GEOSCIENTIST VOLUME 24 NO 3 • APRIL 2014 • WWW.GEOLSOC.ORG.UK/GEOSCIENTIST

The Fellowship Magazine of the Geological Society of London

UK / Overseas where sold to individuals: £3.95

READ GEOLSOC BLOG! GEOLSOC.WORDPRESS.COM

Iron from the Sky Meteorite iron in Egyptian artefacts

FISH MERCHANT Sir Arthur Smith Woodward, king of the NHM fishes

WOMEN GEOLOGISTS Tales of everyday sexism - an Online Special BUMS ON SEATS If universities think fieldwork sells geology, they're mistaken



serving science & profession

ONLINE BOOKSHOP SALE

1-8 April 2014

Selected sale titles on offer at £25.00 each, for one week only

www.geolsoc.org.uk/bookshop

Join our mailing list and be the first to hear about online bookshop sales: marketing@geolsoc.org.uk



IN THIS ISSUE, , ,

ON THE COVER: **10** Iron from the sky

Meteoritics and Egyptology, two very different disciplines, recently collided in the laboratory, write Diane Johnson and Joyce Tyldesley

ONLINE SPECIALS Tales of a woman geologist Susan Treagus recalls her experiences in the male-dominated groves of academe **From the regions** Daniel Welch recounts a West Midlands Group field excursion to the Lickey Hills

FEATURES

16 King of the fishes Sir Arthur Smith Woodward should be remembered for more than being caught by the Piltdown Hoax, says Mike Smith

REGULARS

- **05 Welcome** Ted Nield has a feeling that some eternal verities have become unsellable
- **06 Society news** What your Society is doing at home and abroad, in London and the regions
- **09 Soapbox** Jonathan Paul says universities need to beef up their industrial links to attract students
- 21 Letters Geoscientist's Editor in Chief sets the record straight
- 22 Books and arts Four new books reviewed by Catherine Kenny, Mark Griffin, John Milsom and Jason Harvey
- **25 People** Geoscientists in the news and on the move
- **26 Obituary** Duncan George Murchison 1928-2013
- **27 Calendar** Society activities this month
- 28 **Obituary** David Barnard Thompson 1932-2013
- 29 Crossword Win a special publication of your choice





The PESGB 50th Anniversary Celebration

This exciting one time only event will reflect both on the last 50 years as well as giving specific talks on where the industry will be heading and discussing the issues we may face in the future.

The conference will be followed by a black tie dinner. We wish to celebrate a successful 50 years of the PESGB and all it has achieved, and as always provide a platform to facilitate networking between members.

REGISTRATION NOW OPEN AT:

www.pesgb.org.uk

*Standard £250 / Dinner only £150 / Conference only £175 / *Corporate tables £2,250

*Included in the price is all refreshments, lunch, drinks reception and black tie dinner. This is strictly a members only event and numbers are limited. Tickets will be issued on a first come, first served basis. For more information on corporate tables or if you would like to sponsr please email 50th@pesgb.org.uk



With thanks to our sponsors



To receive *Elements*

Become a member of any of the participating societies:

Mineralogical Society of America • Mineralogical Society of Great Britain and Ireland • The Clay Minerals Society • Mineralogical Association of Canada • Geochemical Society • European Association for Geochemistry • International Association of GeoChemistry • Société Française de Minéralogie et de Cristallographie • Association of Applied Geochemistry • Deutsche Mineralogische Gesellschaft • Società Italiana di Mineralogia e Petrologia • Mineralogical Society of Poland • International Association of Geoanalysts • Sociedad Española de Mineralogia • Swiss Society of Mineralogy and Petrology • Meteoritical Society • Japan Association of Mineralogical Sciences

www.elementsmagazine.org/societies.htm

AN INTERNATIONAL MAGAZINE

To keep abreast of the latest developments in mineralogy, geochemistry, and petrology

2012

impact

factor

3.156

UPCOMING THEMATIC TOPICS IN 2014

- FEBRUARY 2014 ASTEROIDS Guest Editors: Catherine Corrigan and Guy Libourel
- APRIL 2014 OPHIOLITES Yildirim Dilek and Harald Furnes
- JUNE 2014 KAOLIN: FROM ANCIENT PORCELAINS TO NANOCOMPOSITES Paul A. Schroeder and David L. Bish
- AUGUST 2014 UNCONVENTIONAL HYDROCARBONS David R. Cole and Michael Arthur
- OCTOBER 2014 COSMOGENIC NUCLIDES Friedhlem von Blanckenburg and Jane Willenbrig
- DECEMBER 2014 GRAPHITIC CARBONS Olivier Beyssac and Doug Rumble III

To order individual articles or assemble articles for a course pack: www.**minpubs.org** To order back issues: www.**elementsmagazine.net**

INSTITUTIONS

You will receive one copy of *Elements* if you subscribe to one or several of the following journals:

American Mineralogist
Clay Minerals
American Mineralogist
Mineralogical Magazine
The Canadian Mineralogist

If you do not subscribe to any of the above journals or if you wish to order an additional subscription, an institutional subscription is available for \$160\175 a year. Contact your book agent or the managing editor at pierrette_tremblay@ete.inrs.ca

Elements is available online at www.elementsmagazine.org and www.elementsgeoscienceworld.org

Geoscientist is the Fellowship magazine of the Geological Society of London

The Geological Society, Burlington House, Piccadilly, London W1 J 0BG \mathbf{T} +44 (0)20 7434 9944 \mathbf{F} +44 (0)20 7439 8975 \mathbf{E} enquiries@geolsoc.org.uk (Not for Editorial - Please contact the Editor)

Publishing House

The Geological Society Publishing House, Unit 7, Brassmill Enterprise Centre, Brassmill Lane, Bath BA1 3JN T 01225 445046 F 01225 442836

Library

T +44 (0)20 7432 0999 **F** +44 (0)20 7439 3470 **E** library@geolsoc.org.uk

EDITOR-IN-CHIEF Professor Peter Styles

EDITOR Dr Ted Nield E ted.nield@geolsoc.org.uk

EDITORIAL BOARD Dr Sue Bowler Mr Steve Branch Dr Robin Cocks Prof. Tony Harris Dr Howard Falcon-Lang Dr Jonathan Turner Dr Jan Zalasiewicz

Trustees of the Geological Society of London

Mr D T Shilston (President): Mrs N K Ala; Dr M G Armitage; Prof R A Butler; Prof N A Chapman; Dr A L Coe; Mr J Coppard; Mr D J Cragg (Vice president); Mrs N J Dottridge; Mr C S Eccles; Dr M Edmonds; Prof A J Fraser *(Secretary, Science)*; Mrs M P Henton *(Secretary,* Professional Matters); Mr D A Jones (Vice president); Dr À Law (Treasurer); Prof R J Lisle; Prof A R Lord (Secretary, Foreign & External Affairs); Prof D A C Manning (President designate); Dr B R Marker; Dr G Nichols; Dr L Slater; Dr J P Turner (Secretary, Publications); Mr M E Young

Published on behalf of the Geological Society of London by **Century One Publishing** Alban Row, 27–31 Verulam

Road, St Albans, Herts, AL3 4DG

- **T** 01727 893 894
- F 01727 893 895
- E enquiries@centuryone publishing.ltd.uk
- W www.centuryone publishing.ltd.uk

ADVERTISING EXECUTIVE Jonathan Knight T 01727 739 193 E jonathan@centuryone publishing.ltd.uk

ART EDITOR Heena Gudka

DESIGN & PRODUCTION Sarah Astington

PRINTED BY Century One Publishing Ltd.

Copyright

The Geological Society of London is a Registered Charity, number 210161. ISSN (print) 0961-5628 ISSN (online) 2045-1784

The Geological Society of London accepts no responsibility for the views expressed in any article in this publication. All views expressed, except where explicitly stated otherwise, represent those of the author, and not The Geological Society of London. All rights reserved. No paragraph of this publication may be reproduced, copied or transmitted save with written permission. Users registered with Copyright Clearance Center: the Journal is registered with CC, 27 Congress Street, Salem, MA 01970, USA. 0961-5628/02/815.00. Every effort has been made to trace copyright holders of material in this publication. If any rights have been omitted, the publishers offer their apologies.

No responsibility is assumed by the Publisher for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. Although all advertising material is expected to conform to ethical (medical) standards, inclusion in this publication does not constitute a guarantee or endorsement of the quality or value of such product or of the claims made by its manufacturer.

Subscriptions: All

correspondence relating to nonmember subscriptions should be addresses to the Journals Subscription Department, Geological Society Publishing House, Unit 7 Brassmill Enterprise Centre, Brassmill Lane, Bath, BA1 3JN, UK. Tel: 01225 445046. Fax: 01225 442836. Email: sales@geolsoc.org.uk. The subscription price for Volume 24, 2014 (11 issues) to institutions and non-members is £125 (UK) or £143 / US\$286 (Rest of World).

© 2014 The Geological Society of London



WERE METEORITES SACRED? (WOMEN MOURNING: DETAIL FROM THE TOMB OF RAMOSE IN THE ANCIENT EGYPTIAN NECROPOLIS OF THE NOBLES, LUXOR, EGYPT)

FROM THE EDITOR'S DESK:

e are all products of our times, which is why we go out of date. On the other hand, there are (we like to think) certain eternal verities too. Yet for all their eternity, they also go in and out of fashion.

We have recently enjoyed a lively debate about the importance of fieldwork and undergraduate mapping. And on balance, I think most readers would agree that the profieldwork camp easily won the day.

Fieldwork is part of what makes geology what it is, because 'the field is the geologist's laboratory'. We cannot deny that ideas must be tested against reality if we are to be considered 'scientific', and the field, in geology, is where we do it. Nevertheless, we must beware falling into the trap of thinking that this is necessarily how we must *sell* ourselves. It might have worked once, but not now - as PhD student Jonathan Paul points out in *Soapbox* this month.

When I was choosing geology, the world was very different. We all loved the outdoors, we spent as much time as possible there, we already came equipped with boots and waterproofs. And we were few. This meant we were very much poorer, but on the other hand did not have to repay loans, and (certainly in my case) never gave a thought for what we would be doing 'afterwards'. Education was its own reward. And because we were our age, and had done our share of Latin, we knew that the essence of 'education' was found in its verbal root *educare*, 'to lead out' (of darkness, into light).

This is no longer the general view, either among universities or their students. Both have been suckered, by successive governments, into the notion that universities are places of higher vocational training, chiefly providing grist to the industrial mill. This idea has now gained the status of a self-evident truth, and students who used to want nothing more than to stick it to the Man for as long as circumstances allowed - now want a secure and well-paid non-manual job, and a pram in the hall.

If universities are serious about recruiting from a new generation of pallid, indoorsy (but more worldly) youth, they have to change the way they sell themselves. But to do this, scientists - with their distressing tendency always to be always truthful and literal – may need to learn subtler selling skills, and let the eternal verities take care of themselves for a bit.

DR TED NIELD, EDITOR - ted.nield@geolsoc.org.uk 🕥 @TedNield @geoscientistmag

SOCIETY*NEWS*

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



Society's Wollaston and Lyell medals



Last month the Society announced the winners of its medals and funds for 2014...

And they were: Maureen **Raymo** (Wollaston Medal); Martin **Brasier** (Lyell Medal); Julian **Pearce** (Murchison Medal); Peter **Styles** (William Smith Medal); Jane **Francis** (Coke Medal); Christine **Peirce** (Coke Medal); John **Maclennan** (Bigsby Medal); Max **Coleman** (Prestwich Medal); Edward **Rose** (Sue Tyler Friedman Medal); Robert **Chandler** (R H Worth Prize); Craig **Barrie**

(Wollaston Fund); Claire **Corkhill** (William Smith Fund); Paul **Butler** (Lyell Fund); Katherine **Joy** (Murchison Fund); Margaret **Williams** (Distinguished Service Medal); Michael **Babechuk** (President's Award); Hannah **Hughes** (President's Award); Oliver **Shorttle** (President's Award).

These Awards will be presented at President's Day on **4 June 2014**. On that day (full details in the May issue) there will be research talks by the four senior medallists: **Martin Brasier (University of Oxford)** on *The earliest signs of complex life on Earth;* **Julian Pearce (Cardiff University)** on *Geochemical Fingerprinting of Rocks and Minerals;* **Peter Styles (Keele University)** on *A Journey with Maps;* and **Maureen Raymo (Lamont-Doherty Earth Observatory, Columbia University)** on *Sea Level - Past and Future.*

All Fellows are welcome to attend the events of President's Day, though lunch with the award winners will incur a charge. Full details of charges and instructions as to how to register will be published in the May Issue, with which will be distributed the Annual Review 2013.

Publishing news

The Society Publishing House will be exhibiting in Vienna, says Emily Milroy.

If you are attending the EGU General Assembly 2014 (27 April- 2 May) in Vienna, why not drop in at Booth #59 and say hello to the Publishing House? We would be very happy to see you – and even happier if you bought some books!

However, if you are unable to meet us in person, you can benefit from massive discounts in our forthcoming online Bookshop Sale, which runs from 1-8 of this month (April). Thirty of our publications will be priced at just £25 each (while stocks last!).





LONDON LECTURE SERIES



Fracking Speaker: Prof. Richard Davies (University of Durham) Date: 16 April

Programme

◆ Afternoon talk: 1430 Tea & Coffee: 1500 Lecture begins: 1600 Event ends.

◆ Evening talk: 1730 Tea & Coffee: 1800 Lecture begins: 1900 Reception.

Further Information

Please visit www.geolsoc.org.uk/gsllondon

lectures14. 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

Library Book and Print Sale

Visit us in May! Writes Michael McKimm

During the month of May the Library will be holding its latest sale of second-hand or out-of-scope books, journals and maps. Featuring hundreds of items covering geology, palaeontology, archaeology and related subjects, the sale will take place upstairs in the main Library at Burlington House and is open to all. We will also be selling original lithographic prints by the Scottish geologist John MacCulloch, dating from 1819 – 1826. These beautiful black and white drawings depict picturesque scenes of forests and cliffs as well as Scottish landmarks such as Dunkeld Bridge, Perthshire. Visit Burlington House next month for an opportunity to become the proud owner of one of these original prints!

Late night shopping

The Library and book sale will remain open until 7pm on the following days during May: Friday 2; Thursday 8; Thursday 15; Wednesday 21.

The library is open to visitors Monday-Friday 0930-1730. For enquiries email the library library@geolsoc.org.uk or call 020 7432 0999



Geology for Society -policy update



'Geology and the Welsh Economy', a new report from the Society, was launched at an event in Cardiff, writes Gareth Farr*.

The Southern Wales Regional Group recently hosted an event in Cardiff to celebrate the launch of 'Geology for Society'.

The event also formed part of the 50th birthday celebrations of the Geological Society's Engineering Specialist Group, and included the Southern Wales heat of the National Schools Geology Challenge 2014.

Over 100 guests from government, universities, regulators, consultancies and local schools packed out the Grade 1 listed Pierhead building in Cardiff Bay, part of the National Assembly for Wales's estate. This building, built in 1897 is a fine example of how geology has shaped modern Wales. Built with wealth generated from the South Wales coalfield it is constructed from 'Ruabon terracotta' sourced in north east Wales. Such was the demand of this fine Welsh terracotta that over 2000 people were involved in the operation and the town of Ruabon was often referred to as 'Terracottapolis'. Its striking redness marks it out, even among the spectacular new buildings that now surround it. As geologists we naturally look to the past but importantly the event also focused on current and future issues for the geoscience community, including urban growth and regeneration, building a low carbon future, and how we adapt to a changing climate.

We were pleased that the event was endorsed by Edwina Hart, Welsh Minister for Economy, Science and Technology and David Rees, Welsh Assembly Member & Chair of the Cross Party Group for Science and Technology in Wales.

Nic Bilham writes: The Southern Wales Regional Group's event was the first to be hosted by the Geological Society on the National Assembly for Wales's estate. So it was a fitting occasion on which to launch 'Geology for Society', a major new report on the benefits our science brings to society - from protecting human health and the environment to delivering resources and facilitating economic growth. The document is aimed at policy and decisionmakers as well as the wider public, and we hope it will also be a valuable resource for Fellows who want to explain why their science matters.

The report can be downloaded at **www.geolsoc.org.uk/geology-for-society**, where you can also find a wide range of online resources on all the topics it covers, including energy, water, minerals, engineering, geohazards and environmental change.

*Gareth Farr Events Secretary Southern Wales Regional Group. Nic Bilham is Director of Policy & Communications at the Geological Society

NEWS In Brief

Future meetings

The dates for meetings of Council and Ordinary General Meetings until June 2015 will be as follows: ➤ 2014: 2 April, 18 June, 25 September, 26 November; 2015: 4 February, 8 April.

Geological Society Club

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. or at another venue. to be confirmed nearer the date. Once a year there is also a buffet dinner at Burlington House. New diners are always welcome, especially from among younger Fellows. Dinner costs £55 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. 2014: 2 April; 14 May; 24 September: 15 October. ► Fellows wishing to dine or requesting further information about the Geological Society Club, please email Cally Oldershaw (Hon Sec) at cally.oldershaw@btopenworld.co m or T: 07796 942361. DR

Literature searching

Not enough time or struggling to find the information you need? We can search a wide range of resources on your behalf and send you the results directly to your inbox. To find out more about this service, please email library@geolsoc.org.uk

New acquisitions

If you would like to receive by email or post a list of titles recently added to our library catalogue, please call 020 7432 0999.









PETEX is the largest subsurface-focussed E&P conference and exhibition in the UK, attracting thousands of delegates from across the world and across a spectrum of industry sectors, from supermajors to consultancies. Exhibition space is already 90% sold out, featuring the ever popular International Pavilion.



This year PETEX is celebrating 25 years of technical excellence. We're promising a comprehensive programme illustrating the latest global activity in exploration, field development, reservoir management and unconventional exploitation, in addition to the the latest developments in the North Sea.

There will also be a special interactive Session, called the PETEX Forum consisting of a panel of experts who will debate on the technical aspects of hydraulic fracturing in the UK.

Following the success from last time, PETEX will again host the Petroleum Geoscience Research Collaboration Showcase, which this year will be moving into a larger area.

The call for abstracts has launched, and closes at on 13 May, to submit your paper, visit the PETEX website.



vely Social Programme - all of which are included in your standard ticket price.

We are particularly pleased to say that the Wednesday night Evening Excursion will be returing in 2014, bigger and better than ever before!

To register, or for more information: www.petex.info

Keep up to date with us on.....



Adapt or die!

Jonathan Paul* thinks universities are out of touch with young people and losing the plot over student recruitment if they think young people today get at all excited about the open air life

s an enthusiastic undergraduate at the Royal School of Mines (Imperial College London) I became closely involved with outreach programmes aimed at recruiting young people to geology. Now, after having pursued a career in academia (while many of my friends chose industry) I feel the need to vent a little spleen about university recruitment and the problems of choosing a career path after a geoscience degree.

Fieldwork bait

First - recruiting. The old aphorisms I used to trot out to sixth formers ('a conglomerate of all the other sciences'; 'our undergraduates spend the most time in the field' etc.) no longer pass muster. Many students nowadays do not find the prospect of fieldwork attractive, equating it with manual labour and preferring to stay home. The folly of using fieldwork as bait becomes clearer when we consider the ubiquity of computers in most professional geoscience jobs.

Finding a well-paid, comfortable industry job (clean, indoors, no heavy lifting) is fast becoming the deciding factor in university choice. Departments are nowadays rated more highly for their industry links than they are for the brilliance of their academics. From a recruitment point of view, the battle is lost if all you can think of as an inducement is fieldwork.

So what else can we do to attract students to geoscience when education in itself is no longer valued, except as a three or four-year



arm and dry, please

conveyor belt to a job?

There had to come a point when, asked about one's attraction to geoscience, those old stories about rock and fossil collections metamorphosed into egregious interviewspeak ('skillsets', 'deliverables'). Perhaps the greatest problem I faced at the end of my first degree was the massive bifurcation looming ahead: to academia or industry? There were no other options, and their mutual exclusivity was implicit.

Academia

Academia affords a priceless measure of independence, to work in areas of personal interest. But it is a treadmill of its own. Even a small break from the cut-and-thrust of research could disrupt the stultifying progression from PhD to Post-Doc to Lecturer. Henry Kissinger once famously noted that academic politics is so vicious because so little is at stake. But still, many academics would never dream of recommending industry to their students.

And what are the prospects for young geoscientists who do enter industry? Again, in their own way, industry careers can also be remarkably inflexible. Initial, often faintly embarrassing, 'assessment centres' becoming the norm these days - usually lead to some form of graduate scheme; and swearing fealty to the almighty company for the duration. Industry's need for geoscientists (especially geophysicists) stands at an all-time high, yet it is important to remember that the job market goes in sync with cycles in commodity prices, and that a collapse in Brent Crude prices might well put you on the dole.

Nevertheless, forging new links between industry and academic geoscience departments must be the key to recruitment success. Samuel Taylor Coleridge, unusual among the Romantics for his profound appreciation of geology, wrote: "Mr Lyell's system of geology is just half the truth, and no more". I am concerned that fewer geoscientists are being made for the dual 'truths' of academia and industry.

*Jonathan Paul PhD student, Bullard Labs, University of Cambridge



SUAPB(

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

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

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

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

FROM A **RECRUITMENT POINT** OF VIEW, THE BATTLE IS LOST IF ALL YOU CAN THINK OF AS AN INDUCEMENT IS FIELDWORK, SO WHAT ELSE CAN WE DO TO ATTRACT STUDENTS TO GEOSCIENCE. **Jonathan Paul**

RON FROM THE SKY



Meteoritics and Egyptology, two very different disciplines, recently collided in the laboratory, write **Diane Johnson** and **Joyce Tyldesley***

Above: West bank of the River Nile at Luxor, Egypt, famed for pharaonic tombs and mortuary temples from the Middle Kingdom ven though they had access to abundant supplies of iron in both Egypt and the Sinai peninsula, ancient Egyptian metalworkers did not develop iron production technologies before 600 BC. This appears to have been a deliberate choice; textual sources indicate that they were aware of iron from early in Egyptian history, when iron ores were ground up to create pigments used in art and cosmetics.

Although there are no signs of early iron manufacture, archaeology has shown that elite Egyptians were, very occasionally, buried with iron gravegoods long before that date. This raises a number of intriguing questions. Did the ancients actually work iron far earlier than has ever been recognised? Was iron the occasional, accidental, byproduct of copper smelting? Did iron regularly enter Egypt through trade and if so, where did it originate? Or, as the earliest archaeologists suggested, was this meteoric iron: iron that had fallen from the sky, home of the gods?

If it was meteoric in origin, did the idea that it was the gift of the gods influence the perception and use of the metal? As one of us (DJ) is fascinated by meteorites, the other (JT) fascinated by early Egypt, and both of us are fascinated by ancient riddles, we could not resist the temptation to investigate further.

Excavation

Five thousand three hundred years ago, in the pre-literate time before Egypt became a single state ruled by a pharaoh, a man was buried in a sandy grave in the Gerzeh cemetery (70km south of modern Cairo). We know very little about this anonymous man, but we can deduce that he was an important

AS THE EARLIEST ARCHAEOLOGISTS SUGGESTED, WAS THIS METEORIC IRON: IRON THAT HAD FALLEN FROM THE SKY, HOME OF THE GODS?



Gerzer Dead, pictured on an etched slice of an iron meteorite, showing characteristic Widmanstätten patterning

member of his community because his body was surrounded by valuable grave-goods - an ivory pot, a stone palette to grind his cosmetics and a copper harpoon - and adorned with bead jewellery made from precious raw materials including gold, carnelian and iron. So rare were his tubular iron beads that only one other grave in the extensive cemetery included anything similar.

In 1911 the man and his beads were exhumed when archaeologist Gerald Wainwright excavated the Gerzeh cemetery. This unexpected find of iron artefacts in a well-dated context predating the official start of the Egyptian Iron Age by over 2500 years caused archaeologists to question their understanding of ancient Egyptian metalworking technologies. The question was, however, quickly answered when early analysis indicated that the beads were rich in nickel. As all meteorite iron is nickel-rich, this was considered conclusive evidence of a meteoritic origin for the metal. It seemed that the ancients had simply found the iron and worked it as they would have worked copper, without any real understanding of its nature. Wainwright, believing that the deliberate inclusion of iron beads in high-status burials indicated that meteorites had religious importance, went on to develop numerous theories involving meteorite worship in ancient Egypt.

Analysis

In the 1980s, doubt was cast on the meteoritic origin of the Gerzeh beads when archaeo-metallurgists suggested that early nickel-rich iron could have been produced from terrestrial resources, using naturally nickel-rich iron ores or additives. Given the highly oxidised state of the Gerzeh iron beads, and their limited early analysis (which was neither well-published nor conducted to modern standards) this possibility had to be considered. So we decided to start our investigation by re-examining one of the iron beads currently held in the collections of The Manchester Museum.

Non-destructive methods of analysis were employed; electron microscopy to examine surface structures and chemistry and micro x-ray Computer Tomography (CT) to reveal internal structures. We found that the bead itself has the microstructure and chemistry of an iron meteorite, so its origin therefore seems clear. We also found indications of the manufacture method; bending points were clearly seen in virtual X-ray CT slices through the bead, indicating that the meteorite was beaten into a thin sheet and subsequently bent into a tube Gerzel bead images showing optical and virtual X-ray data



The 'Eye of Horus', from grave goods of Tutankhamen

Polychromed columns with carvings of the pharaoh and his wife surrounded by hieroglyphs, in Medinet Habu temple, dedicated to Ramesses III. Luxor, Egypt



▶ shape. This allowed it to be strung on a flax fibre thread, traces of which are still preserved within the bead.

The full meaning of the inclusion of meteorite iron beads in this particular grave remains to be fully understood. As the burial predates writing, we have no textual references to help us. The iron could have come from a small local meteorite fall, or it could have arrived at the site through trade. The cemetery did yield several materials from non-local sources, including lapis lazuli and obsidian, which could have been imported from as far away as Ethiopia and Afghanistan.

Comparisons

Egyptologists have speculated for many years on the use of meteorite iron by the ancient Egyptians. Unfortunately, it is difficult to reach an accurate assessment of the amount of iron in circulation before 700 BC.

The ancient Egyptians built their houses and palaces from mud bricks, and situated them close to water sources. Over time, the vast majority of their settlements, together with any iron they might once have held, have simply dissolved into the landscape. Graves and tombs, cut into the hot, dry desert sands and cliffs, were intended to be more permanent and so offer a more reliable source of evidence, although even here there may be problems.

Many of Egypt's cemeteries were investigated over a century ago, before modern standards of excavation were developed, when it was not uncommon for smaller and seemingly insignificant finds to be ignored in the quest for more valuable grave goods. It also seems likely that cultural expectation would play a part in the recovery of iron from pre- Iron Age archaeological sites: if excavators "knew" that iron could not be present, any find of iron would probably be classified as intrusive (later dating) and simply thrown away. Despite these problems, more than 20 early iron artefacts have been found in securely dated contexts. These came from two tombs on the west bank of the Nile at ancient Thebes (modern Luxor). The majority of these finds have been analysed as 'nickel-rich'.

More than 1000 years after these beads were committed to the Gerzeh grave, a part-iron amulet was placed in the tomb of Queen Ashait (Deir el-Bahri, Thebes). Her amulet takes the form known as a *pesesh-kef;* it is modelled on the figure of a person from the chest to the top of the head, in a similar style to a death mask, but with a small blade mounted downwards from its base.

Initially it was thought that her amulet had been made entirely from silver, but analysis subsequently showed that blade was made of nickelrich iron, although its exact composition has yet to be published. Pesesh-kef blades were traditionally associated with childbirth (when they were used to cut the umbilical cord of newborn babies) and with the re-birth after death. They were used in ceremonies designed to animate the inert including the 'Opening of the Mouth' - a ritual performed at the entrance to the tomb, which would transform the mummy into a latent being with the potential for life.

When King Tutankhamen died in approximately 1327 BC, he and his grave goods were buried in a tomb in the Valley of the Kings. Unlike Ashait's, Tutankhamen's tomb was preserved more or less intact, although archaeology indicates that there had been two robberies soon after his funeral. Several iron artefacts were found among Tutankhamen's surviving grave goods. These included a set of 16 model chisels with iron blades set in wooden handles, stored in a room opening off the burial chamber. As the chisel blades are all less than 1mm thick, they would have been too fragile to use as practical tools. It is, however, possible that they were used in Tutankhamen's own Opening of the Mouth ceremony.

Three iron artefacts were

found wrapped within Tutankhamen's mummy bandages. As the body was the most important element within the tomb, this placing indicates the high ritual and financial value attached to iron by those who wrapped the king for death. A miniature model head-rest (the hard ancient Egyptian equivalent of a pillow) was discovered lying directly behind Tutankhamen's head, inside his gold death mask. The head-rest had been roughly constructed by welding together pieces of iron, probably at too low a temperature.

Wrapped on the right side of the abdomen was an iron 'Eye of Horus' amulet attached to a golden bracelet. The "eye of Horus" was a popular funerary amulet, symbolising protection, royal power and good health. Also wrapped with the mummy was a large and extremely well-made dagger with a rock-crystal pommel, gold sheath and iron blade which, as the excavators noted, was still extremely sharp when discovered lying along the king's right thigh. A second dagger recovered from the mummy was entirely of gold.

Apart from the dagger blade, all of Tutankhamen's iron goods are crudely made. Those which have been analysed have nickel-rich iron chemistry. This suggests that they were of local, Egyptian, manufacture with the meteoric iron being hammered into shape by craftsmen unaccustomed to working with such hard, high-temperature metals. In contrast, recent analysis of the well-made dagger blade recorded three weight percent nickel content, which suggests a smelted origin. Only further testing can confirm this. ►



Above: Head rest from the tomb of Tutankhamen. See text for explanation

Below: Tutankhamen's model chisels. See text for explanation

THIS UNEXPECTED FIND OF IRON ARTEFACTS IN A WELL-DATED CONTEXT PREDATING THE OFFICIAL START OF THE EGYPTIAN IRON AGE BY OVER 2500 YEARS CAUSED ARCHAEOLOGISTS TO QUESTION THEIR UNDERSTANDING OF ANCIENT EGYPTIAN METALWORKING TECHNOLOGIES



Writings

Textual evidence indicates that limited amounts of iron were imported into Egypt from neighbouring territories during the reigns immediately preceding Tutankhamen's. One such text is a letter written by Tushratta, king of Mitanni (a land covering the modern regions of eastern Turkey, northern Syria and western Iraq), to Amenhotep III, king of Egypt. Amenhotep was almost certainly the grandfather and revered role-model of Tutankhamen.

The letter details the dowry of Tushratta's daughter, who was to be sent to Egypt to marry Amenhotep. Intriguingly, it mentions a dagger blade of *habalkinu*: a word derived from the ancient Hittite language which may be translated as "steel". It is therefore a distinct possibility that Tushratta's dagger, initially sent to Amenhotep, was inherited by his grandson Tutankhamen, used for ritual and maybe practical purposes throughout his reign, and buried alongside him as a valued symbol of kingship and kinship.

The earliest ancient Egyptian (hieroglyphic) word for iron was the subject of great debate by early linguists, who

frequently confused copper and iron in their translations. The word bia was eventually recognised as "iron", but it may actually refer to a range of hard, dense, metals including iron. The word was used in many texts, including the funerary Pyramid Texts carved on the internal walls of some royal pyramids. These, some of Egypt's earliest preserved religious writings, date from approximately 2375 BC but are likely to have been composed much earlier. They connect iron with aspects of the sky, with ritual artefacts and with the bones of the dead king who is described as living for ever as an undying star in the sky.

In approximately 1295 BC a new hieroglyphic word appeared. *Bia-n-pet* literally translates as "iron from the sky". The new word was applied to all metallic iron from this time onwards. An obvious explanation for the sudden emergence of the new word would be a major event, such as a large impact or shower of meteorites, witnessed by the ancient Egyptian population. This would have left little uncertainty as to where exactly the mysterious iron came

from, and

would have created a sufficiently strong association between iron and the sky for the new word to become synonymous with all forms of iron. In 2008 a large impact crater formed by an iron meteorite was found in southern Egypt. Although its exact age is unknown, local archaeology suggests that it formed within the last 5000 years, making it a possible candidate event.

Rituals

Most of the early examples of iron in Egypt are obviously symbolic or ritual artefacts; the one exception, Tutankhamen's dagger, may have been either a ritual or a practical tool, or both. All the examples were recovered from graves, and therefore are likely to have some ritual connection with the funeral and/or rebirth of the deceased. This ritual link is also found in early funerary texts, where the association with the Opening of the Mouth ceremony is particularly clear.



Modern copy of Tutankhamen's funerary mask

Felucca sails on the River Nile, Aswan, nr. 'Elephant Island', Egypt

It may be that iron was allowed an important role in this ceremony because meteoritic iron was associated with meteors and thunderbolts; powerful natural phenomena whose own inherent power might increase the potency of the ritual. A specific association of iron blades with the adze, a bladed tool used as a ritual implement, suggests a link to the stars themselves, while the constellation Ursa Major (aka 'The Plough' or 'Big Dipper') forms the shape of the adze, the stars in Ursa Major were considered to be 'imperishable' stars, the name used by the ancient Egyptians for stars not seen to set or rise because of their proximity to the northern celestial pole. Dead and reborn kings were identified with these special stars.

Meteorites may have played a more direct role in state religion. The '*Benben* Stone' was the focus of worship in the temple of the sun god Re at Heliopolis. The word *benben* is derived from the verb *weben* which means 'to shine'. It may therefore be associated with the first ray of sunlight, or with the mound of creation that emerged from the waters of chaos at the beginning of time. The original *benben* stone was lost in antiquity, but contemporary illustrations indicate that it was a pyramid or cone-shaped rock, which has led to suggestions that it may have been a meteorite.

For most of Egypt's long history, iron was a rare and exotic material sourced from meteorites. As iron fell to Earth, it is likely to have been regarded as a 'gift of the gods', which would have given it a powerful ritual magic. However, the technology, chronology and etymology of iron and the iron smelting process in ancient Egypt are poorly understood, creating many challenges when attempting to understand the source and functions of iron artefacts.

Because of the possible variation in smelting materials, we cannot easily know which nickel-rich artefact has been formed from meteorite iron and which has been smelted. Ultimately, this can only be determined by further detailed structural and chemical analysis of individual objects. We hope that with further investigations we will be able to clarify the use and importance of iron – both meteoric and terrestrial in ancient Egypt. ◆ *Diane Johnson works with meteorites in the Planetary and Space Sciences group at the Open University, UK. She also studies Egyptology with the University of Manchester. Diane.Johnson@open.ac.uk

Joyce Tyldesley is Senior Lecturer at the University of Manchester, where she teaches Egyptology online. Her research interests include the development of Egyptian mythology. Joyce.Tyldesley@manchester.ac.uk

FURTHER READING

- 1 Johnson, D., Tyldesley, J., Lowe, T., Withers, P.J., Grady, M.M. (2013) Analysis of a prehistoric Egyptian iron bead with implications for the use and perception of meteorite iron in ancient Egypt. Vol.48, 6, 997-1006, *Meteoritics and Planetary Science.*
- 2 Ogden, J. (2000), Metals, in I. Shaw and P. Nicholson (eds) *Ancient Egyptian Materials and Technology*, Cambridge University Press, Cambridge: 148-176.
- **3 Tyldesley, J.** (2010), *Myths and Legends of Ancient Egypt*, Viking Penguin, London.

Above opposite page: Tutankhamen's iron dagger. See text for explanation



Entrance to the temple at Luxor, Egypt, by night



Mike Smith* tells the tale of Arthur Smith Woodward - born 150 years ago this May - and the magnificent fossil fish collection he curated

he name Arthur Smith Woodward is most commonly linked with the East Sussex village of Piltdown. Sadly, his unwitting involvement in that hoax somewhat overshadows his achievements in vertebrate palaeontology - in particular, of fossil fishes. Arthur was just 18 when he started work at the Natural History Museum (NHM) in London, and soon settled down to a scientific career of hard work and dedication.

Precocious

Arthur had been a precocious student, already publishing a scientific paper before joining the Museum. He soon impressed all with his work ethic and intellect. He was fortunate in one important respect - the Museum's extensive collection of fossil fish, particularly the recently-acquired Egerton and Enniskillen collections. The study of these and others was to lead to a comprehensive catalogue that, over 120 years later, remains an important reference. He described and figured approximately 300 new species of fossil fish. Today some of these same specimens are being re-examined using modern methods that are revealing detail of which Smith Woodward could hardly have dreamt.

Shortly after his parents vetoed a recommendation (from Professor William Boyd Dawkins) that Arthur apply for a vacancy at the Geological Survey of New South Wales (aged 17) Arthur's father drew his attention to an advert in the *Field* (March 25, 1882) for a post at the British Museum.

To apply for the position of Assistant, Second Class, the applicant had to have the permission of one of the three Principal Trustees of the British Museum – the Archbishop of Canterbury, the Lord Chancellor, or the Speaker of the House of Commons! With letters of introduction from local dignitaries in Macclesfield and Leek he was able to obtain the support of Sir Philip Cunliffe-Owen (Director of the South Kensington Museum) and eventually gain the support of the Archbishop of Canterbury.

Arthur joined the Geology Department on Thursday 24 August 1882. His first day did not go well. Keeper of Geology, Henry Woodward FRS FGS (no relation) rather resented the young man from Macclesfield. Firstly he had tried to appoint George C Crick FGS (1856-1917), who was working as a volunteer in his department but was told the position must be filled by examination. Arthur came first of the fourteen candidates sitting the Higher Civil Service Examination but Crick, nearly eight years Arthur's senior, only managed fourth place.

Henry did not like having another 'Woodward' in his department. While initially suggesting Arthur adopt some other name, he decided Arthur should always use his full name, 'Smith Woodward' (Smith was his mother's maiden name), to "avoid confusion". Thus Arthur became known professionally as 'Smith Woodward'. It was also made clear that he was on a year's probation.

Lonely

Many years later in her memoirs¹ Lady Woodward records that his first year in London was a very lonely one. Too young to join the Geological Society, he relied on invitations to meetings; but he had secured the job he most desired, and spent all his time working and studying.

In August 1882 the new Museum building at South Kensington had been open for just 16 months and much of the exhibition space remained to be filled. Smith Woodward's first tasks involved displaying and labelling the fossil vertebrates in the new galleries.

But the main thrust of his future work and research was soon set. In 1882 and 1883 the Museum acquired the fossil fish collections of Sir Philip Malpas de Grey Egerton (1806-82) and William Willoughby Cole, 3rd Earl of Enniskillen (1807-1886). These two collections were undoubtedly the most important and comprehensive set of fossil fish ever assembled, many of them figured by Agassiz in his monumental ►



WANTS AND VACANCIES. SITUATIONS VACANT.

BRITISH MUSEUM. — CANDIDATES into the total wantable of ASSISTAN (2017) was blue than, department of Minerale, special qualitaticat-advanced Physics, and Mathematics, with Theoretical and President Cranalizations, sales 223, finite to Galagy, special qualifications—a fair knowledge of Geology and Falsenberg, solary and the Second Cano, department of Galagy, regular qualifications—a fair knowledge of Geology and Falsenberg, solary and the second cano, department of Galagy, The appointments will be made order limited frompetition—Apply to the Parameter Limited to from the footon, W.C.

Above top: Waterhouse's temple to nature - the Natural History Museum, South Kensington, London Above lower: The advert in the Field to which Arthur responded

Left: Arthur Smith Woodward brilliant and precocious, his career achievements are today sadly eclipsed by one unfortunate event - his innocent involvement in the Piltdown hoax



June 8th Lech. 3. Beneath the stein of the fish are the muscles; the muscle covering the sides of the trunk and the tail is distinctly segmented, the number of segments corresponding to the sumber of vortches. Between each septement is a septement, a haneverse section of which appears as a gig gag white shipe, shown in the diagram :-Each replum is connected with a valebral al of lody of a centum and its processes ; the muscular filter are attached to the septe, those of each Huch segment shetching across between the enclosing septa. Siagrams of vorlebra:ural dates in at whine Candal Ortebra. Abdominal Vorlebra. The spinal column of the fish is divided only in the hos regions, - abdominal and candal. The ordebral centra are biconcare, Huns-The holdown between the centra (darkely shaded in He diagram) are filled with a contilaginous material, - The remnants of the embryonic notochord.

▶ work *Recherches sur les Poissons Fossile* (*Geoscientist* 23.01 February 2013) and containing many type specimens. In the summer of 1883 Smith Woodward attended the Swiney Lectures on fossil fishes given by Ramsey Heatley Traquair FRS, FGS (1840-1912) learning many new ideas on fish systematics.

In his spare time Smith Woodward was studying for the London University BSc and continuing his researches on fossil fish. Between 1884 and 1886 he wrote a series of eight articles for Hardwicke's Science-Gossip on Fossil Sharks and Rays that included 76 figures. He also published his first ichthyological scientific papers, also on sharks, in the *Geological Magazine* (edited by Henry Woodward. Smith Woodward was to be a prolific contributor).

It must have been clear to all that Smith Woodward was exceptionally talented. In 1886 Henry Woodward suggested that he consider writing "an exhaustive catalogue" of fossil fishes, to be published by the Museum. Realising what a huge task this would be, Smith Woodward chose to abandon his formal studies (for the second time) and devote himself to the research necessary to write the Catalogue of the Fossil Fishes in the British Museum (Natural History) - the 'Catalogue'. This was to be a carefully researched series of books (published in four parts in 1889, 1891, 1895 and 1901) that included numerous detailed descriptions of important specimens including many new to science. It included extensive references to all known fossil fish species, something he was only able to do by visiting all the important museums in the UK, Europe and the USA (largely self-funded).

Marriage

Smith Woodward married Maud Leonora Ida Seeley, eldest daughter of Harry Govier Seeley FRS FGS (1839-1909) in June 1894. Seeley was Professor of Geography at University College, London at the time, becoming Professor of Geology and Mineralogy two years later. Maud accompanied her husband on many of his trips abroad and was quite happy to get her hands dirty, helping with excavations and fossil preparation. It was a life-long and happy marriage. They had a son, Cyril, and a daughter, Margaret. Tragically Cyril died while in the Borneo public service at the age of 24.

Smith Woodward had succeeded Robert Etheridge FRS FGS (1819-1903) as Assistant Keeper of Geology in 1892. On completion of the last part of the *'Catalogue'* in 1901 and the retirement of Henry Woodward he became Keeper, a position he undoubtedly deserved given his scientific achievements and dedication. It must also have been very satisfying, having given up formal studies twice, to be awarded (in 1900) an honorary LLD from Glasgow University. Elevation to Keeper by no







Clockwise from far left: A page from Smith Woodward's Swiney Lectures notebook

Mesodon daviesi from the Purbeck Beds at Swanage, Dorset

The four part Catalogue of Fossil Fishes in the British Museum (Natural <u>History)</u>

Geology Department Staff circa 1883. Back row (L-R) Arthur Smith Woodward, William Davies, R Bullen Newton. Front row (L-R) Robert Etheridge, Henry Woodward

Holocentrum melitense - a typical display of a fossil fish

erialis

Slate) acquired

with the purchase of the

purchase of the Egerton Collection. The teeth are small, round or elongate, and used for crushing food such as crustaceans and molluscs

means marked the end of his scientific career - far from it. From 1901 until his retirement (1924) he published 64 papers or articles on fossil fish plus two monographs (*The Fossil Fishes of the English Chalk and The Fossil Fishes of the English Wealden and Purbeck Formations*) for the Palaeontographical Society. In the same period he also published 45 papers on other vertebrates and 20 on anthropology.

During his time at the Museum Smith Woodward described and named approximately 300 new species. The type specimen of *Mesodon daviesi*, a pycnodontid fish, was purchased by the Museum in 1869 and was named after the colleague who recognised it as belonging to genus *Mesodon*. The specimen's counterpart was re-united with the type when the Museum purchased the Beckles Collection in 1891. ►



Lebanon

Several other collections of fossil fish obtained by the Museum rank in importance with the Egerton and Enniskillen collections, one being the Lewis collection (acquired 1875-95). Of the 11,500 or so registered specimens mentioned in the 'Catalogue', the top four collections in number are: Enniskillen (c. 2250), Egerton (c. 1884), Mantell (454) and Lewis (416). However, compared to the general nature of the Egerton and Enniskillen collections, the Lewis collection is composed entirely of Upper Cretaceous fossil fish from Lebanon. They were collected by the Rev. Professor E R Lewis of the Syrian Protestant College, Beirut. Apart from the fact that 30 of the specimens mentioned in the '*Catalogue*', are type specimens, the Lewis collection contains some of the most beautifully preserved fossil fish, such as Aipichthys velifer.

Fossil preparation techniques have come a long way since Smith Woodward's time, such as the acid preparation method pioneered at the Museum by Harry Toombs (1909-87) in the 1930s and 40s, who used weak acetic acid on fossil fish preserved in chalk. Today the Museum uses one of the most effective (and non-destructive) investigative methods – X-ray computed tomography or CT scanning. The collection contains numerous chalk fossil fish preserved in full or partial 3D. CT scanning is currently being used to investigate fossils such as *Sardinioides illustrans*. With careful processing a wealth of detail can be revealed, leading to improved characterisation of species.

Peter Forey wrote in 20042: "The fossil fish collection at the Natural History Museum is, without a doubt, the finest such collection in the world (I make this claim with evidence and without shame)". It is used almost daily by visiting scientists from around the globe. Arthur Smith Woodward certainly did much to make it what it is today, and he should certainly be remembered for that. ◆

*Dr Mike Smith is a consultant structural engineer employed principally in the offshore oil and gas industry. He also works as a volunteer at the NHM on the fossil fish collection

FURTHER INFO

To find out more about this great British scientist why not come to the one-day symposium being held at the NHM in London on **Wednesday 21 May**, to celebrate his 150th birthday? Entrance is free to all but registration is required as numbers are limited. Go to **www.nhm.ac.uk** and type 'Woodward 150' in the search box for further details, or find it in Events on the Society website. The organisers gratefully acknowledge financial support from the Geological Society.

> ACKNOWLEDGEMENTS

Special thanks to **Hermione Beckett** of the Oxford University (CT scan). All other images © **Natural History Museum**

REFERENCES

- 1 Lady Smith Woodward's Memoirs, The Natural History Museum Library Archive
- 2 Forey, P, The Spawning of the Fossil Fish Collection, Set in Stone, The NHM Palaeontology Dept. Newsletter, Autumn 2004. Vol. 2, No. 3

READERS' LETTERS

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

Radwaste factual corrections

The Editor has made it clear that the recent exchange of views over the identification of possible sites for disposal of radioactive waste in the UK is now closed. It is, I think, well understood that the views expressed in *Soapbox* articles, as with any other article in the magazine unless where explicitly stated otherwise, are those of the authors alone, and are not endorsed by the Society. However, some Fellows have expressed concern that simple factual errors may sometimes appear uncorrected in *Geoscientist* as a result of the editorial freedom extended to authors of *Soapbox* articles, and that this may be a source of confusion for Fellows and others trying to get to grips with the topic.

In view of this, I would like to take this opportunity as Editor-in-Chief to make the following factual corrections to information presented in the article 'Fallout over Radioactive Waste', which appeared in the December 2013/January 2014 issue (*Geoscientist* 23.11).

The article stated that: "Reports in 1999 by the Royal Society and the House of Lords Science and Technology Committee recommended a national site search, led by geological criteria. However the 2001 Defra white paper Managing Radioactive Waste Safely ignored this advice, proposing 'voluntarism'. CoRWM, the committee set up to develop deep geological disposal for UK intermediate and high-level radwaste, which reported in 2006, contained not a single Earth scientist."

In fact the 2001 Defra White Paper was the launch of a process to decide how government policy on long-term waste management should be developed, following the failure of the previous policy approach based on geological disposal, and it was written partly in response to the 1999 reports. It did not propose geological disposal, by "voluntarism" or any other means, but it did lead to the establishment of the Committee on Radioactive Waste Management (CoRWM).

CoRWM was also **not** set up to develop deep geological disposal. On the contrary; given concern over lack of public confidence in the previous policy approach, its remit was to consider afresh all the possible options for long-term waste management and to "make recommendations for the long-term management of the UK's higher activity wastes that would both protect the public and the environment, and inspire public confidence". Although CoRWM was therefore not charged with a specifically geological task, the Geological Society nonetheless made strong representation concerning the omission of any geological expertise on CoRWM at that time. The Society

The Society organised a meeting in January 2006 on

'Geosciences and the Long Term Management of Radioactive Wastes', which brought together global experts in Radwaste Disposal to describe their approach to disposal, which was universally for a deep geological repository, albeit within a range of geological scenarios. This meeting was influential in helping CoRWM with its deliberations. In July 2006, CoRWM recommended geological disposal as the preferred technical solution for higher level wastes, together with a principle of voluntarism and equal partnership between any potential host community and the implementing body throughout the site selection process. These recommendations were adopted as Government policy.

After further public consultation on a framework for site selection, the 2008 White Paper did indeed set out a process based on voluntarism, combined with staged technical assessments. A number of deficiencies in the 2008 process became apparent as a result of engagement with communities in West Cumbria, which had expressed an interest in hosting a geological repository. DECC entered into a new round of consultation on the siting process in 2013, to which the Society has contributed, but geological disposal and the principle of community voluntarism as the basis of policy are not in question. A new White Paper is expected later this year. **PROF. PETER STYLES**

BOOKS & ARTS

HAVE NO INTERNET ACCESS? CALL THE LIBRARY BOOKSHOP 0207 432 0999 FOR Advice and to purchase publications

Earth in 100 Groundbreaking Discoveries

Recently, a friend sheepishly returned this book to me. "Sorry, seem to have had it for quite a while", he said as he handed it over. A piece of paper fell out which said "Dear

Mrs Kenny, Thank you for agreeing to review this book...". "What did you write?" asked my friend. The polite version of my reply was that the book had not been in my hands long enough for me to review it.

This is one of this book's defining characteristics. It's nice-looking, easy to pick up; you can dip into it at random and flick through its beautiful illustrations and it's almost impossible not to find something that grabs your attention. The stories about each chosen discovery are entertaining and before you know it, the person who has picked it up is settled in a chair with it, and then – 'borrowing' it.

Despite a strong Earth science/geology slant there is no technical jargon and it has appealed to a wide range of people passing through my lounge. It's like a bound copy of an annual subscription to National Geographic, but without all the adverts for aspirational photography equipment. By the very nature of the book the articles are generally short and occasionally lacking in detail (for example the book contains the only article about the Burgess Shale that I have ever read that does not mention Hallucigenia), but conversely, it is the short 'taster' nature of the articles that make it so easy to dip in and out.

This makes it ideal reading for (as demonstrated) coffee tables, or for people like myself, as a working parent of two small children, whose reading time is often constrained to the run-time of an episode of *Peppa Pig*, bathroom breaks and the 10 minutes between actually getting into bed and sleeping. It's full of celebratory wonder at the amazing planet we call home, and in these often miserable times of double-dip recession and climatic disruption, it is good to step back and take a look at our tiny problems from the vast perspective of our geological past, but also to know that

there's stuff worth saving out there.

It's also a solidly constructed, fairly heavy book, good for use as a bludgeon to threaten a friend who has "borrowed" it for so long it probably counts as stolen.

Reviewed by Catherine Kenny

EARTH IN 100 GROUNDBREAKING DISCOVERIES DOUGLAS PALMER, Published by Quercus Publishing 2011 ISBN 978-0-85738-501-7 416 pages List price: £15.00 www.quercusbooks.co.uk

Sheet Silicates -Clay Minerals: Rock-Forming Minerals

This long awaited 2nd edition to Deer, Howie and Zussman's landmark *Rock-Forming Minerals* series, presents a significant revision and re-organisation of the volume on these important sheet

silicate minerals. The edition reflects the fundamental advances made in clay mineral science during the period since the initial publication in 1961.

Beginning with an introductory overview to the clay minerals (describing the clay mineral 'concept', their structure/classification, identification/characterisation, origin, occurrence, distribution and applications), each group is described and presented in separate chapters in the established format of the RFM series: structure, chemistry, optical and physical properties, distinguishing features and paragenesis. This edition also places more emphasis on

distinguishing features and paragenesis. This edition also places more emphasis on special clay-like properties such as ionexchange, adsorption, their ability to form organic complexes, interactions with water and colloidal characteristics.

In common with the 1st edition, the clay minerals are described in a chapter on each of the Kaolin, Smectite and Mica Clay (Illite) groups and on Vermiculite. This edition additionally includes separate chapters on mixed-layer and inter-layered clay minerals, and the Palygorskite and Sepiolite clay minerals. The chapter on mixed-layer clay minerals examines the contentious issue of the physical nature of the random and longrange ordered phases, with an extensive review of the current XRD and electron microprobe evidence for the various structural interpretations for the mode of origin for these clays.

The focus of the second edition is largely on the nature and occurrence of the clay minerals in a mineralogical and geological context. However, the volume reflects the fact that clay mineralogy is an interdisciplinary science, with considerable reference to the research progress made in many other complimentary science disciplines, including soil science, environmental science and engineering, colloid chemistry and ceramic/material sciences.

Primarily aimed at sedimentary geologists, mineralogists and soil scientists, researchers in related fields will find this revision an essential reference work.

The volume is exceptionally well written, with clear and appropriate figures, diagrams and XRD, microprobe and mineral-chemical data-tables. The author is to be congratulated on an excellent revision, which will remain as the foremost research reference work in the field for many years to come.

Reviewed by Mark Griffin

SHEET SILICATES – CLAY MINERALS: ROCK-FORMING MINERALS V. 3C (SECOND EDITION) DEER, HOWIE AND ZUSSMAN M J WILSON, 2013. The Geological Society of London. ISBN 978-1-86239-359-2 hbk 724pp. ISSN 2041-6296 List price: £120.00

The Self-Potential Method

The self-potential (SP) method is the ugly duckling of modern applied geophysics. Initially developed for mineral exploration, and recording some spectacular early successes, it inevitably fell into disfavour

once it had been shown that many orebodies that were easily detectable by other electrical means produced no SP response. The equipment is cheap, but noise levels are often high and the precautions needed to obtain good-quality results are all too often neglected. The difficulties are most severe in environmental applications, where anomalies are seldom more than a few tens of millivolts and may well be lost in the noise.

Bravely, Revil and Jardani have set out to counter the prevailing negative views, and to do so by adopting an uncompromisingly mathematical approach. The titles of the eight chapters seem innocent enough ('Fundamentals', 'Development of the Theory', 'Laboratory Investigations', 'Forward and Inverse Modelling', 'Applications to Geohazards', 'Applications to Water Resources', 'Applications to Hydrothermal Systems' and, finally, 'Seismo-Electric Coupling') but few pages pass without at least one equation, often of startling ferocity. Fortunately, the prose style is generally lucid and even readers who are unable to follow the mathematics have much to gain from the text. Practical considerations are not neglected, and the case histories chosen are relevant and adequately documented. Their treatments in the book are not always comprehensive, but the original papers can be used by anyone wishing to take things further.

In line with the book's subtitle, the use of SP surveys in mineral exploration is considered only very briefly, and the SP logs familiar in the oil industry (where the effects observed are actually caused by the presence of the borehole and the drilling fluid) are not discussed at all. However, the oil industry is not completely ignored. The cutting-edge seismo-electric research described in the last chapter may well come into its own with the increased use of 'fracking' of lowpermeability gas reservoirs.

One pleasing aspect of the book is that Cambridge UP have not followed their practice (in at least one recent applied geophysics text) of relegating colour illustrations to a supporting website. Where colour is needed, colour is supplied and several of the case studies would have been incomprehensible without it.

It is, perhaps, hard to share completely the optimism of the writer of the foreword, when she claims that the book will "undoubtedly lead to more acceptance of the self-potential method". Nevertheless, it should.

Reviewed by John Milsom

THE SELF-POTENTIAL METHOD. THEORY AND APPLICATIONS IN ENVIRONMENTAL GEOSCIENCES ANDRÉ REVIL & ABDERRAHIM JARDANI, Published by Cambridge University Press: 2013 ISBN 978-0-107-01927-0. 369 pp. UK List price: £75.00 www.cambridge.org/revilandjardani

The Lithosphere: an interdisciplinary approach

.....

This is an impressive volume. From the eye-catching cover design to the integrated style of the book, it is a well crafted compilation of our current knowledge of the lithosphere,

its composition and structure. The interdisciplinary approach makes it particularly attractive for those geoscientists who have never really got to grips with the other lithospheric disciplines that might just be of use (as a geochemist myself, the geophysical aspects of the book are very approachable and, for the non-specialist, the level of the geochemistry content seems appropriate).

The individual chapters cover a wide range of topics, including geophysical, geochemical and structural aspects of the lithosphere. Individual chapters dedicated to specific subjects include, for example, the thermal state, the age, flexure and rheology, electrical conductivity, and the seismic structure of the lithosphere; but within each chapter the evidence is presented for what constitutes the state of the art. This comprises a wide range of separate, yet integrated strands drawing on the geophysical, geochemical and petrological literature. Where a particular line of argument is pursued, the evidence is cited; its strengths and weaknesses are

discussed and complemented by discussion from other geoscience disciplines with no apparent bias. The discussion of the differences (and similarities) between the thermal, chemical, mechanical and rheological boundary layers is particularly well handled using this format which draws on a wide range of petrological, geochemical and geophysical evidence.

The book is well illustrated throughout and, beyond the introductory chapters, there is rarely a double page without an insightful figure. The format is easy to dip into, with a good number of tables summarising key points from which the reader can quickly assemble important references for further investigation. The references cited are plentiful and appropriate, ranging from the to more contemporary articles which together provide opportunities for impressive amounts of further reading.

This book is probably most appropriate for graduate students, researchers and professionals needing a one-stop volume for all things lithospheric. There is no mistaking what this volume is going to tell you – it is 773 pages of non-stop lithosphere that is surprisingly difficult to put down, despite its weight.

Reviewed by Jason Harvey

THE LITHOSPHERE AN

INTERDISCIPLINARY APPROACH IRINA ARTEMIEVA, Published by Cambridge University Press, 2011. 773pp. ISBN 9780521843966 List price: £90.00 www.cambridge.org

BOOKS Available for review

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 a full up-to-date list at **www.qeolsoc.org.uk/reviews**

- NEW! Responsible Leadership lessons from the front line of sustainability and ethics, by Sir Mark Moody-Stuart. 2014 Greenleaf Publishing 354pp (hbk)
- NEW! Essentials of Igneous & Metamorphic Petrology by Ronald Frost & Carol Frost 2014 Cambridge University Press 303pp (sbk)
- NEW! Practical Seismic Data Analysis by Hua-Wei Zhou 2014 Published by Cambridge University Press 481pp (hbk)
- NEW! 52 things you should know about geology by Matt Hall (Ed) publioshed by Agile Libre 2014 130pp (sbk)
- NEW! Landmarks in Foraminiferal Micropalaeontology History 7 Development by Bowden et al., (Eds) 2013. Published by the geological Society for the Micropalaeontological Society 2014 360pp (hbk)

William Smith Meeting 2014

The Future of Sequence Stratigraphy: Evolution or Revolution?

22–23 September 2014

The Geological Society, Burlington House

Conference Sessions:

- Does sequence stratigraphy provide testable predictions?
- Are the assumptions in the sequence stratigraphic model still valid?
- Varying Earth surface systems through time and the consequences for sequence stratigraphic prediction
- Sediment routing and variable sediment supply: do these fundamentally change the model?
- The consequences of non-uniqueness for interpretation and prediction
- What next for sequence stratigraphy? Evolution of revolution?

Confirmed Keynote Speakers:

Ron Steel (University of Texas & University of Aberdeen) William Smith lecture

Henry Posamentier (Chevron) *Does sequence stratigraphy provide testable predictions?*

Andrew Miall (University of Toronto) Are the sequence stratigraphic model assumptions still valid?

Mike Gurnis (Caltech) *Is there a stable reference point for eustatic curve construction?*

Tetsuji Muto (University of Nagasaki) *The consequences of non-uniqueness for sequence stratigraphy*

This meeting is intended to bring together a diverse range of sedimentary geologists to foster a critical examination of the current state of the sequence stratigraphic model, and to highlight robust new methods, concepts and protocols that could evolve or maybe even potentially revolutionize stratigraphic understanding and prediction.

Developments in this area seem likely to come from a combination of outcrop, geostatistical/stochastic approaches, physical experiments including large flume tank studies, and numerical approaches to the modelling of erosion-transport-depositional systems, all under the umbrella of the Landscape Into Rock concept. However, we will also encourage presentation of brand-new innovative methods, including cross-disciplinary methods that bring in ideas from other branches of science.

The meeting will be organized into a series of themed sessions, with an emphasis on provocative but practical presentations. Presentations will be scheduled to ensure there is plenty of time to debate all the issues raised in the meeting. In a final session, the conveners will chair a discussion targeted at achieving a consensus view on how the subject should move forward.

Convenors:

Professor Peter Burgess (Royal Holloway University London) Professor Philip Allen (Imperial College London) Professor Paul Wright (PWGC Itd)

Call for Abstracts:

There is a call for abstracts and oral and poster contributions are invited. Abstracts should be sent in a Word document to **naomi.newbold@geolsoc.org.uk** by **30 April**. The abstract should be approximately 500 words and include a title and acknowledgement of authors and their affiliations where possible.

Further information:

For further information about the conference please contact: Naomi Newbold, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

T: 0207 434 9944 E: naomi.newbold@geolsoc.org.uk W: www.geolsoc.org.uk/wsmith14

Follow this event on Twitter #wsmith14

PEOPLE NEWS

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. Email ted.nield@geolsoc.org.uk, quoting your Fellowship number.

Tony Brown

Tony Brown, of the University of Southampton (Geography & Environment) and Director of its Palaeoenvironmental Research Laboratory (PLUS) was inaugurated as President the Ussher Society (Geosciences SW England) at its AGM in Weston-Super-

Mare in January. Professor Brown researches Quaternary geology of SW England and Africa with a particular emphasis on river gravels and floodplain sediment, climate and human impact. He also undertakes both research and practice in forensic palynology, and enjoys many links with industry - particularly aggregates companies and archaeological consultancies.

Richard Lisle

Richard Lisle, Professor of Structural Geology at Cardiff University, has been presented with a lifetime career award from the International Association for Mathematical Geosciences. The award was made at their 15th Annual Conference in Madrid, September

2013. The award is given 'for an outstanding career expanding structural geology frontiers'

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Blackburn, James Kirk * Bowler, Christopher Michael Lance * Chapman, W T * **Dean, William T** Holroyd, J D * Hudson, Neal F C * Jacqué, Maurice * Jones, Brian Lloyd * Leckie, George Gallie * Little, Betsy A * Middleton, John * Miller, James * Million, Ronald * Moffatt, William Stewart * Robson, Geoffrey Robert * Spencer, Peter Murray * Spurr, Arthur M M* 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**.

DISTANT THUNDER The secret agent

Geologist and science writer **Nina Morgan*** discovers how a geologist saved the skin of the King of France

The career of George William Featherstonhaugh (1780-1866, pron. 'Fanshaw') was nothing if not colourful. Born in London, and after a failed career in commerce, he emigrated to the USA in 1807 where he worked to promote the application of scientific principles to agriculture. He also played a role in the establishment of the first successful railway in the United States, which ran between Schenectady and Albany in New York.

William Smith

When he returned to England in 1826 to research railway developments he met William Smith (1769-1839), who instructed him in the principles of geology. This meeting seems to have marked an epiphany in

Featherstonhaugh's working life. He was elected a fellow of the Geological Society of London, abandoned his work on agriculture and railways, and concentrated on geology. He returned to the United States in 1828, and in 1834 - with the support of Roderick Murchison (1792-1871) - won an appointment as a government geologist in the United States. Featherstonhaugh went on to survey and report on vast areas of America, covering states and territories ranging from Arkansas to parts of Wisconsin, Minnesota, North Carolina and neighbouring states. Only the withdrawal of funding seems to have prevented him from completing a geological map of the United States. In 1839 his focus again

changed, and he drew on his mapping skills to survey disputed territory between the United States and Britain on the border between Maine and New Brunswick. This apparently gave him a taste for the diplomatic life, and he successfully campaigned to become the British Consul in La Havre, France. He took up the post in 1844, and for a few years enjoyed a quiet and congenial career.

Revolution

Then, in 1848, the February Revolution hit France, forcing King Louis Philippe to follow his predecessor, Charles X, into exile in England - and enabling Featherstonhaugh to draw on both his diplomatic and geological skills. As Roderick Murchison recalled:

"In the French revolution of 1848, when Louis Philippe fled from Paris and was hid in a cottage with Queen Amelie[sic] on the south bank of the Seine opposite to Havre, it was Featherstonhaugh, the British Consul at Havre, who managed to get the family of 'Mr. Smith' over by night, and popped them into a British steam-packet. Even in this act the Consul was the geologist, for he passed off the ex-King as his uncle, William Smith, the father of

English geology!" Luckily for all concerned, biometric passports had not yet been invented, and none of the immigration officials realised that the father of English geology had died nine years earlier!

Acknowledgement Sources for this vignette include The Life of Sir Roderick Murchison by Archibald Geikie; the entry for George William Featherstonhaugh by Robert Stafford in the Oxford Dictionary of National Biography, and the Wikipedia entries for Louis Philippe and the 1848 revolution. Image: By Taber via Wikimedia Commons

*Nina Morgan geologist and writer based in Oxford

OBITUARY DUNCAN MURCHISON 1928-2013

Reference of the second second

Murchison, the father of UK organic petrology, graduated in Geology from King's College, Newcastle where he was President of the Students' Union (1953-54). He then worked as a geologist with Royal Dutch Shell, completing his PhD with Stanley Westoll at Durham University prior to joining the Department of Geology in Newcastle (January 1958). He was appointed Lecturer (1960), promoted Senior Lecturer (1968), Reader in Geochemistry (1971) and Professor of Geochemistry (1976). He was Dean of the University's Faculty of Science (1980-83) and served as Pro-Vice-Chancellor from 1986 until retirement in 1993, when he was made Emeritus Professor. He also served as Acting Vice-Chancellor (1991).

Treasurer

Duncan was a Fellow, Council member and Treasurer of the Geological Society of London and belonged to a number of international commissions. He was President of the Royal Microscopical Society, was ICCP Treasurer for many years and its President (1979-83). He was the 1987 Thiessen medallist and lifelong honorary member of TSOP.

His first paper, *Reflectance*

Father of organic petrology, distinguished academic leader and society officer

of vitrinite, was published in 1958. Together with Jones, Goodarzi, Cook and many others he developed and published an important body of work on the optical properties of metal oxides, ore minerals, natural and carbonised coal macerals and the impact of igneous intrusions on coal rank and sediment maturity. Duncan carried out pivotal early work in vitrinite reflectance and with Westoll also published Coal and Coal Bearing Strata (1968). Duncan was elected Fellow of the Royal Society of Edinburgh in 1971.

He founded the Organic Geochemistry Unit in Newcastle in 1968, and together with Archie Douglas

and Mick Jones made it the UK centre for coal petrology and organic geochemistry introducing the first postgraduate courses in this area. The OGU became a Postgraduate P-institute during the UGC Earth science reorganisations of the late 1980s and became the 'Fossil Fuels and Environmental Geochemistry Postgraduate Institute' (FFEGI), more commonly known as NRG. Many of the coal and organic petrologists currently working in coal science and fossil fuels today hail from the Unit Duncan founded.

Character

Duncan was friendly, full of laughter, but serious when it

came to science. Above all, he will be remembered as a colourful fellow, always jovial, of great character. He was a keen photographer, philatelist, and an entrepreneur. With Mick Jones he established a successful geological consultancy at Newcastle, carrying out vitrinite reflectance measurements for oil and gas companies and drilling services.

Duncan won the Society's **Distinguished Service** Award (2007) in recognition of his Herculean task as Treasurer, overseeing a complete revision of the Society's accounting methods, bringing into accord with charity accounting rules. In the words of his citation: "All of this was achieved at the expense of long hours of travel from Newcastle including many letters to GNER about the state of their toilets - and was done with a characteristic sense of good humour that made the acceptance of unpalatable necessities that much easier".

Steve Larter, Fari Goodarzi and Judith Potter. You can read a longer version of this obituary online

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.

17 11 2011	1 1 1 2 7 16 16	\ <i>\ (\ ' \ / (\ ' \)</i>) \
	JIBAINI	M_{1}/L_{P}
	/ / \ \	

COURSE	DATE	VENUE AND DETAILS					
Surface and Borehole Geophysics for Ground Investigation	3 April	Venue: Fugro House, Wallingford, Oxfordshire. A free one-day technical course on the theory and practical application of surface geophysical survey techniques and wireline/borehole techniques including demonstration. Contact: Steve Poulter T: 01491 820423 E: s.poulter@fes.co.uk					
Cone Penetration Testing (CPT)	4, 11 April	Venue: Fugro House, Wallingford, Oxfordshire; De Vere Village Hotel Leeds North, Otley Road, Leeds. A free one-day technical course describing the principles of CPT in situ testing. Contact: Steve Poulter T: 01491 820423 E: s.poulter@fes.co.uk					
Borehole Design Construction and Operation	28 April - 02 May	Venue: School of Engineering and Geosciences, Newcastle University. 30% discount to Fellows. See website, or W: www.ncl.ac.uk/cegs.cpd/contact.php. Contact: ceg.cpd@ncl.ac.uk					
Lapworth's Logs	n/a	'Lapworth's Logs' is 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 APRIL 2014

MEETING	DATE	VENUE AND DETAILS	
Zeolites – just boiling Stones? Geologists' Assoc.	4 April	Venue: Burlington House. Time: 1730 for 1800. Contact Sarah Stafford E: sarah@geologistsassociation.org.uk	
From Mantle to Mineralisation: The Diary of a 60 Ma Magma Chamber. West Midlands Regional	8 April	Venue: Lapworth Museum of Geology. Speaker: Brian O'Driscoll, Keele University. Time: 1800 for 1830. Contact Daniel Welch E: geolsoc_wmrg@live.co.uk	
Social Event - Skittles. Southern Wales regional	9 April	Venue: Halfway, Cathedral Road, Cardiff. Time: 1730 for 1800. Contact E: swales.rg@geolsoc.org.uk	
Christchurch Earthquake - geotechnics of rehabilitation. Engineering Group	9 April	Venue: Burlington House. Speaker: Prof. Mike Davies. Time: Not available at time of writing. Contact: Mike Casey T: +44 (0)113 242 8498 E: Tom.Casey@arup.com	
GA Field Meeting: The Chalk of the Hertfordshire and Cambridgeshire Border. Geologists' Assoc.	12 April	Field Excursion. Leader: Haydon Bailey. Contact Sarah Stafford E: geol.assoc@btinternet.com. W: www.geologistsassociation.org.uk/lectures.html	
Geological Storage of Carbon Dioxide: meeting the global challenge. Geological Society; AAPG	14-15 April	Venue: Burlington House. See website for details. Contact: Naomi Newbould E: naomi.newbold@geolsoc.org.uk	
Symposium in Honour of David Roberts Royal Holloway, University of London	14-15 April	Venue: Department of Earth Sciences, Royal Holloway University of London. See website for details and links. Call for abstracts deadline extended.	
Railway Earthworks & Cutting Stability - Lessons from the Winter of 2012. Southern Wales Regional	15 April	Venue: Main Building, Cardiff University, Park Place, Cardiff. Speaker: Mike Gallop, Network Rail. Contact E: swales.rg@geolsoc.org.uk	
The Geology & Geotechnics of the Forth Crossing Solent Regional	15 April	Venue: University of Portsmouth; Lecturers: Stephen West & Jenny Symons, Ramboll. Time: 1800. Contact: Wendy Fergusson E: wendy.furgusson@ramboll.co.uk	
Fracking (title TBC). Geological Society	16 April	A London Lecture. Please see advert on p.6 Speaker: Richard Davies (University of Durham). Contact: Naomi Newbould E: naomi.newbold@geolsoc.org.uk	
Geological Factors in Major Landslides and Slope Stability. North West regional	18 April	Venue: The Swan, Golborne Road, Winwick, Warrington. Speaker: Steve Hencher. Time not available at time of writing. Contact: Nik Reynolds E: geologicalsociety.northwest@gmail.com	
AGM and Talk on Chalk Mines Home Counties North Regional	22 April	Venue: Sir Robert McAlpine, Eaton Court, Maylands Avenue, Hemel Hempstead HP2 7TR. Time: 1800 for 1830 (AGM) 1900 (Talk: 'Chalk mines and solution features in Hertfordshire and the problems they cause'). Speaker: Dr Clive Edmonds. Contact: homecountiesnorth@geolsoc.org.uk	
Rockwatch Fossil Collecting Field Trip	26 April	Venue: Shorncote Quarry, Gloucs. Time: 1030 - 1600. For Rockwatch members only. Contact: Geraldine Marshall E: rockwatchatga@btinternet.com	

OBITUARY DAVID THOMPSON 1932-2013

avid Barnard Thompson, known to many as 'DBT', was born and educated in Manchester before being among the very first intake of students at Keele University, which he left, in 1954, with a first class honours degree.

In 1967, David became a founder member of the Association of Teachers of Geology (ATG) - the organisation which has supported geology teaching and geology teachers ever since (becoming the Earth Science Teachers' Association (ESTA) in 1988). David not only founded ATG/ESTA; he 'was' ATG/ESTA for many years, as a Council member for 37 years, for a very long stint as Editor of the journal between 1979 and 1986, and as President from 1986 until 1988.

ESTA

In appreciation, David was granted Honorary Life Membership of ESTA in 1990. This underplays the critical role David had in guiding ESTA and in marshalling the troops for battle every time that Earth science education was under threat. He played high-profile roles in influential committees, in lobbying, and in examination assessment, maintaining and developing the role of Earth science education in this country for many years.

In 1972, after 15 years' teaching in Manchester, David was appointed lecturer in geology and science education at Keele Geoscience educator and founder member of the Association of Teachers of Geology

University, and promoted to Senior Lecturer in 1977. He taught his students how to educate children to think, how to engage them in learning and how to aspire to become 'the professional teacher' that David always was. Many new teachers learnt from him and prepared to pick up the baton at a later date.

David received several long-term visitors from abroad. One of them, Nir Orion, wrote: "I met ... many young Earth-science education researchers who came to Keele from all over the world like pilgrims, to learn from David about the essence of Earth-science education. We all came because David is one of the two founders of modern Earth-science education. David was the best person in the world to learn from about Earth-science education ... and about the essence of education in general. David was a born educator and was one of the few researchers whom I met during my career, who could teach and educate by being a role model and not by lecturing." Nir went on to transform school-level Earth science education in Israel.

Worth Prize

David was given an Honorary Award by the International Geoscience Education Organisation at its Conference in Hilo, Hawaii in 1997 for his contributions to geoscience education worldwide, while the profound influence that David has had on geoscience education in this country was recognised by the Geological Society in 2002 in awarding David the R H Worth Prize.

David was a truly inspirational figure in geoscience education, science education and geology. His work inspired generations of teachers both in this country and abroad but even more importantly, these teachers have gone on to inspire generations of young people to become involved in geology. They in turn learned a whole variety of skills crucial to them in later life and often developed a hobby for life as well.

> By Chris King

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.

ACROSS

- 1 Underground rumbles (10)
- 6 Graphically illustrate (4)
- 9 What a previously underground stream does (7)
- **10** Remnant portions of nappes after erosion has removed their connections (7)
- **12** Symbiotic but non-mutual relationship between organisms of different species (10)
- **13** Volcanic product (3)
- **15** Fly whose aquatic larva has tectonic tendencies (6)
- 16 River bends (8)
- 18 New-born (8)
- **20** Angle between a linear structure, such as a fold axis, and the horizontal (6)
- **23** Medical imaging scanner (1,1,1)
- 24 Communism, Fascism, Platonism, etc (10)
- **26** Erosional feature formed by stream, river, turbidity current, etc (7)
- 27 Remove guilt (7)
- 28 Time equivalent of upper (4)
- **29** They who hold that only the self certainly exists (10)

DOWN

- 1 *En echelon* faults that dip and downthrow in the same direction (4)
- 2 Volcanic mid-Atlantic freezer (7)
- **3** Mixed rock, part metamorphic, part igneous (13)
- 4 Phosphoprotein common in cheese, hence the name (6)
- 5 Showers of glass from the sky (8)
- 7 What minerals do for the original material, during fossilization (7)
- 8 Big gun author of Smith Map book (10)
- **11** They who study the system that protects organisms from infection (13)
- 14 Thrifty, literally with money figuratively, with truth (10)
- **17** Hugo's 'morne plaine' (8)
- 19 Electron acceptor in the west? (7)
- 21 Three stacks of Wight chalk (7)
- 22 Higher than a neutral 7 (6)
- 25 Thunderer (4)

WIN A SPECIAL **PUBLICATION!**

The winner of the February Crossword puzzle prize draw was Anthony Lewis-Bates of Plymouth, UK.

All correct solutions will be placed in the draw, and the winner's name printed in the June 2014 issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - 22 April.**

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 FEBRUARY

ACROSS:

- 1 Duck billed 6 Utah 9 Coulomb 10 Lambent
- 12 Appendages 13 Err 15 Retort 16 Reddened 18 Comedies 20 Andean 23 Ion 24 Blueprints
- 26 Pompeii 27 Orients 28 Dirt 29 Interstate

DOWN:

- 1 Dace 2 Crumpet 3 Biodegradable 4 Libido
- 5 Eclogues 7 Therein 8 Heterodyne
- 11 Misidentifies 14 Brachiopod 17 Delusion
- 19 Monomer 21 Estonia 22 Oppose 25 Isle

EARTHWORKS www.earthworks-jobs.com

More than 330,000 unique users per month point their browsers to www.earthworks-jobs.com to see the latest, worldwide, research, academic and professional jobs in the Geoscience, Environmental, Engineering, Water, Mining and Oil & Gas Sectors.

> Advertisers e-mail copy to copy@earthworks-jobs.com for publication within 2 hours of receipt,

> > call+44(0) 1223 900342

Earthworks-jobs.com

Geological Storage of Carbon Dioxide: meeting the global challenge

14-15 April 2014

The Geological Society, Burlington House, Piccadilly, London W1J OBG

Fossil fuels will continue to constitute a significant part of the energy mix, nationally and globally, for several decades at least. Urgent action is required to avoid dangerous climate change as a result of the CO2 released when they are burnt. Carbon capture and storage (CCS) has the potential to achieve this objective, if implemented at sufficient scale, by capturing the CO2 and trapping it safely underground.

This is the third in a series of international conferences on CCS held jointly by the Geological Society of London and AAPG Europe. It will examine the challenges of implementing CCS at large scale from a global perspective, bringing together academic, industry and government speakers from Europe, North America and Australia to share and discuss the latest research findings and field experience.

Key questions will include:

- What is the scale of the global challenge, and where is the CO2 storage capacity to meet this challenge?
- What development and storage potential is offered by novel geological settings and trapping mechanisms for geological storage of carbon, including migration assisted trapping in unconstrained formations?
- What are the principal constraints on large scale storage of CO2?
- How can migration and leakage be measured and monitored at commercial scale?
- How can the geoscience of CCS inform public engagement and confidence-building, and political decision-making?

The conference will take forward the outputs of the CCS session to be held at the AAPG Annual Convention (Houston, 6-9 April), and will report in turn to the EAGE CO2 Geological Storage Workshop (Stavanger, 22-24 April). It will conclude with a panel discussion on policy implications, at which the conference delegates will be joined by an invited audience of those from government, industry, regulators, NGOs and others involved in planning and policy-making.

Confirmed speakers include:

Rick Chalaturnyk (University of Alberta), Florian Doster (Herriot-Watt University), Ian Duncan (Gulf Coast Carbon Center), Andrew Garnett (University of Queensland), Sarah Gasda (University of Bergen), Stuart Gilfillan (University of Edinburgh), Marc Hesse (University of Texas), Charles Jenkins (CO2CRC), Mike Kendall (University of Bristol), Sam Krevor (Imperial College London), Bryan Lovell (University of Cambridge), Jerome Neufeld (University of Cambridge), Chris MacMinn (University of Oxford) and Jim Underschultz (University of Queensland).

Communicating Contested Geoscience new strategies for public engagement

A 1-day conference on how to communicate key geoscience challenges to the public

20 June 2014

The Geological Society, Burlington House, Piccadilly, London W1J OBG

Geological issues are increasingly intruding on the everyday lives of people across the UK. Whether it be onshore exploration and extraction of oil and gas, subsurface injection of waters for geothermal power or deep storage of carbon and radioactive waste, many communities across the country are being confronted with controversial geo-engineering interventions under their backyard. Alongside the complex scientific and technical challenges this brings is the problem that, to most people, the geological subsurface is an unknown realm. That combination presents particular difficulties for professional geoscientists communicating what they do and what they know to the lay public. Developing public participation strategies that effectively engage with citizens, communities, and stakeholder groups, require geoscientists to better appreciate what the public hows and what they have concerns about.

This conference will be a forum to bring geoscientists from universities, industry and government together with specialists in communication and public engagement to explore the challenges of communicating contested geological issues to the wider public.

The one-day meeting will focus on three current and pressing societal concerns in the UK: (1) radioactive waste disposal; (2) shale gas and fracking; and (3) carbon capture and storage.

These themes will be explored through a mix of keynote talks and expert panel discussions, alongside active Q & A from an audience of geoscience and communication practitioners.

Registration Fees Non-Fellow £60 Retired £25 Student £10

Fellow £40

lain Stewart (Plymouth) - <u>istewart@plymouth.ac.u;</u> Zoe Shipton (Strathclyde) -<u>zoe.shipton@strath.ac.uk;</u> Clare Bond (Aberdeen) - clare.bond@abdn.ac.uk; Nick Smith (Manchester) - nick.t.smith@nnl.co.uk

For more information, please contact:

Georgina Worrall, The Geological Society, Burlington House, Piccadilly, London W1J 0BG T: 0207 434 9944 E: georgina.worrall@geolsoc.org.uk W: www.geolsoc.org.uk/Communicating-Contested-Geoscience

Timings: These lectures will be given at Joyn and Joyn on these days (with tea (offse served for half an hour tofort each), so please let us know, when respecting a place, which talk you would like to attrind. "From: The Configeral Society of Lenden, Barding the Intertors on the lowers to for a like the served on the Markow Barding and the served for half and hour tofort each). The form of the lower is not in the lower is maked on a talk hour to forth one of the at 1 years and well at the data to serve the building on these for an at lower and a respect to the lower region in some of the at 1 years and the lower to be place, in a result are taked. For holes in diversing the control of the Control of the serve of the building on these takes.

Geologists' Association Lectures 2014

3 January	Virtual fieldwork using Google Earth: exploring global tectonies from your armchair	Jes Withinson
7 February	Japan: volcanie soils and agriculture from prehistory to present	Gine Barnes
March	Foremie Geology: The Applications of Geology to Policing and Law Enforcement	Lawrance Donnelly
4 April	Zeulines - Just holling stones?	Hadimir Zholobersh
y May	AGM and Presidential Address A walk on the Chalk Side Part 2: Flint, basins and the end of the Chalk in the British area	Roy Mortimure
6 Jane	Big, had and hizarre, the devil frog from the Late Cretaceous of Madagascar	Susan Deans
s July	Late Mesonoic Insects in Search of the Fossil Silk Read	Dr Ed Jarsenhousk
3 October	The Incredible Story of the Stone Pipe Company slog-sllsg, Landon, Manchester and Dahlin	High Torrers
December	The rise, fall and resurgence of UK domestic mineral supply	Andrew Biophorth

Fermor Meeting 2014: Comparative Planetology

Geological Society erving science & profession

Further information:

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

T: 0207 434 9944 E: naomi.newbold@geolsoc.org.uk W: www.geolsoc.org.uk/fermor14

Follow this event on Twitter #fermor14

19-20 May 2014

The Geological Society, Burlington House

A great deal of new data on the terrestrial planets and moons has been produced recently from numerous planetary orbiters, together with rovers. This meeting is planned to bring together scientists who are studying aspects of planetary science on terrestrial planets in the inner solar system. Presentations will fall under three broad themes: Planetary crusts and interiors, planetary surfaces and surface processes (including volcanism, tectonic activity, sedimentation, and impact cratering), and planetary climates and atmospheres. Links between the three themes will be investigated, to develop ideas of exchange between the interior, exterior and atmosphere of planetary-scale bodies.

Volcanism

Cratering

Rovers

Topics for discussion:

- Internal structures
- Sedimentation
- Samples

Conveners:

Professor Hilary Downes FGS Professor Ian Crawford FRAS Dr Peter Grindrod FGS, FRAS

Registration fees:

GSL and RAS Fellows £100 Non-Fellows £150 Retired £55 Students £50

- Tectonics
- Analogues
- Remote sensing

Speakers include:

Dr Ellen Stofan (NASA Chief Scientist) Venus-Earth-Mars-Titan: Comparing Surfaces, Comparing Climates

Dr David Catling (University of Washington, Seattle USA) Atmospheric evolution on Rocky Planets

Dr Mary Bourke (Trinity College Dublin, Ireland) Blows and flows on Martian dunes

Professor Sanjeev Gupta (Imperial, London, UK) Recent explorations of the Curiosity rover

Dr Nick Tosca (St Andrews, UK) *Alien surfaces: interpreting the mineralogical record of early Earth and Mars*

Dr David W Mittlefehldt (JSC Houston) Dawn at Vesta

SOCIETY OF

Puddingstone and related silcretes of the Anglo-Paris Basin geological and archaeological perspectives

For further information please contact:

Georgina Worrall, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

T: 020 434 9944 E: georgina.worrall@geolsoc.org.uk

W: www.geolsoc.org.uk/puddingstone14

16-19 May 2014

Burlington House, London, UK

A joint meeting of the Geological Society, the Geologists Association and the Society of Antiguaries

Hertfordshire Puddingstone and its regional counterparts have long been of interest to both geologists and archaeologists, while recent developments in the understanding of modern silcrete and recent petrographic and stable isotope studies of the puddingstone silica cements are providing new insights into the origin of puddingstone. Even though Hertfordshire Puddingstone is a remarkably tough rock, it has been found in place in only a few locations. In contrast, puddingstone that has been moved and used by humankind is much more common. In particular, Roman puddingstone querns are found over a wide area and are of particular interest to archaeologists. In the last six years there has been growing cooperation between geologists and archaeologists on puddingstones studies, to investigate both the Hertfordshire Roman puddingstone quarry and to look further afield. In 2011 a second Roman puddingstone quarry was found in Northern France, in an area of the Paris Basin that includes fossiliferous Paleogene puddingstone. The meeting will cover puddingstones and silcretes of similar age in both the Hampshire and Paris Basins, and the weekend field trip will include East Hertfordshire/ Essex, then Saint-Saëns and Sotteville in Northern France. It is anticipated that both the meeting and the post-conference field trips will lead to further co-operative research between archaeologists and geologists.

Conveners:

Jenny Huggett (Petroclays, **Chris Green** (Society of Antiquaries) **Rory Mortimore** (Geologists Association)

Speakers include:

Bryan Lovell, David Nash, Mike Parker Pearson, Jane Tubb, Chris Green, Jenny Huggett, Tony Brown