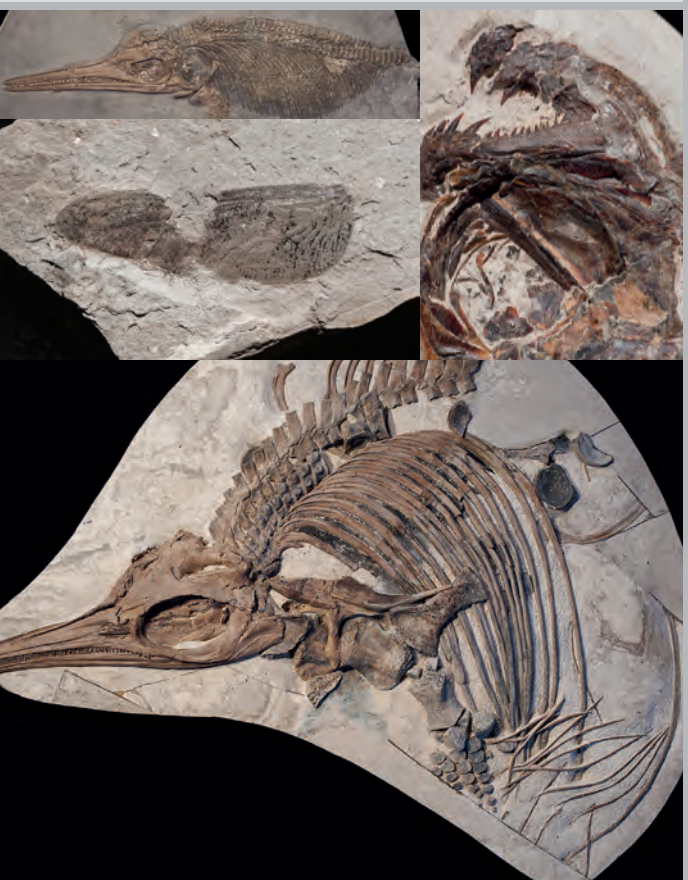
GEOLiteracy TOUR

14-16 MAY 2019

Plumbing the Depths of the Kimmeridge Clay

With Dr Steve Etches MBE

LONDON | BIRMINGHAM | ABERDEEN



Although the Kimmeridge Clay is one of the most highly studied of the world's hydrocarbon source rocks, over the past 100 years its macrofossils have been somewhat neglected. In fact, the Kimmeridge Clay Formation was once described as the 'least interesting suite of rocks' to collect from for palaeontologists studying the Jurassic Period. Dorset, home to the complete Jurassic succession, is a mecca for fossil collectors and many of the major national natural history museums contain material collected from this area. But 35 years ago, when Steve Etches first began collecting from the Late Jurassic Kimmeridge Clay, he soon realised that these strata had been underexplored, underrepresented and specimens had been poorly documented and recorded. His great journey began.

Kimmeridge Bay, East and West, has the finest suite of Kimmeridge Clay rocks anywhere in the world and the Upper Kimmeridge Clay succession has been assigned the International Type Section for these strata. The bay lies along one of the most remote areas of the Dorset Coast. Access may only be made at beach level within Kimmeridge Bay itself, and for 2.5 miles to the east, sections of the beach are cut off at high tide by sheer cliffs and steep headlands. West of Kimmeridge Bay, the coastline falls within the MOD ranges and access is restricted much of the time by live fire practise. There is no vehicular access and the logistics of collecting along this section are difficult and dangerous. For all these reasons, it was apparent to Steve, that collecting from this locality had not previously been carried out in a scientific, ordered, bed by bed manner. He made the decision to collect from these strata exclusively, to fill this palaeontological void.

Steve's talk focuses on the diversity of his collection: the stunning specimens, with many world firsts and specimens still undescribed, and their scientific importance. And, more importantly, the stories around the finds, their painstaking extraction and preparation, to reveal the secrets of these amazing fossils, how they lived, bred and died in the seas of Kimmeridge, 157 million years ago.

Register now for only £20 at

pesgb.org.uk/events/geoliteracy-tour-2019/