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A STORY OF BOYISH ENTHUSIASM, RIVALRY, SHOWING OFF AND A NEVER-ENDING QUEST FOR STORAGE SPACE... Front cover A geological map of England and Wales, 1835

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NEWS VS COMMENT



ditors should not talk about their organs too often, I always think; it makes them seem self-absorbed. However I will break the rule on this occasion because the issue is an aspect of a wider phenomenon touched on in this month's second feature.

The information industry in general is in a state of flux, as the implications of digital storage and delivery work their way through the system. Removing our reliance on printed paper for these functions will have consequences every bit as unforeseeable as the introduction of word processing in the 1980s, when for writers and editors, 'top copy' tyranny finally collapsed. However, what digitisation is forcing us to do is to be more discriminating about different types of information, and how best to deliver them - making the medium fit the message, in other words.

Like *Radio Times, Geoscientist* (formed by the amalgamation of the Institution of Geologist's magazine *British Geologist* and the Society's monthly newsletter) was for many years after primarily a 'listings' service - a directory of meetings, with abstracts. This sort of information is now much better delivered online than in print, because there it can be continually updated and disseminated, free and on-demand. As a result, the printed Calendar has shrunk to a vestigial page, listing only meetings in the month of issue.

Much the same sort of transformation is now overtaking news. Even daily newspapers now find their thunder regularly stolen by more immediate media, which now include their own online versions. Print dailies face many of the same problems that Sundays always faced; when everyone else has shorter lead times and higher frequency, you must do more opinion, more reviews and perhaps the odd investigative exclusive.

We are all now bombarded with geological news, so a magazine with a lead of one calendar month at least is not the natural home for breaking stories. So, marking another stage in a transition to a less news-based, more reflective *Geoscientist*, we shall henceforth publish two spreads of reviews in our section 'Books & Arts'. This will help both to cut the lead-time for reviews and broaden the range of books and events that we cover.

This new world of information delivery is central to our second feature this month, in which Map Librarian Paul Johnson reviews the history of the Society's map collection, and the digital future that awaits it. And if you would like to review a book for *Geoscientist*, please visit the *Geoscientist Online* Books & Arts page for a regularly updated list of available titles.

DR TED NIELD EDITOR

SOCIETYNEWS

ELECTION – FELLOWS

The following names are put forward for election to Fellowship at the OGM on 28 November:

ADEKILE Adedotun; ADVAKAAT Eldert Lieven; AGBEJOBI Olawale Olutayo; ANASTASSIADES A Eraclis; BACKSTROM Lars Gosta Erik; BAINES Christopher Joseph; BALE Sean Michael; BARKER, Michael lan; BARRON Christopher James; BATCHALI Siva Soumya; BEDFORD Steven; BERNAU Robin James; BISHTON Scott; BOYCE Craig Alan; BRYDON Christopher Leslie; BUMSTEAD Martyn Leslie CAPPELLETTI Flavia; CARWITHEN Leah Elizabeth; CASSIDY Sean; CAVEN Sarah; CHAMBERLAIN Matthew Davis; CHAN Vincent Yu Kwan; CHAPAGAIN Binod; CHEVRIER Philippe; CHIK Yu Sum; CHUGG Gareth; CLARK Lloyd; CONVERY Marie Elizabeth; COOPER James; COUVES Colette Rose; CURTIS Thomas; DALE Tabetha Fispeth: DAVIES Paul: DEMUTH Frances Carol: DEWHURST Thomas: DOYLE Brendan: DRUMMOND Daniel Nicholas: EDMUNDS Huw Richard Llewelyn; EYERS Shirley; FAROQY Anna; FOSTER Michael; GANN Susan Elaine Russell; GILCHRIST Stephen James; GILFILLAN Laura Joyce; GRAYSON Emma; GUEDEZ Maria Carolina; HENRY Samuel William Richard; HIGGS Stephanie; HIPKINS Emma Victoria; HO Cho Man; HO Chun Ning; HODGINS Jonathan; HOPKINS Daniel; HULL David Michael; IMIOLCZYK Stefan David; INGLIS Catherine; INGRAM David John Ralston; JAKUC Mikolaj Hubert; JOHNSON Simon William Lloyd; JOHNSON Sean Christopher; JOHNSTON Andrew Ian; JOYCE Angela Theresa; KIRK Fraser Andrew; KIRKBY Rachael Helena Leigh: KIRKWOOD Charles William: KNEVITT Oliver: KOCHER Thomas; KOJI Hirai; LAM Wing Yuen; LARWOOD Jonathan Gilbert; LAW Andrew David John; LEE Chen Wah; LEITCH Susan; LEVISON Alan; LEWIS Emily; LOFTHOUSE Christopher; LOURENCO Sergio Duarte Nunes; LUI Jade Victoria; LYGKAS Georgios; MACALLISTER Donald John; MAK Yiu Man; MANKIEWICZ William; MATTHEWS Thomas; MAUSCH Wojciech; MCGILLYCUDDY Yvonne; MORETTI Helena; MORRISON Donald; MUIRHEAD David K; MUKHERJEE Abhishek; NAIR Dinesh; NORTH James; O'HARA Peter Joseph; PATEL Nehal; PAUL Yee Yu; PENGILLY Oliver; POWLING Thomas: PURVIS Jonathan William Thomas: RAWCLIFFE Heather Joanne; RICHARDS Lachlan John; RITCHIE Sarah; ROBERTS Gareth; RODWAY Kristopher; ROSE Alexis Victoria; ROWELL Christopher David; SANDERSON Marcus James; SELL William Harrold; SHELLNUTT John Gregory; SMALE Lara; SMITH Graham Paul; SPRING John Stuart; STEWART Matthew; SWEENY Kirsty Helen; TAYLOR Claire; THOMAS Hugh Mario; THOMAS Daniel Mark; THOMPSON Andrew; TSE Sin Fung (Elmer); TURNER Oakley; TYERS Paul; VAN DER WIELEN Simon Eduard; VENKATESAN Jayyarama; VILES Heather; WALLIS Joanna Louise; WELLS Kevin; WHEELER Simon Darren; WILKS Dominic John; WILSON Augustus O'Hara; WILSON James Alexander; WORMALD Sarah; YEUNG Kai Wing; YIP Shing Lam; YIU Wai Cam; YOUNG Kateline

Candidates upgrading to Fellowship:

ANDERSON Ross Peter; AL-NUAIMI Alexander Nicholas; BROUGH Amber Louise; COUSINS Ben Lewis; GJERTSEN James; HENRY Peter; LACEY Jack; MAIR Kathryn Elizabeth; PACEY Adam; XERRI Rodney



FUTURE MEETINGS

Dates for meetings of Council and Ordinary General Meetings until June 2013 shall be as follows:

- 2012: 28 November
- 2013: 6 February (1500); 10 April



Plate Tectonics online

Judi Lakin (Education Officer) reports on a new online teaching and learning module on the unifying theory of terrestrial geology

We are pleased to announce that our latest on-line resource - *Plate Tectonics* - should be live on the Society's website by the time you read this. Although aimed at a target audience of 14 to 16 year-old students, the module should also appeal to a wider range of students and non-geologists. Learning from our experience with *The Rock Cycle*, the module uses seven localities as case studies that can be 'drilled down into' for full explanations of their tectonic setting. Each locality is identified on an interactive 'hub' map and the Plate margins are illustrated with additional maps and animations. A final section looks at evidence found in the UK for past tectonic events.

As for *The Rock Cycle*, a 'Test your knowledge' section for students now has quizzes and 'drag and drop' questions; while new extension material in the 'Teachers' zone' includes useful links, and a glossary.

The Society is grateful to Centrica for the generous sponsorship of this project; and to the team of senior teachers and academics who have worked with the Society staff in making the Plate Tectonics module a reality: namely, Pete Loader, Ian Kenyon, Nick Rogers, Gordon Neighbour, Alan Smith and Stuart Smallwood.

Plate Tectonics will appear on the Society's new website, being made ready for launch at time of going to press. Once this has happened (but not before), the URL will be **www.geolsoc.org.uk/plate-tectonics**. *Editor*

CHRISTMAS AND NEW YEAR CLOSURE

The Society (London and Bath) will be closed from 24 - 31 December inclusive, re-opening on Wednesday 2 January 2013.



Research Funds open for bids

The 2013 round of Society Research Funds is now open for applications. Applications for support from any of the Society funds must be made on the 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. In order to be considered at the next available committee meeting, applications and supporting documents should reach the Society no later than 1 February 2013. The average award has been about £1000.

Novas are again generously providing bursaries for undergraduate field mapping and supervisors are asked to encourage their students to submit their applications.

Fermor Fund anniversary

Early in 1991 the Society received a significant bequest from Lady Frances Mary Fermor to establish the Fermor Fund as a memorial to her late husband, Sir Lewis Leigh Fermor KT OBE FRS (1880- 1954), for the "furtherance of research into those branches of geology that deal with the study of the principles governing ore deposition the occurrence of minerals and of mineral bearing rocks and fundamental research into the origins of Precambrian rocks, including extraterrestrial occurrences."

To commemorate the Fund's 20th anniversary the Society invited bids for small research grants, travel awards to support attendance at a major conference in the UK or overseas and funds for research workshops designed to promote networking. Bids were also invited for a 'Fermor Prize' to be awarded to the best, second and third undergraduate independent projects, on the basis of nomination by the student's supervisor.

A committee, chaired by Professor Philip Allen, and including Professor David Vaughan (Manchester) and Dr Richard Herrington (NHM), met in September to review 12 applications. Seven awards were made, details of which can be found online. The winner of the Fermor Prize, Ross Anderson of Harvard University, also won a research grant that enabled him to attend the 2012 Fermor Meeting.



[LECTURES] Shell London Lecture Series



Geological Aspects of Renewable Energy

Speaker – Bruce Levell (Vice President of Emerging Technologies, Shell; 2009 Petroleum Group Silver Medallist) **14 November 2012**

Moving to a lower carbon energy system and, over time, displacing fossil fuels with renewable energy will involve new challenges for geologists. Below ground geothermal energy is an obvious example. Underground energy storage may be a more effective and flexible solution than batteries to the challenges of matching renewables' intermittent supply to demand.

The siting of renewable energy projects, onshore and offshore, is based fundamentally on conditions created by geology. The new resources required to manufacture the energy-conversion equipment for renewable energy are placing new demands for resources from all across the periodic Table of the elements.

 Programme – Afternoon talk: 1430 Tea & Coffee: 1500 Lecture begins: 1600 Event ends.
 Programme – Evening talk: 1730 Tea & Coffee: 1800 Lecture begins: 1900 Reception.

FURTHER INFORMATION

Please visit **www.geolsoc.org.uk/shelllondon lectures12**. Entry to each lecture is by ticket only. To obtain a ticket please contact the Society 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: Naomi Newbold, The Geological Society, Burlington House, Piccadilly, London W1J 0BG, T: +44 (0) 20 7432 0981 E: Naomi.newbold@geolsoc.org.uk



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SOCIETYNEWS...

The Geological Society Club



FROM THE LIBRARY

The library is open to visitors Monday-Friday 0930-1730. For a list of new acquisitions click the appropriate link from http://www.geolsoc.org.uk/info

The Geological Society Club, 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 £52 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. **2013:** 16 January; 20 February; 13 March; 10 April (Burlington House); 15 May.

Fellows of the Society wishing to dine should send cheques, payable to 'Geological Society Club', to: Cally Oldershaw, c/o Shashu Lalji, Department of Earth Sciences, Natural History Museum, Cromwell Road, London SW7 5BD. E: cally.oldershaw @btopenworld.com DR

Offsite access – more journals!

Several additional e-journals, including Lethaia and Journal of Petroleum Geology, are now available to Fellows of the Society. Fill in an Offsite Access Application Form (if you don't already

have an Athens account) from the Library. Visit the Virtual Library, www.geolsoc.org.uk/virtuallibrary, for a full list of journals and volumes available.



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/ 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.

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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!

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For more information www.geolsoc.org.uk/use

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Open University under threat

BY NICK ROGERS

Nick Rogers* laments the coming of a philistine utilitarian view of education that is now threatening to destroy everything the OU has worked for since its foundation

The Open University's Department of Earth Sciences has punched well above weight for 40 years, building an enviable reputation. It is now under threat from the Brown Review and changes in HE funding affecting the whole Open University.

A few years ago the Labour government introduced an 'equivalent or lower qualification' (ELQ) policy, whereby if you already had a degree then the government would not pay its share of the fees towards a second. This had a minimal effect elsewhere in HE but caused a 10-20% reduction in OU core funding from 2007-11.

BROWN REVIEW

ELQ was but a prelude to the Brown Review. Now, from October 2012 the OU will have to charge £5000 for the equivalent of a year's tuition. This means that the popular Level Two Geology module, currently a snip at £350, will cost £1250. Students can get loans for this if they are registered for a qualification and studying at a rate of 30 credits per year. Currently OU students can build up credit for a qualification that they do not need to declare at the outset. This new requirement requires a complete turnaround in OU operations and student behaviour. Result? The OU is now in direct competition with the rest of the sector.

The funding changes reflect a more general shift towards a 'utilitarian' view of education in which its purpose becomes to create a skilled and qualified workforce able to contribute to the knowledge-based economy. These views have been

progressively espoused in various utterances from ministers, officials and advisers of almost every political hue over the past decade.

UTILITARIANISM

Education is not just vocational training; but politicians seem to have forgotten that. Where, in today's cutthroat HE market, is social wellbeing, developing an informed society regardless of income or status? The Open University has played a pre-eminent role in achieving these for over 40 years, but its position at the epicentre of adult higher education is now vitally threatened by educational utilitarianism.

The OU showed how part-time distance education could produce graduates with degree-level knowledge and skills. By introducing university education to those sectors of society who had been denied it, the OU made a major contribution towards 'life-long learning'. It gave adults the chance to interact with their fellow students, tutors and academics, all passionate about their subject, and not for the sake of getting a better job, but because it helped sate their hunger for knowledge. Such broader benefits are now being ignored. Sadly, they cannot be reduced to a simple metric.

The OU's original purpose was to increase social mobility and well-being through higher education. No doubt part of the motivation was utilitarian, but this was not at the forefront among 69'ers who pioneered the OU from temporary huts on the outskirts of Bletchley. Ian Gass, our first Professor, said that their aim was not to train Earth scientists but to provide an education in Earth sciences. The question remains as to whether it will be in a position to make that claim for future generations.

* **Nick Rogers** is Chair of the Education Committee, The Geological Society, and is Associate Dean and Science Programme Director, The Open University.



SOAPBOX CALLING!

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

If you can write it entertainingly in **500 words**, the Editor would like to hear from you.

Email your piece, and a selfportrait, to **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).

THE OPEN UNIVERSITY'S DEPARTMENT OF EARTH SCIENCES HAS PUNCHED WELL ABOVE WEIGHT FOR 40 YEARS, BUILDING AN ENVIABLE REPUTATION. IT IS NOW UNDER THREAT FROM THE BROWN REVIEW AND CHANGES IN HE FUNDING Nick Rogers he nature and causes of mass extinctions in the geological past have remained topics of intense scientific debate for the past three decades. Central to this debate is the question of whether one, or several large bolide impacts, the eruption of large igneous provinces (LIPs), or a combination of the two were the primary mechanism(s) driving the environmental and habitat changes that are universally regarded as the proximate causes for four of the five

major Phanerozoic extinction events. Recent years have seen a revolution in our understanding of both interplanetary environments and LIP eruptions and their environmental effects, so that a simple 'impact-kill' scenario no longer seems an adequate explanation for the end-Cretaceous mass extinction - or any other. Instead, combinations of massive sequential volcanic eruptions and the breakup of giant comets, leading to rapid climate change and environmental catastrophe, have emerged as the leading causes of such events.

MATURED

Considerable recent research efforts have focused on understanding the context and nature of the environmental changes that surrounded the five major mass extinctions. Significant new analytical data and observations have resulted - from fields as diverse as geochronology, geochemistry, palaeontology, sedimentology, stratigraphy, palaeomagnetism, volcanology and geophysics. The body of scientific evidence based on these new data has matured to a point that requires us to review hypotheses about the cause(s) of these eco-evolutionary events. To this end, the Natural History Museum, London, will host an international conference on March 27-29 next year (see advertisement, page 4) to bring together researchers from many disciplines to assess the current records on volcanism, impacts and mass extinctions, and the stratigraphic and geochemical records of environmental change across major mass extinction episodes.

The conference will try to assess the present status of the historic 'gap' between proponents of different mass extinctions cause scenarios and hypotheses, by integrating evidence from different disciplines. The intention will be to identify mutual interests and complimentary expertise, and so foster a new, collaborative, interdisciplinary community-wide approach to resolving the field's outstanding problems. Data and concepts presented and discussed will have broad implications extending through and beyond the geoscience community, because they will summarise the type of important baseline data necessary for understanding ancient and modern species extinctions.

The two main culprits proposed in the early 1980s as potential causes for major mass extinctions are asteroid impacts and large volcanic eruptions. The most popular case remains that of the Cretaceous-Tertiary Paleogene (KPg or KT) mass extinction, which is associated with both an impact (Chicxulub, Yucatan) and flood basalt (Deccan Traps, India).

VOLCANISM

Deccan volcanic flows probably occurred as "pulses", some flows being truly gigantic with calculated original volumes >10,000 km³ and erupted in < 100 years (possibly only a decade). For comparison, ►

VOLCANISM, IMPACTS & MASS EXTINCTIONS

Professor Gerta Keller et al.* survey the state of mass extinction studies, over 30 years since Walter and Luis Alvarez, Frank Asaro and Helen Michel discovered the KT impact



Deccan Traps in India show layered lava flow forming high (3000m) mountains and coverin an area the size of France. Their original exter was about three times the size of Franc ▶ the largest historical basaltic eruption (1783, Laki, Iceland) erupted some 15 km³ of lava in about a year. So a single huge Deccan flow could have amounted to at least 667 'Lakis' in less than 100 years! The vast amount of carbon and sulphur dioxides injected in the atmosphere from just one of these massive eruptions would have been on the same order of magnitude as those estimated to have been ejected by the Yucatan asteroid impact.

Debates over the proximate mechanisms of the KT extinction continue, but they are likely linked to these enormous pulsed injections of gases into the atmosphere, generating alternating episodes of cooling and warming, acid rain (leading to a marine calcification crisis), increased weathering and terrestrial runoff (leading to large nutrient influx into oceans and causing oxygen-depleted oceanic conditions hostile to marine life). In the case of the KT extinction, the impact would have exacerbated an already heavily stressed environment, due to Deccan volcanism, injecting gases in the same amounts and time scales as the individual huge, short volcanic pulses.

Using palaeontology, palaeomagnetism and high-precision dating, we now know that the Deccan Trap eruptions occurred in three phases, with the main phase-2 near the end of the Cretaceous being closely associated with the KT mass extinction, and occurring within the same timeframe as the Chicxulub impact.

IMPACTS

That the mass extinction of species at the KT boundary was caused by the impact of a 10km asteroid has been a mainstay of both popular journalism and much professional literature since the discovery of a thin layer of iridium at the KT boundary in 1980. As understood at that time, the main reservoir for impactors was the asteroid belt, with a small contribution from comets.

Recent years have seen a revolution in our understanding of the interplanetary environment and this simple picture is no longer adequate. Asteroids of 10km diameter straying from the main asteroid belt are exceedingly rare. At the level of mass extinction, the 10km solitary asteroid is the least likely of several possible impact scenarios. In contrast, large populations of comets have been discovered, held in deep freeze on the fringes of the planetary system. Many are large, such as 250km diameter Chiron, which may enter an Earth-crossing orbit strongly influenced by Jupiter within 0.2 million years.

A Chiron-sized comet may have a mass

eruptions (Iceland) of 1783 asted nearly a year, extruded about 15km3 of lava and caused major famine and climate changes over several years. Such eruptions are an example in miniature of just one of a series of gigantic **Deccan flows** that amounted to 667 Laki eruptions

Laki volcanic

mage: Rudolf Tepfenhart / Shutterstock

(.com

Inset: A 2006 Hubble telescope image of Comet P/73 Schwassmann-Wachmann, a small Jupiter family comet which began to disintegrate in 1995. A Chironsized object in this situation, which might have 1 to 10 million times the mass, would constitute a dangerous and

prolonged terrestrial hazard

Ceno.

Mesozoic

Perm. Tria.

Dev.Car.

Sil.

Ord

Palaeozoic

Mass extinctions, impacts and large igneous provinces during the Phanerozoic. Stratigraphic subdivisions and numerical ages from the 2004 International Stratigraphy Chart (ICS). Genera compilation from Sepkoski (1996), Hallam and Wignall (1997) and MacLeod (2003)



Plienshach

Serpukhovian

Ludlovian

40 60

20

Extinction Intensity (Percent Genera)

Maokouan

M. Cambrian

- F/F

80%

Impact Events (Crater Dia. km)



Volcanism (LIPs & CFBPs)





FEATURE GEOSCIENTIST



KT outcrop at the Brazos Rive Texas shows two (yellowgreen) impact spherule layers in bedded claystones of latest Maastrichtian age nearly 2m below the KT mass extinction Gerta Keller



Fieldwork in India investigating intertrappean sediments for clues to the rate and nature of the KT mass extinction. Curious locals try to be heloful



equivalent to 10,000-15,000 Chixculubsized impactors, and its progressive Jupiter-influenced disintegration would yield a highly enhanced impact hazard at all scales with a prodigious dust influx into the stratosphere for the duration of its breakup. The duration of this enhanced hazard is difficult to predict, and could be anywhere from a few thousand to a few hundred thousand years.

In that situation, the terrestrial impact rate will increase by a factor several hundred during the half million years or so of the breakup, with an expectation of, say, a 10km body impact somewhere along the route accompanied by many smaller ones as evidenced by the terrestrial record. Fireball storms over the duration of the breakup are liable to destroy stratospheric ozone and intermittently reduce incident sunlight. Such events, as much as impacts, may mean major biological trauma.

MASS EXTINCTIONS

Evidence from palaeontology, sedimentology, geochemistry and geochronology reveals that none of the 'big five' mass extinctions was brought about by a single, instantaneous event causing sudden environmental collapse. All are characterised by prolonged periods of high stress before and after mass extinctions and three (end-Permian, end-Devonian, end-Ordovician) show multiple extinction phases, sometimes separated by hundreds of thousands of years. Extinction patterns are varied, sometimes affecting marine life more than terrestrial, but they are invariably selective and predominantly target shelly creatures that depend on the secretion of calcium carbonate. Despite these common patterns, no single cause has emerged, suggesting that multiple causes may produce the same catastrophic environmental effects.

The KT mass extinction is primarily known for the demise of the dinosaurs, the Chicxulub impact as the presumed sole cause - and a rancorous 30 year-old controversy. However, among the five major mass extinctions, only the KT shows close correspondence between the mass extinction, an iridium anomaly, a large impact crater (Chicxulub) plus one small crater (Boltysh), one of the largest continental flood basalt eruptions (Deccan Traps) and major climate and sea level changes. Given the revolution in understanding of these events over the past decade a simple impact-kill scenario now seems inadequate.

The KT mass extinction affected primarily non-avian dinosaurs and marine organisms with calcareous shells. Many

groups died out gradually or decreased in diversity and abundance well before the boundary, including dinosaurs, ammonites, inoceramids, rudists and planktic foraminifera. Only the latter, and to some extent nannofossils, show major, apparently sudden species extinctions coincident with the KT boundary and Ir anomaly, but even in this group a gradual decline in abundance and diversity of specialised species began with the rapid climate warming about 150,000 years before the KT boundary, followed by cooling.

A recent study of planktic foraminifera in sediments between the massive Deccan lava flows of phase-2 documents their extinction in the lead-up up to the KT mass extinction. Accumulated evidence based on Chicxulub impact spherules throughout the Caribbean Central and North America also suggests that this impact may predate the mass extinction. This meeting will explore the links between the mass extinction, Deccan volcanism and the Chicxulub impact.

TRIASSIC-JURASSIC

The TJ mass extinction affected both the marine and terrestrial ecosystems severely and synchronously, coinciding with global greenhouse warming and major perturbations in the carbon cycle. It snuffed out the conodonts, nearly extinguished ammonoids, and led to the disappearance of reef communities for millions of years. Dinosaurs were the winners, benefiting from the ecologic opportunity granted by the high extinction rate of the dominant crurotarsan reptiles.

The cause for these environmental and biotic calamities has long been puzzling. Recently, a viable scenario emerged with U-Pb dating of the Central Atlantic Magmatic Province (CAMP) at ~200 Ma, synchronous with the TJ boundary. CAMP is now widely thought to have triggered the cascade of linked biotic and environmental catastrophes in the Earth system, including the observed extreme global warming and cooling.

Many scientists hold extreme global warming to have been directly responsible for the mass extinction, whereas others argue that short pulses of cooling, induced by volcanically derived sulphate aerosols, may have been equally detrimental to the ecosystem. Although kill-mechanisms and details of the chain of events continue to be debated, new data linking CAMP volcanism to environmental and biotic change at the TJ boundary is now wellfounded on multiple lines of stratigraphic, geochronologic, geochemical and paleontological evidence. These need to be reviewed and integrated into one or more predictive models that can be tested against existing observations.

PERMIAN-TRIASSIC

This mass extinction event (252Ma) marks the most severe crisis of the fossil record, culminating in a spectacular *coup de grâce* at the end of the Permian. In the oceans, extinction losses were devastating - and remarkably unselective - while on land, extinctions were equally catastrophic plant communities suffering the worst crisis in Earth history.

Attempts at linking this mass extinction to a meteorite strike have been unsuccessful. The Siberian Traps, a vast area of flood basalts that erupted at precisely the time of the crisis, appear to be the most likely cause. However, it is one thing to highlight a coincidence and another to link these two very different phenomena. The killing mechanism could have been the combined effect of sulphur dioxide (causing short-term cooling) and the longer-term global warming effect of carbon dioxide. Both gases were released from Siberian Trap eruptions, in addition to those released from coal and evaporites baked by the lava. However, it is still unclear how these emissions caused environmental damage sufficiently severe to trigger a catastrophe of such scale.

END FRASNIAN

The Late Devonian mass extinction (Frasnian-Famennian (FF) 376.1 ± 3.6 Ma) occurred over several million years with a series of extinction pulses in the latest Frasnian. Most severely affected were major reef builders (corals and stromatoporoids) causing the neardisappearance of reefs, along with decimation of marine invertebrates. Terrestrial environments were relatively little affected.

Impacts, volcanism, oceanographic and climatic changes have all been proposed, and continue to be debated, as causes for this mass extinction. The 65-75km Siljan Ring crater (Sweden ~377 Ma) has been proposed as one cause, although it is relatively small and no evidence exists for multiple impacts that might explain the series of extinction pulses. Another potential cause are the Viluy Traps in Eastern Siberia; but preliminary dating suggests a younger age (370Ma).

Changes in the oceanographic and climatic systems are relatively well documented for this critical interval. Most prominent are the black shale facies that developed in the world's ocean during the Pillow lavas from Curaçao, part of the late Cretaceous Caribbean Oceanic Plateau, which has been implicated as the cause of oceanic anoxia and environmental crisis at The Cenomanian-Turonian

boundary

Vincent Courtillot

sampling Deccan

basalt for palaeomagnetic

studies

Late Frasnian black carbonates (Kellwasser facies -Antiatlas/Moroc co) indicating oxygen-poor conditions in shelf waters during the FF crisis



latest Frasnian, denoting anoxic to euxinic conditions. These probably resulted from higher primary productivity triggered by increased nutrient input from enhanced weathering. A goal of our meeting will be to integrate current data into one or more predictive models that can be tested against existing observations. Current knowledge suggests that recurrent eutrophication, anoxia, perturbation of the global carbon cycle and climate change may all have contributed to the end-Devonian mass extinction.

END ORDOVICIAN

The end-Ordovician saw a rapid rise in extinction (in two pulses) concomitant with a rise in originations. The extinction removed a few entire clades but caused minimal disruption to marine ecosystems. The first pulse targeted benthic organisms in deep and shallow-water environments as well as graptolites and nektic groups. Suggested killing mechanisms include glacially induced cooling, falling sea level and reduction of habitable shelf-space and chemical recycling in the oceans.

The second extinction pulse is associated with a strong sea-level rise and ocean anoxia, marking a brief warm event. Extinctions were less selective, wiping out faunas across a range of depths and killing off, mainly, the survivors of the first extinction pulse. To date there is no impact or volcanic evidence associated with these extinctions. Although there is no consensus about how climate change directly influenced global biodiversity, in the absence of volcanism or impacts at the end of the Ordovician, a few alternatives present themselves. Another goal of this meeting is to explore causal mechanisms of mass extinctions other than volcanism and impact.

SMALLER EVENTS

Although the 'big-five' extinction events have received most research attention, realisation is growing that smaller ('second order') extinction events have also played a significant role in shaping life on our planet. Over the last 200 million years such second-order (predominantly marine) extinction events (e.g., Tithonian, Aptian-Albian, and Cenomanian-Turonian) are invariably associated with the global deposition of black shales - signifying widespread oceanic anoxia and severe environmental perturbation. These periods are all marked by the eruption of vast oceanic plateaus (oceanic LIPs), and a causal link between these voluminous undersea eruptions and the associated extinction events/environmental crises is

now accepted by many researchers.

Among the 'kill-mechanisms' are: the release of carbon dioxide and associated warming; trace metal poisoning; nutrient upwelling due to disturbed circulation, and oceanic acidification from sulphur dioxide release. The meeting will explore these biotic stresses that may lead to mass extinctions.

CONCLUSION

Current data suggest that the leading causes of mass extinction events are either massive (LIP) volcanism (four out of the big five), or impacts - particularly the breakup of large comets. Should the two coincide, as during the KT mass extinction, this would almost certainly cause a mass extinction as one would exacerbate the other. Some or all of these effects are observed or speculated to have occurred during all five mass extinctions. However, at least one (end-Ordovician) cannot be associated with either impacts or volcanism.

We intend, at this conference, to bring together many disciplines and proponents of all the different scenarios, to assess and integrate the current records of volcanism, impacts and mass extinctions, as well as the stratigraphic and geochemical record of environmental change across major mass extinction events. We trust that it will identify mutual interests and complimentary expertise and above all foster a new, collaborative interdisciplinary and community-wide approach to resolving the outstanding problems in this field.

ACKNOWLEDGEMENTS

For more information, references and contacts, readers are referred to Geoscientist online, where a longer version of this feature is also available. For registration details see advert on p.4 or visit www.massextinction.princeton.edu.html for information and www.minersoc.org/massextinctions.html

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Paul Johnson * tells the story of the Society's maps



a never-ending quest for additional storage space. Over time, the Society has gone through phases of voracious map acquisition through to disdain and neglect of them. It has never really quite known what to do about these cumbersome sheets, but it finds them both beautiful and incredibly useful. In the two centuries of the Society's existence, they have given a pantheon of geologists a God'seye view of field, formation and fault-line.

Above: A map of the principal features of

the geology of Yorkshire, 1853

UNABASHED

From the outset, The Geological Society has had an unabashed love of maps. The first Committee of Maps was created in 1809, barely two years after the foundation, demonstrating an early eagerness for committees and maps, both of which continue to this day. Even before that date, several sheets had been presented to the Society - including works by Sir Joseph Banks and George

Bellas Greenough.

In these early years the interest was in discovery. New maps brought new realms and new evidence to the meeting-room table for the gentlemen of the Society to debate. Years go

by, the cartographic collection expands, the needs of Empire develop. There are railways to be driven and coal to be mined. The same maps that were drawn for academic inquiry become tools for industry. Whenever schisms have developed



between the academic and commercial, throughout the history of the Society, maps have united them.

On occasion maps have played a part in rivalries between members of the Society. Perhaps the Society's most prized map (and dare I say possession?) is William's Smith 1815 'A Delineation of the Strata of England and Wales...' The Society first received a copy of Smith's map on 2 June 1815, two months ahead of its publication date. In 1828, the sooty thumbprints of the fellowship were too numerous, so the Council ordered it to be varnished, framed and displayed on the wall of the meeting room.

There it joined Greenough's 1820 map of England and Wales which had enjoyed sole occupancy of the meeting room's wall for the previous year.

DISTANCE

At the time there was something of a distance between William Smith and the Society. The maps, published five years apart, were a particularly sore spot. It has been claimed that Greenough's map owes more than something of a debt to Smith's earlier work, a debt acknowledged on the posthumously published 3rd edition of Greenough's work. Within the society of 1828, the primacy of Greenough's map, in its lofty position at the Society's new Somerset House, apartments demonstrates how things stood at that date.

Of the two maps, only Smith's has had books and TV programmes devoted to it. With its celebrity came public demand for viewings. Currently there is nothing behind the curtain that protects the map from the sun. The map is presently enjoying the company of a J M W Turner and a Barbara Hepworth at the front of the summer exhibition in the Duveen Galleries of Tate Britain. Attending the exhibition allows the viewer to get closer to the map than usual and instead of gazing up from below, it is currently possible to examine it in finer detail than is usually the case. Nor is this the first occasion on which Smith's map has enjoyed a holiday by the Thames. During the Festival of Britain, the Society took the chance to show off its cartographic wonder and the map took its place in 'The Earth' section of the Dome of Discovery on the South Bank.

LARGE BOMB

Ten years prior to the Festival, the map collection was being put to far more practical usage. The Society remained open during the war despite all of its windows having been blown out by a large bomb that detonated in St. Above: Geological map of Anglesea by Henslow, John Stevens, 1796-1861 1822 James's churchyard. Buffeted by the blitz, our maps were being studied in the search for new oil supplies within the UK. Other subjects for the men from the military were the suitability of sites for airfields and latterly (the window glass still not replaced), terrain in Normandy was investigated in the search for suitable beachheads.

These wartime geologists would have relied on the work of Thomas Sheppard FGS, who ensconced himself in the library and systematically recorded everything he could find. When the Society was in its infancy, annual lists of the library holdings were published, and made available by subscription to users. This practice fell into disuse as the list became longer, the number of subscriptions diminished and it became burdensome to the Society's coffers. Subsequently, the cataloguing of the collection fell into relative neglect.

Mr Sheppard's comprehensive list was compiled from the 1910s and used within the library for some time afterwards. Only the UK portion of that list now survives. Post-war, the cataloguing of the map collection was again left unattended. The redoubtable Mrs Nutt, Chief Librarian, had a brave stab at remedying the situation, before in the 1980s - Wendy Cawthorne took up the reins and started indexing the maps properly.



Far left: One inch to the mile map of Arran Special Sheet 1910

Left: Geological sketch map of New Zealand constructed from official surveys and the explorations of Dr F van Hochstetter, Dr Julius Hast and others. 1873

'Geognostische karte Sicilien' by Prof Friedrich Hoffmann 1839

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Meanwhile, Mrs Nutt's successor Sheila Meredith lobbied for a dedicated Map Librarian to put the maps into a state of order once and for all. I am the fourth person to have held that position and the entire map collection is now searchable via the catalogue on our website.

SPACE

Cataloguing an unruly map collection is one thing. Housing it is quite another. From the beginnings of the Society the map collection has pressed for more and more space. Maps demand cabinets, demanding room and expenditure. Often, used maps were dissected and mounted on linen to be stored folded in ranks of green boxes upon the Library shelves. Rarer, more delicate works lay un-creased in drawers. When the Society expanded into rooms vacated by chemists in 1971, a Map Room was created. Rather intimidating vertical map

Below: One inch to the mile map of England & Wales Sheet 102SE Brough under Stainmore 1893 presses were purchased (and only screwed to the floor 20 years later, after several near misses involving the combined weight of several hundred maps toppling to the floor). Together with various cupboards and storerooms in the basement, the Society's entire map collection is still housed in the

Map Room. Although it is getting

rather full... One area of map librarianship that hasn't been given much thought by the Society, is that of preservation. The varnish that was applied to Smith's map in 1828 did not preserve it well, and may even have damaged it. It was replaced in the 1930s with another copy. The same is true of its wall-mate. When maps of the collection became too badly damaged, they were disposed of rather unceremoniously - and were in some cases destroyed. Despite this, the map collection now has more than 40,000 sheets, nearly all on paper.

If these maps are to remain useful in an era of digital cartography and GIS systems, they need to be scanned to preserve them. Some of the historic maps in the collection have already been scanned and are available as prints from our website. Please see advert, page 30 and go to

www.geolsoc.org.uk/mapsale. The Society is currently drawing up plans for the rather grander task of digitising all of its maps, to ensure the longevity of this treasure for years to come.

ACKNOWLEDGEMENTS

In compiling this piece I am indebted to **Wendy Cawthorne** for her assistance, and to **Gordon Herries Davies's** book 'Whatever is Under the Earth: The Geological Society of London 1807-2007'.

* **Paul Johnson** is the Society's Map Librarian. Contact: **paul.johnson@geolsoc.org.uk**.





Igneous Rocks and Processes

It's a tough call to produce an igneous petrology book that engages the readers and draws them on, but it's hard to imagine a better attempt than this by Robin Gill. Although the cover blurb suggests use for "introductory or intermediate-level courses in igneous petrology" I reckon first-year students would find much of it hard going, whereas third and fourth-year undergraduates would find it an invaluable source of support.

This is avowedly not a book on field relations, though there is a physical volcanology chapter that covers eruption styles comprehensively enough. Another digression is an early chapter covering experimental petrology that also teaches the use of binary and ternary phase diagrams.

Apart from those and a highlyreadable introductory chapter, the text works its way systematically through each broad class of igneous rocks (basalts and related; gabbroic; ultramafic and ultrabasic; andesite-dacite-rhyolite; granitic; alkali) with the emphasis on identifying each by normative and modal mineralogy, texture, and geochemical fingerprinting. Competing models of magmagenesis and fractionation are met head on and discussed, with multiple references to the recent literature. The tangled web of igneous rock names is negotiated sympathetically, distinguishing between categories that seem to have genuine petrogenetic significance, and those that are arbitrary divisions within a continuum.

The tectonic settings where rocks of each type may be found are discussed, but (rightly) not treated as an aspect of the diagnostic process. Appendices describe various means of identifying igneous minerals with a petrological microscope, and how to do petrographic calculations. The text is supported by boxes, and exercises (with answers) so that conscientious students can consolidate their learning.

It's a shame to find a book of this quality illustrated in black and white, apart from a colour plate section. However, most of the photographs are available in colour on the associated website. The appendices are supported online too, although the worksheet for calculating normative mineralogy would have been more useful as a functioning spreadsheet rather than as a pdf template.

If I wanted to nit-pick I would point out that, contrary to an assertion on page 24, there are places where a'a lava reverts (downflow) to pahoehoe. But that would be too churlish; so instead I will end by complementing Robin Gill on his fine treatment of carbonatites, a fascinating suite of volcanic rocks that even Sigurdsson's much-vaunted *Encyclopedia of Volcanoes* (2000) managed to overlook.

Reviewed by David A Rothery,

IGNEOUS ROCKS AND PROCESSES: A PRACTICAL GUIDE ROBIN GILL, Published by Wiley-Blackwell 2010 ISBN 978-1444330656 hbk 440pp List price: £90.00, http://eu.wiley.com



The Geology of Barcelona

This guide seeks to describe the geology and scenery of Barcelona and amply succeeds. The authors, both residents of the city, accomplish the difficult task of combining a general landscape appraisal with sufficient technical detail, at points visited, to satisfy both the keen amateur and professional geologist.

Following a brief touristic introduction to the main websites for geology, travel and hotels in the Catalonian capital, the regional geological setting is explained succinctly with clear schematic maps and a section. An overview of the literature sets the historical context of geological research, which is also covered by an extensive bibliography. Most of the literature is in Spanish and Catalan until the last decade. This literature summary interrupts the flow from the geological introduction to the lengthier (sevenpage) stratigraphic and paleogeographic overview; it would have been better located with the bibliography.

Excursions are the key to the success of this book. Three field trips, each a comfortable day's walk, start on the high ground with an overview of the landscape, and in descending, encounter all the major geological units from oldest to youngest and conclude in the city's Mediaeval and Roman heart. Each excursion combines a well designed schematic map that incorporates geology, viewpoints, stopping points that link to photographs, and essential Metro and funicular access information. Directions and descriptions in the text and photo captions link clearly with the maps. Mineral and structural details are well explained with good annotated photographs. The captions are substantial and complement the text.

Excursion one begins by funicular to the Collserola Hills, high above Barcelona. This seven to eight kilometre traverse of Palaeozoic metamorphic and Permian granitic terrains has panoramic views of the geological structure and Barcelona. Excursion two, six kilometres in length, picks up where the first ends, crossing a thrust zone with complex faulting, well illustrated in photographs and sections. Excursion three covers the Pleistocene coastal strip and Barcelona's core. As in situ geology is obscured, this ramble focuses on locally quarried masonry, historic seismicity and fluvial geomorphology.

This book carries a useful glossary; its production design and quality are excellent, its layout clear, the text efficiently proofed. Its authors have successfully balanced local detail within a general overview. Through its descriptions, maps and photographs, this guide provides informative excursions for the mind's eye and is a strong enticement to visit - or revisit – this beautiful city.

Reviewed by John Henry

THE GEOLOGY OF BARCELONA: AN URBAN EXCURSION GUIDE

WES GIBBONS & TERESA MORENO, GA Guide No 70, Geologists' Association, 2012. ISBN 978 0900717 56 7 List price: £12.00, www.geologistsassociation.org. uk/GAGuideSales.html



Understanding Earth's Deep Past

In the last few years there has been a lot of talk about global warming caused by anthropogenic CO_2 and so it is refreshing to read a book considering the warming events that have occurred naturally in the deep geological past, and how long they have lasted. As well as warming, increase in CO_2 has had a number of other effects on Earth's systems.

We are in a generally cool ('icehouse') condition at present; but most of Earth's history has been spent in its warmer ('greenhouse') condition. Understanding the transitions between these two states is important and is given prominence in this discussion.

The book is an excellent survey of research in this field, and of what further work needs to be done. However, much of the modelling described and predictions made are based on 20th and 21st Century data, and are therefore somewhat limited. Much of the book is a plea for further computational resources, although it does acknowledge the limitations of such work. It looks at what needs to be known and uses proxies, (for CO_2 concentration, for example) in an attempt to achieve more.

It talks not only of the research agenda but the strategies and tools required to implement it. It discusses the resource requirement; the education and outreach needed to the general public, who are presently barraged with information about global warming but who at present have limited understanding. Also discussed are the policymakers and their understanding of the data on which they base their policies.

The greenhouse/icehouse fluctuation in Earth climate remains one of the least understood aspects of Earth history. This book gives an excellent overview of thinking on climate change, both past and present and it is a very useful introduction to the subject. It is surprisingly well written, in an interesting and easy-reading style with many clear and informative diagrams that support the text well. With a fine binding and blessed with high production values it constitutes outstanding value at £23.00.

Reviewed by Steve Rowlatt

INTRODUCTION TO NUMERICAL GEODYNAMIC MODELLING

NATIONAL RESEARCH COUNCIL, Published by National Academies Press 2011 ISBN: 978-0-309-20915-1 pbk 194pp List price: £23.00, www.nap.edu



Basic Geological Mapping

Death, taxes and - if you have ever been a geology undergraduate - a mapping dissertation, are unavoidable trials we have all faced. What saved me in the field years ago was an earlier edition of this book, and I was heartened to see that the same logical layout and clear, nononsense text has been adopted for this fifth edition.

This invaluable volume is a ideal accompaniment to planning and executing an undergraduate mapping project and the subsequent production of fair-copy maps. Comprehensive lists of matériel for all likely climates, advice on compass clinometers, hammers and chisels are all there, as would be expected. Especially useful though are the suggestions on how to construct field notes that will actually mean something when you return! If these are read before embarking on a mapping project, your chances of success (of producing a map that makes geological sense) can only be improved. The level of assumed prior knowledge is reassuringly low, as demonstrated by comprehensive descriptions of how to take basic field measurements, and even instructions for (when that moment of blind panic sets in) how to use your compass - Silva, prismatic or otherwise.

Illustrated with scores of clear figures and photos, with informative captions, an undergraduate mapper (or a rusty one, returning to the field) would be hard pressed to find a more user-friendly guide to the craft. The section on technological aids is somewhat redundant for most undergraduate mapping projects and, for me, does not add enormously to its value. However as the nature of mapping changes I suspect this section will become more and more relevant and will grow in subsequent editions; though hopefully not at the expense of the lavishly detailed classical techniques.

Although this handy pocket volume will never wholly substitute for a course of lectures and practicals, and will not give the same reassurance as having one's own dissertation supervisor on hand in the field, it is probably the next best thing. Mine got me out of a few uncertain moments in the field, and I'm sure this edition will do likewise for today's budding geologists. As a pallid geochemist now, it almost makes me want to dust off my compass clinometer. Almost.

Reviewed by Jason Harvey

BASIC GEOLOGICAL MAPPING (5TH EDN.) RICHARD LISLE, PETER BRABHAM AND JOHN BARNES, Published by Wiley-Blackwell 2011 ISBN 978-0-470-68634-8 217pp. List price: £22.50, www.wiley.com/wiley-blackwell

REVIEWS: COPIES AVAILABLE

We have received the following books. Please contact **ted.nield@geolsoc.org.uk** if you would like to supply a review. You will be invited to keep the review copy. See Geoscientist Online for an up-todate version of this list.

 NEW! Evolution of Fossil Ecosystems (2nd ed) by Paul Selden and John Nudds (Manson) 287pp

NEW! Lost Antarctica - adventures in a disappearing land - James McClintock. October 2012 Palgrave-Macmillan 231pp hbk

Disaster Deferred - a new view of Earthquake Hazards in the New Madrid Seismic Zone. (2012) by Seth Stein. Columbia University Press pbk, 282pp

Continuum Mechanics in the Earth Sciences by William I Newman Cambridge University Press

Theory of Reflectance and Emittance Spectroscopy (2nd Edn) by Bruce Hapke. Cambridge University Press.



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. Letters will be edited. For references cited in these letters, please see the full versions at www.geolsoc.org.uk/letters

CARBON CAPTURE & STORAGE



Sir, I have just read, with great interest, Bryan Lovell's review of a new book *Clean Energy, Climate and Carbon* by Peter Cook. Our former President is very much a climate change realist. Nevertheless, he would appear to agree with Cook that Carbon Capture and Storage (CCS) must now be an essential part of human strategy for avoiding excessive climate change. This would appear to make my hope that CCS not be relied upon as an excuse for perpetuating "business as usual" look hopelessly optimistic.

I would be extremely interested to know how Professor Lovell thinks we can avoid tracking inevitably towards at least four Celsius increase in global average temperatures if we make no attempt to phase-out fossil fuel use and leave some in the ground? Martin Lack

Bryan Lovell replies: *Sir*, Martin Lack reassuringly describes me as a climate change realist. He and I agree that, realistically, it is unwise to continue to burn fossil fuels and to dump the carbon directly into the atmosphere once we've had the use of it. We can also agree that, realistically, coal and gas will continue to

be burned in large quantities for many years to come, to provide the electricity so eagerly consumed around the world. The carbon produced by burning that coal and gas cannot with impunity be dumped into the atmosphere. So we need to capture and store that carbon, by developing a 21st Century CCS industry on a scale comparable to that of the 20th Century oil industry.

This prospective CCS industry is nothing

like 'business as usual'. Its development will require adopting an attitude that the fossil-fuel industry is no more simply 'the problem' than we, the consumers of its products, are. *Carbon* is the problem. Managing the transition we now have to make to a low-carbon economy is going to be even trickier without CCS. CCS is going to be even trickier without the skills of the fossil fuel industry, new business and new thinking.

SHALE GAS

Sir, At present the main thrust of the renewable resources lobby is to maximise the use of wind power whether on or offshore. Use of this technology requires the construction of a large number of gas-fired fast reaction power stations to supply the power when there is low or indeed very strong

wind, when the turbines cannot supply power. Without new sources of British gas either large imports from Russia or (equally bad) large imports of liquefied gas from the Middle East, Australia or similar are required. In both cases substantial leakage and use of transport power is required exacerbating the greenhouse gas problem.

> Fracking provides the opportunity for substantial British employment, savings

in imports, lower greenhouse gas liberation and lower costs for all. Michael Martineau

E GAS



FRONTIERS MEETING 2012 Nanogeoscience: a new frontier in science and technology for Earth and environmental systems



10 December 2012

The Geological Society of London, Burlington House, Piccadilly, London

Frontiers Meetings are 1-day meetings focused on short presentations and discussion to explore developments in emerging geoscience areas, followed by an open access discussion forum

Convenors

Vicky Coker (Manchester), Éva Valsami-Jones (Birmingham), David Vaughan (Manchester)

Registration for this meeting is free, but you must pre-register your interest in attending (Please email Steve Whalley at the address below)

Call for papers

Over recent decades, there have been dramatic developments in techniques for studying nanometersized particulate materials that occur naturally, or that can be synthesised in the laboratory or on an industrial scale. Nanomaterials have properties which are distinct from their larger sized compositional equivalents and which are, in some cases, of practical value in fields ranging from technology to medicine. Nanotechnology presents both opportunities and threats, the latter because of the limited knowledge of how industrial nanomaterials behave when released into the natural environment. Nano-particles also play a key role in the natural geochemical cycling of the elements, not least because they have large surface area for the uptake of toxic materials ranging from radioactive species to organic pollutants and inorganic pollutants such as arsenic. Oral presentations are invited on all aspects of nanogeoscience.

Abstract Submission Deadline: 28 September 2012

Please submit abstracts to Steve Whalley at steve.whalley@geolsoc.org.uy

For further information about the meeting, or to submit an abstract, please contact: Steve Whalley, The Geological Society, Burlington House, Piccadilly, London W1J 0BG T: 020 7434 9944 F: 020 7494 0579 E: steve.whalley@geolsoc.org.uk W: www.geolsoc.org.uk/frontiers

PEOPLE

CAROUSEL

All fellows of the Society are entitled to entires in this column. Please email ted.nield@geolsoc.org.uk, quoting your Fellowship number.



DAVID VAUGHAN

David Vaughan, Professor of Mineralogy and Director Emeritus of the Williamson Research Centre for Molecular Environmental Science at the University of Manchester and a recent member of Council, has been elected President of the Mineralogical Society of America. This is only the second time in the Society's 93-year history that its President has been chosen from outside North America. Geoscientists in the news and on the move in the UK, Europe and worldwide

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Bowler, Christopher Michael Lance * Chappell, Bruce * Chapman, W T * Chesterman, Jonathan Patrick Hutchison, Charles Strachan King, Bruce * Lumsden, George Innes Middleton, John * MacLean, Ronald G * Williams, Colin L *

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 (*). The symbol § indicates that biographical material has been lodged with the Society.

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

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







HELP YOUR OBITUARIST

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

DISTANT THUNDER

Is anybody there?

As geologist and science writer Nina Morgan discovers, geology of a sort has already provided clues to life on Mars

In his search for life on Mars, the 19th Century astronomer Percival Lowell is often considered to be a figure of fun today. But perhaps we only scorn his ideas now because they were actually ahead of their time. The Mars Rover Curiosity (see Online Special) carries instruments like the Mars Hand Lens Imager, as well as a range of spectrometers to study the mineralogy of rocks on the surface and high resolution cameras to photograph landforms. His conclusions may be different, but like NASA scientists today, Lowell relied on geological evidence as he searched for life on Mars.

Lowell believed that a network of canals which he mapped on the surface of Mars represented irrigation canals, demonstrating that water and intelligent beings once existed there. In his book *Mars* (1895), Lowell compared the general geological characteristics of Mars with those of Earth.

"Now, in the special case of Mars, we have before us the spectacle of a world relatively well on in years, a world much older than the Earth ... Advancing planetary years have left their mark legible there. His continents are all smoothed down; his oceans have all dried up. Teres atque rotundus, he is a steadygoing body now... But from the fact that our own development

Right: Percival Lowell



has been comparatively a recent thing, and that a long time would be needed to bring even Mars to his present geological condition, we may judge any life he may support to be not only relatively, but really older than our own. From the little we can see, such appears to be the case."

So far, so reasonable. But then he goes on to note that:

"The evidence of handicraft [i.e. the building of the canals], if such it be, points to a highly intelligent mind behind it. Irrigation, unscientifically conducted would not give us

such truly wonderful mathematical fitness in the several parts to the whole as we there behold. A mind of no mean order would seem to have presided over the system we see – a mind certainly of considerably more comprehensiveness than that which presides over the various departments of our own public works. Party politics, at all events, have had no part in them; for the system is planet wide. Quite possibly, such Martian folk are possessed of inventions of which we have not dreamed ... Certainly what we see hints at the existence of beings who are in advance of, not behind us, in the journey of life. "

Although his comments on public works and party politics may still ring true, his ideas about intelligent beings are perhaps a little strange. A case of 'logic – but not as we know it'!

ACKNOWLEDGEMENT

This vignette was inspired by news about the Curiosity landing reported in articles including: *There's life on Mars*, by geologist and journalist Michael Hanlon, on **www.telegraph. co.uk** on 6 August 2012; the blog feature, *Life on Mars?* Curiosity drops in to find out by Stephen Harris, at www.theengineer.co.uk (3 August 2012) as well as pictures and captions at mars.jpl.nasa.gov/msl/multim edia/images/ . Other sources include *Mars* by Percival Lowell, Houghton, Mifflin and Company. An html version of Mars is available at www.wanderer. org/references/lowell/Mars/.

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: **www.geolsoc.org.uk/hogg**, where the programme and abstracts from the Conference on Geological Collectors and Collecting are available as a pdf file free to download.

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



DEREK FLINN 1922-2012

Distinguished and colourful structural geologist of Liverpool University who specialised in the geology of Shetland

erek Flinn was born in Harrow and educated at Dr Challoner's Grammar School,

Amersham. He had a distinguished wartime career, serving between 1941 and 1946 as a sergeant (refusing a commission) in the Royal Marines (Special Boat Service, Ceylon). The story goes that he and a senior officer who was a geologist became stranded behind Japanese lines and spent their time looking at the rocks. It was this experience that attracted Derek to geology.

Now whenever students from Liverpool get together, it is not long before we begin to exchange Flinn stories: how he overturned a Landrover in Shetland, or how he awarded 160% to a student who had fully understood that 'How do you measure birefringence' involved a discussion of different indicatrices with different symmetries.



PRIZES

In1947 he began to study geology at Imperial College, London, graduating in 1950 with first class honours and three prestigious undergraduate prizes. Professor Janet Watson FRS once remarked that Derek



was one of the brightest students of his generation. In 1952 he completed his PhD before spending a year as an Imperial College Exchange Student at ETH, Zurich.

In 1953 Derek was appointed lecturer at the University of Liverpool, where he spent the rest of his career. He was promoted to Reader in 1965 and awarded a personal chair in 1975, acting as Head of Department between 1978 and 1983. Derek was a brilliant structural geologist and it was said that in the 1950s and 1960s, John Ramsay and Derek Flinn were the only people who could understand each other's papers. His work was recognised internationally, and in 1957 he was awarded a fellowship at the University of Chicago and in 1960 spent a year as a Royal Society Exchange Fellow at the Institute of Geology and Mineral Deposits in Moscow. In 1962 he toured Norway and Sweden at the expense of the King of Sweden and between 1964 and 1979 delivered several lectures in America sponsored by USGS. In the 1980s he did fieldwork and lectured in Libya.

SHETLAND

Derek's work always centred on his beloved Shetland. As part of his final-year dissertation at Imperial College he had spent two months mapping in Unst under the direction of H H Read. He went on to map the Delting area for his PhD. His aim since that time was to determine the geological history of the highly complex Shetland Island Group using all appropriate Earth science methods. The excellence of his geological mapping was reflected in the award of contracts from BGS to map large areas of Shetland.

In 1986 Derek was appointed Emeritus Professor and Honorary Senior Research Fellow at Liverpool, where he continued to research the geology of Shetland until shortly before his death. He developed a great interest in Shetland local history and wrote a book Travellers in a bygone Shetland (1989). He was an outstanding teacher in the field, and in the laboratory where he taught mineralogy, using both optical and reflected-light microscopy.

In 1974 Derek Flinn obtained a DSc (University of London) and in 1982 was awarded the Murchison Medal of the Geological Society of London, followed (in 1996) by the Clough Medal (Geological Society of Edinburgh).

Derek married Glenys Williams, the University Librarian in 1956. He is survived by their two daughters, Nesta and Janet, and five grandchildren.

By Jane Plant A longer version of this obituary may be read on the website.



ENDORSED TRAINING/CPD

Course	Date	Venue and details	
Health & Hydrogeology Conference	7 November	Geological Society, Burlington House. Fees apply. Jointly organised with the RSC. See website for details and registration	
Soil & Rock Description and Site Investigation	12-16 November	University of Sussex. Instruction: Prof. David Norbury. Fees apply. See website for details and registration.	
Structural Modelling and Analysis Using Move	13-15 November	Midland Valley HQ, Glasgow. Fees apply – 10% discoubnt for Fellows. See website for details and registration.	
Clastic Exploration & Reservoir Sedimentology Training Course	19-23 November	Kuala Lumpur, Malaysia. Fugro Robertson Limited. Fees apply. See website for details and registration.	
Cone Penetration Testing	23 November	Exeter. Fugro Robertson Ltd. Free. See website for details and registration.	
Deepwater Turbidites	26-27 November	Kuala Lumpur, Malaysia. Fugro Robertson Ltd. Fees apply. See website for details and registration.	
Lapworth's Logs	n/a	'Lapworth's Logs' are a series of e-courses involving practical exercises of increasing complexity. Contact: info@lapworthslogs.com. Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson.	

DIARY OF MEETINGS NOVEMBER 2012

Meeting	Date	Venue and details
Hong Kong Regional Group Founders' Day Dinner	2 November	Hong Kong Football Club, Happy Valley, 1900 - 2300. Speaker: Dr Rod Sewell . See website for fees and registration.
Carbonate talk, Central Scotland Regional	6 November	BGS Common Room, Edinburgh, 17:45 for 1800, Rachel Wood speaker. Contact: Lesley McLellan E: Lesley.McLellan@ls.glasgow.gov.uk
Geological Society Careers Day 2012	7 November	BGS, Keyworth. See poster advert, p.31 and passim.
Lunar Science Event Royal Astronomical Society, Geological Society	9 November	Burlington House, 1030-1530. Free (RAS and GSL members). Non members £15, Students £5. Payment at door with ID. Contact: Ian Crawford E: i.crawford@bbk.ac.uk
Geology & Geotechnics South East Regional, Engineering Group	13 November	Gatwick Manor Hotel, Crawley, 1800 for 1830. Speaker: M Cooper. Contact: Ron Williams E: rew182@btinternet.com
Portland Gas Storage Facilities Solent Regional Group	14 November	NOC, So'ton. Evening. Speaker: Dr Andrew Hindle (Infrastrata). Contact: Karen Allso (Secretary) E: karen.allso@ramboll.co.uk
Geological Aspects of Renewable Energy Geological Society, Shell UK	14 November	A Shell London Lecture. See p.7
Geoscience, environmental & engineering careers evening, Southern Wales Regional	15 November	Cardiff University Viriamu James Gallery. 1730. See website for flyer. Contact: Karl Llewelyn E: kllewelyn@srk.co.uk
Founders' Day Lecture and Dinner 2012 Geological Society	15 November	Burlington House & Le Méridien, Piccadilly. Speaker: Prof. Jane Francis. See advert p.32 (back cover) and <i>passim</i> .
Chartership Workshop, East Midlands Regional	TBC	Venue TBC Contact: David Boon E: dboon@bgs.ac.uk
Fred Sherrell Award Evening & AGM 2012 South West regional	21 November	Dolphin Hotel, Bovey Tracey. 1830 for 1900. Contact: Danielle Pullen E: swrg@geolsoc.org.uk
Glossop Lecture and Award 2012 Engineering Group	21 November	RGS, Kensington. Speaker: Ruth Allington. Glossop Award: Thomas Clifford (Aggregate Industries Ltd.) See website for contact, details & registration.
PG Research Collaboration Showcase Petroleum Group, AAPG, PESGB	21-22 November	Earls Court 2, London. See website for details and registration. Contact: Steve Whalley T: +44 (0)20 7432 0980; F: +44 (0)20 7494 0579; E: steve.whalley@geolsoc.org.uk
Hertfordshire Puddingstone Friends of Forster Country	24 November	Stevenage Council Chamber, 1400 Speaker: John Catt. Tickets £3.00 Contact: T: 01438 351462, or 01438 361470.
Groundwater Modellers' Forum 2012 Hydrogeological Group	27 November	Priory Rooms, Birmingham. Fees apply. See website for details and registration. Contact: Corinna Abesser E: cabe@bgs.ac.uk
Industrial Structural Geology: Principles, Techniques and Integration Petroleum Group	28-30 November	Burlington House. For details and registration see website. Contact: Steve Whalley T: +44 (0)20 7432 0980; F: +44 (0)20 7494 0579; E: steve.whalley@geolsoc.org.uk

OBITUARY

RONALD GEORGE MACLEAN 1925-2012

Oil industry geologist who discovered the missing US warplane Lady be Good, wrecked in the Libyan Desert

G (Ronnie) MacLean was born in Southsea on 23 August 1925, and his first four years were spent in India where his father was with the Indian Agriculture Service. On returning to the family home at Tobermory on the Isle of Mull he went first to the local primary school and then boarded (happily) at George Watson's College, Edinburgh and, from 1939, at Glenalmond in Perthshire.

He went up to Trinity College, Oxford in 1943 to read Mathematics and Physics; but the following year he was called up to undertake flying training in Canada for the Fleet Air Arm. Returning to Oxford in 1946, but switching to Chemistry, he was again called upon for more flying training only four months later. Finally demobilised in 1947 he taught for a while at Glenalmond, but then resumed his education at Oxford, studying Geology before graduating in 1949.

ANGLO-IRANIAN

Ronnie joined the Anglo-Iranian Oil Company that year and was posted to Persia. Field surveys in remote areas, often for months on end, were much to his liking. In 1952 he married Bette, also from Tobermory, and the first six months of their married life were spent in Sicily where Anglo-Iranian were exploring. There then followed a three-year spell in East Africa (based in Mombasa and Dar-es-Salaam) before being posted to Libya in the mid-1950s. (The company changed its name to British Petroleum in 1954.)

His role as Senior Geologist, based in Tripoli, was to supervise a team of some half-dozen geologists, including the present writer and he is remembered as a kind and generous boss. His and Bette's first child, Carol, was born in the British Army hospital in Tripoli in 1958.

FIELD SURVEYS IN REMOTE AREAS, OFTEN FOR MONTHS ON END, WERE MUCH TO HIS LIKING

In the same year, Ronnie was conducting an aerial reconnaissance over the Calanscio Sand-sea when he spotted what appeared to be a near-intact US bomber lying on the desert floor. Later, two BP geologists located the Liberator on the ground; it had crash-landed in 1943 and remained undiscovered for 15 years. Its name was 'Lady be Good' and a tragic story later unfolded, involving the discovery of the crew's skeletons and a poignant diary of their final days.

CLAN MACLEAN

A posting to Greece followed in 1960, followed by three years at BP's headquarters in London (1962-65). Ronnie's final posting with BP was to Trinidad, but then in 1967 he decided on a career change. He was appointed by the UN as Director of a project in Poland to exploit potash deposits, based in Warsaw (1968-1970). Another, longer, UN project followed, in Santiago, Chile (1970-76). Then followed a period of consulting, based in London before he retired and settled

with Bette in Edinburgh. Retirement interests included researching the history of Clan MacLean, occasional games of golf, their summer cottage on Tiree, and keeping in touch with his old BP colleagues. Bette died in 2005 and Ronnie had been a devoted husband. He died in Edinburgh on 5 April 2012, aged 86, and is survived by daughter Carol, son John, and five grandchildren.

By **Michael Ridd** with assistance from **Carol Foster** (née MacLean)



CROSSWORD NO. 163 SET BY PLATYPUS 10 11 12 13 14 15 17 18 19 20 21 22 23 24 25 26 28

ACROSS

- 1 Aquamarine is a blue or turquoise variety of this mineral (5)
- Any mineral whose presence or 4 absence - determines the name of a rock (9)
- Calcium magnesium sulfide 9 mineral first described from the Bustee Meteorite (9)
- 10 Unhappy (or overturned) bunny (5)
- **11** French art movement, named by a critic seeking to insult it (13)
- 14 Ecclesiastical screen (4)
- **15** Of similar shape and size (10)
- 18 Climbing sideways (10)
- 19 Sicilian volcano (4)
- 21 Described by peculiar qualities (13)
- 24 Indian capital (5)
- 25 Artificial copy (9)
- 27 Rameses, Hatshepsut and co (9)
- 28 Water jugs. What's fancy a drink? (5)

DOWN

- 1 Fine-grained carbonate rock with shelly material (10)
- Mars colour (3) 2
- 3 Letting contracts eg for exploration (6)
- Wastes, sich as CO₂, released into 4 the environment (9)
- 17th Century Danish bishop and 5 pioneer of palaeontology (5)
- 6 Pearly king of the deep (8)
- Plants seed, metaphorically (11) 7
- 8 Drawn straws (4)
- 12 Unpoetically (11)
- 13 Without care for the consequences (10)
- Genetic makeup of a cell, organism 16 or individual (9)
- 17 Gong winner (8)
- 20 Bearlike (6)
- 22 Largest artery (5)
- 23 Water in a saturated reservoir rock, surrounding an oil pool (4)
- Brown, Scotch, Burton, Pale and 26 Belgian for example (3)

WIN A SPECIAL PUBLICATION

The winner of the September Crossword puzzle prize draw was Stephen Flux of Gunn, Northern Territory, Australia.

All correct solutions will be placed in the draw, and the winner's name printed in the February 2013 issue. The Editor's decision is final and no correspondence will be entered into. Closing date -November 26.

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

Name
Membership number
Address for correspondence
Postcode

SOLUTIONS SEPTEMBER

ACROSS:

- 1 Geoid 4 Ephemeral 9 Nullified 10 Rebut
- 11 Cryoturbation 14 Late 15 Utterances
- 18 Troglodyte 19 Beef 21 Embryological 24 Axial 25 Criticize 27 Press Gang 28 Evens

DOWN.

- 1 Geniculate 2 Oil 3 Drifts 4 Emigrated 5 Hydra 6 Marginal 7 Ribonucleic 8 Lute 12 Yttrocerite 13 Usefulness 16 Extolling 17 Globules
- 20 Ignite 22 Yucca 23 Lamp 26 Ice

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Holocene Climate Change





ORA K Con New Constant

Call for papers and posters

ence paper and poster contribution rd abstract to Steve Whalley by Oc welcome. Pl 26, 2012. Full manuscripts for peer review for publication in a the GSL will be required at latest by 5 July 2013. GSL are included in the Book Citation Index (BKC), as par Web of Science. Citation records will accrue towards

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Wednesday 7 November 2012

British Geological Survey, Nottingham

The Geological Society

Careers Day is the essential meeting place for geoscience students and the geoscience industry, where university undergraduates and postgraduates will have the chance to find out about the latest career options and talk to industry leaders about how they might gain entry into that sector.

The day will run from 10am – 4pm and will include presentations on careers, a CV writing workshop, an interview techniques workshop and an exhibition fair. The day will end with a beer reception.

Registration

This event is free to attend and covers all delegate material, lunch and a beer at the reception, but you must register for the event and the workshops must be pre-booked.

Contact Information

Naomi Newbold Tel: 0207 432 0981 Email: naomi.newbold@geolsoc.org.uk Web: www.geolsoc.org.uk/careersday12

Ceers Day 2012





LECTURE & DINNE





Thursday 15 November 2012

Founders' Day Lecture

R

Geology at the end of the Earth: exploring Antarctica's green history Speaker: Professor Jane Francis, *University of Leeds*

Founders' Day Dinner

Venue: Le Meridien, Piccadilly

After dinner speaker: Dr Rory Mortimore, President, Geologists' Association

Dress: Black Tie

Ticket price: £80

Timings:

- 18.00 Tea & coffee served, Burlington House
- 18.30 Lecture by Professor Jane Francis
- 19.30 Drinks reception at Le Meridien
- 20.30 Dinner served
- 22.00 After dinner speaker
- 24.00 Carriages

Contact details:

Naomi Newbold, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

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- E: naomi.newbold@geolsoc.org.uk
- W: www.geolsoc.org.uk/founders12