The magazine of THE GEOLOGICAL SOCIETY OF LONDON

Geoscientist

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Stromatolites - survivors threatened
St Aubyn Collection on tour
Christmas reader offer!

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Juvenestus sumus

The Lord of Misrule (aka the Abbot of Unreason) used traditionally to surface at Yuletide; but are students today neglecting their ancient duty to make fun of their elders? Ted Nield seeks to excuse a youthful prank…

I recently heard, on very good authority, that at one highly regarded UK Earth science department, postgrads have taken to locking their desks for fear of plagiarism. Good God, what can things have come to?

One might expect this from academics for whom, to paraphrase Henry Kissinger, the stakes have become so low that they have lost all touch with reality. Such is academe's occupational hazard - and is precisely the self-inflation that students used to puncture. But no more; for today I fear, when even an appearance at the tattiest Burco Boiler conference must be made to count for something in the wretched struggle to land the dismalest demonstratorship at the most contemptible lavatory of learning, students have become far too afraid of offending. When this happens, history shows, it is unhealthy for the academy.

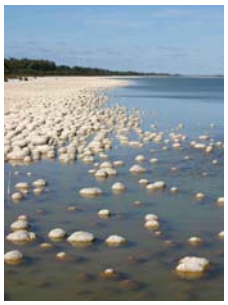
Now - as a postgrad student I once received a registration form for just such a Christmas conference about fossil reefs, which ended with the words: *"I will/not be presenting a paper entitled……".* Ever the editor, I found this irresistible. Over the dotted lines provided I scrawled: "*Granulite metamorphism in NW Scotland*". It was the truth - I had not the least intention of presenting such a paper. I thought no more of it until some months later I was asked for an abstract. Incredulous, I wrote off:

"Following Ilkley, Moore, Bart and Hatt, (1930) granulitic terrains in the Isle of Muck will not be discussed in relation to those of the Isles of Wight, Thanet and Dogs. Recent work not performed by the author, using isotopes of Elysium, Nauseam and Cranium, will not be presented. The work of Webb, Foot, Wardle and Dukinfield (*Acta Geologica Erratica non-grata 12.1*) will not be shown to be applicable in areas (such as the author's) where Cranium quotients fall below expectations."

Now, surely, they would see the joke, I thought. Well, a few days prior to the event my long-suffering supervisor happened to visit the convener. Looking forward to all the kudos he would soon accrue, he said: "I see one of your students is giving a paper!". When supervisor duly avowed no knowledge of this, convener consulted (clearly for the first ever time) the abstract book that had been compiled, typed, cyclostyled and stapled entirely by his school-leaver secretary – and who had in fact been made to organise the whole caboodle.

I might have felt sorry for embarrassing my supervisor, but he was a good egg, thought the prank hilarious, and was happy to see stout party suffer a little fall. For frankly, sending out illiterate forms may be bad enough; but dumping everything on a hapless and unsupervised minion is despicable.

Folly, mischief - and priggish rectitude - are surely the proper preserve of cocky young men. I may have grown out of it now, but I maintain that everyone who abuses their authority needs a good slapping. Students, irreverent ragamuffins since the Middle Ages, should always by instinct be thumbing their noses rather than browning them. Alas, a rising tide of solemnity, debt, RAEs and salami science is killing this ancient tradition off. Time for Yorick to do a Lazarus.



Front cover: Thrombolitic stromatolites in the brackish Lake Clifton, Western Australia. Photo: Ken McNamara. See p16

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Broad Church

Revd. Dr Mark Betson FGS explores some things that the Church and geoscience have in common…*

With a number of articles in *Geoscientist* discussing science and religion and, more specifically, science and the Church, I thought I should say something about what the Church of England (CoE) does to engage congregations (and beyond) in trying to relate what they hear about Earth science with their faith.

The CoE, and the whole Anglican Church, is broken up into dioceses governed by bishops. Within these there exists a dedicated bunch of individuals called Diocesan Environment Officers (DEOs), whose role is to advise on and promote environmental issues. DEOs come from a diverse range of backgrounds and may be lay or ordained people within the Church. Owing to tight financial constraints that apply to everyone nowadays, the role is usually one hat among many worn by the person - who may combine it with an advisory post on social responsibility, or with being vicar of a parish.

DEOs stand on the front line of interaction between bishops and churches of the diocese, and the news of Earth and environmental science communicated in the media. Most are not science specialists, but all are open-minded about what is going on in science, and conscientious about the advice they give. I am sure most will have shared my experience of occasionally holding my head in my hands in disbelief at the lack of concern and complete misunderstanding of things (both environmental and theological) that one occasionally finds. I was once asked, for example, if we should encourage global warming (burn as many fossil fuels as possible), so as to destroy this world and thereby hasten the Second Coming!

Happily this type of view is not common (even in the US, now). Much more common is an earnest desire among churchgoers, priests and bishops, to understand what is going on and what, in faith, they can do about it. Translating that desire into practice is a DEOs' daily challenge - one made especially hard by the information overload (from media, environmental groups and government) about what actions we should be taking.

Having been educated as a geoscientist, worked in an environmental consultancy and now as a trained theologian working in a parish and wearing a DEO hat, I have been privileged to see both sides of the coin. The challenge comes down to something facing many geoscientists who deal with the public and any kind of non-specialist organisations – communication. Simply putting evidence before people and expecting them to see what you see rarely works well. Science is not free from a human element and scientists need to believe in what they are saying - and be ready to have that belief challenged by non-scientists. When that happens, both parties emerge with a better level of understanding of matters that are a concern to everyone. Here endeth the first Lesson!

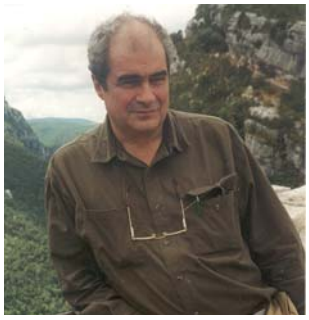
Information on the Church of England's national environmental campaign can be found at:
http://www.shrinkingthefootprint.cofe.anglican.org/

** Diocesan Environment Officer, Diocese of Chichester*

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 ted.nield@geolsoc.org.uk. Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

Contents

Carousel



Paul Marinos (National Technical University of Athens) has been named the 2010 Jahns Distinguished Lecturer. The Association of Environmental & Engineering Geologists (AEG) and the Engineering Geology Division of the Geological Society of America (GSA) jointly established the Richard H. Jahns Distinguished Lectureship in 1988 to promote student awareness of engineering geology trough a series of lectures offered at various locations around USA. Lectures will start in January 2010 and run through June 2010, when Paul Marinos will be on sabbatical in the United States. Requests for scheduling lectures should be directed to Paul Marinos at marinos@central.ntua.gr

All Fellows of the Society are entitled to entries in Carousel. Please email ted.nield@geolsoc.org.uk, quoting your Fellowship number

Poster children

The Anglo American Environmental Geochemistry Poster Competition winners were announced at an evening event in Burlington House, writes Dawne Riddle


Gibson


Lovell


Plant


Tonge

The 2009 Anglo American Environmental Geochemistry Poster Competition winners were announced at Burlington House on October 5. Dr Christopher Oates (Head of Geochemistry, Anglo American plc) told *Geoscientist* that the purpose of the Competition had been "to underline our commitment to improving environmental quality for all by funding a prize for the best poster on environmental geochemistry by a young researcher". Dr Oates, who instigated the Award, also acted as Anglo representative on the judging panel.

The presentation of three awards came at the end of an evening ceremony celebrating the environmental work of Anglo American and their research partner, Imperial College London. President Designate Bryan Lovell (Cambridge University) welcomed the distinguished guests to the Society, and Dr Ian Gibson, former MP and Chair of the Parliamentary and Scientific Committee, thanked Anglo American plc for their generous sponsorship. Professor Jane Plant (Imperial College) reviewed some of the environmental geochemical research currently being jointly pursued by Imperial College scientists in collaboration with Anglo American, including risk assessments associated with Anglo mining operations worldwide.

"Western mining companies have long tradition and depth of experience in managing mines sustainably" said Prof. Plant. "Mining industries in rapidly developing countries like China and India desperately need their help" she said.

Baroness Jenny Tonge, the House of Lords Liberal Democrat Spokesperson for Health, presented the awards to the winners. Anglo offered a total £6000 to be divided among winners as the judges saw fit. Baroness Tonge explained that there had been 30 entrants and seven shortlisted posters, from whom three winners had been chosen.

In third place was Madeleine Bell (Durham University) for *Biochar application to temperate soils: a carbon sink with environmental co-benefits?* . Second came Ramanan Baheerathan (Glasgow University) for *Quantifying Mass transport Processes in Biofilms with Magnetic Resonance Imaging (MRI).* Overall winner in first place was Theresa Mercer, (Hull University) for *The Environmental Impacts of Chromated Copper Arsenate Treated Wood.*


Mercer


Baheerathan

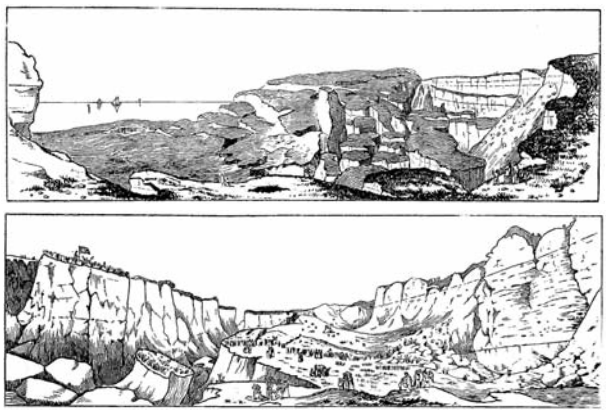

Bell

Photos: Ted Nield

DISTANT THUNDER

Xmas marks the spot

Geologist and science writer Nina Morgan recounts how a rude awakening on Christmas Day put the fear of God into the local population – and revealed some great geology.*



Christmas day 1839 was nothing if not memorable for inhabitants of the Devon town of Axmouth. At 1am on Christmas morning, a labourer named Critchard, returning from Christmas Eve festivities found that the path below the coastline cliff had begun to sink. At 4am he heard 'a wonderful crack'. That night massive fissures on the cliff tops gave way and huge blocks of land subsided towards the sea. The deafening crashing of falling rocks was accompanied by 'flashes of fire and a strong smell of sulphur', and witnesses reported hearing sounds like 'the rending of cloth'. In all around 50 acres of the coastline were severed from the mainland in a massive landslip.

As luck would have it, not one but two eminent geologists and men of God were practically on the spot: The Reverend William Daniel Conybeare, vicar of Axminster; and The Very Reverend Dr William Buckland, Reader in Mineralogy at Oxford University. (Buckland, a native of Axminster, along with his wife happened to be spending Christmas at nearby Lyme.) The two sprang into action to describe the scene in great detail, while Mrs Buckland made several drawings of the newly formed landscape.

Although Conybeare and Buckland were soon able to confirm that the landslip was the result of heavy rainfall the previous autumn reducing beds of loose sand lying below the surface to a semi-fluid quicksand, many popular theories were put forward as to the cause of this 'most extraordinary and terrific explosion of nature'. These ranged from earthquakes to volcanic eruptions, with a good dose of fire and brimstone thrown in. A pamphlet published in London, entitled *A brief Account of the Earthquake, the solemn event which occurred near Axmouth*, described the event as the fulfilment of a prophecy in the Book of Revelation.

But although the landslip caused damage on a truly Biblical scale, many local people soon found ways to profit from it. Farmers charged entrance fees to visit their 'fallen ground', where crops continued to grow. On one day 1000 tickets were sold. Some enterprising locals sold refreshments from their ruined houses, and a new piece of dance music, *The Landslip Quadrille*, was published. In August 1840, when farmers set out to harvest their displaced fields, a grand rustic fête attracted huge crowds of visitors.

Whether Buckland or Conybeare were among them is not recorded. But in any case, they had already received their reward. The opportunity to study such a spectacular example of geology in action must have seemed to them like the best Christmas present ever. Merry Christmas all!

Acknowledgments

Descriptions of the contemporary reactions to the landslip are taken from the paper, *The coastal landslips of south-east Devon,* by Muriel Arber, Proc. Geol. Assoc. Vol. 51, part 3, 1940, pp. 257-71, and *The Life and Correspondence of William Buckland, D.D. F.R.S.* by his daughter, Mrs Gordon, John Murray, London, 1894.

* *Nina Morgan is a geologist and science writer based near Oxford*

If the past is the key to your present interests, why not join the History of Geology Group (HOGG)? For more information and to read the latest HOGG newsletter, visit the HOGG website at: www.geolsoc.org.uk/hogg.

Deaths

• Read obituaries online at www.geolsoc.org.uk/obituaries.

The Society notes with sadness the passing of:

Archer, Alan*
Baumer, A*
Bishop, Richard*
Broadhurst, Fred
Francis, Christopher Michael George*
Knight, Jack*
Mills, Anthony B*
McKinlay, Alex C M*
Purdy, Ed
Truss, Stephen*

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and collects them once a year in its *Annual Review.* 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 (*).

If you would like to contribute an obituary, please email ted.nield@geolsoc.org.uk to be commissioned. You will receive a guide for authors and a deadline for submission. You can also read the guidelines 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 in the next available *Annual Review.*

Help your obituarist

The Society operates a scheme whereby Fellows may deposit biographical material for use by their obituarist. The object is to assist obituarists by providing useful contacts, dates and other factual information, and thus to ensure that Fellows' lives are accorded appropriate and accurate commemoration. Please send your CV and a photograph to Ted Nield at the Society.

Christmas Reader offer

Thunder Egg 101. Thunder Eggs typically form in tennis-ball-sized pockets in volcanic rhyolites. The centre is generally filled with variants of chalcedony - agate, jasper or opal - and, as here, quartz and selenite are often also present. Image available on www.earth.uk.net.

Earth Images

For the Christmas season *Geoscientist* has extended its special offer with Earth Images, the website that features the world's largest private collection of rock and mineral images, available as fine art prints and canvases (see *Geoscientist 19.6*, cover and p7)

The collection, amassed by Richard Weston, professor of Architecture at Cardiff University, has been added to since its spring launch, and for Christmas they have also introduced the 'Favourites Collection', ready-to-hang canvases in presentation gift boxes – perfect Christmas gifts at just **£25 each**.

Here you'll find 20 stunning images from beautifully translucent Fluorites, intriguing Paesina stones, a really fine Thunder Egg and some exceptional Agates. As before, Earth Images is offering a **10% discount to Fellows** on prints and canvases, with a **further 10%** of the purchase price donated to the Society.

Go to www.earth.uk.net and enter code G102 when you reach the basket stage of the online purchase.

The collector

As the Society looks forward to hosting a London exhibition of the St Aubyn Collection, Jessica Shepherd marks the start of its tour by exploring the secret life of a great collector…*

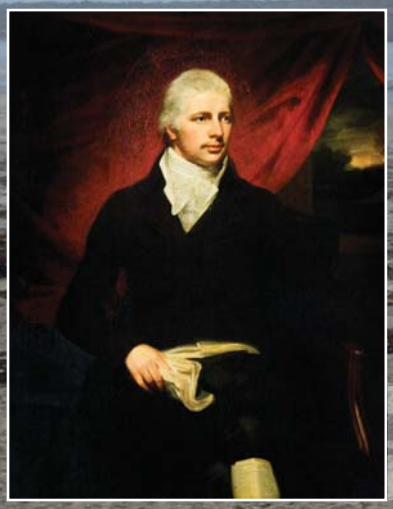
Sir John St. Aubyn (1758-1839) was a collector and a facilitator to the arts and sciences. His particular interest was mineralogy, and he created a sizeable mineral collection containing many specimens, some found by him but most bought from dealers or as whole collections.

Sir John St. Aubyn, 5th Baronet was born in London on 17 May 1758. He was captivated by science and the arts and was a keen collector. His father had been brought up by a Dr. William Borlase, a passionate mineral collector and natural scientist, and his father's interest is likely to have fuelled Sir John's fascination with the natural world.

Sir John was also interested in the arts and collected a huge number of engravings and etchings that were sold at Phillips's Auction Rooms in 1840 in a sale lasting 17 days. Sir John was also a patron of the painter John Opie, and was a pallbearer at the artist's funeral. The remaining few pieces of Sir John's art collection can now been seen at St. Michael's Mount, Marazion and at Pencarrow House, Bodmin.

The St. Aubyn family had two estates in Cornwall – Clowance and St. Michael's Mount, which Sir John inherited in 1772. The 5th Baronet chose to live in London however, because there he could satisfy his taste for fine art and literature. Towards the end of his life, Sir John spent a brief time at Shortgrove Hall, Saffron Walden; but when he moved again in 1834, he donated a collection of minerals to Saffron Walden Museum.

Sir John St. Aubyn is said to have spent a lot of time with a number of young ladies in his youth, but the first to share his home at Clowance was Martha Nicholls, daughter of Clowance's groundsman and a well known



Sir John St. Aubyn (1758-1839), St. Michael's Mount Collection ©

landscape gardener. Sir John never married Martha, even though she bore five of his children. Instead, aged 64, he married Juliana Vinicombe of Marazion, daughter of a farm labourer. She and Sir John had nine children together.

History of the Collection

The origin of Sir John St. Aubyn's mineral collection is unknown, but it must have been substantial by 1794, when he met and employed the French expatriate Count Jacques Louis de Bournon to order his collection. De Bournon is among the most famous mineralogists of the late 18th Century, and was the *prima causa* behind the founding of the Geological Society of London. He eventually returned to France and became director general of the '*cabinet des minéraux*' of Louis XVIII.

Sir John St. Aubyn also spent time with other famous mineralogists of his day. From 1783, he became a friend of Rudolph Erich Raspe, now known mainly as the author of the classic *Travels and Campaigns of Baron Munchausen*, but who was employed by Matthew Boulton and James Watt to oversee mining activities in Cornwall. In 1799, Sir John bought a proportion of the 3rd Earl of Bute's mineral collection from another Society founder Dr William Babington for £3000. He also purchased a smaller mineral collection from the son of Richard Greene in the same year for £100. (Richard Greene of Lichfield opened the first public museum in Britain.)

Sir John St. Aubyn's ability to network and communicate ideas is well represented by the diversity of labels in his mineral collection. He obviously had connections with many dealers during his lifetime. However, surprisingly there are no records of

The Civil and Military Library in Devonport, Plymouth City Museum & Art Gallery ©
It is the closest building on the right and was designed to look like an Egyptian Temple

Sir John St. Aubyn 'The Mineralogist', St. Michael's Mount Collection ©
Sir John with his geological hammer

Juliana Vinicombe, Sir John's wife, St. Michael's Mount Collection ©

St. Michael's Mount, Plymouth City Museum & Art Gallery ©

Sir John's ever being in correspondence with the Cornish collector Phillip Rashleigh, nor do they appear ever to have exchanged minerals. Perhaps the two did not get on!

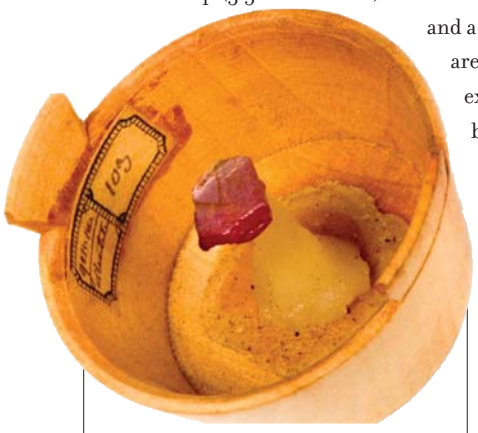
On the 10 August 1839, Sir John died, leaving his estate deeply indebted. Much of his property had already been sold. In 1834, the mineral dealer Isaiah Deck was commissioned to dispose of his extensive mineral collection. At this time Sir John donated a large proportion of his minerals to the Civil and Military Library at Devonport. This collection was later presented to Plymouth City Museum and Art Gallery (PCMAG) in 1924.

St. Aubyn Collection Drawer, Plymouth City Museum & Art Gallery ©

Between 1834 and 1840, a local chemist called John Prideaux catalogued Sir John's minerals. Prideaux had an interest in mineralogy and lectured at the Camborne School of Mines (as well as being an important figure in the abolition movement). John Prideaux catalogued the St. Aubyn collection by placing them in drawers and labeling the panels inside using the system published by Robert Allan in 1834.

Micromounts

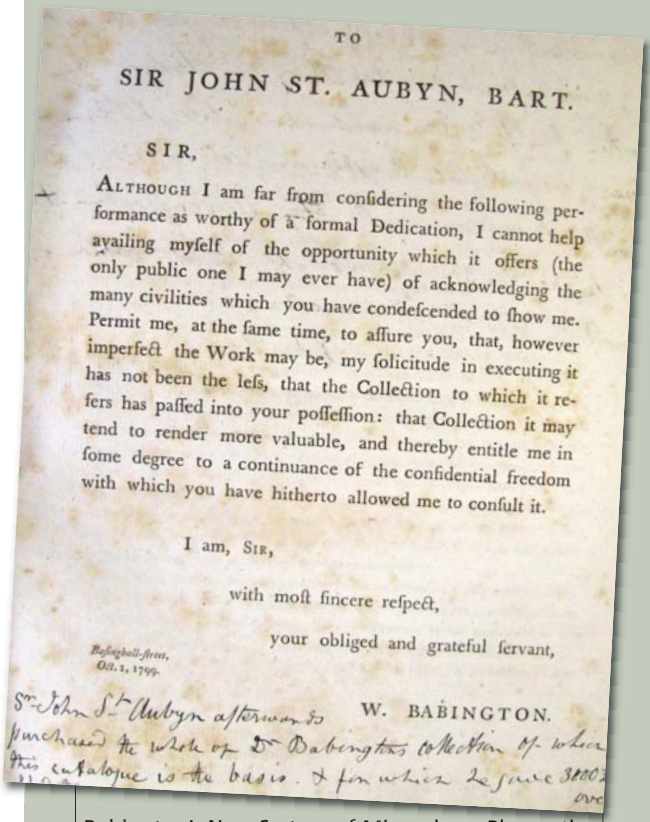
In addition to Sir John's minerals there are approximately 300 micromounts in the collection. Most of these consist of a small wooden cup (3.5cm diameter) with a wax column in the middle and a gem on the top. They are very unusual and extremely delicate, bearing the impressions of the fingerprints of their maker all those years ago. Could these be the prints of de Bournon himself? It is reasonable to suppose that de Bournon made them for Sir John while he was in England.



One of our micromount specimens, Plymouth City Museum & Art Gallery ©
If you look really closely you can see finger prints in the wax columns...

Catalogues

Alongside Sir John St. Aubyn's Collection are several catalogues. In 1799, Babington published a catalogue titled *A New System of Mineralogy*. The catalogue, written using Baron Born's Lavoisierian principles of new chemistry, describes approximately 2000 minerals. This catalogue is important because it describes the minerals that Sir John bought from Babington in 1799, most of which were previously owned by the 3rd Earl of Bute.



TO

SIR JOHN ST. AUBYN, BART.

SIR,

ALTHOUGH I am far from considering the following performance as worthy of a formal Dedication, I cannot help availing myself of the opportunity which it offers (the only public one I may ever have) of acknowledging the many civilities which you have condescended to show me. Permit me, at the same time, to assure you, that, however imperfect the Work may be, my solicitude in executing it has not been the less, that the Collection to which it refers has passed into your possession: that Collection it may tend to render more valuable, and thereby entitle me in some degree to a continuance of the confidential freedom with which you have hitherto allowed me to consult it.

I am, SIR,

with most sincere respect,

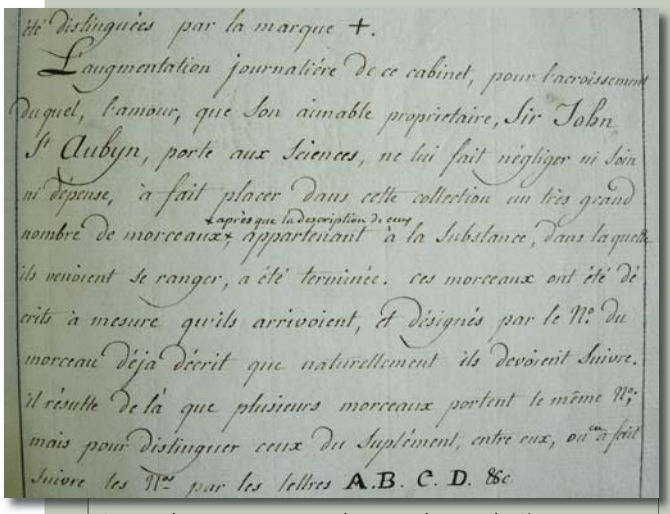
your obliged and grateful servant,

Basinghall-street, Oct. 1, 1799.

W. BABINGTON.

Sir John St. Aubyn afterwards purchased the whole of Dr Babington's collection of which this catalogue is the basis. & for which he gave 3000 guineas

Babington's New System of Mineralogy, Plymouth City Museum & Art Gallery ©
On the front page of this catalogue there is a wonderful piece about Sir John, possibly suggesting that he funded the publication of this book.



été distinguées par la marque +.

L'augmentation journalière de ce cabinet, pour l'accroissement duquel, l'amour, que son aimable propriétaire, Sir John St Aubyn, porte aux Sciences, ne lui fait négliger ni soin ni dépense, a fait placer dans cette collection un très grand nombre de morceaux, après que la description de ceux-ci apparteniant à la Substance, dans laquelle ils venoient se ranger, a été terminée. ces morceaux ont été décrits à mesure qu'ils arrivoient, et désignés par le N.° du morceau déja décrit que naturellement ils devoient suivre. il résulte de là que plusieurs morceaux portent le même N.°; mais pour distinguer ceux du Suplément, entre eux, on a fait suivre les N.os par les lettres A.B. C. D. &c

Count de Bournon's catalogue, Plymouth City Museum & Art Gallery ©
This is one page of many, which was written in French between 1794 and 1815.

Between 1794 and 1815, de Bournon arranged Sir John's minerals so that they followed the crystal structure, as advocated by the Abbé Haüy. But de Bournon never completed his catalogue. We also believe that volume one is missing, which would have described 606 specimens of witherite, barytes, strontianite and quartz.

PCMAG also holds three other catalogues, written in English. One is very large and has pre-printed headings 'Order, Species, and Case' and covers Allan's orders 1-11, so the second volume is missing. Alongside this is an index list of mineral names written in another hand in black ink. The book bears a stamp, indicating that it was bought from Thompson's Commercial Stationers, Old Town Street, Plymouth. This part of Plymouth was severely bombed in the war, and so this book is likely to pre-date 1940. This index also only covers orders 1-11. Lastly, we have Mr Elliot Steele's list of Devonport Minerals, written in pencil and pen, and a number of loose pieces of paper covering many audits over the years.

In recent years, there has been some ambiguity hanging over de Bournon's catalogues, because both volumes were written in French. In 2008, Margaret Morgan (Royal Cornwall Museum) started translating two volumes. One year later, many minerals have been reunited with their French descriptions. Margaret was also able to unveil the mystery behind our triangular labels (picture). It was discovered that Count de Bournon used them as pointers to show something of interest on the specimen. Below is a translated quote where he describes the action of placing this distinctive label on a specimen:

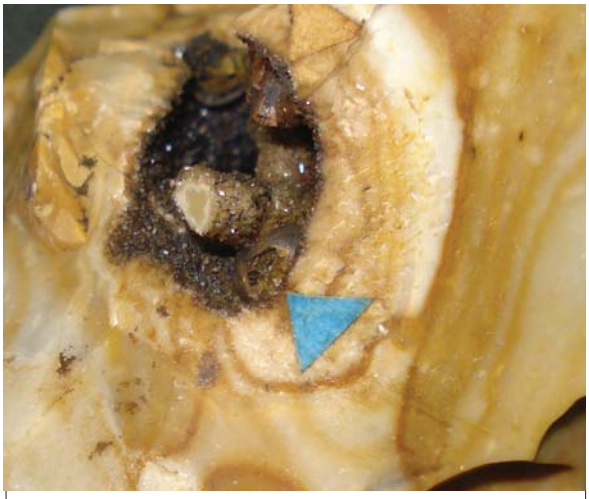
"J'ai indiqué, par un petit morceau de papier bleu, un octaèdre très alongé de la pyrite blanche arsènicale, dont ce morceau enferme plusieurs octaèdres parfaits".

["I have indicated, by a small piece of blue paper, a very elongated octahedron of the white arsenical pyrites, of which this piece contains several perfect octahedrons" (De Bournon, 1815, pp.388).]

We have also discovered during the translation that a number of interesting essays were hidden within the catalogue. These essays are historically important because they were never published and they present de Bournon's ideas about geology almost 200 years ago.

Exhibition

PCMAG will be touring an exhibition about the life of Sir John: *'Sir John St. Aubyn – The Secret Life of a Collector'*. If you want to know more about this unique collection, this exhibition will provide a rare opportunity to see his herbarium and mineral specimens. The tour starts at the Royal Cornwall Museum on the 9th January 2010, and will arrive at the Geological Society, London a year later. For more information, please telephone PCMAG on 01752 304774.



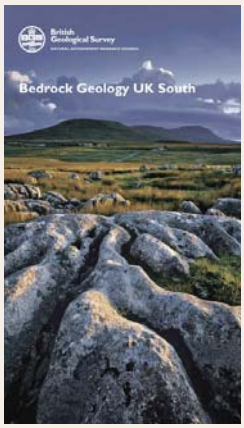
Flint, with a blue Count de Bournon label, Plymouth City Museum & Art Gallery ©

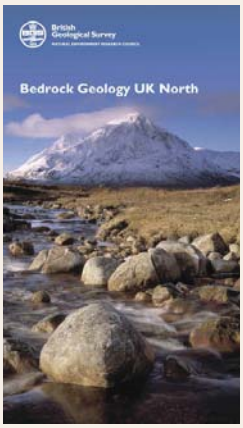
Reviews

Books available for review:

Interested parties should contact the **Reviews Editor, Dr. Martin Degg 01244 392749; m.degg@chester.ac.uk,** only.
Reviewers are invited to keep texts. ***Review titles are not available to order from the Geological Society Publishing House unless otherwise stated.***

1:625 000 Scale Bedrock Geology UK North & South 5th edition 2007 : North [ISBN 978 0 7518 3501 4 flat, 978 0 7518 3502 1 folded and cased] & South [ISBN 978 0 7518 3503 8 flat, 978 0 7518 3504 5 folded and cased], £10 each





Bedrock geology UK North, by P. Stone
Bedrock geology UK South by A.A. Jackson

Published by: British Geological Survey
Publication date: 2008
ISBN: 978 085272585 6 & 978 085272586 3
List Price £10 each and £15 each with folded map in plastic wallet (25% academic discount)

www.bgs.ac.uk

Since these maps were first published in 1948, with indispensable 10km grid lines, there have been considerable advances in our understanding of the bedrock stripped bare of any superficial Quaternary deposits. The maps have been completely overhauled and many (geological!) faults have been added to give a sense of tectonic grain without becoming overwhelming. Furthermore, while the maps can be mounted together and cover the whole of Northern Ireland, they now have a generous 80km overlap across Cumbria and North Yorkshire along with a number of informative cross sections. In addition, an excellent pair of attractive, well written and concise explanatory booklets has been produced to go with each sheet.

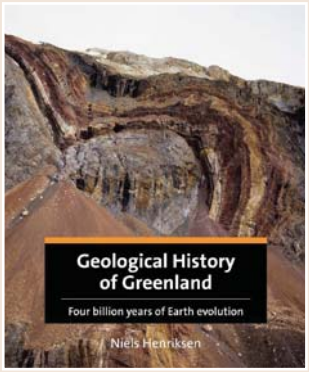
The Precambrian units are placed into a revised framework with modern terminology so they are subsumed into a combined sedimentary and metamorphic index with key horizons dated to within a million years. Only the igneous and meta-igneous rocks remain separated into age-classified intrusive and extrusive columns beneath the main key. While this overall scheme is very simple, quite subtle variations in rock types can be shown by the use of different colour tones to add complexity for those who seek it, without becoming off-putting for causal users. Compared with earlier editions the most striking change is to the southeast of the Great Glen fault in Scotland, where most of the country rocks in the Grampian Mountains are now assigned to the Dalradian.

In much of the North West Highlands the line work has often been completely re-jigged and clearly linked to various thrusts which are neatly traced across country. Though 1:50,000 sheet lines are neatly shown in red, dividing lines for historic Scottish sheets are not shown, as since metrication they are usually published in two halves. Unfortunately the sea is left blank and the coast highlighted by a white zone which ignores and even omits some outlying islands and rocks (Skerryvore for example), and many coastal place names are left unlabeled unlike earlier editions. Conversely, Lough Neagh in the middle of Northern Ireland is coloured in and not even subdued with pale tones. While the shores of large lakes can usually be picked up, this is disconcerting.

In northern England the recently revised distribution of the Lias to the west of Carlisle has been omitted, though the Isle of Man is now mainly Ordovician sediments, which was apparent long before the 4th edition was published in 2001. Compared with earlier editions the Jurassic has been simplified, while the Carboniferous has been improved with additional units and the monolithic Lower Old Red Sandstone replaced with four units which cast Herefordshire in a totally different light. Clearly, like Mid-Wales, Cornwall and South Devon have undergone a radical overhaul as the use of regional variations in the index and addition of a series of southward dipping thrusts and linking faults present a much more coherent picture.

The next priority must be to produce a pair of maps showing superficial deposits at this scale. This will take some doing, as along with ongoing mapping this requires a modern synthesis as radical in its own way as the overhaul of the Precambrian coverage on these excellent bedrock geology maps.

David Nowell, New Barnet, Hertfordshire



Geological History of Greenland – Four Billion Years of Earth Evolution

Niels Henriksen
Published by: Geological Survey of Denmark and Greenland (GEUS)
ISBN: 978-87-7871-211-0
List price: £43.99
272pp

www.gazellebookservices.co.uk

This beautifully produced volume summarises the results of more than 60 years of geological investigations in Greenland and the surrounding shelf areas. Greenland's exceptionally well exposed mountainous arctic landscape preserves evidence for close to four billion years of Earth evolution and continues to attract significant international research interest. The substantial areas of Precambrian basement exposed have in particular yielded crucial insights into the evolution of the early Earth. Generations of UK university researchers have participated in the summer expeditions that mapped this remote terrain and contributed to present understanding.

The key features of the volume include its generous size (30 x 25cm), the splendid photographic images and accessible colour diagrams, and the way in which has been presented in a form that is suitable not only for the general, interested reader, but also for students and geologists without specialist knowledge of Greenland geology. Introductory chapters set the scene, with a brief review of Greenland's geological evolution from the Eoarchaean to the Quaternary, a history of research, and a synthesis of the way in which ice has moulded the landscape. Then follow chapters that deal in turn with the crystalline basement, the Gardar Province, Proterozoic to Ordovician sedimentary basins, the development of the Caledonian and Ellesmerian fold belts, Upper Palaeozoic to Palaeogene basins, and Palaeogene volcanism. Summaries of the geology offshore and the Quaternary glacial history are followed by chapters on mineral, oil and gas resources. All are copiously illustrated with a mix of field photographs (including numerous stunning images of mountain-scale structures and rock successions), palaeogeographic maps and other specially drawn colour diagrams (e.g. sketch cross-sections, sedimentary logs, geophysical profile).

The diversity of geology within Greenland means that no major processes are left untouched within the book. Highlighted blocks of text accompanied by well presented and easily readable diagrams explain basic geological concepts for the non-specialist as the book progresses. These include subjects as wide-ranging as basic rock identification, geological mapping, deep-sea drilling, and the generation of oceanic crust. This is a particularly strong feature of the book. Indeed, it could be argued that this is just as effective an introductory text book for geology undergraduates as any of the commonly used examples in the UK and abroad. In summary, this is an outstanding contribution to the Earth sciences literature. It is one of the best books available on geology for a broader public, but will still manage to satisfy the academic or industry-based geologist who wishes for an update on the geology of this perennially fascinating piece of the Earth's crust. No library should be without a copy.

Rob Strachan, Portsmouth

Letters

Geoscientist welcomes readers' letters, and every effort is made to publish them as promptly as possible. You can help by keeping letters to around 300 words or fewer. Please write to **Dr Ted Nield,** Editor, at The Geological Society, Burlington House, Piccadilly, London W1J 0BG or email ted.nield@geolsoc.org.uk.

All letters are published at **www.geolsoc.org.uk/letters,** and a selection subsequently presented in the magazine. Please note that letters may be edited.

Online only Journal? Bring it on!

From John Milsom (Rec'd & Pub'd 7 October 2009)

Sir, I have been surprised by the complete absence, in either the pages of *Geoscientist* or in your more capacious on-line mail box, of letters in support of the switch to an electronic option for the Society's journals. I would like to rectify that. The opponents of this change seem to me to be lacking in any sense of proportion, and sometimes compound that by being needlessly offensive (viz. Stephen Dulson and his reference to "nerdy teletubbies").

Stephen calls the £10 annual charge outrageous, and Tim Horscroft twice describes it as punitive, yet it is less, per issue, than the cost of a Sunday newspaper. Given the catalogue of benefits the opponents of the change claim to derive from their paper copies, I would have thought that they would be prepared to "stump up" (Peter Sykes) at least that much.

Nor have I much respect for the logic shown by those who suggest that pdf-only users be given a discount, rather than the paper-copy brigade be surcharged. This is pure semantics – the net real result is still that one group pays more than the other. And if this move is, as Peter fears, not merely a laudable attempt to save money but also "some green carbon-friendly policy", then am I only Fellow who welcomes it? For me the new regime will be a welcome release from the embarrassment at having this expensive-to-produce, hard-to-recycle and impossible-to-shelve publication regularly arriving on my doormat.

Clearly, I use my *JGS* rather differently from your other correspondents, most of whom either state or imply that they read it avidly from cover to cover. That is not the way that I treat it. For me, the most important part of the *Journal* is the back cover, where I may find listed one or two papers that I must read, a number of others that I would like to read if I get time, some that, while not immediately interesting I know I might read in the future if my work takes a certain path, and a number that I know I will never read or ever want to. I make no apology for this selectivity. It is not an indication, as Stephen seems to suppose, that I do not keep myself up-to-date with research, but an acceptance on my part of the fact that to do so I am going to have to read articles in many journals and not just in the *JGS*. I do feel that those who claim that their interest would wane if they could not receive a paper copy cannot have been very interested in geology in the first place.

London platform – mind the gap

From Hugh Owen (Rec'd & Pub'd 14 October 2009)

Sir, With reference to the article by Michael de Freitas and Katherine Royse (*Geoscientist 19.10 pp 20,21*) the revisiting of the London Platform is to be applauded. It allows the re-opening of the vexed question of the "Variscan Front" of authors in relation to the southern boundary of the Platform.

The difference of opinion regarding this alleged Variscan structure is well illustrated in the revised Thames Valley Regional Guide (Sumbler *et al.* 1996). The available deep borehole data indicate that this so-called Front is a Jurassic-Cretaceous boundary structure and there is no evidence that it is of Variscan origin. The evidence available indicates a massif of late Palaeozoic origin (Variscan), the London – Brabant Massif, progressively on-lapped by early Mesozoic sediments and probably completely submerged in England by the Oxfordian. Late Jurassic sediments are preserved within graben structures in the southern area of the London Platform (e.g. Plumptre 1959, Owen 1971). Major rift faulting occurred at the Jurassic-Cretaceous boundary, with elevation of the London Platform and subsidence of the Weald graben, the bounding fault being a little north of the modern Chalk cuesta face.

The Early Cretaceous sedimentation history of the subsiding Wealden graben is one of the erosion of the Jurassic and subsequently Palaeozoic sediments of the highlands of the Platform to the north. This analysis led Perce Allen (e.g. 1976, 1981) to revise his concept of the Wealden environment in southern England. It also sparked off the search for oil in the region immediately to the south of the bounding fault. Movement along a similar trending fault along the Thames line led to the removal of Lower Gault over the northern London area and there is some evidence of instability along this line within the Chalk.

Subsequent rejuvenation of the southern bounding fault with a southward directing thrust is evident in the Gault south of the Chalk cuesta face at Shere, Surrey (Owen 1963) and in the M20 cuttings between Wrotham and Hollingbourne. The evidence here is of an early to mid-Pleistocene date after the formation of the sea-cliffs of Chalk now the Chalk cuesta face.

References available online.

GEOMETRY course

A new teaching borehole array is being created by Newcastle University hydrogeologists, reports Adler deWind

Newcastle University's School of Civil Engineering and Geosciences is constructing a borehole array as a practical teaching tool for their Applied Hydrogeology MSc course. The six boreholes, all 50m deep, are arranged in a cruciform pattern with each borehole set at a different distance from the central pumping well. Located on the University's farm at Cockle Park near Morpeth, the boreholes penetrate sandstone in the Stainmore Formation just below the Namurian/Coal Measures boundary. They have been arranged with one row running along the dip and the other along the strike to give geological variation. Geoff Parkin, Director of Post-Graduate Studies said: "In addition to providing facilities for demonstrating techniques of borehole design, construction and operation, the boreholes will also be used to study borehole and aquifer hydraulic behaviour and monitor the local groundwater environment".

The borehole array has been given the name GEOMETRY (Groundwater Engineering, Operation, Monitoring, Evaluation and Testing (L)aboratoRY) and is the latest addition to the School's series of full-scale Earth Systems Laboratories that include instrumented river catchments, an infrastructure embankment, mine water remediation sites, a sustainable urban development area and geodetic monitoring.

Rick Brassington, Visiting Professor of Hydrogeology said: "The GEOMETRY Project has only been made possible by the generous support of nine industrial sponsors that are involved in geoscience, groundwater and water supply industries. Work started in September with the aim of having the boreholes ready for students to use in the current academic year".

Farm-in

Banks Mining, a North-East based energy company, provided their in-house drilling team to construct the boreholes. Water-well casing was donated by Marton Geotechnical Services Ltd and headworks, casing and pipes were given by Blair Drilling Ltd. Dales Water Services Ltd has carried out a yield test and a submersible pump is being donated by Grundfos Pumps Ltd. The pump will be hung on Wellmaster rising main, donated by Angus Flexible Pipelines and will be installed by J.P. Whitter (Water Well Engineers) Ltd. The boreholes will be geophysically logged for detailed geological and groundwater related information by European Geophysical Services Ltd and will be instrumented using Diver groundwater level data loggers provided by Schlumberger Water Services.

Banks drilling rig at Cockle Farm

View showing line of boreholes along dip. Photos: Rick Brassington.

Funny old world

Unconsidered trifles, by 'Snapper'

Martyr dumb

Prof. Dick Selley, returning from a field trip to study the *vendange* on the *Côtes de Cornubia* (where a bumper vintage is forecast) reports reading *en route* a tourist brochure, urging trippers to "Visit the Jurassic World Heretic Coast". Presumably it was written by a creation scientist.

***Monitors**: Dick Selley. All contributions gratefully received. Please write to the Editor at Burlington House, or email* ted.nield@geolsoc.org.uk *marking your submission 'snapper".*

• *Most GeoNews appears first in Geoscientist Online* •

IN *Brief*

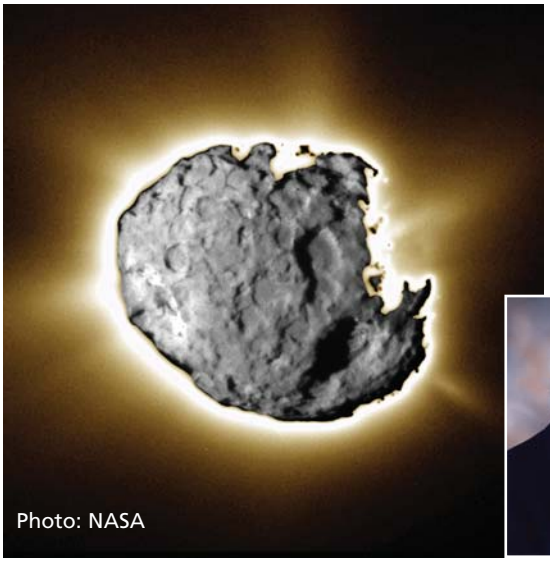


Photo: NASA

Joe McCall writes: Particles retrieved from the tail of comet Wild-2 by NASA Spacecraft Stardust have been exhaustively examined, and care taken to distinguish cometary material from terrestrial contaminants. Glycine has now been positively identified, an amino acid which is a fundamental building block of proteins[1]. Chains of amino acids are strung together to form protein molecules in everything from hair to enzymes that regulate chemical reactions within living organisms.

Amino acids have been found before in primitive carbonaceous chondrite meteorites, such as Orgueil, France and Murchison, Australia; but those from meteorites yield equal amounts of right-handed and left-handed molecules, whereas as Pasteur discovered, life processes always favour right-handedness[2]. This is the first discovery of an amino acid in cometary material. Glycine is recorded as being the only optically inactive amino acid[3], so I am not sure whether any biogenicity test can be applied.

It is claimed that this discovery supports the idea that the building blocks of life are prevalent in space, strengthening the idea that life in the universe may be more common than we think.

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2. Bevan, A & de Laeter, J 2002. Meteorites - a journey through space and time. Smithsonian Institution Press, Washington, D.C. & London, 215 pp.

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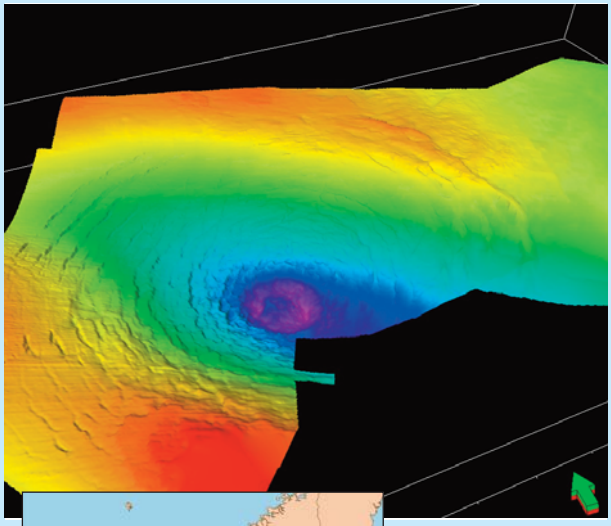


Silverpit "crater" in false colour (red/yellow = shallow, blue/purple = deep). Released under the GFDL with the permission of the copyright holders. Credit and copyright: Phil Allen (Production Geoscience Ltd) and Simon Stewart (BP).

Prof. Simon Stewart (Heriot-Watt), Julian Rush (Channel 4 News), Prof. John Underhill (Edinburgh University).

The vote recorded an overwhelming (80:20) majority against the impact hypothesis (red).

• *Most GeoNews appears first in Geoscientist Online* •

Silverpit
"not impact crater"

A Petroleum Group debate voted overwhelmingly against the hypothesis that the Silverpit Structure (North Sea) was caused by meteorite impact. Dawne Riddle reports.

Science, as we all know, is not a democracy and being popular is not the same thing as being right. However if the majority view counts for anything, then a recent debate at the Geological Society has indicated that the less glamorous "withdrawal" hypothesis for the origin of the Silverpit Structure (S. North Sea) has now overtaken the impact crater idea, which (in a sign of the times) was portrayed throughout as the "traditional" explanation.

The crater-like structure was discovered by petroleum geoscientists Simon Stewart of BP and Philip Allen, then of Production Geoscience Ltd, during routine analysis of seismic data. Allen noticed an unusual set of concentric rings and hung an image of them on the wall of his office, hoping someone else might be able to shed light on the mystery. Stewart, visiting the company on an unrelated matter, saw the image and suggested it might be an impact feature. The discovery coupled with the impact hypothesis were reported in *Nature* in 2002. Since that time considerable debate has surrounded the idea, with other geologists – notably Prof. John Underhill of Edinburgh, advocating some form of collapse due to the withdrawal of material – salt - from below.

The debate, which took place on 6 October, formed the first of a series of Petroleum Group debates sponsored by BP and attracted an audience of over 100. Channel 4 News science correspondent Julian Rush opened the proceedings and chaired the debate. Speaking first, Simon Stewart presented a simple model that in his view was diagnostic for any withdrawal structure, namely that the profile of collapse should be traceable throughout the section below the structure and the zone of withdrawn material. He contended that this condition was not fulfilled in the seismic sections of Silverpit, and adduced other lines of evidence – such as the (disputed) central "rebound" spike – which he said could not be explained by withdrawal.

Speaking for the opposing view, John Underhill presented a detailed analysis of the structural trends in this part of the North Sea, including new data on the presence of NW-SE trending dykes (related to the igneous centres on the Isle of Mull, invisible on older, low-resolution scans). These, he believes, are what mobilised the salt and then initiated its withdrawal in the Paleogene. Underhill maintains that his theory is consistent with aeromagnetic results, the known extent of the distribution of devolatilised coal and unusual Chalk diagenesis and velocity effects. Underhill further suggested that the correct interpretation of these structures would have commercial implications for prospectivity through depth conversion and the understanding of Bunter gas occurrence – and, crucially, of the gas's chemical and isotopic composition.

The audience, made up dominantly of hydrocarbon industry seismic interpreters with a scattering of researchers and academics, preferred the Underhill model - for which, after a 20-minute period of debate, they voted overwhelmingly, 80:20.


Rush


Underhill


Stewart

Photos: Ted Nield

• *Most GeoNews appears first in Geoscientist Online* •

Stromatolites -

Ken McNamara investigates the slime that ruled the Earth for billions of years*

Tucked away at the southern end of Shark Bay in Western Australia is a quiet spot called Hamelin Pool. It's a rather unusual place. The seawater here is twice normal marine salinity, and the beach is made of billions of fingernail-sized shells of the bivalve *Fragum erugatum*. These bivalves are one of the few forms of life able to live in this hypersaline water, along with sea-snakes – and stromatolites; for it was here, in the 1950s, that scientists first realised that these structures - hitherto known only from the fossil record - were still forming today.

Rising from the sea like serried ranks of concrete cauliflowers, these domes of aragonite are essentially living rocks, each having been constructed by benthic microbial communities, dominated by cyanobacteria, along with sulphate-reducing bacteria, microalgae and true bacteria. Formerly known as blue-green algae, the filamentous and spherical cyanobacteria are, like the microalgae, photosynthetic. Only in the last few years have we begun to understand the complex sequence of events by which different microbial communities construct these living rocks. Moreover, the discovery of a number of other different types in a variety of lakes in south-western Western Australia is showing that the archetypal Shark Bay stromatolites may not be as typical as once thought. These other stromatolites are also, intriguingly, providing insights into the reason for the great decline in stromatolite diversity that took place during the late Proterozoic. Because not only does Western Australia boast arguably the world's greatest diversity of modern stromatolites, it also possesses their richest fossil history - including the earliest evidence of life on Earth (early Archaean, Pilbara region).

**Department of Earth Sciences, University of Cambridge, UK*

great survivors under threat

Layers of meaning

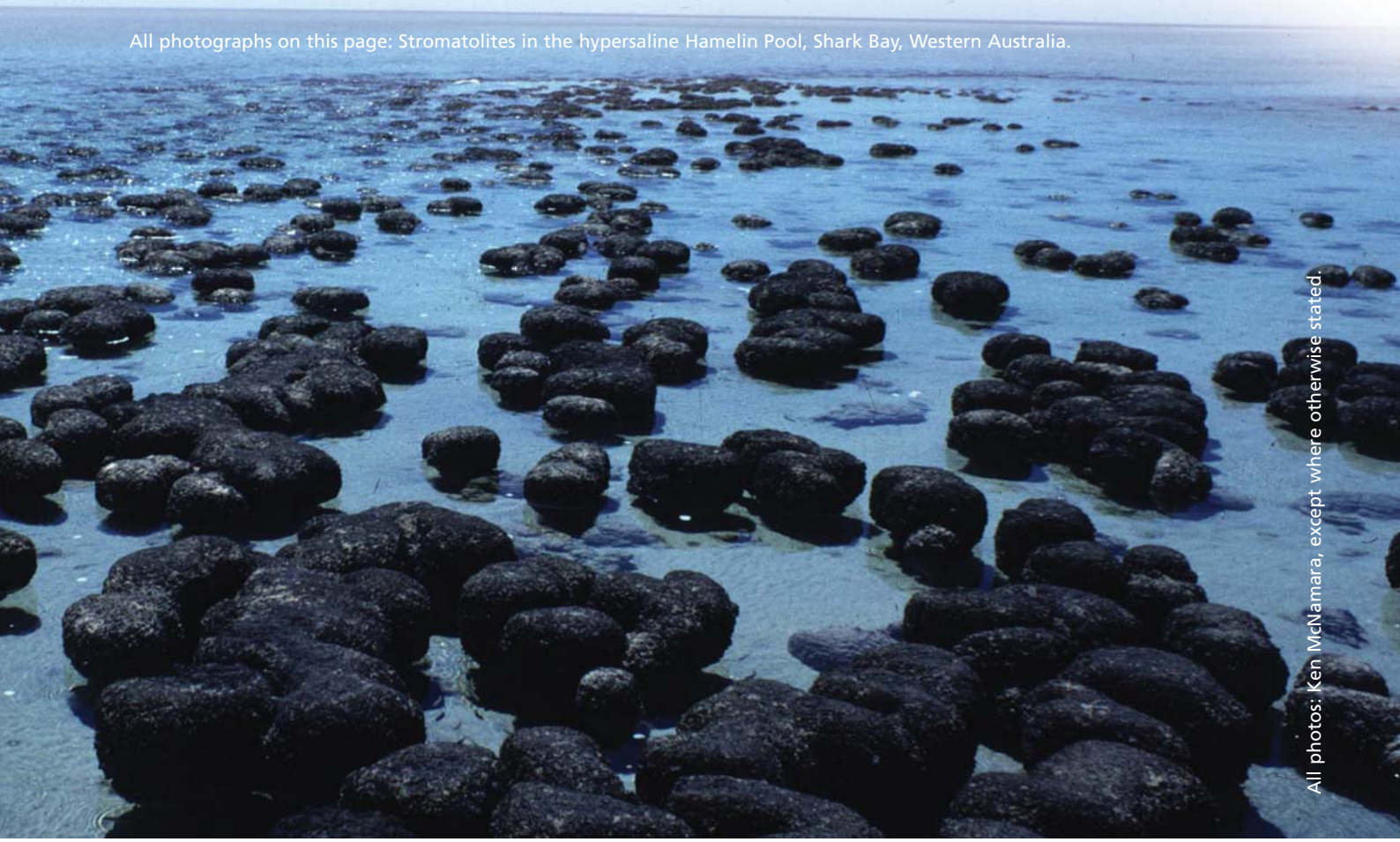
Stromatolites were first identified as discrete organosedimentary structures in 1908 by Ernst Kalkowsky, Professor of Mineralogy at Dresden University. Kalkowsky recognised some Triassic sedimentary rocks from the Harz Mountains in Germany as unique; he correctly interpreted these rocks, built of thin, domed layers of sediment, as being of microbial origin. He named them *stromatoliths* from the Greek *stroma*, meaning layer and *lithos* meaning stone, so giving rise to the modern term stromatolite.

In this article I follow a number of authors in using the term stromatolite in the broad sense of carbonate structures constructed by benthic microbial communities, whether layered or not. Other authors use the synonymous term 'microbialite'. I use the term thrombolite as a variety of stromatolite that is formed almost exclusively by microbially-induced precipitation, that lacks much or any internal lamination. Such stromatolites have a characteristic clotted structure.

Modern stromatolites

Stromatolites are constructed by the activity of microbial communities that trap and bind sediment, but are also able to precipitate carbonate minerals. Researchers from the University of Miami, led by Pam Reid, have recently discovered the intricate way in which stromatolites are constructed by studying ones that flourish in shallow, warm seas around the Bahamas. This research has revealed how a complex sequence of changing benthic microbial communities colonise and then build the stromatolites. Of vital importance to how they grow is the dynamic balance between the rate of sedimentation and periodic biomineralisation by the colonies of microbes living on the stromatolite's surface.

Bahaman stromatolites are built in four phases. Firstly, a pioneer microbial community is established which is dominated by filamentous cyanobacteria (mainly *Schizothrix*) that arrange themselves vertically, then wrap around grains of sand, trapping them in a mucus-like film. These are then replaced by another microbial community containing quite different microbes, known as 'heterotrophic' bacteria. These



All photographs on this page: Stromatolites in the hypersaline Hamelin Pool, Shark Bay, Western Australia.

All photos: Ken McNamara, except where otherwise stated.


Thrombolitic stromatolites in the brackish Lake Clifton, Western Australia.

new bacteria are basically organic sludge-degraders, similar to the type that decompose compost heaps. These bacteria form a continuous mucilaginous sheet on top of the first layer of sediment. Next, a third group of bacteria comes to the party. These are sulphate-reducing bacteria that, by feeding on the mucus-like film left by the first community, promote the growth of aragonite crystals and the formation of a thin crust.

The fourth, and final, bacterial community to colonise the surface is dominated by spherical coccoid cyanobacteria (mainly *Solentia*). These are active microbes that bore into the previously crystallised aragonite crust, leaving behind tiny tunnels that become filled by new crystal growth - a sort of bacterial reinforced concrete. Rather than destroy the mats' fabric, these cyanobacteria contribute to the construction of the stromatolite. This sequence of colonisation by different types of bacterial communities is repeated thousands and thousands of times, resulting in the slow growth (0.1 to 0.5mm per year) over hundreds, or even thousands, of years.

Although the perception has been that when fossil stromatolites are found this indicates hypersaline conditions, because of the environment in which they form in Hamelin Pool, this is not the case. Salinity probably has little influence on their development. Moreover, arguments that the lack of grazers on the Hamelin Bay stromatolites is due to hypersalinity - implying that the Proterozoic decline in stromatolite diversity was caused by there being more grazers – are not supported by observations on other Western Australian stromatolites.


Stromatolites in the saline Lake Thetis, Western Australia.

In Western Australia stromatolites are also known to occur in saline lakes (Lake Thetis), brackish lakes (Lake Clifton and Lake Walyungup) and freshwater lakes (Lake Richmond). What these sites, along with Hamelin Pool, have in common is that they are found close to limestone (the coastal Pleistocene Tamala Limestone, an aeolian calcarenite). This means that the groundwater feeding the lakes is rich in calcium bicarbonate. The other significant factor that determines whether stromatolites form is that the groundwater providing the carbonate for construction should be low in nutrients. This means that the microbial communities have very few competitors. In other parts of the world stromatolites have been found growing in what are, to most organisms, highly stressful environments. Hot springs in Yellowstone National Park, USA, freezing lakes in Antarctica, and highly alkaline lakes in East Africa all contain stromatolites - but few nutrients to encourage competing organisms.

Microbial communities construct stromatolites in two ways. One is by trapping fine sediment with a sticky film of mucus that each cell secretes, then binding the sediment grains together with aragonite precipitated from the water. Because the cyanobacteria are both photosynthetic and able to move toward the light, they can keep pace with the accumulating sediment. They therefore always remain on the outer surface of the stromatolite. Some of the Shark Bay stromatolites are formed by this method, but others form in the second way - mainly from the precipitation of aragonite, forming a framework that incorporates little sediment.

This variability in internal structure depends on their position relative to the shoreline, as hydrodynamic activity affects the amount of sediment in the water, while water depth affects the components of the microbial communities. Understanding the subtle difference in their morphology at different water depths is potentially very important in interpreting the palaeoecology of Precambrian stromatolites. In the intertidal zone at Hamelin Pool so-called 'pustular-mat' stromatolites occur. These are formed principally by the coccoid cyanobacterium *Entophysalis*. These stromatolites are not laminated and have a poorly-defined internal structure. They are predominantly formed by the trapping and binding of coarse, sandy carbonate sediment.

From the lower intertidal region down to the upper subtidal zone, 'smooth-mat' stromatolites occur. These are constructed by a community dominated by the filamentous cyanobacterium *Schizothrix*, which are laminated, have a well defined internal texture and a smooth outer surface. They are also formed by the trapping and binding of coarse, sandy carbonate sediment. The deepest stromatolites found live at a

depth of about 3.5m, where they occur as weakly laminated, coarse-structured 'colloform-mat' stromatolites up to a metre tall. These are constructed by a complex microbial community, including cyanobacteria *Microcoleus* and *Phormidium*, as well as *Entophysalis*. Some algae, mainly diatoms, are also found in this zone. Like cyanobacteria, some diatoms can secrete copious quantities of sediment-trapping mucus. Studies by Pam Reid and colleagues have shown that these subtidal stromatolites are formed from micritic carbonate mud precipitated by the microbes.

Whereas many of the Hamelin Pool stromatolites are typically well layered, the stromatolites in lakes are generally either poorly layered, or not layered at all, developing a thrombolitic texture (box). Situated about 100km south of Perth, brackish Lake Clifton is a 21.5km long, narrow lake, no more than one kilometre wide, and reaching a maximum depth of only about 3.5m. Like other coastal lakes in Western Australia, the water level rises during the winter and drops during the summer as the discharge of groundwater into the lake oscillates seasonally. Consequently, many of the stromatolites become emergent during the summer. At the northern-eastern end of the lake the thrombolitic stromatolites are so numerous that they have coalesced to form a reef about 30m wide and extending for at least 5km.

The Lake Clifton stromatolites are formed largely by the product of the precipitation of aragonite by the filamentous cyanobacterium *Scytonema*. Linda Moore, while working at the University of Western Australia, discovered that variations in groundwater discharge to Lake Clifton affect not only the distribution of stromatolites but also their shape. The brackish water in which they grow is populated by a diverse invertebrate fauna containing many grazers, mainly crustaceans (isopods, amphipods and ostracods) and worms (polychaetes and nematodes). The stromatolites provide both a source of food and a refuge for these animals, showing that the salinity of the water has little to do either with stromatolite formation or whether or not they are able to persist under grazing pressure.

To test the observation that stromatolites can grow effectively under high grazing pressure Linda Moore and her colleagues at the University of Western Australia established a tank in the laboratory in which stromatolites were kept with grazing invertebrates. After 14 weeks they found that not only had the stromatolites not deteriorated, but they had actually grown, severely weakening the old yarn about the late Proterozoic decline of stromatolites being due to increased grazing pressure from newly evolved invertebrates.

Stromatolites in the other lakes have their own unique features. For instance, those in the saline Lake Thetis, about 240km north of Perth, are broad, low domes up to 3m across, within which coarsely laminated stromatolites show evidence of columnar growth, like many Precambrian forms. Also, many of the stromatolites, when eroded during seasonal exposure, form doughnut-like structures, the central part having eroded

Archaean stromatolites from the 3430 million year old Strelley Pool Group in the Pilbara region. Photo courtesy, Geological Survey of Western Australia

A columnar stromatolite from the 3,430 million year old Strelley Pool Group in the Pilbara region.

Stromatolites in the saline Lake Thetis, Western Australia.

away, possibly because it was less well lithified. Interestingly these mirror very closely the structures seen in the Purbeck Limestone in Dorset, most famously at the "Fossil Forest" at Lulworth Cove. Here, what are clearly thrombolitic stromatolites are said to have grown around tree trunks. Apart from the fact that modern stromatolites are not known to grow in this manner, these structures have a close modern analogue in the Lake Thetis stromatolites that have never been near a tree in their lives.

Stromatolites, as I have indicated, are formed of aragonite. However in Lake Walyungup, close to the southern outskirts of Perth, stromatolites are preserved most unusually as hydromagnesite. Studies at Curtin University in Perth suggested that this mineral is an early diagenetic replacement for aragonite. Possibly so much calcium carbonate is removed from the water in the lake that it becomes enriched in magnesium. This high level of magnesium is shown also by the growth in the lake of primary dolomite.

Ancient stromatolites

About 800km northeast of Hamelin Pool, deep in the heart of the Pilbara region of Western Australia, lies the North Pole Dome (Australian humour – it's actually one of the hottest places on Earth). Remarkably, the layered red, white and black rocks that poke up through the green spinifex grass are little changed from when they were deposited as sediments about 3.43 billion years ago. In the early 1980s geologists Roger Buick and John Dunlop first suggested that these mysterious, structures were stromatolites. Although some that doubted this, subsequent discoveries have demonstrated their biological origin.

The first stromatolites found by Buick and Dunlop in the Strelley Pool Chert were simple domes; but more recently more complex structures have been found. Some are small, cone-shaped stromatolites, arranged in clusters, not unlike an egg carton. Others are the more typically domed-shaped, while some are wavy or columnar in shape, and in a few instances branched. Until these discoveries, this range of morphologies was not thought to occur until the Proterozoic. Seeing this relative complexity of structures at such an early date suggests a reasonably long evolutionary prehistory, perhaps pushing back the origin of life to closer to 4000 million years.

The environment in which these stromatolites grew is still open to question. The Warrawoona Group, within which the Strelley Pool Chert occurs, consists largely of volcanic rocks, mainly basalt, several kilometres thick along with a variety of sedimentary rocks. Because of the similarity of some of the stromatolites, especially the 'egg carton' forms, to stromatolites growing in some hot spring environments today, geologists at the Geological Survey of

Upper Jurassic thrombolitic stromatolites, 'Fossil Forest', Lulworth Cove, Dorset.

Western Australia have argued for a similar hot-spring setting for these Archaean forms. However, a team at Macquarie University consider it more likely that these most ancient of stromatolites grew in an extensive shallow sea into which lava periodically erupted from nearby volcanoes.

Stromatolites are so common in many Proterozoic rocks in Western Australia and show such high diversity that Kath Grey of the Geological Survey of Western Australia has demonstrated that they are valuable tools for correlation between sedimentary basins in the region. Moreover, because different stromatolite forms seem to be restricted to certain sediment types, which reflect deposition under different environmental conditions, they are also providing invaluable information on interpreting ancient environments. For instance, Grey has shown how, in the 2000 million year-old Duck Creek Dolomite in south-western Pilbara, two forms of stromatolites can be recognised. One is a columnar variety called *Pilbaria*, which can be interpreted as having grown in shallow lagoons and into the lower intertidal zone. The other, a broader-domed branching variety called *Asperia*, appears to have inhabited pools of water in high intertidal or supratidal regions. These two types of stromatolites can be recognised in many Proterozoic rocks, and similar analogues can still be seen living today.

Conservation

Despite the fact that microbial communities and the stromatolites they construct have lived on this planet for three-quarters of its existence, they are not escaping the devastation that *Homo sapiens* has inflicted on other ecosystems. Although environments such as tropical rain forests are fast disappearing because of direct exploitation, stromatolites may be suffering more indirectly. This is most clearly shown in the brackish water stromatolites of Lake Clifton. Increases in human population density in the area, and extensive application of superphosphate to agricultural areas over the last few decades, have the potential to affect stromatolite growth adversely. Artificially increased nutrient levels in Western Australian lakes and the consequent potential decline in the stromatolite-producing microbial communities is a good, albeit sad, analogue for what really occurred in the Late Proterozoic when animal and plant communities began to expand, along with rising nutrient levels, resulting in the rapid decline in stromatolite diversity.

Attempts have been made to preserve some of the Western Australian stromatolites by creating

Upper Jurassic thrombolitic stromatolites, "Fossil Forest', Lulworth Cove, Dorset.

reserves. The Hamelin Pool stromatolites are now part of the Shark Bay Marine Park and a World Heritage area. At Hamelin Pool and Lake Clifton boardwalks have been constructed that allow visitors to walk over the stromatolites and the sensitive microbial mats. The Lake Clifton stromatolites, which occur in Yalgorup National Park, are currently under assessment for listing as an endangered ecological community under the Australian Environment Protection and Biodiversity Conservation Act.

The vulnerability of living stromatolites arises from their sensitivity to the quality of the groundwater and their very slow growth. Until community awareness of the fragility of these structures is heightened, this ecosystem that has survived 3500 million years is in danger of being destroyed. As a guide to the health of this planet, there can surely be no better measure than this most ancient of all ecosystems.

Further reading

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Society Business

Christmas and New Year closure

The Society (London and Bath) will be closed from 24 December to 31 December inclusive, re-opening on Monday 4 January 2010.

Honorary Fellows – nominations

Edmund Nickless, Executive Secretary, writes: The following names have been put forward by Council for election as Honorary Fellows of the Society. These are the first names to come forward following the redefinition of the category earlier this year. Fellows may comment in writing to edmund.nickless@geolsoc.org.uk. The names will go forward for voting at the OGM on 28 January 2010.

The names that have been put forward following nomination to Council are: Prof. Aubrey Manning (University of Edinburgh); Prof. Sospeter Muhongo (Tanzania); Prof. Iain Stewart (University of Plymouth).

Brief biographical details of the nominees are available at www.geolsoc.org.uk/honoraryfellowship.

Council nominations - reminder

Fellows received, with the October issue of *Geoscientist*, a nomination form for the election of new Council members. Details of the process are on the forms and also in the Governance section of the website. The closing date for receipt of nominations is **8 January 2010.** Nominations will NOT be valid unless they are fully completed, signed and accompanied by a statement by the nominees. Forms should be returned to Prof. Edward Derbyshire c/o Executive Secretary, The Geological Society, Burlington House, Piccadilly, London W1J 0BG. *EN*

Research Funds - reminder

The 2010 round of Society Research Funds is now open for applications. Applications for support from any of the Society funds must be made on the appropriate form, which can be downloaded from the Society Awards and Research Grants page on the website - www.geolsoc.org.uk/grants.

The form must be completed in full and accompanied by two letters of support from Fellows of the Society. Please send to the Awards Secretary at the Geological Society. Applications and supporting documents should reach the Society no later than **1 February**. The average award has been about £1000.

Mike Coward Fund: For fieldwork in structural geology as applied to regional tectonics. **William George Fearnsides Fund:** To advance geological science. **Edmund Johnson Garwood Fund**: For the encouragement of research in stratigraphy, with palaeontology, and in physical geology. Must be between 28 and 51 years of age. **Gloyne Outdoor Geological Research Fund**: For the prosecution of outdoor research preferentially of a palaeontological or stratigraphical character, and preferentially within the limits of the British Commonwealth. **Annie Greenly Fund**: For detailed geological mapping. **Timothy Jefferson Field Research Fund**: Must be under 28 years of age; for a field project for research in Earth science. Not for military activity or development. **Elspeth Matthews Fund**: For members of the Society for geological field-based research anywhere in the world. Preference for those under 30 years of age. **Daniel Pidgeon Fund**: To promote geological original research. Must not be more than 28 years of age. **Jeremy Willson Charitable Trust:** The Jeremy Willson Charitable Trust, and the Willson family, generously supports the Geological Society Grants programme, in memory of their son and brother, Jeremy Willson, who died of new variant Creutzfeldt-Jakob Disease (vCJD) in March 2006. The Jeremy Willson Award supports field-based projects with a focus on the physical environment. To find out more visit www.jwct.org.uk. **Joseph Burr Tyrrell Fund**: To assist geologists of Great Britain and Ireland to travel to and in Canada; or to assist in the publication of meritorious papers by geologists of Great Britain and Ireland upon the geology of Canada; or to assist such geologists in any other way best adapted to further this object. **Distinguished Geologists' Memorial Fund:** To a geologist under the age of 30; in the form of travel bursaries to enable recipients to broaden their experience and for professional development.

PGC on Lyell

Neal Marriott, Director of Publishing, writes: The Publishing House is pleased to announce that the *Petroleum Geology Conference* series has been successfully launched in the Lyell Collection and can be explored at http://pgc.lyellcollection.org/. The site includes PGC volumes 4, 5 and 6, and will also feature PGC7 when it is published in 2010. The site is the first to be made available via H2O, HighWire Press' upgraded online hosting platform, and is accessible to all Fellows of the Society, as well as members of PESGB and the Energy Institute. Lyell Collection Complete subscribers will also get access, at no additional charge.

This is just one of three new sites to be launched on the Lyell Collection between now and the turn of the year. The capture of the content of *PGC*, *Scottish Journal of Geology* and *Proceedings of the Yorkshire Geological Society* for online delivery, and preparation of the new sites on which the content is hosted has been ongoing for much of the last year – an arduous and frequently difficult task.

Particular thanks are due to Sarah Gibbs at the Publishing House for the very considerable time and effort she has committed to ensure this next, successful step of Lyell Collection development. Thanks are also due to Linda Treffinger and the team at HighWire Press for successfully orchestrating the surprisingly complex of site build and launch. When you visit, we are sure that you will agree that their effort has been more than worthwhile.

Sir Peter Kent Lecture

Burlington House, Thursday 7 January 2010


Sir David King

The Society's flagship science policy lecture will be delivered by Professor Sir David King, Director of the Smith School of Enterprise and the Environment, University of Oxford, and former Chief Scientific Adviser to the UK government. Further details will be published at www.geolsoc.org.uk/spkl.

The Geological Society Club

The Geological Society Club, the successor to the body that gave birth to the Society in 1807, meets monthly (except over the field season!) at 6.30 for 7.00 in the Athenaeum Club, Pall Mall. Once a year there is also a special dinner at Burlington House. New diners are always welcome, especially from among younger Fellows. Dinner costs £45 for a four-course meal, including coffee and port. The Founders' Dinner has its own price structure. There is a cash bar for the purchase of aperitifs and wine. Next year two meetings will be held at new venues yet to be arranged.

Please note – you should keep checking dates here as they may be subject to change without notice.

2010: 13 January; 17 February (Venue tba); 17 March; 21 April (Burlington House) 19 May (Venue tba)

Any Fellow of the Society wishing to dine should contact Dr Andy Fleet, Secretary to the Geological Society Dining Club, Department of Mineralogy, The Natural History Museum, Cromwell Road, London SW7 5BD. Email: a.fleet@nhm.ac.uk - from whom further details may be obtained. *DR*

Shell London Lecture Series 2010 Programme

We are delighted to announce the 2010 programme of Shell London lectures.

Entry to each lecture is free to all, but by ticket only. To obtain a ticket please contact Alys Hilbourne (below). Due to the popularity of the series, tickets will be allocated on a monthly basis rather than "first come first served". We cannot guarantee that we will be able to allocate you a ticket to every lecture you may wish to attend.

We will **not** be taking indications of interest months in advance this year; but if you would like to attend the talks, please send your email address **now** to Alys Hilbourne, asking to be added to the mailing list. We will then email you each month, giving you the opportunity to let us know if you would like to be entered in the draw for tickets. Alternatively, you should write to us, or call, around **three or four weeks in advance of each talk** to let us know if you wish to be included in the ballot.

There will be two performances of each talk as follows:

- **Matinée:** 14.30 Tea & Coffee; **15.00** Lecture; 16.00 Ends
- **Evening:** 17.30 Tea & Coffee; **18.00** Lecture; 19.00 Reception; 20.00 Ends

2010 Programme

Date	Speaker	Title
Weds 13 January	Professor Lynne Frostick (President, GSL)	**Living with the Rising Tides**
Weds 10 February	Dr Marc St-Onge (Canadian Geological Survey)	**Hot prospects in the cold: the new geological map of the Arctic**
Weds 10 March	Professor Martin Blunt (Imperial College London)	**Carbon capture and storage: our only hope to avoid global warming?**
Weds 14 April	Professor John Grotzinger (Caltech)	**Mars Science Laboratory: The search for habitable environments**
Weds 12 May	Chris Finlayson (Shell)	**TBC**
Weds 9 June	Dr Derek Vance (Bristol University)	**The Chemistry of the Oceans: Past, Present & Future**
July	-	-
August	-	-
Weds 8 September	Dr Marie Edmonds (Cambridge University)	**A lot of hot air: Degassing and volcanic eruptions**
Weds 13 October	Professor Jay Melosh (Tucson, Arizona)	**Impacts**
Weds 10 November	Rob Kleibergen (Shell)	**TBC**
Weds 8 December	Professor Martin Culshaw	**Geological hazards: how safe is Britain?**

Further Information

A film of each talk will appear online shortly after the talk has been given. To view last years' presentations please visit www.geolsoc.org.uk/shelllondonlectures09

Please visit www.geolsoc.org.uk/shelllondonlectures10 or contact: Alys Hilbourne, Event Manager, The Geological Society, Burlington House, Piccadilly, London W1J 0BG, T: +44 (0) 20 7432 0981 E: alys.hilbourne@geolsoc.org.uk.

Sponsored by Shell

Ask a geologist

The Society website has launched a service designed at answering those nagging questions…

Ted Nield writes: Ever wondered why so many of the southern continents point south? Dug up something odd in the garden? Ever thought that acid rain might be speeding up erosion? What is the oldest thing in the world? Can a crystal cure your bunion?

If questions like this keep buzzing around in your head, "Ask a Geologist" could be the answer. We will field any question about the Earth, the planets, geological time, fossils, anything. We may not know the answer right away, but we will try to find someone who does from among our 10,000-strong Fellowship.

All anyone has to do is send an email to askageologist@geolsoc.org.uk stating the question. (If you have found something you would like identified, please attach a photo of it to your email.) Answers are then posted online. You can read some of the recent answers at www.geolsoc.org.uk/askageologist. If you think any of them could be improved, corrected, please email askageologist@geolsoc.org.uk.

For a list of **new acquisitions** click the appropriate link from **http://www.geolsoc.org.uk/gsl/info**

From the Library

The library is open to visitors **Monday-Friday 0930-1730.**

Christmas offer!

Maps for sale

Buy your own copy of a map from our collection! Christmas special offer from the Library

The Library has begun scanning some of the older maps in our collection and you can now purchase a full-size copy of these maps. If you would like to see which maps are available, thumbnails can be viewed on the Library pages of our website at:
http://www.geolsoc.org.uk/gsl/op/edit/info/collections/map/page6574.html
Copies can be purchased from the Library for £25 (plus postage & VAT). We are planning on scanning as many out-of-copyright maps as we can, although it will be a lengthy process. If there is an unscanned map in our collection you would like to buy, you can order it for £70 (plus postage & VAT) to cover the scanning costs. Please contact the Map Librarian (*paul.johnson@geolsoc.org.uk*) for further details.

Online access to *Atlantic Geology*

Online access to *Atlantic Geology* is available to all members of the Society until April 2010. Contact the Serials Librarian eileen.jamieson@geolsoc.org.uk for a password. Access to this journal is not available via Athens passwords. Visit the Virtual Library (http://www.geolsoc.org.uk/gsl/info/lyellcentre) to read more about online access to this journal and the 61 Athens authenticated journals.

Virtual 'Help yourself box'

The Library has a selection of journal issues which are not required due to duplication, defect or damage. A list of these can be found on our website in the section on Library Collections - Serials, under the heading 'Surplus Journals' www.geolsoc.org.uk/gsl/info/collections/serial/page3358.html.
Here you will find information on how to request them. They are available to both individuals and libraries. Please note that there may be a charge depending on the type of material and the weight, if posted.

Document delivery

Don't forget that the Geological Society Library can usually supply photocopies more cheaply than other providers e.g. British Library & the publishers. Remember - our journals have been bought with your money, and are here to be used!

Electronic copies

The Library is now able to arrange the supply copies of papers by Secure Electronic Delivery (SED) direct to your PC, if preferred to standard photocopies. The cost of this service via the Society's Library is £8.50 + title-specific copyright fee (if applicable) and VAT. For more information and to check whether you can receive documents in this way visit http://www.bl.uk/sed.

Copies ordered personally via BL Direct will *automatically* incur the copyright fee, regardless of whether the copy is required for private study/non-commercial research rather than for commercial purposes.

The Geological Society Library continues to offer a photocopying service to its members, charging 25p per A4 page or 30p per A3 page plus a handling charge and VAT. A standard copyright fee of £7.66 +VAT is added to each 'commercial research' request. Further details of the service, its charges and appropriate forms can be obtained by contacting the Library or looking on the Website.

Continuing Professional Development (CPD) Courses

•8-10 December - Gemcom Software Europe Ltd - *Gemcom Gems Foundation Workshop* Venue: Coalville, Leics. Unit 6 Phoenix Business Park, Telford Way, Coalville, LE67 3HB T: +44 (0)1530 835554 F: +44(0)1530 839989 E: sales-eu@gemcomsoftware.com **W: www.gemcomsoftware.com/**

•11 December - Fugro Engineering Services - *Cone Penetration Testing (CPT).* Free 1-day CPD course. How does CPT work? How to make use of CPT data in geotechnical and geo-environmental investigations - including a demonstration of various cone types, geophysical down-hole logging and core-scanning. Venue: Glasgow. Contact: Steve Poulter T: 0870 4021423 E: s.poulter@fes.co.uk **W: www.fes.co.uk.**

A Professional School in Ground Engineering at the Building Research Establishment (Watford), First Steps Ltd. For reservations and information contact Christine Butenuth, info@firststeps.uk.com, 0207 589 7394, www.firststeps.eu.com.

Developing Geological Knowledge for CGeol Status, First Steps Ltd. For reservations and information contact Christine Butenuth, info@firststeps.uk.com, 0207 589 7394, www.firststeps.eu.com.

Managing Performance through People, The Open University. Online Course. Contact David Robinson, d.t.robinson@open.ac.uk, 0870 900 9577, www.open.ac.uk.

Effective Leadership Skills, The Open University. Online Course. Contact David Robinson, d.t.robinson@open.ac.uk, 0870 900 9577, www.open.ac.uk.

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For endorsed courses run by ESI Ltd, visit www.esinternational.com or contact CoursesUK-ESI@esinternational.com

For endorsed courses run by FUGRO Engineering Services, visit www.fes.co.uk/courses or contact s.poulter@fes.co.uk

DECEMBER 2009

Western Regional

•1 December - *Careers Evening.* Venue: University of Bristol. **Contact:** Charlotte Woodhall-Jones. E: Charlotte.Woodhall-Jones@hotmail.co.uk.

•1-2 December - *Glaciogenic Reservoirs and Hydrocarbon Systems.* This international conference brings together leading researchers from industry, government and academic institutions involved in the research of glaciogenic sedimentary environments and their resource significance. Venue: Burlington House. Registration – Online - see Website. **Contact:** Steve Whalley, The Geological Society, Burlington House, Piccadilly LONDON W1J 0BG T: 020 7432 0980 F: 020 7494 0579 E: steve.whalley@geolsoc.org.uk.

Southern Wales Regional

•2 December - *River Geomorphology and AGM.* Speaker: Dr Andrew Brookes (Jacobs). Venue: Room 1.25, Main Building, Cardiff University. Convener: Margaret McBride. E: margaret.mcbride@jacobs.com

•2 December - *Reconstructing the History of the Antarctic Ice Sheet: Clues from the past for the future.* Shell University Lecture Series. Speaker: Tina van der Flierdt. Venue: Lecture theatre WG5 in the Aston Webb Building at the University of Birmingham. **Contact:** Alys Hilbourne T: 020 7432 0981 F: 020 7494 0579 E: alys.hilbourne@geolsoc.org.uk.

North West Regional

•3 December - *AGM and Quiz Night 2009.* Venue: Stamford Arms, Bowden, Altrincham. Time: 1830. **Contact:** Gillian Hurworth T: 0161 4996836 E: gillian_hurworth@coffey.com.

•4 December – Information Day at the BGS. The British Geological Survey invites you to a tour of its information resources, encompassing its Records Centre, Materials Collections, Library, Enquiry services, and 3D Visualisation Suite. The tour will focus on the value of our extensive holdings and how we manage them. The tour will show the wide variety of information we can provide for engineers, geologists, planners, academics, consultants and others. Free. To book please **contact** Becky White T: 0115 936 3021 E: rwh@bgs.ac.uk.

•9 December - *The Sameness of Rocks, the Uniqueness of Earth History, and what all that means for hydrocarbon exploration.* Shell London Lecture. Speaker: Bruce Levell (Shell). Venue: Burlington House. Performances 1500 and 1800, preceded by tea. Free, but by ticket only. **Contact:** Alys Hilbourne T: 020 7432 0981 F; 020 7494 0579 E: alys.hilbourne@geolsoc.org.uk.

South West Regional

•9 December – *Lecture & Christmas Quiz.* (Time and venue not available at time of going to press.) Speaker: Tracey Laight (SRK). **Contact:** Margaret McBride E: margaret.mcbride@jacobs.com.

•11 December - *HPHT Arena 2009: A One Day Workshop Dedicated to the North Sea's Hottest Plays.* Venue: Kings College Conference Centre, University of Aberdeen. Registration open online. See website. **Contact:** Steve Whalley, The Geological Society. T: 020 7432 0980 F: 020 7494 0579 E: steve.whalley@geolsoc.org.uk.

West Midlands Regional

•15 December - *Limited Life Geotextiles, and AGM.* Speaker: Professor Bob Sarsby (School of Engineering and the Built Environment, University of Wolverhampton). Venue: Birmingham University, Dome Lecture Theatre, Geology Department. Time: 1830. **Contact:** Adrian Jones E: adrian.a.jones@uk.mwhglobal.com.

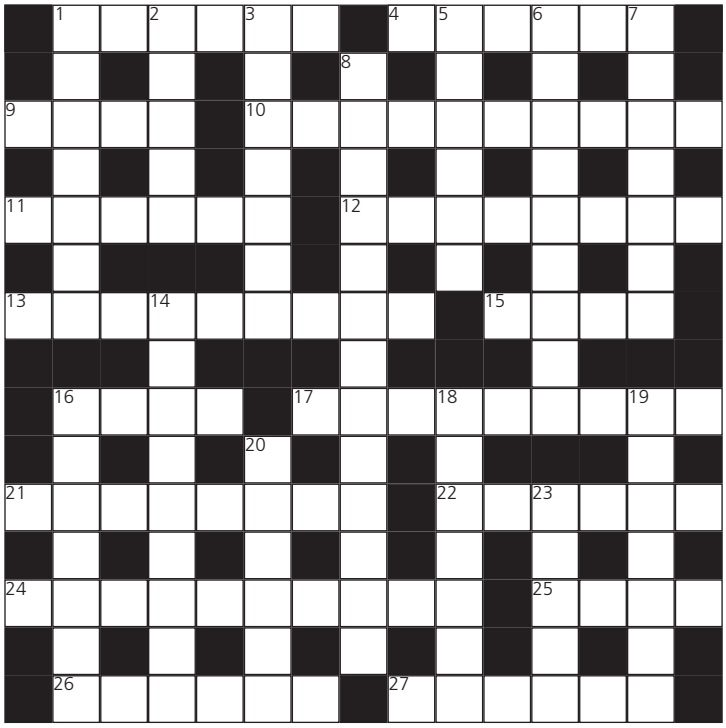
•15-17 December - *Exploration Remote Sensing - GRSG AGM 2009.* Venue: Burlington House. Information, abstracts, GSRG Student Awards, see website. Contact: Dan Taranik, Anglo American plc. 20 Carlton House Terrace, London SW1Y 5AN, UK T: 44 (0)207 968-8838 E: dtaranik@angloamerican.co.uk W: www.geolsoc.org.uk/grsg.

Yorkshire Regional

•16 December – AGM & Christmas Quiz. Venue: The Adelphi, Leeds. Buffet at 1800, meeting starts at 1830. Speaker: Jonathon Saunders. **Contact:** Katie Dunn E: katie.dunn@WorleyParsons.com.

•December (Date not available at time of going to press) *Lecture and AGM: Storage, Sorting and Documentation: good practice and practical solutions.* Venue: Leeds City Museum and Art Gallery. **Contact:** Will Watts T: 01723 232572 E: Will.watts@scarborough.gov.uk W: www.geocurator.org.

Crossword no. 130 set by Platypus



Solutions October:

Across: **1** Normal **4** Stress **9** Ovum **10** Burlington **11** Adesite **12** Polarity **13** Ancestors **15** Limn **16** Axes **17** Microgram **21** Orthicon **22** Vitric **24** Collimator **25** Asia **26** Tuning **27** Wesley

Down: **1** Nevadan **2** Ramps **3** Ambient **5** Triple **6** Engorging **7** Shorten **8** Proportionate **14** En Echelon **16** Airport **18** Reverse **19** Acidify **20** Acumen **23** Trail

Win a Special Publication of your choice!

The winner of the October Crossword draw was **Liam Murphy** of Southwark.

All correct solutions will be placed in the draw, and the winner's name printed together with the November winner, in the February 2010 issue. The Editor's decision is final and no correspondence will be entered into. Closing date – 18 January 2010.

The competition is only open to all Fellows and Candidate Fellows of the Geological Society who are not current Society employees, officers or trustees. This exclusion does not apply to officers of joint associations, specialist or regional groups.

Please return your completed crossword to Burlington House, marking your envelope "Crossword". Do not enclose any other matter with your solution. Overseas Fellows are encouraged to enter by scanning the signed form and emailing it as a PDF to ted.nield@geolsoc.org.uk.

Name .....

Fellowship Number .....

Address for correspondence .....

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.....Postcode .....

Across

1 Far from source (6)
4 Lie on your bed, Smith (6)
9 Neural cell prolongation (4)
10 Fern of the hirsute virgin (10)
11 Noachian destination (6)
12 Other end of 1 across (8)
13 It's a fluke (9)
15 Never accept a lift from a stranger or miss may regret it (4)
16 Lowly footsoldier (4)
17 Movement of a motile organism using gravity for orientation (9)
21 Conglomerate, Greekly (8)
22 Old stuff on the inside (6)
24 Dried like coconut (10)
25 Widely held belief, unsupported by evidence (4)
26 Light-sensitive lining of the eye (6)
27 Wrinkled retainers, Latinly (6)

Down

1 Right handed (7)
2 Echo locating mechanism (5)
3 Current measuring apparatus (7)
5 Ground shake (6)
6 Tending to presume the non-existence of a god (9)
7 Multicellular, eukaryotic metazoa (8)
8 Relocations of objects, for example, of rocks along faults (13)
14 Non archival paper placed on presses in the form of a roll (9)
16 Pioneering French microbiologist (7)
18 Mathematical finitary relation in which the number of places in the relation is three (7)
19 Resistance of mass to a change in its state of motion (7)
20 Most ancient mineral, very often (6)
23 Neither heaven nor hell, exactly (5)

Subscriptions: All correspondence relating to trade subscriptions should be addressed to the Journals Subscription Department, Geological Society Publishing House, Unit 7 Brassmill Enterprise Centre, Brassmill Lane, Bath BA1 3JN, UK. Tel: 01225 445046. Fax: 01225 442836. The subscription price for 2009 to institutions and non-members is £102.00 (UK) and £116/US$232 (overseas), post free. *Geoscientist* ISSN No 0961-5628 - USP 007-097 is published monthly by The Geological Society, Unit 7 Brassmill Lane, Bath, BA1 3JN. Periodicals postage paid at Middlesex, N J POSTMASTER: send address changes to Geoscientist, PO Box 177, Middlesex New Jersey 08846. US Agent: Pronto Mailers International, 200 Wood Avenue, Middlesex, New Jersey 08846.

WILLIAM SMITH 2010

Landscapes into Rock

21 – 23 September 2010

The aim of this meeting is to bring together geoscientists from different sub-disciplines to address the problem of the interactions between erosional and depositional landscapes, sediment routing systems and the building of stratigraphy. By studying these interactions we gain a better understanding of the dynamics of the coupling between exhumation, erosion, transport and deposition of sediment in source to sink systems, and an enhanced ability to invert stratigraphy for forcing mechanisms.

CONVENERS

Philip Allen
Imperial College London

Hugh Sinclair
Edinburgh University

Paul Bishop
Glasgow University

Robert Gawthorpe
Manchester University

CONFERENCE THEMES:

THE EROSIONAL ENGINE

CONVENORS: Alex Whittaker (Imperial College London) and Andy Carter (Birkbeck College, University of London)
KEYNOTE SPEAKERS: Kelin Whipple (Arizona State University), Niels Hovius (Cambridge University)

THE DYNAMICS OF SEDIMENT ROUTING SYSTEMS

CONVENORS: Alex Densmore (Durham University) and Ruth Robinson (St. Andrew's University)
KEYNOTE SPEAKERS: Jim Syvitsky (University of Colorado-Boulder), Chris Paola (University of Minnesota)

LANDSCAPES INTO ROCK: THE MAKING OF STRATIGRAPHY

CONVENORS: Sébastien Castelltort (ETH-Zürich) and Emma Finch (Manchester University)
KEYNOTE SPEAKERS: Mike Leeder (University of East Anglia) William Smith Lecture 2010, Rudy Slingerland (Pennsylvania State University)

INTEGRATIVE STUDIES OF SEDIMENT ROUTING AND THE PETROLEUM SYSTEM

CONVENORS: Ian Lunt (StatoilHydro) and Mike Blum (ExxonMobil)
KEYNOTE SPEAKERS: Ole J. Martinsen (StatoilHydro), Peter Burgess (Shell)

Statoil

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