

# Geoscientist

The Fellowship magazine of The Geological Society of London | [www.geolsoc.org.uk](http://www.geolsoc.org.uk) | Volume 21 No 1 | February 2011

## COLORADO RAFTING

Teaching teenagers  
geology in the  
Grand Canyon

## GREAT UNWASHED

Primordial basalts  
of Baffin Island

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# UNDER THE VOLCANO

Social volcanology on Merapi

# Life and the Planet

*New perspectives in Earth system science*

5th and 6th May 2011

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Launch of the NERC Long-term Co-evolution of Life and the Planet Programme

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Dr Graham Shields, *University College London*

Professor Andrew Watson, *University of East Anglia*

**Keynote speakers include:**

Dr James Lovelock, *Independent scientist*

Professor Lynn Margulis, *University of Massachusetts*

**AD SPACE**  
The Earth that sustains us today was born out of a few remarkable revolutions, started by evolutionary innovations and marked by global environmental consequences, including abrupt rises in oxygen and extreme glaciations. The coupled evolution of life and the planet has continued up to the present, and now includes the planet-reshaping activities of our species.

This two-day discussion meeting will showcase recent progress in understanding the development of the Earth as a system. The meeting will outline how new science can help in tying down critical uncertainties, regarding the nature and timing of past events. Finally, it will explore how an improved understanding of life and the planet in the past can help us achieve future sustainability.

## Call for posters

Conference poster contributions are welcome. Please email your poster abstract to Georgina Worrall.

For further information about the conference, or to submit a poster abstract, please contact:

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# Unconventional Resources have Unconventional Reporting: True or False?

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## ALL CHANGE

**W**oody Allen famously wrote – in  
the script to his 1977 hit *Annie  
Hall*, that “a relationship is like  
a shark – it needs to move  
forward to survive”. It is now  
seven years since this magazine  
was last radically redesigned.

Subsequently, in Bicentenary Year (2007) we took the  
existing design to full colour. Apart from that - and  
a few minor adjustments - our basic plan, typefaces  
and layout have remained largely unaltered.

This design, which comes courtesy of our new Art  
Editor Heena Gudka of Century One Publishing, we  
hope brings us not only up to date, but marks a  
radical upgrade in our presentation that will find a  
grateful audience among those of our readers who  
have said, from time to time, that our old fonts were  
too weedy for them to read, especially when placed  
over tints or images.

Your new *Geoscientist* is bolder, more confident  
and easier on the eye – especially older eyes. And  
while it means we will never again need to use  
tinted or photographic backgrounds, it marks no  
diminution in our commitment to striking visuals  
and high quality photographs.

Our editorial structure remains unaltered, though  
you will find that some things have changed  
position. We used, for example, to put “People”  
first; but that was a decision taken before we carried  
obituaries. Many readers have commented that to  
open a magazine and find obituaries was not  
perhaps the best policy, and we agree. Obituaries  
now come fittingly at the back.

Each issue will in future carry two features – one  
lead feature at 2500 words and a second feature at  
1250. In other sections, like Geonews, People and  
Society News, stories will be shorter and crisper in  
style. Many will highlight online versions written  
more expansively for those interested in following  
them up, in depth. This will mean that detailed and  
important news about, for example, changes to  
CPD or Chartership procedures, will appear in full  
online, flagged by abbreviated items in the print  
version of Society News.

*Geoscientist* belongs to you – in the very real  
sense that it is the magazine of the Fellowship, not  
of “The Society”. While it relies hugely upon  
contributions from staff and its Editorial Board,  
the people who really matter are – as Leonard  
Sachs used to say - “chiefly yourselves”. So,  
contributions - particularly of feature articles - are  
warmly invited. Features are the backbone of the  
publication, and provide a great opportunity  
for you to highlight your geological work to a  
wider readership.

If you wish to discuss a feature idea, or indeed if  
you have any views on our new design, please write  
to ted.nield@geolsoc.org.uk.

**DR TED NIELD** EDITOR





# Geology on the map!

BY NINA MORGAN

**Nina Morgan\*** geologist, journalist, historian and creator of our *Distant Thunder* column, believes she has identified a new road to geological understanding – and, perhaps, of holiday strife...

The British Geological Survey (BGS) is doing a great job in promoting the public understanding of geology by making tremendous amounts of geological information available free and palatably via OpenGeoscience ([www.bgs.ac.uk/opengeoscience](http://www.bgs.ac.uk/opengeoscience)). Their recently launched app for iPhones/iPad (*Geoscientist 20.11, p9*), which provides a clever way to home into the geology under your feet, takes things further.

## IPHONE – BUT DO YOU?

No doubt these resources will be widely welcomed by schools as well as digitally-enhanced members of the public who own – and know how to use – these expensive devices. But, like William Smith himself, for me nothing can beat a paper map for really putting geology into perspective. As Smith said of them in a document included with the copy of his Geological Atlas at the Hope Library (Oxford University Museum of Natural History): "By their colouring they bring up the natural features of the Country and facilitate the acquirement of Geology." Paper maps also have the obvious advantage that anyone can use them without fancy widgets, gizmos, internet, broadband, 3G or WiFi. Admittedly, unfolding a paper map in the teeth of a howling gale – let alone on the front seat of a car – is not everyone's idea of convenience.

However, a road atlas,

in the standard familiar format with geology superimposed along with the roads and place names could well be. As an inexpensive vehicle to promote interest and understanding among a wide section of the public at large, a geological road atlas has a lot going for it. After all, in spite of the enthusiastic take-up of sat-nav systems by drivers, many people still don't leave home with out a road atlas.

## PIECE OF CAKE

With topographic, location and geological data now all available in digital format, marrying road maps with geological maps to produce a road atlas should be, technically, a piece of cake. Admittedly there would be some licensing issues to overcome, but recent moves towards simpler and more opening licensing arrangements should make this easier.

"But before we embark on producing a new product, we do need to ensure that the demand is there" says Jerry Hodgson, Head of CartoGIS at the BGS. "The BGS has always been keen to get its geological mapping information to users through as many routes as possible, whether this be in the form of printed maps or via web services or smartphone apps. A geological road atlas is an intriguing idea and we would be interested to hear the reaction to it from potential users."

Now that the seeds have been sown, we need a "grass-routes" campaign for a geological road atlas! Write to BGS today, addressing your comments to Jerry Hodgson at [jdho@bgs.ac.uk](mailto:jdho@bgs.ac.uk) and get this project on the road!

\* Nina Morgan is a science writer based near Oxford

## SOAPBOX

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

Pictures should be of print quality – as a rule of thumb, anything over a few hundred kilobytes should do.

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

“AS AN INEXPENSIVE VEHICLE TO PROMOTE INTEREST AND UNDERSTANDING AMONG A WIDE SECTION OF THE PUBLIC, A GEOLOGICAL ROAD ATLAS HAS A LOT GOING FOR IT”  
Nina Morgan



A geological road atlas could guide you reliably from Aalenian to Zweikanter

# The great unwashed

Geochemists think they have discovered lavas that derived directly from a region of primordial mantle, unchanged since the Earth formed. **Harriet Jarlett\*** reports

## GEOCHEMISTRY

Scientists have long believed that any traces of the Earth's primordial geochemistry were destroyed long ago by the planet's many geological processes, which differentiate and recycle Earth materials, washing them clean of all traces of their origins. However, new evidence from rocks in the Canadian Arctic suggests that some samples may still provide clues to the Earth's earliest history.

“LEAD ISOTOPE COMPOSITIONS SUGGEST A SOURCE AGE OF 4.55 TO 4.45 BILLION YEARS”  
**Harriet Jarlett**

Matthew Jackson (Boston University) and co-authors<sup>1</sup> believe they have identified clear isotopic evidence that Cenozoic lavas from Baffin Island and West Greenland, Canada, derive from a deep Earth reservoir that has remained inaccessible to the Earth's washing-machine processes for four and a half billion years. Their work involves the first ever combined analysis of helium, lead, neodymium and hafnium on these lavas, which are mid ocean-ridge basalts (MORB) erupted during the opening of the North Atlantic.

The greatest evidence for the existence of this reservoir of primitive materials is the higher ratio of primordial (<sup>3</sup>He) to radiogenic helium (<sup>4</sup>He). Radiogenic <sup>4</sup>He is produced during the decay of unstable isotopes of uranium and thorium. This indeed is the source of all our available helium gas - a precious resource that is, thanks to its artificially low market price, currently being squandered in toy balloons at a much faster rate than it can accumulate. By contrast, <sup>3</sup>He levels have been declining



continuously since accretion, as this primitive isotope leaked out in volcanic activity. Unusually high levels of <sup>3</sup>He seen in these rocks can only mean that they were derived from a mantle source that has never degassed.

But helium is not the only clue. The lavas' lead isotope compositions also lie very close to the 4.5Ga geochron, suggesting an age of between 4.55 and 4.45 billion years for their source - also dating them to a remote era before planetary differentiation, when the rock cycle began to overwrite the geochemistry of the source materials of our planet.

The lavas also contain a 5% higher ratio of the element samarium (Sm) to neodymium (Nd) than is found in chondrite meteorites. Neodymium is produced during the radioactive

**Above: Basalts of Baffin Island. Photo by Don Francis (McGill University)**

decay of samarium, so the higher ratio found in the Baffin Island lavas seems also to point to a primitive source.

Coauthor Richard Carlson (Carnegie Institution of Washington) says that these lavas "set the stage for everything. Primitive mantle, such as we have identified, would have been the ultimate source of all the magmas, and all the different rock types, we see on Earth today."

\* Harriet Jarlett is a UCL graduate geologist working as an intern on Geoscientist

## REFERENCE

- 1 Jackson M G, et al. *Evidence for the survival of the oldest terrestrial mantle reservoir.* Nature, 2010; 466 (7308): 853  
DOI: 10.1038/nature09287

# Leonard Horner: pioneering reformer

Ann Jones\* reports the publication of a biography of a tireless reformer and geologist who, as one of the Society's earliest recruits, witnessed the fiercest controversies of his day

## HISTORY OF SCIENCE

Leonard Horner started a revolution in education; the quietly implacable factory inspector who laid the foundations for workers' safety and tireless promoter of geological research who befriended some of the brightest stars of science of his day.

In the first full-length account of Horner's life published November 2010, he emerges as one of the major figures in 19th Century educational and social reform. Author Patrick N O'Farrell (Professor Emeritus, Heriot-Watt University) studied the family archives of Horner's great-great-grandson Lord Lyell, 3rd Baron of Kinnordy, as well as sources in the Geological Society of London, the National Archives and elsewhere to locate key first-hand accounts of Horner's life and achievements.

Leonard Horner (1785 -1864) first made his mark in 1821 as co-founder and secretary of the Edinburgh School of Arts, the world's first mechanics' institute – forerunner of Heriot-Watt University. Intended to open doors to professional education, the Edinburgh School of Arts equipped its students to meet the changing needs of business, industry and society - an ethos still central to the University today.

After founding the elite Edinburgh Academy in 1825 he was headhunted

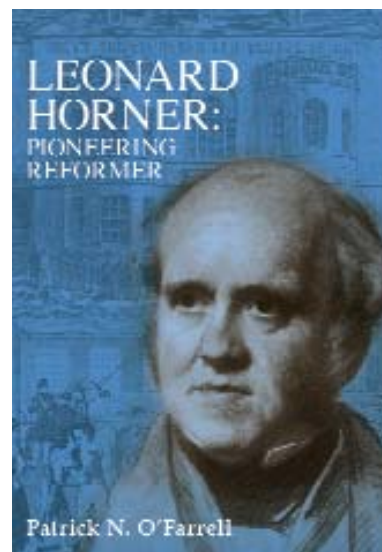
to serve as the first (and only) Warden of London University in 1827. There, Horner's reforming zeal enraged a powerful cabal of professors who claimed his scalp four years later in a ferocious row over who ruled the roost on the University Council. Horner's determination was to serve him well in his greatest challenge. In 1833 he became one of the first Factory Inspectors, appointed to police the new Factory Act, designed to limit the working hours of children employed in mills, and ensure their right to education. Horner's tenacious campaign for reform earned praise from both Tory peer Lord Ashley and Karl Marx.

“ ONE OF THE MAJOR FIGURES IN 19TH CENTURY EDUCATIONAL AND SOCIAL REFORM ”

Ann Jones

Despite his daunting workload Horner pursued a life-long passion for geology. Born in the same year that James Hutton presented his *Theory of the Earth* to the Royal Society of Edinburgh, Horner studied geology at Edinburgh University and explored the formations on Arthur's Seat that had inspired Hutton. Joining the Society in 1808 as one of

Right: Leonard Horner: pioneering reformer published by Heriot-Watt University to mark the 40th anniversary of its Edinburgh campus. Copies £20 plus p&p from [www.hw.ac.uk/shop.htm](http://www.hw.ac.uk/shop.htm) Blackwell Bookshop, Edinburgh Campus, or by order from any bookshop. ISBN 978-0-9566729-0-2



its earliest Fellows, Horner twice served as President and curated the Society museum. Among his friends he numbered Sir Humphry Davy, Charles Lyell (who married Horner's daughter Mary) and Charles Darwin, who was tipped to marry another of Horner's daughters but was apparently put off by her formidable intelligence.

Horner was a keen supporter of the British Association for the Advancement of Science. Hosting breakfast at the Edinburgh meeting in 1834, his guests included Jean Louis Rodolphe Aggasiz, pioneer of glacial theory, William Buckland, two GSL Presidents and not least, Adam Sedgwick - founder of the Cambrian system, whose lively dispute with Murchison is also recounted in the book.

\* Archivist, Heriot-Watt University





# Reptiles recover after climate change

Ecosystem collapse might not have to spell the end for animal communities, according to a new study of Carboniferous rainforest communities published in the journal *Geology*, reports **Sarah Day**

## PALAEOECOLOGY

The collapse of ecosystems like rainforests is one of the feared outcomes for climate change. However, scientists from Royal Holloway, University of London and the University of Bristol have found evidence that, 300 million years ago, the effect of such a collapse was beneficial to the evolution of reptiles<sup>1</sup>.

“Climate change caused rainforests to fragment into small ‘islands’ of forest” explains Dr Howard Falcon-Lang, one of the authors of the study. “It isolated populations of reptiles, and each community evolved in separate directions, leading to an increase in diversity”. A similar phenomenon was observed by Darwin in the Galapagos islands, where isolated groups of animals (giant tortoises, finches) evolved differently in isolation from their parent population.

“This is a classic ecological response to habitat fragmentation” says Professor Mike Benton from the University of Bristol, who co-authored the paper. “You see the same process happening today; it’s even been studied on traffic islands between major road systems!”

The scientists studied the fossil record of reptiles around an event in the Carboniferous, when rising temperatures and a drier climate caused devastation to the rainforests that then covered much of modern-day Europe and North America. They found that, rather than ‘suffering’ from the event, reptiles changed their diet as they adapted to the new climate and environment, becoming increasingly diverse.

“It is fascinating that even in the face of devastating ecosystem collapse, animals may continue to diversify through the creation of endemic



populations” says co-author Sarda Sahney (University of Bristol). However, she said that the conclusions of the study should not bring about complacency towards today’s rainforest ecosystems. “Life may not be so lucky again in the future, should the Amazon rainforest collapse” she warned.

**Above:** Carboniferous rainforests collapsed as climate changed – yet reptiles boomed

## REFERENCE

- 1 S Sahney, M J Benton and H J Falcon-Lang, ‘Rainforest collapse triggered Carboniferous tetrapod diversification in Euramerica’, *Geology*, December 2010, v. 38, p. 1079-1082.

“ A CLASSIC ECOLOGICAL RESPONSE TO HABITAT FRAGMENTATION ”  
**Mike Benton**

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## [ FUNNY OLD WORLD ]

**Unconsidered trifles, by ‘Snapper’**

**Monitor: Marian Holness.** All contributions gratefully received. Please write to the Editor at Burlington House, or email [ted.nield@geolsoc.org.uk](mailto:ted.nield@geolsoc.org.uk) marking your submission “snapper”.

## IN BRIEF

### ■ HOT KENYA ROCKS

Kenya’s Geothermal Development Company is drilling six geothermal wells at Menengai, a huge caldera volcano, just north of Nakuru (Gregory Rift Valley) writes *Joe McCall*. Due for completion by June 2011, by December Kenya hopes to be looking for developers.

Kenya already has three such installations at Olkoria (Lake Naivasha). Exploration started in 1956 – though production only began in 1981. The field covers 70km<sup>2</sup> and boasts 110 wells (50 production, six re-injection). Thirteen further prospects have been identified, of which three (all near caldera volcanoes Longonot, Suswa and Menengai) have been surveyed. The total potential is estimated at >2000 MWe.

Menengai, a trachyte central volcano of shield form is underlain by a high-level magma chamber and encloses a vast caldera first erupted at 0.18 Ma, about 30 km<sup>3</sup> in volume and 12km across. The last lavas erupted only 8300 years ago. Active fumaroles produce mainly CO<sub>2</sub> with some steam, while there is a danger of asphyxiation from mofettes within the caldera.

During the 1957 groundwater survey of Nakuru, drilling three kilometres north of the caldera produced low pressure steam at 60m. I was dubious about the viability of geothermal resources because of the dominance of CO<sub>2</sub> over steam emissions; but several techniques developed since (hot rock, steam and hot groundwater, re-injection), have been successful elsewhere (e.g., in the Paris Basin).

The Menengai venture stands every chance of success in this energy-poor country. The Menengai site lies close to the town of Nakuru, immediately at the foot of the southern outer slope of the slumbering volcano.

# SOCIETY NEWS



## ELECTIONS TO COUNCIL 2011-12

The October 2010 issue of *Geoscientist* invited Fellows to nominate new members of Council, including President-designate. A preliminary ballot will be conducted, the results of which will determine the list for the formal vote at the Annual General Meeting to be held on 8 June 2011.

### VOTE ONLINE NOW!

By the time you receive this issue, full details of all candidates will be available online, where you will also be able to **vote**. (It was not possible to include this information with this issue, because the February copy deadline preceded the closing date for nominations.) The March issue will include the full details now available on the website, and will include a postal ballot paper; **but we encourage Fellows to vote online now**. Go to [www.geolsoc.org.uk/vote2011](http://www.geolsoc.org.uk/vote2011) log on, and follow the instructions.

**Closing date** for all voting, online and postal: **31 March 2011**. *Edmund Nickless*

SOCIETY REMINDERS

### HONORARY FELLOWS

Edmund Nickless writes: Fellows are reminded that they may nominate candidates for Honorary Fellowship at any time. To find out how to do this, please go to [www.geolsoc.org.uk/honorary\\_fellowship](http://www.geolsoc.org.uk/honorary_fellowship).

### FUTURE MEETINGS

- OGMs: 13 April 2011
- Council: 2/3 February 2011; (residential); 13 April 2011.

## Society Awards 2011

Former Society President Steve Sparks (Bristol University) heads the list of the Society Awards 2011. Also featuring this year is *Geoscientist* magazine stalwart Joe McCall, who gains a Distinguished Service Award. Awards will be presented on President's Day, 8 June 2011. The full list reads as follows.

*Wollaston Medal*: Robert Stephen John **Sparks**; *Lyell Medal*: Christopher **Paola**; *Murchison Medal*: Bruce **Watson**; *William Smith Medal*: Robert Stuart **Haszeldine**; *Aberconway Medal*: Rebecca **Lunn**; *Coke Medal*: Jon **Paul Davidson**; *Coke Medal*: Christopher **Stringer**; *Bigsby Medal*: Alexander **Densmore**; *R H Worth Prize*: Peter **Kennett**; *Wollaston Fund*: Heiko **Pälike**; *William Smith Fund*: Daniel **Le Heron**; *Lyell Fund*: Emily **Jane Rayfield**; *Murchison Fund*: Sarah **Sherlock**; *Distinguished Service Award*: **Gerald Joseph Home McCall**.

Two President's Awards (yet to be decided) will also be given.



## 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 18.30 for 19.00 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, in November, has its own price structure.) There is a cash bar for the purchase of aperitifs and wine.

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

**2011:** 23 February; 16 March; 13 April 2011 (Burlington House - prov.); 18 May

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](mailto:a.fleet@nhm.ac.uk) - from whom further details may be obtained. *DR*



[LECTURES]

## Shell London Lecture Series



### Challenged by Carbon: The Oil Industry and Climate Change 16 February 2011

Is there a low-carbon future for the oil industry? As the debate over climate change evolves, can the oil industry be saviours rather than villains, through

the capture and underground storage of carbon dioxide? Challenging the prejudices of both environmentalists and the oil industry, Bryan Lovell will address the subject of his recent book 'Challenged by Carbon: The Oil Industry and Climate Change'.

Dr Bryan Lovell is Senior Research Fellow in Earth Sciences at Cambridge University, and President of The Geological Society.

- **Programme** – Afternoon talk: 1430pm Tea & Coffee: 1500 Lecture begins: 1600 Event ends.
- **Programme** – Evening talk: 1730 Tea & Coffee: 1800 Lecture begins: 1900 Reception/Book launch.

### FURTHER INFORMATION

Please visit [www.geolsoc.org.uk/shellondonlectures11](http://www.geolsoc.org.uk/shellondonlectures11). Entry to each lecture is by ticket only. To obtain a ticket please contact Leila Taleb around four weeks before the talk. Due to the popularity of this lecture series, tickets are allocated in a monthly ballot and cannot be guaranteed.

▶ **Contact:** Leila Taleb, Event Manager, The Geological Society, Burlington House, Piccadilly, London W1J 0BG, T: +44 (0) 20 7432 0981 E: [leila.taleb@geolsoc.org.uk](mailto:leila.taleb@geolsoc.org.uk)

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## Rare book of the month!

**The eruption of Krakatoa and subsequent phenomena: report of the Krakatoa Committee of the Royal Society, edited by G.J. Symons (1888)**

*Michael McKimm writes:* As hoards of people rushed with digital cameras to capture the terrific sunsets last April, when the ash from Eyjafjallajökull stretched over northern Europe, so in 1883 painters readied their easels as the after-effects of the eruption of Krakatoa produced stunning light-shows all over the world.

The drawings shown here, the frontispiece to the Royal Society 1888 report on Krakatoa, are reproduced from crayon sketches made on the bank of the Thames on 26 November 1883 by Mr W. Ashcroft. They illustrate the appearance of the sunset three months after Krakatoa's blast, a phenomenon which was echoed in observations from places

as far apart as central America and Scandinavia, where affiliates of the Royal Society avidly documented the startling skies.

An engrossing document of the geological, meteorological, seismic and magnetic implications of the eruption, the report is also a fascinating insight into the global reach of a scientific organisation in the Victorian period, as world-encompassing as Krakatoa's ash itself.

The Library operates a sponsorship scheme to help preserve and restore its rare books. For more information, contact Michael McKimm in the library, or see the Sponsor A Book page on the Society's website: [www.geolsoc.org.uk/sponsorabook](http://www.geolsoc.org.uk/sponsorabook)



### ■ DONATION

Chariot Oil & Gas has donated to the Library a copy of The geology of Namibia by R McG Miller, Geological Survey of Namibia, three vols. (2008).

### ■ FEES UP

The Copyright Licensing Agency copyright fee has been increased to £9.00 + VAT. This will be added to invoices for photocopies required for commercial research.

### ■ PETROLEUM ABSTRACTS

Fellows and Corporate Affiliates can use Petroleum Abstracts (50 years' data!) for searches inside the Library at no charge. Alternatively, staff can undertake literature searches for a fee. Other databases available include GeoRef and Immage.

### ■ NINE MORE OFFSITE!

Fellows now enjoy offsite access to a further nine journals using 'Athens' logins: Applied Earth Science, Clay Minerals, European Journal of

Mineralogy, Geotectonic Research, Mineral Processing and Extractive Metallurgy, Mineralogical Magazine, Neues Jahrbuch für Geologie und Paläontologie, Neues Jahrbuch für Mineralogie, and Newsletters on Stratigraphy. Descriptions of their subject areas and content can be found on the E-journals section of our website at [www.geolsoc.org.uk/ejournals](http://www.geolsoc.org.uk/ejournals).

### ■ MISSING BOOK

Unsaturated soil mechanics by Lu, Ning & Likos, William J: (Wiley 2004) is missing from the shelves and the Librarian would be grateful for its return.

### ■ LIBRARY SITE

The Library's New Year book sale is now online at [www.geolsoc.org.uk/library\\_surplus](http://www.geolsoc.org.uk/library_surplus) With books, maps, special issues of journals and individual reprints from various magazines, now is the time to pick up a bargain!

**C**limbing towards the growing summit dome of Mt Merapi one cannot help but think 'I am going to die' - and then 'I am so stupid'. Anyone who has studied past eruptions of Merapi (Central Java, Indonesia) should surely know better. Every two or three years the dome collapses - sending pyroclastic flows down its slopes. Less frequently, larger explosive eruptions threaten over one million people living on the fertile but deadly flanks of this volcano.

Despite the danger, in late 2007, just one year after a dome collapse eruption, cultural expert Aris Suharyanto, local villager Riyanto and I - a social volcanologist - climbed to the summit. In the dark, among house-sized boulders of andesitic rock and against the backdrop of growling rock falls, I realised that the villagers with whom we were living were correct. This volcano is alive. No-one believed this more strongly than Mbah Maridjan, Merapi's "spiritual caretaker", who, when asked about the dangers said: "The creatures will protect us".

Tragically, in October 2010, burning pyroclastic flows expelled during the largest eruption in living memory killed Mbah Maridjan - along with over 250 others. Despite efforts to evacuate this elderly and humble man, he refused to leave until he had performed *sholat maghrib* (Islamic sunset prayers) because he felt it was his duty to stay and appease the unseen creatures of the mountain and fulfil his Islamic duties. He did so. His body was found still in a position of prayer.

Many residents living on Merapi have a spiritual relationship with the volcano that appears to have influenced their reactions during its frequent episodes of unrest. The local blend of Javanese and animistic beliefs has been shaped by years of eruption experiences, producing a distinctive culture of hazard - or, as others describe it, a "disaster subculture". This is not unique to Mt Merapi. Examples can be found all over the globe.

### ALIVE

At Vesuvius and Etna (Italy), Christian religious ceremonies incorporating saintly relics have been held in an attempt to stop flows of lava<sup>1</sup>. Such folk traditions need not always be dangerous. During the 2004 Indian Ocean Tsunami, 78,000 residents of Simeulue Island (150km off the west coast of Sumatra, Indonesia) self-evacuated<sup>2</sup>, saved by a traditional lullaby whose lyric recalled the warning signs and advised running to high ground. Around Mt Pinatubo (Philippines) despite no official record of pre-1991 eruptions, historical eruptions had been memorialised within the legends of the Aytas people, warning of the potential for large events<sup>3</sup>. These examples suggest that while a local subculture can place communities at increased risk, as people attempt to "prevent" the hazard, it can, conversely, form the basis of local resilience.

*"Those who ran down from the village to a place of safety told of the suicide procession. There was hardly a survivor who didn't have a relative or friend walking out to welcome death and honour the god. They had seen them go, accompanied by their music." ►*

# THE CREATURES WILL PROTECT US

**Kate Donovan** and **Aris Suharyanto\*** have been living on Mt Merapi, Indonesia, attempting to understand the people who live, farm - and die there





► (Mt Agung, 1963, described by Anna Mathews in *The Night of Purnama*).

In 1963, hundreds of people were killed as they processed towards Mt Agung (Bali, Indonesia) as it erupted. Many bodies were later found still clutching traditional gamelan instruments. Mt Agung had not erupted for 500 years; locals interpreted the eruption as representing gods coming down from the mountain and decided to welcome them at their many temples. In 2006, media reports suggested that residents living on Mt Merapi were refusing to evacuate. Perhaps the tragedy of Agung was about to repeat itself on Merapi.

The man at the heart of these news stories was Mbah Maridjan. He had been appointed by the Sultan of Yogyakarta (a large city just 30km south of the volcano) to hold ceremonies for the creatures that apparently lived at the summit. He was refusing to leave his home, and by doing so was apparently inspiring others to do likewise. This may not have been the entire story, however. Were these people really willing to face a horrible death for the sake of their traditional beliefs alone?

To try to answer this question volcanologists and geologists need to immerse themselves in the everyday lives of communities at risk, and employ the techniques of social science. This hybrid subject could be referred to as social volcanology<sup>4</sup>, using methods of social research to explore the local perception of volcanic hazards.

## DIVERSITY

Mbah Maridjan's reaction to official evacuation policy and his trust in his traditional faith demonstrated the Indonesian's cultural belief in the connection between nature and human life. Ancient beliefs remain strong in Indonesia. Natural disasters are often interpreted as punishment for political corruption, or perceived lack of respect towards traditional customs in the wake of modern ideas. Mt Merapi's eruptions have not only created a subculture specific to its immediate slopes. They play an important role in Javanese culture as a whole.

Indonesia is one of the most geologically active and culturally diverse countries in the world. At the heart of this archipelago of more than 17 500 islands lies Java, the country's cultural and political hub and home to over 40 active volcanoes and 130 million people. Mt Merapi, a stratovolcano considered

Holy temple on the slopes of Mt Merapi. Would the tragedy on Agung in 1963 be repeated here?

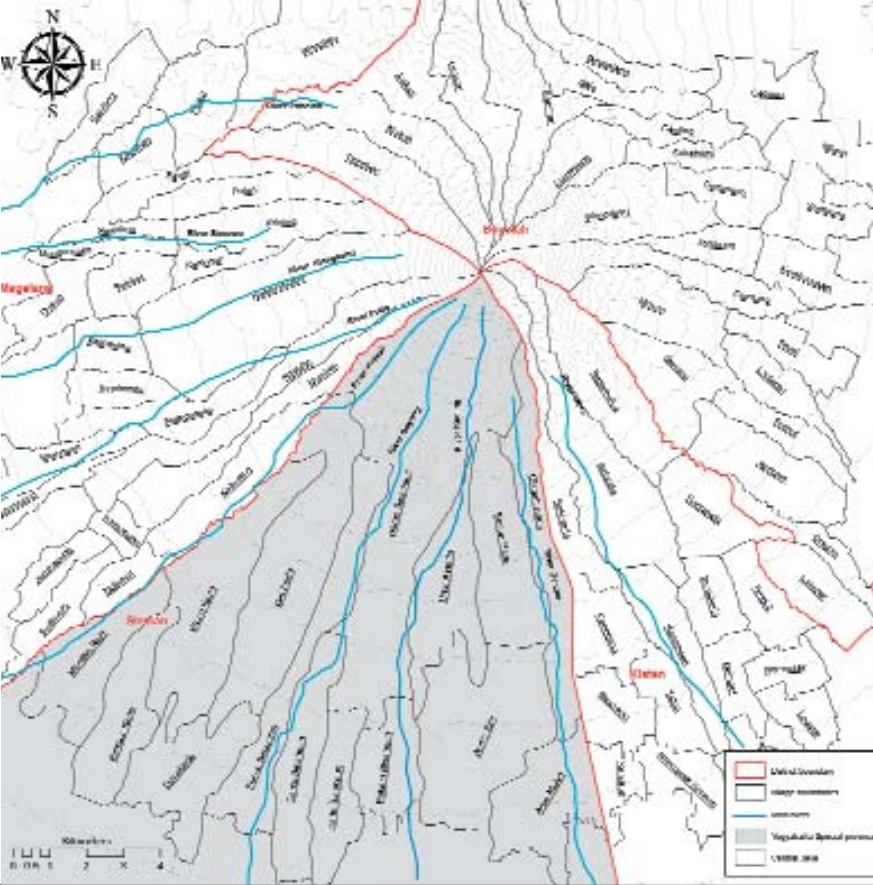


When Mt Merapi erupted in October 2010 – not long after this photo was taken – 210 villagers living on its slopes were killed



Gathering fodder for livestock on the slopes of Merapi. Inhabitants of Pelemsari, one of the settlements destroyed, travelled many miles each day to find suitable grazing for their cattle





The slopes of Mt Merapi are densely populated, and divided into an intricate jigsaw-pattern of village lands

by some to be in a continuous state of eruption due to its constant dome growth activity, sits at its heart. Its cone looms over two large cities - Yogyakarta city (pop. 400,000) and Surakarta (Solo) city to the east (pop. 600,000 – see map). In the last 200 years this volcano has shown two styles of eruptive activity. In the 19th Century it produced relatively large explosive eruptions, while in the 20th, viscous lava domes have cyclically grown and collapsed. The most recent eruption (October, November 2010) saw an increase in explosive behaviour and confirmed that Merapi's activity is now primarily directed towards its southern flanks.

### DISASTER SUBCULTURE

From 26 October through to mid-November 2010, Mt Merapi expelled large pyroclastic flows, destroying villages on these southern flanks. One of the many settlements destroyed was Pelemsari, home of Mbah Maridjan, located just two kilometres from the summit between two main drainage systems: the River Gendol and the River Kuning. Among dense undergrowth, this scattering of traditional Javanese households eked a living, selling milk and livestock. The people owned only small plots of land that provided some food to feed their families, while grass for cattle had to be laboriously collected from elsewhere on the volcano's slopes.

Despite this humble, quiet day-to-day existence, once a year Pelemsari played host the Labuhan ceremony, the largest and most important traditional event in the region. Its purpose was to appease the creatures that, according to local belief, lived at the summit. Lasting over two days, it brought participants from across Indonesia to the tiny settlement, eager to receive a blessing.

In the early morning, Mbah Maridjan would lead a silent procession consisting of staff from the Kraton (the palace of the Sultan of Yogyakarta), villagers and pilgrims to a sacred place of worship one kilometre above the highest house on the volcano's southern side, set not within dense forest, but surrounded by the grey scree that caps the summit. Through the swirling mist, one could hear the *gemlukur* (rockfalls); and as the chanting began, Pak Pujo (Mbah Maridjan's aide) lifted cloth and rice above his head as an offering to the *Makhluk halus alus*, or unseen creatures as a sense of anticipation grew within the kneeling crowd. Once the offering was made, the crowd surged forward, each ▶



Before



After

The village of Pelemsari, as it appeared before and after the eruption



An early morning procession led by Mbah Maridjan to the sacred place above the highest house on Merapi's southern flank. Maridjan was killed in the recent eruption, his body found in the position of prayer

▶ person trying to get their own piece of the blessed food. Later, back in the village, the story of the *Labuhan* would be told through a traditional and elaborate dance.

This begins with Sultan Panembahan Senopati, being presented with *Endog Jagad*, or “Egg of the World”, by a mysterious stranger. The Sultan is asked to eat the egg; but in order to make sure it was not poisoned, he orders both his loyal assistant and his gardener to try first. Immediately they turn into *Buto* - giants or creatures. Being fearful of these, the Sultan orders them to live at Mt Merapi, promising to provide them with food and clothing every year in the form of *Labuhan*. With the completion of the ceremony, the creatures are appeased and will protect the village from eruption. However, frequent eruptions remind the villagers of what might happen if the creatures are “unhappy”.

### MODERN MYTH

In 1994 a dome collapse sent pyroclastic flows towards a settlement called Turgo. Tragically, at this time Turgo was hosting a wedding ceremony and 64 people were killed. Mt Merapi residents believe that the wedding party died because they had disobeyed instructions given to them by the creature of Turgo. Pak Karyo, a resident of Pelemsari, explains:

*“In 1994 the famers in the village of Turgo were given permission to live in Tugro by the creature, with one request: If you plan a ceremony or wedding do not use the days Jumat Kilwon and Selasa Kilwon [specific days in the Javanese calendar]. The victims of the 1994 eruption were attending a wedding on Selasa Kilwon.”*

The area in Turgo that was destroyed was abandoned.

The house holding the wedding is now a ruin. Remnants of the nuptials were never removed, and the area is now avoided as if cursed. Turgo is now a reclusive settlement - reflecting the stigma of losing so many of its community, and by the conviction that they brought it on themselves.

This and other modern myths, well known among local people, suggest three

things. First, by being able to place blame elsewhere, the local community are able to better cope psychologically with the dangers they face. Second, the stories also suggest that unaffected populations perceive themselves as less vulnerable and more skilful. This complacency renders them less likely to prepare for a future eruption, ironically making themselves more vulnerable. Third, if these stories are entirely believed then the only preparation deemed necessary might be to hold ceremonies to appease the creatures.

As more people fall victim to Mt Merapi, more myths are created. For example, during the 2006 eruption two local people were killed in a bunker near Pelemsari. Yadi, from Batur (five kilometres south of Pelemsari) explained:

*“The people who died...were wrong to be in the bunker because they knew it was dangerous. The creature wanted them”.*

### “OUR VILLAGE IS SAFE”

With so many killed last year, including Mbah Maridjan, will similar myths arise, as residents return to their stricken settlements? The answer may relate to the widespread perception that ‘our village is safe’.

This idea comes not only from a belief in the supernatural creatures’ ability to protect certain dutiful settlements but also from previous eruption experience. On the northern saddle between Mt Merapi and Mt Merbabu ( a volcano immediately north of Merapi – cover image) communities clinging to the unstable slopes have not been directly affected by an eruption in living memory. Farmers here find it unimaginable that Mt Merapi could erupt in their

direction - and therefore have no plans to evacuate. Harno, a

resident of Bulu Kidul on the north east of the volcano, says:

*“It is impossible for Merapi to spit here, this is the back bone. We have never evacuated from here. It is impossible...”*

As Harno implies, the volcano is thought in this region to be a giant sitting with its back to the northern villages. The erupting volcano is thought to be vomiting; and because vomit comes only from the mouth, the belief is that Mt Merapi too will only spew southwards. As Ismail, from Selo (the



Anticipation grows among the kneeling crowd



Dancers re-tell the story of the Labuhan



The settlement of Bulu Kidul, on the north west flank of Merapi



Inhabitants of Bulu Kidul believe they are safe from eruptions because their village is situated on Merapi’s “backbone”





largest settlement on Mt Merapi's southern flank) says:

*"If you climb Merapi from the south the Sultan says that it is dangerous and impolite because you are climbing up the face of Merapi"*

With such a strong conviction that their villages are safe, many locals on Mt Merapi do not believe that evacuation is necessary, especially when this means abandoning their livestock and potentially losing all they have. For these extremely poor communities their livestock are their livelihoods, savings and future. As Narti from Pelemsari explains:

*"If I stayed in the evacuation place I get food but my cow does not"*

These people have to balance the risk between definitely losing their income if their livestock starve, or possibly losing everything in an eruption. In 2006, many villagers were unwilling to accept the loss of their livestock and continued to care for them throughout the crisis. This meant that communities at risk only evacuated part-time, returning home during daylight hours. Similarly, in the initial stages of the 2010 eruption, the local population tried to return to their homes. Sadly this risk became too great. Pelemsari was one of the first settlements to be destroyed as pyroclastic flows thundered down the once-lush slopes.

## FUTURE

Living within the community on Mt Merapi, one soon begins to appreciate the people's daily struggle to survive, which outweighs the less frequent risks emanating from the volcano. As the 2010 eruption demonstrated, these people are extremely vulnerable, and their vulnerability is influenced by many variables as traditional beliefs become intertwined with social, economic and political influences, creating complex scenarios at times of elevated risk.

To understand the elements of their vulnerability, including cultural vulnerability, and so improve volcanic risk reduction, a new breed of interdisciplinary science is required. The integration of social science methods into volcanology produces a new area of study, called "social volcanology". By exploring both the people and the hazard together, we gain a holistic picture. Using an innovative and unrestricted spectrum of methods allows hazard experts to work with communities, and develop risk reduction strategies that are acceptable

to them. The future of social volcanology relies on identifying and monitoring high-hazard regions, and will only be effective if used in collaboration with physical volcanology to produce a holistic view of risk. Collaboration and mutual respect are vital to the practical application of such research.

As for those who must live alongside Mt Merapi on a daily basis, thousands are currently doing so in temporary shelters. As they recover, they will continue to balance the benefits of living in this fertile region against the dangers of an eruption. In the south, recent experience has changed people's attitudes towards the volcano and many are trying to find other places to live. The head of Pelemsari hamlet says he is too heartbroken to return and is looking for another place to live. But those who do return may continue to use their beliefs as coping mechanisms.

As the memory of this recent eruption fades into mythology, only one thing remains certain. Mt Merapi will erupt again. ■

\* Kate Donovan, Department of Earth Sciences, University of Oxford, UK. Aris Suharyanto, The Intercultural Institute Yogyakarta, Indonesia.

## ACKNOWLEDGEMENTS

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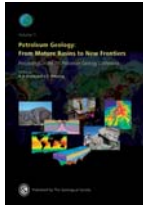
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Edited by B. A. Vining and S. C. Pickering

The Proceedings of the 7th Petroleum Geology Conference is the seventh in a series that has become a tradition known as the 'Barbican' conferences. They started life over 35 years ago, in 1974, with a focus solely on North-West Europe, and have a reputation, both from the conferences and the accompanying proceedings volumes, of being at the forefront of petroleum geoscience; the standard reference for successive generations of petroleum geoscientists.

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- advanced research tools
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#### New titles

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- Journal of Micropalaeontology
- Petroleum Geoscience

In addition, two new archival titles will be launched on the Lyell Collection in 2011 and made available to all subscribers at no additional charge.

- Transactions of the Edinburgh Society
- Transactions of the Glasgow Society





# ROCK, TIME AND TEENAGERS

**Howard Lee FGS** recently sold himself down the river with a bunch of adolescents. It was a learning experience for all

It's probably on the "bucket list" of every geologist (even a lapsed one like me). So when the opportunity came to raft down the Colorado River through the Grand Canyon, I jumped at it. But there was a catch. I would be one of a small group of adults chaperoning teenage boy scouts. Everything has its price.

As the day of departure drew near I took it upon myself to educate the troupe a little about the incredible geological story

**Above:** Possible exfoliation joints in Permian Esplanade Sandstone, North Canyon, mile 20.7. Scouts in middle distance for scale

represented there. Perhaps I should have got the hint when the Scoutmaster kept postponing my session (eventually making it a 'filler' on the long coach ride between Las Vegas and our lodge at Marble Canyon). I should have realized the interest gulf when, given the choice to visit Barringer Meteor Crater, or a common or garden cinder cone...they chose the cinder cone!

I couldn't bear the thought that the Scouts would traverse such spectacular geology blindly. It

would be like visiting a great art gallery and barely noticing there was paint in frames along the walls. I would not bother them with rock classification, current bedding, metamorphosis, dykes and sills, or the tectonic significance of the uplift of the Colorado Plateau. Just stick to the basics, I thought. Suffice it that they grasp an inkling of the time spanned by the Canyon rocks, or the fact that they could not have breathed the air of that far-off Earth where the oldest rocks of the



Crinoid stem in the Redwall Limestone at Redwall Cavern, mile 33



The Great Angular Unconformity exposed in Blacktail Canyon, mile 120. Cambrian Tapeats Sandstone lies unconformably on the basement complex of Vishnu Schist and Zoroaster Granite - a gap of 1.2 billion years



A dyke of Early Proterozoic Zoroaster Granite forms one wall of the Grand Canyon, near mile 122. In the background most of the major units of Grand Canyon Geology can be seen. Middle distance: Late Proterozoic Shinumo Quartzite forms cliffs above the slope of Hakatai Shale, with the Mississippian Redwall Limestone at the top. Far distance: the white stripe of the Permian Coconino Sandstone is easy to spot, overlain by Toroweap and Kaibab Formations

► canyon formed, or that the age of dinosaurs came and went in one of the very last chapters of the Canyon story.

## JAW DROPPED

The Scouts had been up without sleep for some 16 hours when I was finally allowed to make my presentation. I had figured on 20 minute stops – 100 million years per minute. But with each sentence I watched eyelids grow heavy, heads loll and mouths slacken. I edited as I spoke. Out went the Columbia and Rodinia supercontinents. I kept Snowball Earth...one boy's jaw dropped ... but it was slumber rather than interest. I kept in the arrival of atmospheric oxygen by the time of the Tapeats Sandstone; but out went Ediacara fauna, and Pannotia. I'm not sure how many were awake when, five minutes later, I had arrived at the end of the Permian; but life in the audience had had a mass extinction of its own. I left out the entire Mesozoic and Cenozoic except to mention the incision of the Grand Canyon and volcanic eruptions in the last five million years.

Humbled, I resigned myself to appreciating my surroundings alone, and gave myself up to appropriate reflections. I kept quiet about the Upper Permian Kaibab Limestone on the riverbank opposite us when we loaded up the "J-rig" rafts the following day, but it wasn't long before the guides had us on a small hike into Jackass Canyon to look at reptile tracks in Coconino Sandstone blocks that had fallen from the cliffs above. When I effused about these 275 million year-old, pre-dinosaur footprints, I'm not sure if I sparked much interest. The Scouts were here for the rapids. For me, the rapids were an inconvenience that made me put my camera away.

By evening we had reached the expansive Redwall Cavern dotted with crinoid and bryozoan fossils of the Mississippian Redwall Limestone. We camped by Nautiloid Canyon, named for the fossils in its walls. By now people were asking me to distinguish the fossils from the rock and were

getting photos for themselves. Progress! We slept under the stars as the moon illuminated clouds in the gap between the canyon walls.

The next day found us in an exploratory adit for the Marble Canyon Dam. This project which would have flooded a major portion of the Grand Canyon, was started in the 1950s but was cancelled after an outcry. As we wound our way further into the inner recess of the Canyon we stopped and swam in the Little Colorado River (the main Colorado River at that point is dangerously cold to swim in, even in summer) where I searched the Cambrian Tapeats Sandstone (in vain) for fossils. There were abundant worm-like burrow trace fossils but sadly no shells. I wondered if this could be the portion of the Tapeats that predates the “Cambrian explosion”.

## CONVERSION

The first sign of conversion came at mile 64 when the Great Angular Unconformity hove into view. This chronological gap between the Tapeats Sandstone and the approximately 1100 Million year-old Dox Sandstone was not to be missed, so I begged the guide to let me climb the short way up the cliff to the exposure. To my amazement, two Scouts scrambled up with me, eager to have their photo taken with 550 million years in the span of their hand. Two down, twenty to go. Happily, as soon as I started talking to them about schists, cleavage and dykes – something I clearly should have done earlier - everyone took notice.

Our remaining days in the Canyon were spent sometimes hanging on for dear life through rapids, sometimes on long lazy stretches, just gazing at the staircase of terraces rising above us. We hiked into slot-canyons, bathed in the turquoise waters of Havasu Creek, visited ancient native ruins perched on cliff tops at night. Geology was a regular topic of conversation, but even though every Scout had been taught Earth science before high

**Right: Reptile tracks in an erratic of Coconino sandstone, Jackass Canyon, mile eight**



school, I found a profound lack of what might be called “geo-literacy”.

One Scout thought that the Colorado River had been responsible for all the rocks in the canyon, from the Vishnu schist to the Kaibab Limestone. The concept of continents being born, mountains rising, rivers flowing, continents dying and breaking up, over and over again was just too vast for his understanding. Most had real trouble with time periods – thousands, millions and billions seemed to be interchangeable, as if they all represented a single quantity: “lots”. One of the other adult leaders commented that if the seas had come up and gone down over geological time then it shows there is no need to blame man for global warming now...

Perhaps the most disturbing conversation I had was with an adult leader. “Do you really believe in science? I mean do you think there is a religious explanation for this, or are you a full-on scientist?” I gave my usual comment that science and religion don’t occupy the same territory. Science is evidence-

based and faith is not. I believe evidence.

For many people science is just another competing faith, and one they take with a pinch of salt. At least half of my son’s friends (seniors - “upper 6th” - in high school) do not believe in evolution. We live a stone’s throw from Bell Labs in a well-heeled New Jersey Suburb. This is no hick, bible-bashing backwater; this is Manhattan commuter belt, big-pharma land, Alcatel-Lucent city. All the adults and their scouting offspring are considered well-educated. Other people here have told me they simply do not believe geological timescales; so when it’s common – even the norm - for “educated” people not to understand the basic principles of our planet, I worry for the future. I worry about our Scouts who, in a decade or two, will be decision-makers in an age pressed harder by climate change and natural resource shortages.

The child is father to the man, as Wordsworth reminds us. If I can’t bridge the geo-literacy gulf in the Grand Canyon, how will they ever understand? ■

## FURTHER READING

- 1 **Grand Canyon River Guide All new edition**, 2009, Westwater Books, Colorado USA, ISBN-13: 987-0-916370-16-9.
- 2 **Geology of National Parks 5th Edition** 1995; Harris, Ann G; Tuttle, Esther; Tuttle, Sherwood. Kendall/Hunt Publishing Company, Dubuque, Iowa, USA. ISBN 0-7872-5275-1.
- 3 **Geology of the Grand Canyon area:**  
[http://en.wikipedia.org/wiki/Geology\\_of\\_the\\_Grand\\_Canyon\\_area](http://en.wikipedia.org/wiki/Geology_of_the_Grand_Canyon_area)

*Geoscientist* welcomes readers' letters. These are published as promptly as possible in *Geoscientist Online* and a selection printed each month. Please submit your letter (300 words or fewer, by email only please) to [ted.nield@geolsoc.org.uk](mailto:ted.nield@geolsoc.org.uk). Letters will be edited. For references cited in these letters, please see the full versions at [www.geolsoc.org.uk/letters](http://www.geolsoc.org.uk/letters)

## CLIMATE CHANGE STATEMENT



Sir, I was pleased to see that the Society has dared to publish a climate change statement (*Geoscientist* 20.11). There must have been a lot of debate on the concluding sentence: "...In the light of the evidence presented here it is reasonable to conclude that emitting further amounts of CO<sub>2</sub> into the atmosphere over time is likely to be unwise, uncomfortable though that fact may be". The term "uncomfortable" will apply equally to the effect

of sea-level rise. Anthropologists and sociologists should now be enlisted to model and publish descriptions of the way civilisation has reacted to such events in the past, some of which have been reported in *Geoscientist*, and which geneticists call "population squeezing". Meanwhile, geologists can try to get comfortable in the front line of debate.

Chris Garland

## BRAZIL FOSSILS

Sir, Martill & Heads complain that "it is no longer possible to collect fossils anywhere in Brazil" and that they "were compelled to leave material behind". We of the Sociedade Brasileira de Paleontologia (SBP) were very happy to learn (*Geoscientist* 17.11) that the Brazilian government's efforts towards preventing the despoliation of the nation's paleontological resources are achieving success. Brazilian law forbids the ownership of fossils collected in the country, all of which belong to the Union. Therefore, it is illegal for any private party (individual, corporate, Brazilian or foreign) to own - let alone sell, buy, or export - Brazilian fossils.

Foreign palaeontologists are welcome to work in Brazil, and with Brazilian fossils, but ought to follow the current legislation of the Science and Technology Ministry.

Max Langer, Roberto Iannuzzi, Ana Maria Ribeiro, Marina Soares, Soraia Bauermann, Patrícia Rodrigues & Carolina Scherer



## AGW - WHAT DISSENT?

Sir, I wonder what proportion of fellows considers that Anthropogenic Global Warming is real? I can speak on behalf of the Geological Society's Stratigraphy Commission, a straw poll of professional stratigraphers. Here, the ratio is currently somewhat in excess of 9:1 in

favour of the mainstream "IPCC" position. In a recent paper in *GSA Today* discussing the likely validity of the 'Anthropocene' concept, 21 out of 22 Commission members opted to be co-authors, with one dissenter.

Jan Zalasiewicz

## UTTER DISMAY

Sir, I am writing to express my utter dismay at articles by yourself and Bob Ward (*Geoscientist* 20.10). My dismay at Ward's piece is caused by its unscientific nature, and insinuation about the motives of Joe Brannan. Your emotive editorial is full of unjustified assertions and insinuations. Your statement that errors in the latest IPCC Assessment Report were "trivial" is debatable. Your claim that "denialists...being unconstrained by evidence...can construct any number of simple messages whenever they like" is insulting to Fellows who, like me, maintain that the scientific evidence is unclear. Most scientists who are seriously sceptical about AGW want an open, scientific discussion of evidence, rather than the closed, bullishly assertive mentality too frequently displayed by some parts of the AGW establishment.

Peter Whiteside

**Editor writes:** Had I harboured doubts about Joe Brannan's motives in writing the review to which Bob Ward objected, it would not have been published. The definition of a "denyer" (who disbelieves something despite all evidence) definitively excludes anyone who (truly) cares about evidence. That denyers cloak themselves in the honourable guise of the true sceptic is precisely the scandal being exposed.

## POOR ARGUMENT

Sir, I should like to express my disappointment at the standard of the arguments being used by "believers". For instance the CO<sub>2</sub> concentration appears to have increased more or less linearly in the last 100 years since 1910 but the temperature rise has been intermittent and non-linear. For half of those 100 years it has been rising and for the other half it has been constant or falling, weakening the link between cause and effect. Archaeologists tell us that people in Roman times and the Middle Ages enjoyed a warmer climate than today, before the advent of coal-fired power stations and cheap air travel.

Robert Freer

**Reply from Colin Summerhayes:** Sir, The Medieval Warm Period (MWP AD 900-1400) was followed by the Little Ice Age (LIA - AD 1400-1750). LIA cooling was not uniform, but focused in certain sunspot-free periods. Some believe the LIA extended into the 19th Century's Dalton Minimum (1790-1830). Links between CO<sub>2</sub> and temperature are subject to many feedbacks. CO<sub>2</sub> is absorbed by and emitted from the land and ocean at different times, rates and places, obscuring a direct temperature connection. Major eruptions like Pinatubo (1991) change global temperature for 1-3 years. Temperature is also affected by changes in Earth's albedo.



## Fossils of the Gault Clay

Hundreds of budding geologists in the southeast of England (including this reviewer) must have cut their teeth on the Gault Clay at Folkestone, and will have cried out for an identification manual as clear and comprehensive as this. The book is number 12 in the series produced by the Palaeontological Association on the fossils of some of Britain's most collectable deposits, and PalAss is to be congratulated on its continuing commitment to this series.

The book, while perhaps aimed mainly at collectors (who will find it an invaluable identification guide), is also a key reference work for those interested in the ecology and systematics of this abundant Cretaceous fauna. It is comprehensive, covering all the taxonomic groups likely to be found in the Gault (including the more specialist areas of bioimmuration, bioclastrations and bioerosive trace fossils), and ranging from calcareous nannofossils to reptiles. The quality of the black-and-white photographs is excellent, and highlights the care with which the book has been produced. Importantly, given that it is likely to be well thumbed, the book has a high-quality binding that will withstand prolonged heavy use.

The book is more than an identification guide. As well as helpful introductory material on the Gault Clay it provides very useful guidance on sample preparation for microfossils, including vertebrate teeth and other elements, and on macrofaunal ecological associations found in the Gault. It may also stimulate renewed interest in the Gault among collectors, perhaps leading to new information on some of the less well-known groups, such as bryozoa. Most chapters clearly indicate that only the most common species are described, thereby avoiding the trap of implying that all species likely to be found in the Gault are illustrated. The extensive reference list provides the reader with a way into the more extensive historic literature, which will assist those looking to identify the rarer components of the fauna.

Perhaps the only disappointment is the lack of guidance on curation and preservation, especially the notoriously pyrite-rot-prone nature of many ammonites on which some advice would have been welcome. However this minor omission should not detract from the value of this impressive book to amateur and professional palaeontologists alike.

*Reviewed by Keith Duff, Stamford*

### FOSSILS OF THE GAULT CLAY

JEREMY R. YOUNG, ANDREW S. GALE, ROBIN I. WHITE & ANDREW B. SMITH (eds); Published by: The Palaeontological Association; Publication date: 2010; ISBN: 978-1-4443-3542-2; 342 pp, 57 plates.  
List price: £18.00, [www.palass.org](http://www.palass.org)



## Periglacial and Paraglacial Processes and Environments

Away from the direct influence of glaciers and ice sheets, cold climate conditions create distinctive environments characterised by intense freeze-thaw processes and permafrost. As global climate warmed spasmodically into the present interglacial, landscapes responded to the removal of land ice and permafrost melting through a sequence of complex responses, including a readjustment to high sediment availability for transport by newly developing fluvial systems. It was to this particular situation that the term 'paraglacial' was coined about 30 years ago. Since then the concept has been developed and extended.

This SP is divided into three sections, the first dealing with periglacial environments. This is followed by a section on paraglacial processes and environments in the British Isles, and a final section relating to more general paraglacial issues. Individual papers range from subject overviews to site-specific investigations. In the opening section, a key paper is the evaluation of periglacial geomorphology from a French perspective; this provides useful discussion on global change issues and the 'paraglacial fever' that seems more prevalent in the British Isles.

It is to this 'paraglacial concept' that many of the ensuing papers are devoted, either with doctrinal adherence or with more thoughtful evaluation with respect to the environmental sensitivity of cold climates. As with many concepts, it has been redefined and extended beyond the intentions of the original authors to include a range of geomorphic situations and timescales. Thus, depending on your point of view, some papers will be observed to develop 'paraglacial' using the word with dogmatic zeal; while others reflect that the term is overused, adding little new understanding, particularly when it involves dropping consideration of distinctive periglacial conditions and environmental control. Here, the important paper (by Slaymaker) is a rational evaluation of the topic and raises the significant theme of disturbance regime landscapes, well developed by Hewitt in a later paper.

Overall, this is an interesting publication bringing together a number of studies that demonstrate key issues in cold-climate geomorphology and elaborate on the subject's role, with particular reference to sensitive environmental responses to ongoing climate change. The collection provides a thoughtful commentary on the paraglacial concept.

*Reviewed by Wishart A Mitchell,  
Department of Geography, Durham University*

### PERIGLACIAL AND PARAGLACIAL PROCESSES AND ENVIRONMENTS

J KNIGHT & S HARRISON (eds) Geological Society Special Publication No.320, The Geological Society of London. Publication date: 2009; ISBN: 978-1-86239-281-6; 272 pp  
List price: £90.00; GSL Member price: £45.00,  
[www.geolsoc.org.uk](http://www.geolsoc.org.uk)

### REVIEWS: COPIES AVAILABLE

Interested parties should contact the Reviews Editor, Dr. Martin Degg 01244 513173; [m.degg@chester.ac.uk](mailto: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.

- **The Western Alps: From Rift to Passive Margin to Orogenic Belt** de Graciansky, P-C; Roberts, D G & Tricart, P (2010), Elsevier (as PDF).
- **Heavy Crude Oils: From geology to upgrading - an overview** Huc, A.-Y (2010), Editions Technip.
- **Introducing Palaeontology: A guide to ancient life** Jackson, P N W (2010), Dunedin.
- **Planets: A very short introduction** Rothery, D A (2010), Oxford.

# PEOPLE

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

## CAROUSEL

All fellows of the Society are entitled to entries in this column. Please email [ted.nield@geolsoc.org.uk](mailto:ted.nield@geolsoc.org.uk), quoting your Fellowship number.

### DAVID ELLIS



David Ellis, has been elected President of the Stone Federation of Great Britain, at its AGM held on

25 November 2010. David joined Sandberg Consulting Engineers in 1997, taking over the management of the Geology Department and associated testing laboratories, and became a partner in 2000.

### CHRIS LEE



Chris Lee has received the Draper Memorial Medal, highest award of the Geological Society

of South Africa "for exceptional contributions to the advancement of South African geology" in recognition of his contribution to the Earth sciences, and for his work on the geology and economic resources of the Bushveld Complex.

### NEIL WELLS



Neil Wells, Geological Services Manager, Hanson UK, has been appointed Natural Resources

Manager for the parent company HeidelbergCement's Competence Centre Materials T.E.A.M. area, which covers northern and western Europe, UK, Spain, Israel and Turkey. He will be based in Brussels. Contact [neil.wells@heidelbergcement.com](mailto:neil.wells@heidelbergcement.com).

## Early career X-factor

Could the two existing Early Careers Challenge Trophy awards attract one more (at least) and so become the regional heats of a national final? writes **Paul Maliphant** (Southern Wales)

Tracey Laight (left) with James Dendle, Paul Maliphant and Jenny Moss (right)



Thames Valley and then Southern Wales regional groups have pioneered competitions that challenge their early-career members to showcase their knowledge and expertise in competing for trophies named for their groups founders. It is therefore a curious coincidence that both groups were founded by geologists born in Trinidad - giving us the Richard Fox Shield and - the Paul Maliphant Trophy!

In 2010, the Southern Wales event attracted eight entries, and shortlisted three for the final

presentation evening:

■ James Dendle (Resource Geologist, SRK Consulting (UK) Ltd) – *Tonkolili Iron Ore Project, Sierra Leone;*

■ Tracey Laight (Resource Geologist, SRK Consulting (UK) Ltd) – *The Marenica Uranium Deposit, Namibia;*

■ Jenny Moss (Seismic Interpretation PhD Researcher, University of Cardiff) – *Sub-seabed hydrocarbon fluid escape: an example of natural fluid blow-out from a reservoir, offshore Namibia.*

Congratulations to Tracey, who was the deserving

winner (picture), but also James and Jenny, her worthy opponents.

We are now seeking at least a third regional group to set up its own Early Careers competition. Then, winners could converge on Burlington House for a Regional Groups Early Careers Challenge Trophy - for which some sponsorship has already been secured!

► The inaugural event is pencilled in for spring 2012; so any other regional group wishing to join in should contact Paul Maliphant [Maliphantpc@halcrow.com](mailto:Maliphantpc@halcrow.com)





## HELP YOUR OBITUARIST

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

## 10,000th Fellow!



**Dawne Riddle writes:** For the first time in its 204-year history, the Geological Society's

standing membership has passed the 10,000 mark with the election to Fellowship of Gordon Poole (picture).

Gordon, 31, works as a Data Geologist for African Eagle Resources plc, London – a mineral exploration company: [www.africaneagle.co.uk](http://www.africaneagle.co.uk).

Gordon graduated with a BSc in Geology from University College Dublin in 2003 and joined African Eagle in 2005 after a stint at the Geological Survey of Ireland. Gordon joined the Irish

Geologists' Association when he was only 14, and subsequently served on their Council and as web and newsletter editor. He is conscious of the importance of geological societies both for professional networking and maintaining and developing his scientific knowledge.

A keen mountaineer, orienteer and diver, Gordon looks forward to using his Fellowship to update himself and broaden out – particularly in geophysics and geochemistry – to getting into the field (being "data geologist" can be tying, he admits) and to progress towards Chartership in due course. Gordon is also a member of the Irish Association of Economic Geologists.

## IN MEMORIAM [WWW.GEOLSOC.ORG.UK/OBITUARIES](http://WWW.GEOLSOC.ORG.UK/OBITUARIES)

### THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Coleman, John Arthur R *	Locke, Matthew *	<b>Craig, James *</b>
Mann, Paul Dunstan *	Richardson, Alfred James *	Morley, William *
Harwood, H J *	Jones, James Peter *	
Wilson, Henry Hugh *	<b>John, Thomas Urias *</b>	

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. The most recent additions to the list are 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](mailto:ted.nield@geolsoc.org.uk) to be commissioned. You can read the guidance for authors at [www.geolsoc.org.uk/obituaries](http://www.geolsoc.org.uk/obituaries). To save yourself unnecessary work, please do not write anything until you have received a commissioning letter.

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

**Dr Fergus Gibb** is eager to find a good home for the following journal issues. Buyer must collect/arrange transport from Sheffield. Mineralogical Magazine v.32 (1961) to v 69 (2005) [Bound to v 48]; Mineralogical Abstracts v 15 (1961) to v 54 (2003)[Bound to v 38]; Journal of Petrology v 12 (1971) to v 26 (1985)[Bound to v 19]; Scottish Journal of Geology v 1 (1965) to v 46 (2010); Journal of the Geological Society v 130 (1974) to v 166 (2009); American Mineralogist v 52 (1967) to v 90 (2005). Interested parties should email [F.Gibb@sheffield.ac.uk](mailto:F.Gibb@sheffield.ac.uk).

## DISTANT THUNDER

As St Valentine's Day approaches, Nina Morgan\* gets to the heart of what makes palaeontologists tick

For keen collectors, geology is not so much an occupation as a major preoccupation. This was certainly the case with William Buckland (1784-1856), first reader in geology at Oxford University. In a letter written in 1832 to the his ex-student, the politician and enthusiastic collector of fossil fish, Sir Philip de Malpas Grey-Egerton (1806-1881), Buckland offers congratulations on Egerton's impending marriage in terms only a keen fossil collector can appreciate.



*Christ Church,  
January 23rd 1832*

*My Dear Sir Philip,  
Mrs Buckland begs to unite with me in the offering of our most sincere congratulations to you on the brilliant Discovery announced in your last, of a Jewel of great price which you have resolved to make your own, and to submit to the inspection of the learned at our proposed scientific meeting in June next. The only rival specimen I have heard of as likely to be present, and which has the reputation of being the greatest Beauty in the mineral world, is a specimen that will be brought by the Marquis of Northampton, who has joined our Society, and has lately possessed himself of a fossil lizard enclosed in amber more exquisitely beautiful than the*

*fairest of the fossil Saurians, and which your specimen alone I expect to find possessing the power to eclipse... I presume our friend Lord Cole will appear in his unenviable state of single blessedness.*

*Again, repeating our united congratulations, and with most sincere wishes for your happiness, I remain,*

*Yours always very sincerely,  
W. Buckland.*

Presumably Anna Elizabeth Legh, Egerton's intended, knew what she was getting into. And if she had any doubts, she could always have consulted Mrs Buckland, the former Mary Morland. Legend has it that William Buckland was first attracted to Miss Morland when he observed her reading a book by

French naturalist and zoologist, Georges Cuvier. After their marriage, in 1885, he promptly whisked her off on a geological wedding tour of the continent that lasted nearly a year.

► Ref: William Buckland's letter to Philip Egerton and the story of the Buckland's wedding tour appear in *The Life and Correspondence of William Buckland, D.D., FRS* by his daughter Mrs Gordon, published by John Murray in 1894.

► Visit: [www.geolsoc.org.uk/hogg](http://www.geolsoc.org.uk/hogg) Registration for the HOGG Conference on Geological Collectors and Collecting is now open. A full programme and registration form are available for download from the HOGG website.

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

## Palaeontological passion

OBITUARY



# DAVID NORMAN CLARK 1950 -2010

Petroleum geologist, independent consultant and honorary lecturer

**D**avid was born on 1 October 1950 in Hampton, Surrey and obtained a BSc in Geology at Kingston Polytechnic (1972). He then went on to complete a PhD at Imperial College's Royal School of Mines on the Middle Jurassic carbonates of the Lot valley, France. He was awarded his DIC in 1976. In the same year he joined Shell International Oil Company in Rijswijk, The Hague, where he worked as a Research Geologist. In 1980 he became an operational geologist in Oman, working for Petroleum Development Oman.

Between 1981 -1985 he

worked for Union Texas Petroleum in London as Exploration Geologist and from 1985 to 1986 worked as a Divisional Manager for GB Petroleum Consultants, also in London. He worked for Core Laboratories London in the same role between 1986 and 1989. His next employment was as Geological Advisor to Sun Oil International (London), and then on posting to Jakarta, Indonesia and Kuala Lumpur, Malaysia (1990 – 1993). Between 1994 and 1997 he worked for ARCO (Texas). In 2005 he joined Gulf Keystone (London) as Vice President, New Ventures Exploration Team.

In 1995, David set up an independent consultancy that was to keep him in permanent employment for the next 15 years. He was well respected by his peers for his forthright opinions and his academically sound approach. He never put his name to anything he did not agree with from a geological perspective.

## PASSIONATE

He was passionate about geology all his life, and loved to share his enthusiasm with others, teaching on myriad company training courses. Every year he gave up two weeks' annual leave to teach at St Andrew's University, which appointed him

Honorary Senior Lecturer. It was to this university that he bequeathed his specimens, books and reports. During his lifetime he was to publish over 50 academic papers (the last in 2009 on the Ballard Down Fault in the Dorset Purbeck sequence).

In 1974 he married Christine Payne who had been a fellow geology student at Kingston Polytechnic. They had three children, Tobias (b.1977), Emma-Louise (b.1980) and Amelia-Anne (b.1984). David was a loving father and later in 2001 he became proud grandfather of Felicity May.

David worked as a co-opted Committee member of the Society's Petroleum Group. He enjoyed meeting other Fellows at Burlington House and attended all the Christmas dinners over a 35-year period! He was a member of the Geologists' Association, the PESGB and the SEPM. He was a director of Clark Research Limited.

Sadly he had contracted skin cancer during his work overseas, and despite gruelling chemotherapy, continued to work up until the end of his life. He died on 31 July 2010. He will always be remembered as a kind and generous man with a keen sense of humour, always willing to share his knowledge with those who were less experienced in the petroleum industry.

By **Graham Evans**



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**DIARY OF MEETINGS FEBRUARY 2011**

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Meeting	Date	Venue and details
Transport and Fate of Groundwater Contaminants (Hydrogeology Group)	9 February 	<b>The Geological Society (Burlington House)</b> . The meeting will examine key transport and attenuation processes and current issues relating to contaminants in groundwater and how our perceptions and understanding of the problems and their solutions have progressed. <b>Contact:</b> Daren Goody E: dcg@bgs.ac.uk <b>Contact:</b> Simon Bottrell E: s.bottrell@see.leeds.ac.uk
Earthquakes and Tsunamis at Subduction Zones: The 2004 - 2005 Sumatra Earthquakes (Shell University Lecture)	16 February  	<b>Cambridge University</b> . <b>Speaker:</b> Dr Lisa McNeill (National Oceanography Centre, Southampton). Entry is free to all, but by ticket only. To obtain a ticket please contact Leila Taleb E: leila.taleb@geolsoc.org.uk <b>Time:</b> 1730 Lecture begins; 1830-1930 Reception.
Challenged by Carbon: Geologists, the Oil Industry and Climate Change (Shell London Lecture)	16 February  	<b>The Geological Society (Burlington House)</b> . <b>Speaker:</b> Dr Bryan Lovell (President). See Society News (this issue) p11 for details.
Tuffs and Traces - biodiversity in terrestrial ecosystems in the Upper Silurian Old Red Sandstone of SW Wales (Geologists' Association - South Wales)	19 February 	<b>Wallace Lecture Theatre, School of Earth and Ocean Sciences, Main Building, Cardiff University</b> . <b>Time:</b> 1030 for 1100. <b>Speaker:</b> Susan Marriot (Institute of Research in the Applied Natural Sciences). <b>Contact:</b> Dave Jones T: +44 (0)29 2046 6096 E: david.jones@environment-agency.gov.uk
Natural Hazards of High Subsurface Fluid Pressures (Shell University Lecture)	23 February  	<b>Heriot Watt University Conference Centre</b> . <b>Speaker:</b> tbc. To obtain a ticket please contact Leila Taleb E: leila.taleb@geolsoc.org.uk. 1730pm <b>Lecture begins:</b> 1830-1930 Reception.
Careers Day (Geological Society)	23 February 	<b>Our Dynamic Earth (Edinburgh)</b> . 10.00 Registration; 11.00 Welcome; 11.05 Careers in Earth Science - presentations, chiefly by early-career Earth scientists from a range of industrial and academic sectors. (Full listing available January 2011); 15.00 Careers panel Q&A session; 15.30 Exhibition - A chance to discuss opportunities, collect information and to meet other Earth scientists. Registration for this event is free, but compulsory. <b>Contact:</b> Georgina Worrall T: +44 (0)20 7434 9944 F: +44 (0)20 7494 0579 E: georgina.worrall@geolsoc.org.uk
New and Emerging Plays in the Eastern Mediterranean (Petroleum Group)	23-25 February 	<b>The Geological Society (Burlington House)</b> . New ideas on tectonic evolution of the region, basin formation, new plays, petroleum systems, and the linkage between the onshore and the offshore. Basins: Levant, offshore Nile, Herodotus, offshore Cyrenaica, offshore Sirt, Pelagian, Malta, Sicily Channel, Adriatic, and others. <b>Confirmed Keynotes:</b> Hugh Jenkyns, Oxford; Alastair Roberston, Edinburgh; Peter Bentham, BP Egypt; Mohammed Soussi, Tunisia; Jean Mascle, GeoAzur; Tim Bevan, BP. Online registration open. <b>Contact:</b> Steve Whalley: +44 (0)20 7432 0980; E: steve.whalley@geolsoc.org.uk

OBITUARY



# CHRISTOPHER MARTIN PEARSON 1942-2010

Geotechnical engineer, project manager and management consultant

**B**orn 19 February 1942, Chris Pearson left school to find his first job with a firm in Southall called "Le Grand Sutcliffe and Gell". Chris moved on to British Rail, Western Region in the early 1960s where he was employed as a Geotechnical Engineer managing a wide range of geotechnical challenges associated with viaducts and bridges, tunnels, cutting and embankment stability, track stability, drainage, and structures.

In 1965 Chris set

up Wembley Laboratories Ltd, Geotechnical Consultants. He developed this company quickly and profitably, with growth based considerably on repeat business from both public and private sectors. By 1969 he had a total staff of 30 including geotechnical engineers, soils technicians and field personnel.

In 1973 Chris joined Nuttall Geotechnical Services Ltd as Geotechnical Manager with responsibility for procurement, tendering and Project Management for complex on-shore and off-shore geotechnical site investigations.

Chris joined Tyrone Group Soil Engineering Ltd (1979) and became a Director in 1981, with an

engineering and laboratory staff of 27. Chris led geotechnical investigations from tender to completion, including site supervision on larger or technically demanding projects.

## INDEPENDENT

After a seven-year break away from geotechnical work, during which he worked as a consultant with an international management consultancy group, Chris returned to the geotechnical and environmental consultancy business and practised as an independent Geo-environmental Engineer from 1995. Chris undertook a wide range of UK, European, and some offshore work on geotechnical and environmental projects. Chris enjoyed sailing and reluctantly sold his boat when work commitments meant that he was not getting enough time to sail.

Chris joined Waterman Environmental Ltd as Senior Consultant in May 2000 where he managed geotechnical and environmental projects. Chris was primarily based on site, managing several major ground investigations,

demolition and remediation projects. While Chris was Resident Engineer for the demolition of the works at Peruvian Wharf, East

London, including the demolition of a large concrete sugar silo, he managed to sprain his ankle – not on site, but while running for a bus home! Chris was Resident Engineer for the remediation of the former Pitwines Gasworks in Poole, which was completed successfully for residential use.

Chris extended his retirement by two years, leaving Waterman in February 2009; but continued working freelance - in particular with Anderson Contractors, with whom he developed a relationship during the remediation of the gasworks at Pitwines in Poole, Dorset. Chris died from a stroke on the morning of Saturday 6 February 2010. This was completely unexpected, but Anne (his former wife, to whom he was about to be re-married) was at his side and said that he suffered no pain.

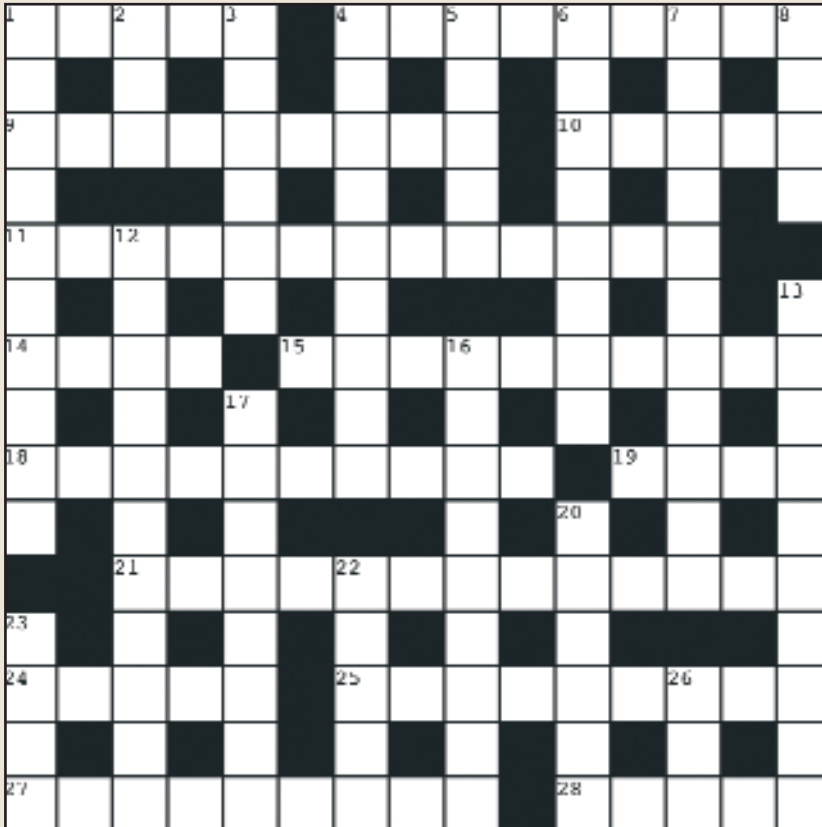
## LARGER THAN LIFE

Chris is remembered fondly by colleagues as a larger than life character, driving his Jaguar, smoking a cigar, being happiest working on-site with a professional team managing the challenges presented by the geology and contamination during demolition, construction or remediation works.

► By Carl Slater



**CROSSWORD NO. 143 SET BY PLATYPUS**



**ACROSS**

- 1 Of the countryside (5)
- 4 Miserly persons (9)
- 9 Buoyant ascent of earth materials like halite and granite (9)
- 10 Chemical compound derived by reacting an oxoacid with an alcohol or phenol (5)
- 11 Sounding like the thing (14)
- 14 These formic fiends evolved from wasp-like ancestors between 110 and 130 million years ago (4)
- 15 Beautiful Italian woman, becomes deadly in English (10)
- 18 Outbreed, technically; miscegenate racially (10)
- 19 Rest against, architecturally (4)
- 21 To do with the naming of things (13)
- 24 Order from on high (5)
- 25 Annual increments (9)
- 27 The art of handling practical details on a large sale enterprise (9)
- 28 Rotational, sideways stress (5)

**DOWN**

- 1 Amoeboid protozoa with intricate mineral skeletons (10)
- 2 Drowned river valley (3)
- 3 Within the unpriestly portion of humanity (6)
- 4 Class of three-lobed extinct arthropods (9)
- 5 Crud that accumulates around a drill-bit, named by reference to filling southern stew (5)
- 6 Taxonomic encyclopedia of fossil groups, associated indelibly with R C Moore (8)
- 7 Space before the main volume - of a tomb, perhaps (11)
- 8 Waisted Channel Island (4)
- 12 Egregious - but in a good way (11)
- 13 Soil additive that improves productiveness (10)
- 16 Servants for rent (9)
- 17 Solitary Christian monks (8)
- 20 Seneca, Epictetus, and originally, Zeno of Citium (6)
- 22 Original army stores - home of the original lukewarm, thick brown tea (1,1,1,1,1)
- 23 The Society was explicitly founded partly to stimulate this form of enthusiasm (4)
- 26 Any one of the 15 known crystalline phases of water (3)

**WIN A SPECIAL PUBLICATION**

The winner of the November Crossword puzzle prize draw was **Jonathan Wonham** of Stavanger, Norway.

All correct solutions will be placed in the draw, and the winner's name printed in the April issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - March 14.**

The competition is open to all Fellows, Candidate Fellows and Friends 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 scan the signed form and email it as a PDF to [ted.nield@geolsoc.org.uk](mailto:ted.nield@geolsoc.org.uk)

Name .....

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**SOLUTIONS NOVEMBER**

**ACROSS:**

- 1 Algal 4 Sovereign 9 Holograms 10 Divan
- 11 Olistostromes 14 Axon 15 Condensing
- 18 Isogametes 19 Bubo 21 Pharmacopoeia
- 24 Alibi 25 Flintiest 27 Cementing 28 Mangy

**DOWN:**

- 1 Achromatic 2 Gel 3 Legato 4 Soapstone
- 5 Visor 6 Rudiment 7 Investiture 8 Nuns
- 12 Isomorphism 13 Ignorantly 16 Drenching
- 17 Bahamian 20 Sputum 22 Mufti 23 Talc 26 Eon

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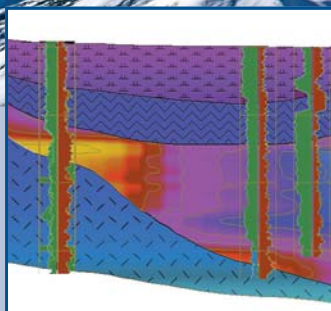
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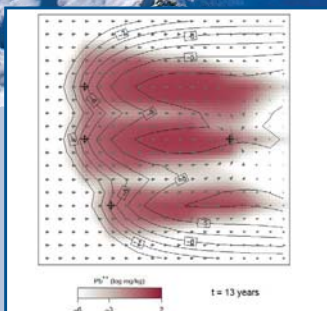
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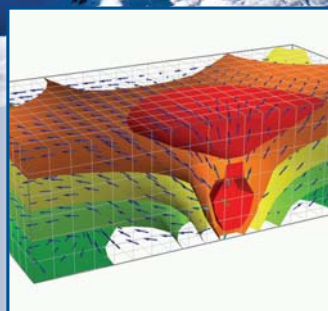
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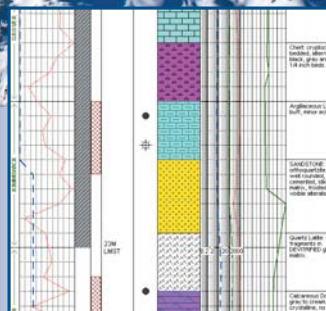
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