

Geoscientist

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APPING THE ANTE

Douglas Palmer on the
future of geological
illustration

L'AQUILA VERDICT

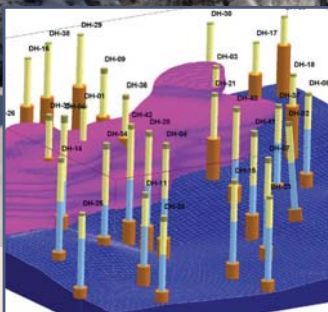
Seismologists
appeal jail sentence

DIGGING FOR VICTORY

Edgeworth David's deadly tunnels

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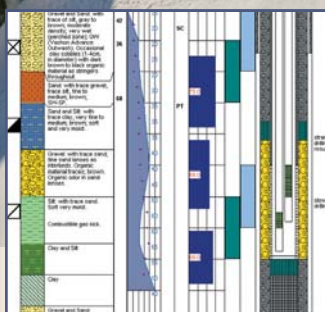


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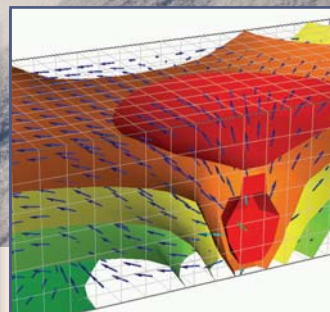


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Geology and Me

Hugh Dennis

"Comedian and geology enthusiast"

Tuesday 12 March 2013
Central Hall, Westminster, London

PESGB is pleased to announce that the speaker for the next Stoneley Lecture on 12th March 2013 will be well known comedian, actor and presenter Hugh Dennis.

While best known for *Mock the Week*, *The Now Show* and *Outnumbered*, Hugh is passionate about the outdoors and recently presented a BBC TV series entitled *The Great British Countryside* which examined the relationship of geology to the landscape and the industrial past. He says he is never happier than when at the top of a hill in the rain, looking at the landscape stretching away to the horizon.

Please put this date in your diary, and as the Stoneley Lecture is very much a public event, please invite your friends, family and work colleagues to attend.

PROSPECT FAIR 2012, 12-13 DECEMBER 2012, BUSINESS DESIGN CENTRE, LONDON. For more information, visit www.pesgb.org.uk

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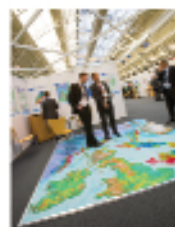
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“MOUNT EREBUS,
ANTARCTICA'S ACTIVE VOLCANO,
FIRST CLIMBED IN 1907 BY
GEOLOGIST TANNATT WILLIAM
EDGEWORTH DAVID
Front cover: © Getty Images”

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L'AQUILA VERDICT

never thought I would ever see people being
locked up for poor science communication –
hardly, surely, a life-or-death matter, such as
may face a doctor or policeman any working
day. Well, sometimes, it is. And, as a result of
some spectacularly poor science
communication, so the indictment read, 309
people died - victims of collapsing buildings during
the l'Aquila earthquake of 7 April 2009.

The guilty verdicts against six scientists and one
civil defence official, which brought sentences of six
years' imprisonment for manslaughter, have
stimulated widespread – and mostly knee-jerk –
condemnation. The shroud of Galileo has rarely
seen quite so much action, as it has been waved
furiously by outraged pro-science groups
worldwide. Yet the trial was never a witch-hunt
against science, as many have sought to portray it.

Of course, the sentences are absurd and
disproportionate. Of course the fact that the Italian
system chose to deal with this matter through
criminal proceedings was inappropriate and
primitive. Clearly – deservedly - Italy is now a
public laughingstock. With luck, the sentences will
be overturned on appeal. But the trial was never
about the failure of senior seismologists to do the
impossible and predict the unpredictable - even
though the Italian people have been duped into
believing it. This trial was about a failure to give
adequate warnings based on what the authorities,
and their advisory group, knew.

In disaster movies, false reassurance and playing
down imminent danger is the role traditionally
reserved for officials and small businessmen, fearful
for their wallets or public order; while scientists
urge precautionary action. But l'Aquila 2009 was no
movie, and life is both stranger and nastier than
fiction. In a cruel twist, the survivors blamed
scientists for failures rooted in Italy's civil protection
agency, which claimed scientific support for its
dangerously complacent pronouncements.

Scientists were in the dock in this trial; but the
issue from the start was not science. It was,
explicitly, poor risk communication. And make no
mistake – here there was a real case to answer. In
the lead-up to April 7, the risk communication was
lamentable, incompetent, disgraceful. But this was
not the scientists' fault. It was the fault of the
system, which has now decided to scapegoat them
for its failures.

The sentences handed down express the degree to
which the Italian public feel betrayed by those very
people they thought they could most trust. That
trust was not, in fact, misdirected. Unfortunately,
their vengeance is.

DR TED NIELD EDITOR



SOCIETY NEWS

ELECTION – FELLOWS

The following are put forward for election to Fellowship at the OGM on 6 February 2013:

AFOLABI Olamide; **AGUIRRE** Eduardo; **AKENZUA** Aiyevbekpen Helen; **ALI** Yaser; **ALLAN** Iain Stewart; **ANDERSON** Caroline Rose; **AYENI** Omotayo; **BAUDRAIN** Franck; **BAULCH** Matthew Alan; **BAXTER** Helen Abigail; **BELCHER** Robyn; **BERRE** Jan-Erik; **BLACKWELL** Nia Lyn; **BRANCH** Thomas Cameron; **BRAUN** Doron; **BREEN** Hannah Sarah; **BUNZLI** Marc Andre; **CAIRNS** Ryan; **CHAUHAN** Devraj Singh; **CLARKE** Aaron Thomas; **CLAYTON** Jennifer; **COLLINS** Alice Kathryn; **COX** David James; **DALEY** Stuart Alexander; **DART** Michelle Rosanne; **DOMZALSKI** Rudy; **EDGAR** Trent Douglas; **EILBECK** Katherine Emma; **FAIRWEATHER** Tom; **FAULKNER** Simon Timothy William; **GARSDIE** Adrienne Leigh; **GOODE** Fiona; **GORETTI GONZAGA** Ruth; **HABERER** Raingard Maria; **HALSALL** Nigel; **HELM** Douglas George; **HEN-JONES** Rosalind; **HYDE** Samara Ann; **IBRAHIM** Diar Mohammed; **JONES** Amy Ffion; **KING** Alexander; **LANE** Melanie; **LAU** Wai Yan; **LAW** Shing Cheong Francis; **LIA** Thomas James; **LOTA** Jasmeet Kaur; **MACDONALD** Robert Angus; **MAHMOUD** Mohamed Diaeldin Abdelfattah; **MANAMSA** Kat; **MARRINAN** Brendan; **MARSH** Rebekah Karen Patricia; **MCGILL** Sean; **MCLEAN** Craig Alastair; **MCMULLEN** Steven Lee; **MOLNAR** David Lee; **MUIR** David John; **OLLERTON** Harry George; **OWEN** Joshua; **PAICE** Andrew Philip; **PATEL** Ajay Kumar; **PATON** Anthony; **PATTEN** Victoria Imogen; **PHILLIPS** Max; **PINAULT** Lewis James; **POWELL** Chris; **READ** Natalie Anne; **REVELL** Thomas; **RIDOUT** David Matthew; **ROWLEY** Eleanor Jane; **RUSS** Martin Stuart; **SAYERS** Ben Andrew; **SCHMITZ** Robrecht; **SCHULTZ** Gehrig Stannard; **SCOTT** Ann Marie Evelyn; **SHEACH** Ewan; **SHERWIN** Catherine; **SHORE** Jack; **SMITH** Alexander; **SMITH** Victoria Sarah; **SO** Wing Fat; **SORDY** Christopher Michael; **SPENCE** Richard; **STEEL** Ian Thomas; **STEPHENSON** Hannah Grace; **TAME** Catherine; **TARN-DYSON** Graham James; **TEE** Thian San; **TEH** Michael Jin Choong; **TOWLE** Adam; **TRISTRAM** Dominic; **VIEILLEDENT** Louis Georges Marcel; **WHITE** Abigail; **WOJCIK** Michael Joseph; **WORTHINGTON** Magnus Francis; **YEOMANS** David Ian; **YIU** Hei Man; **YOO** Byeongwook.

The following candidate fellows wish to upgrade and be elected to fellowship:

BLAMEY Christopher Jan; **DAVIDSON** Ann Elizabeth; **FAULKNER** Duncan James; **FISHER** Hollie Elizabeth; **HAWKINS** Louise Margaret; **JONES** Ceri Louise; **JOY** Lucy Claire; **PHILLIPS** Stacey; **PICCOLI** Santino Nyal; **RICHARDSON** Carson Adam; **RODDA** Andrew James; **SMITH** Oliver William; **TATKO** Alexander Elliot; **THOMPSON** Max; **THOMPSON** Matthew; **WARREN** Tracey; **WHITE** Lee Francis

Lyell goes mobile!

The Geological Society has launched new specially-designed mobile sites for four of its Lyell Collection journals, writes *Marketing Coordinator Emily Milroy*.

The sites enable researchers and students to access information in the field, and will also benefit students wishing to use the *Journal of the Geological Society*, *Quarterly Journal of Engineering Geology and Hydrogeology*, *Petroleum Geoscience* and *Geochemistry: Exploration, Environment, Analysis*, off-campus.

Content and layout have been created specifically for small-screen viewing. Mobile sites can be accessed using the usual URLs:

- <http://jgs.lyellcollection.org>
- <http://qjehg.lyellcollection.org>
- <http://pg.lyellcollection.org>
- <http://geea.lyellcollection.org>

Institutional subscription users (without a personal username and password) will have to obtain a mobile voucher, tied to their institution's subscription. To obtain one, access the Lyell Collection from your institution's network and click on the link. The voucher will be emailed to you, with instructions on how to redeem it. Vouchers remain valid for six months.

► For more information, visit the Online version of this story



Research Funds open for bids

The 2013 round of Society Research Funds is now open for applications. Applications for support from any of the Society funds must be made on the form which can be downloaded from the Society Awards and Research Grants page on the website www.geolsoc.org.uk/grants.

The form must be completed in full and accompanied by two letters of support from Fellows of the Society. Please send to the Awards Secretary at the Geological Society. In order to be considered at the next available committee meeting, applications and supporting documents should reach the Society no later than 1 February 2013. The average award has been about £1000.

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

FUTURE MEETINGS

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

- 2013: 6 February (1500)
- 2013: 10 April

CHRISTMAS AND NEW YEAR CLOSURE

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



Council nominations – reminder

Fellows received with the October issue of *Geoscientist* two nomination forms – one for the election of new Council members and the other for the President-designate 2013/2014.

Details of the process were on the forms and are also in the Governance section of the website.

The closing date for the receipt of nominations is **4 January 2013** and nominations will NOT be valid unless they are fully completed, signed and accompanied by a statement by the nominees. Please return to Professor Alan Lord, c/o Executive Secretary, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

Affiliates Scheme relaunched

The Corporate Affiliate Scheme was launched many years ago to link the Society with our industry supporters, says Colin Summerhayes.

As business needs change, our CA Scheme must evolve. So, in October the Society re-launched it, introducing a credit system allowing our supporters to choose how they use an allocation of 250 credits each year on information services or room hire. This will be in addition to the many existing benefits that Corporate Affiliates currently enjoy, including discounted conference attendance, copies of *Geoscientist* and significant recognition both on our website and at Burlington House.

The Society will monitor how allocations are used and will send each Corporate Affiliate a quarterly statement, together with a newsletter reporting on significant developments at the Society, and future events.

We hope that this new arrangements will better meet our Corporate Affiliates' business needs, whether by helping them to find Earth science-related material by using our information services, searching for maps, or by using Burlington House for meetings or corporate events.

► Please contact **Joanna Mears** to discuss any aspects of the Corporate Affiliate Scheme, E: joanna.mears@geolsoc.org.uk



Images: By Matt From London via Flickr.com

[LECTURES]

Shell London Lecture Series



Incoming! - Learning to love the meteorite

Speaker – Dr Ted Nield

19th December

Meteorites have been the stuff of legend throughout history, and since 1980 the idea that dinosaurs were wiped out by one 65 million years ago has become one of the most widely known scientific ideas of all. However, the causes of the end Cretaceous mass extinction were complex, and the idea that major meteorite strikes are always bound to be bad news for life on Earth is being challenged by fresh discoveries.

New research is suggesting that 470 million years ago, a stupendous collision in the Asteroid Belt (whose debris is still falling) bombarded the Earth with meteorites of all sizes. A revolutionary idea is emerging that the resulting ecological disturbance may have been responsible for the single greatest increase in biological diversity since the origin of complex life – the hitherto unexplained Great Ordovician Biodiversity Event.

Ted Nield is the author of *Incoming!* (Granta Books) and Editor, *Geoscientist*.

■ **Programme** – Afternoon talk: 1430 Tea & Coffee: 1500 Lecture begins: 1600 Event ends.

■ **Programme** – Evening talk: 1730 Tea & Coffee: 1800 Lecture begins: 1900 Reception.

FURTHER INFORMATION

Please visit www.geolsoc.org.uk/shelllondonlectures12. 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



In association with
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SOCIETYNEWS...

The 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. Once a year there is also a special dinner at Burlington House. New diners are always welcome, especially from among younger Fellows.

Dinner costs £52 for a four-course meal, including coffee and port. (The Founders' Dinner, in November, has its own price structure.) There is

a cash bar for the purchase of aperitifs and wine.

■ **2013:** 16 January; 20 February; 13 March; 10 April (Burlington House); 15 May.

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

Library e-newsletter launched

The Library has launched a new bi-monthly e-newsletter to keep you up to date with news and views from the Library. From important recent library additions to fundraising activities, electronic journal updates and interesting events, the newsletter will be your first port of call for everything to do with the UK's premier Earth science library. To subscribe please email **library@geol.soc.org.uk**



Library and Information Services



Neal Marriott writes: The Geological Society is pleased to welcome a new member of staff, Fabienne Michaud. Fabienne takes on the role of Library and Information Services Manager and will be working with library staff to maintain existing services and develop new ones.

This important appointment marks the next phase in the development of the Society's information services, following the library review process commissioned and approved by Council.



FROM THE LIBRARY

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

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

NEW CHARGES

In accordance with the Copyright Licensing Agency the copyright fee on photocopies for commercial/corporate use has increased to £12.50 per copy.

There has also been a slight increase in charges for Inter-Library Loans of books and photocopies. See www.geolsoc.org.uk/library_charges for more information.

VIRTUAL 'HELP YOURSELF BOX'

The Library has a selection of journal issues which are not required due to duplication, defect or damage. A list of these can be found on our website in the section on Library Collections - Serials, under the heading 'Surplus Journals'

Here you will find information on how to request them. They are available to both individuals and libraries. Please note that there may be a charge depending on the type of material and the weight, if posted.

DOCUMENT DELIVERY

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

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WIFI ACCESS

WiFi (wireless fidelity) access to the Internet is now available to all readers. If you are visiting the Library and have a WiFi-enabled laptop you can ask the staff for a password to give you free Internet access.

PICK OF THE CROP

To see what other books, maps & serials the Library has acquired, why not register to receive a copy of *Recent additions to the Geological Society Library*, either by post or email? Contact Wendy Cawthorne on wendy.cawthorne@geolsoc.org.uk

Dragon's Den

BY CHRISTINE BUTENUTH AND MIKE DEFREITAS

Christine Butenuth and Mike DeFreitas*

wonder if a 'Self-Employed Geoscientists' Group' is needed to help budding entrepreneurs



Geoscientists who have been made redundant, or arm-twisted into 'voluntary retirement', as well as those still awaiting a first job, know that unemployment can make you feel invisible and unwanted. And the awful truth is, you may well be right.

Being 'wanted' part-time can be problem, if it doesn't pay enough. Part timers may not wish to relinquish what they have, but find their choice of something different is then restricted. A retiree may not be on a final salary pension, and may wish to earn more. So where are these geoscientists, with their experience and undimmed vigour? Being invisible makes them incredibly difficult to reach and help.

EMPLOYMENT AGENCIES

Many head first to the Employment Agencies; but the experience can be mixed and dispiriting. It is easy to forget how much you know and love your subject, and that this could be generating income. But how?

Turning expertise and ideas into a service or product means solving four basic problems. First, identify what you know and like, that others will be interested in buying. Second, narrow this down to a product and service that is yours, and yours alone. Third, identify the market and fourth, get to that market.

Solutions to these problems are not simple, but everyone who starts a business benefits from training. Training means avoiding all the wasted effort and resources that we call 'learning the hard way'.

All manner of 'career coaches' ply their trade online, but scientists and engineers need a different kind of guidance, sorting out ideas for a business that will truly be 'theirs'. This usually requires a private and personal

journey, during which you consider your talents, experience and aspirations. It is often tough and may be disheartening, but tried and tested pointers are there to help you. You are not always the best judge of yourself. You need an outsider who can see you as others do – especially your potential clients.

SPECIALIST GROUP?

Those involved with Fellowship and Chartership know that the Society is sensitive to the needs of individual Fellows; there is a will to support them, for they are the Society; and suggestions as to how it can best serve its members come best from the grassroots.

Is there a need, then, for a 'Self-Employed Geoscientist Group'? This would provide a forum for individuals, who have been successful as single person Limited Companies and sole traders, to pass on their experience to beginners. It would also provide networking and collaboration, and a forum for all those whose employment is not as full as they would wish. It could become a seedbed for spin-outs from other Specialist Groups, and a focus for entrepreneurs looking for "get-up-and-go" geoscientists.

If you think this idea has potential, please let us know at office@firststeps-geo.co.uk marking your email 'Specialist Group'. With sufficient support, a proposal for forming such a Group can be developed.

* Dr Christine Butenuth (originator of www.settingupyourownbusiness.co) and Dr Michael de Freitas, First Steps Ltd

SOAPBOX CALLING!

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

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

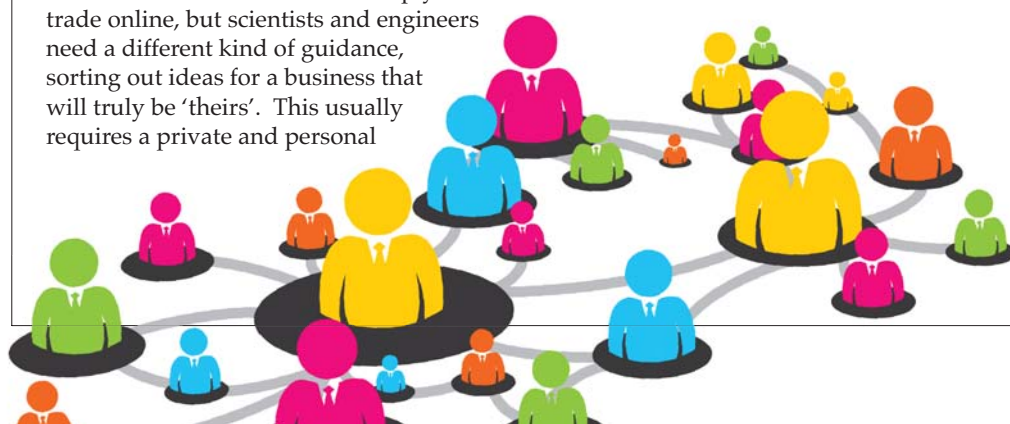
Email your piece, and a self-portrait, to ted.nield@geolsoc.org.uk. Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

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

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

“ THIS WOULD PROVIDE A FORUM FOR INDIVIDUALS, WHO HAVE BEEN SUCCESSFUL AS SINGLE PERSON LIMITED COMPANIES AND SOLE TRADERS, TO PASS ON THEIR EXPERIENCE TO BEGINNERS ”

Christine Butenuth and Mike DeFreitas



These days, illustration is *de rigueur* for the communication of Earth science but it has not always been so, and even today the tools for the job are evolving rapidly. One particular device may help revolutionise the way we communicate our science and have a particular impact on teaching and learning – the handheld iPad or android tablet.

EARLY WRITINGS

From early writings in the 16th Century on what we now call geology or more fashionably, 'Earth science', 'fossils' were the most common subject of illustration because of their puzzling form and nature. At that time 'fossil' meant 'something dug up' and therefore included both minerals and the fossil remains of past organic life. Their depiction for publication in books and early 'scientific' journals required no more technique than was applied to living organisms or aspects of human biology.

There was no shortage of highly competent artists and illustrators who could produce faithful representations of crystals, minerals and fossils. Nevertheless, it was some time before the illustrative potential of subjects within the wider span of geology was realised. Gradually throughout the 18th Century, geological structures (from stratification to folds and volcanic phenomena) were illustrated along with visual interpretations of landscape and topography and the distribution of rocks in time and space, depicted in maps and sections. The accuracy of illustration was probably enhanced by the use of the camera obscura. Its further development and the invention in 1807 of the camera

lucida by William Hyde Wollaston (1766-1828, FGS 1812), led to an even more accurate representation of many geologically related materials, which were and still are best interpreted and represented by drawings.

As Martin Rudwick has spelt out in several publications since the early 1970s, it was not really until modern geology took off in the early decades of the 19th Century that illustration was widely used in field notes and correspondence, lecture hall and publications. And perhaps it is no accident that many of the early members of the Geological Society of London, such as Henry De la Beche and William Conybeare, not only had a good eye for illustration but were also personally adept at sketching both geological phenomena - and caricatures of their colleagues.

The main constraint on illustration for publication was the relatively high cost of reproducing high quality images, especially if they required hand colouring in the decades before the widespread use of colour printing in the late 19th Century, especially for complex images such as geological maps. Technically, there was of course a whole succession of new illustration and printing techniques, evolving from engraving on wood and copper to aquatint, mezzotint and steel engraving, which advanced both the quality and quantity of images that could be printed from a single plate.

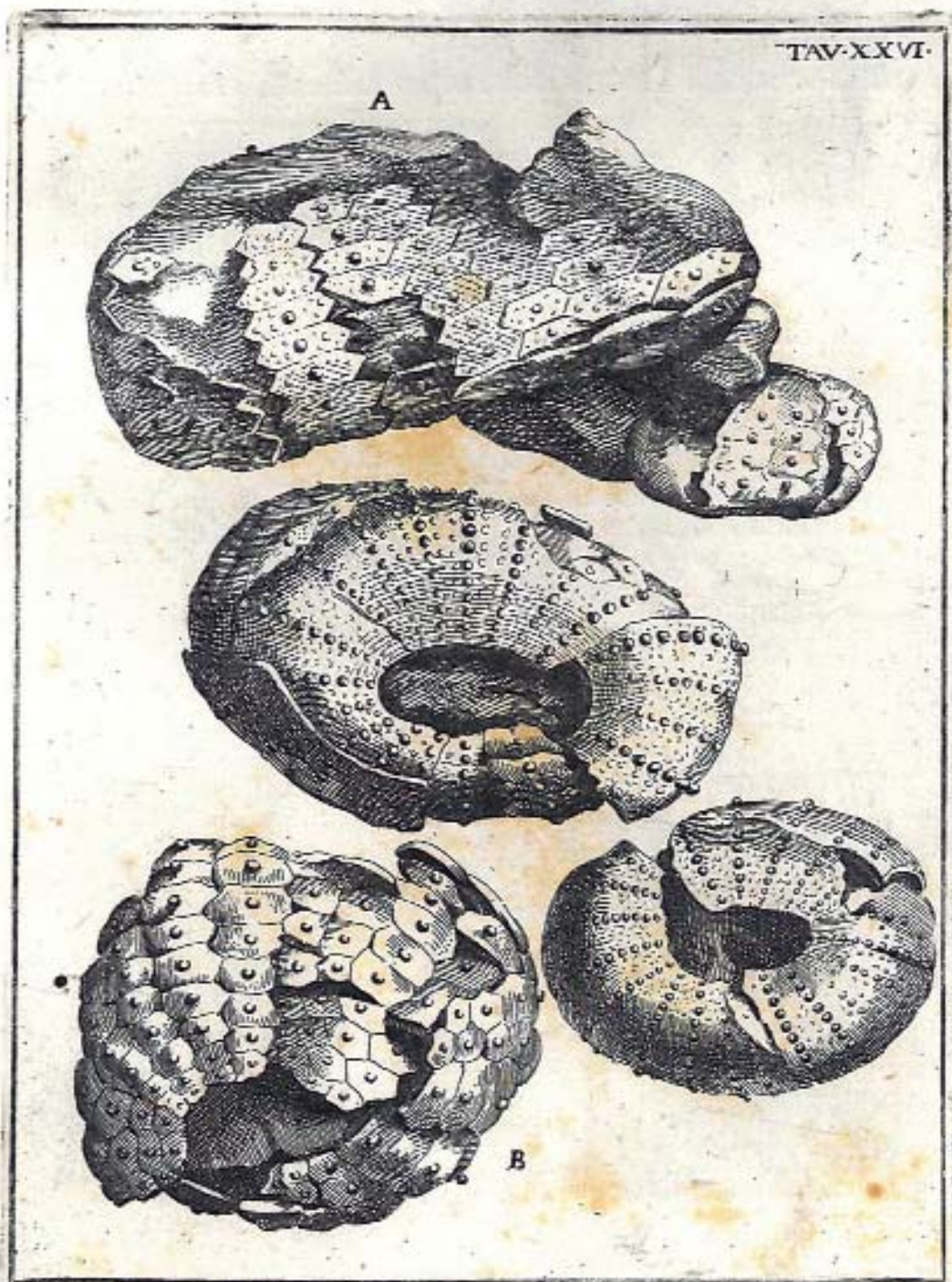
NEW CHALLENGES

Even with the advent of photography in the 1820s, it took decades before the results were good enough for illustrating relatively small objects, such as fossils or thin sections of rocks; but inevitably, it did happen. Now, we have such high ►

APPING THE ANTE

Author **Douglas Palmer *** draws on his experience of converting a book into the iPad app '*NHM Evolution*' to consider what the future holds for geological illustration

Copper engraving
of 'Echini varie
compressi, & fracti'
illustrated on Plate
26 of Augustino
Scilla's book on
fossils originally
published in 1670
but the text and
plates were still
being reproduced
well into the 18th
Century, as with
this copy printed in
Rome in 1752



► expectations of the kind of resolution achievable by photography that the limiting factor is more that of the mass printing process than the definition of the original image. The modern era with its new techniques of electron microscopy opened a whole new micro-world of wonderful images from both inorganic and organic sources, ranging from atoms to chromosomes and a host of fossil microstructures and organisms.

Further advances in imaging techniques using a variety of physical phenomena and energy sources such as gravity, heatflow, vibration, electricity, electromagnetic waves, magnetism, radioactivity etc., have revealed detailed images of a multiplicity of novel geological phenomena. Digitisation of the images, their electronic transformation and transmission has again helped revolutionise communication of a wealth of geologically derived visual material.

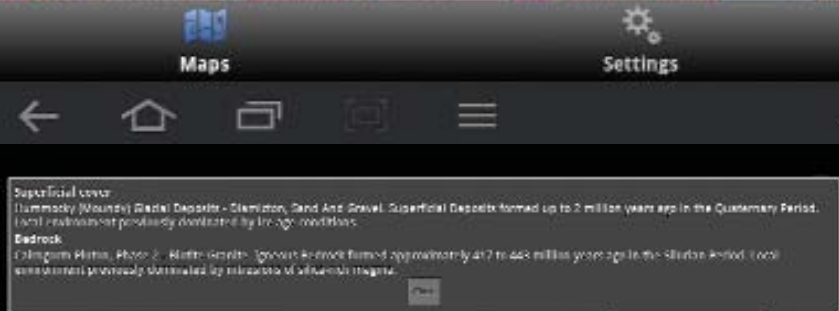
We can now view geological phenomena, ranging from the spectacular false-colour images, such as those of the Chicxulub impact crater, revealed by gravity survey, and satellite radar images of large terrains with a variety of geological features to an ever-increasing number of remarkable and highly informative computer-generated digital images and models of fossil organisms based on various sources such as CT (computerised tomography) scans.

Never before has there been such a wealth of visual material for the communication of geology, especially in the lecture hall. But until very recently the means of transmitting these images for wider publication has been limited largely by the confines of the printed page and cost of their reproduction. Although many of the modern digital images depict three-dimensional structures in new ways that give a much better sense of shape and form than traditional photography and illustration has achieved, they are still constrained by the two-dimensional nature of the reproducing medium.

Furthermore, the business of making the new array of imagery available for educational purposes has become increasingly difficult because of the cost of permissions for reproduction in popular or semi-popular publications. We are almost back to the situation of centuries ago when geologists, such as Gideon Mantell, were faced with the almost crippling cost of reproducing illustrations essential for the informed communication of their work - be they maps, sections or fossils.

Computers and search engines such as Wikipedia and Wikimedia commons

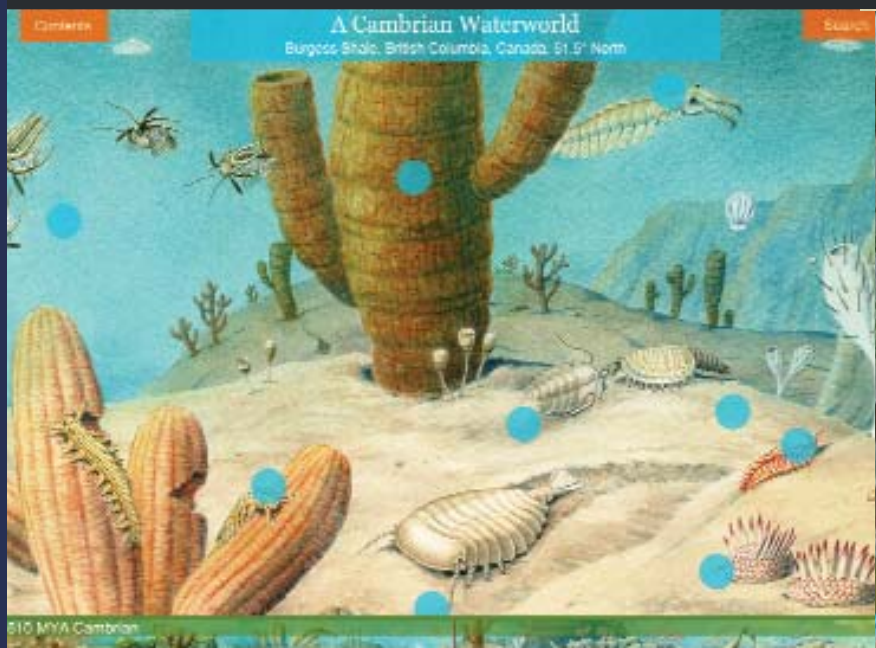
Screen grab from the BGS geology map of the Sgoran Dubh Mor and Gleann Eanaich region, south of Aviemore and Cowlumbidge in the Cairngorms

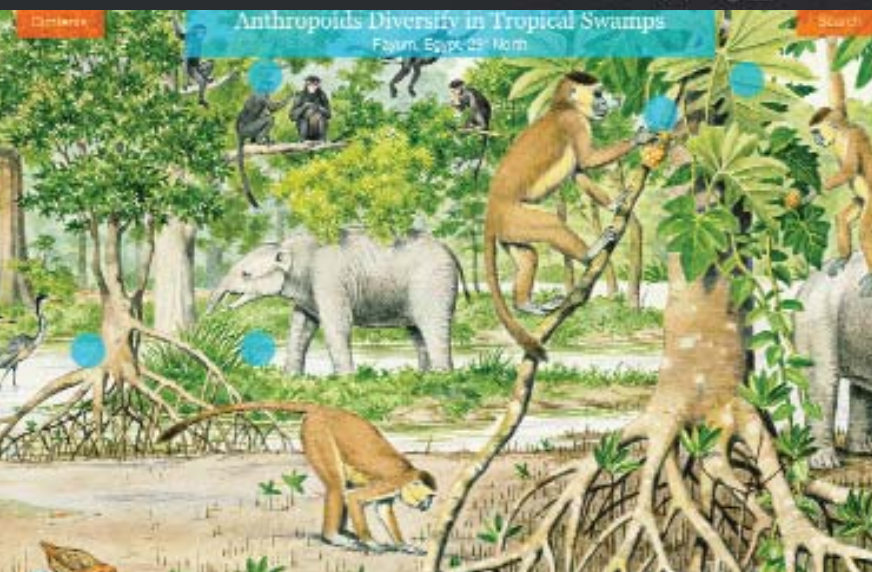
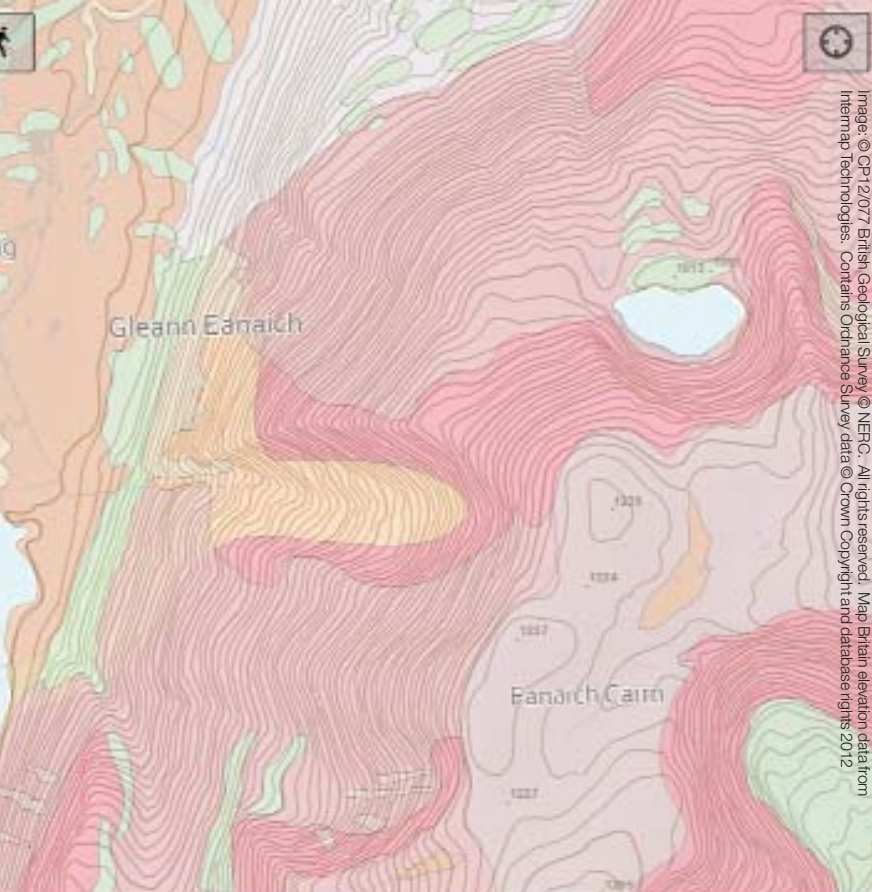


The same region viewed on the BGS iGeology3D app for androids



Screen grab from the NHM Evolution app Timeband, showing a reconstruction of the Burgess Shale. Using the iPad, a tap on the blue dots gives information about the species





Fayum, Egypt, 34 million years ago. The lowermost strip shows a *segue* of adjacent site reconstructions with a cursor, which can be used for rapid navigation through all 100 reconstructions

Guimarota, Portugal, 152 million years ago. Tapping the blue name band at the top reveals information about the site and provides a further link to the Timeglobe and the site's original location

(images) have made many of the new images widely available to view but often without clear indications of copyright ownership, so that any author has to be very careful about reproducing any such images. The owners of many of the images, who have put much time and effort into their generation have been understandably dismayed to find their work effectively 'pirated'.

APPS ADVENT

The new 'kids on the block', which could, I think, revolutionise the communication and understanding of our wealth of geological imagery, are the hand-held, multitouch tablet computers, such as the new generation of mobile phones and iPad/tablets.

Many geologists will no doubt already be familiar with the incredibly useful and free iGeology and mySoil apps (available for the iPhone, iPod touch, iPad and Android phone) produced by BGS, which access the detailed subsurface and surface geology of the British Isles. There is also the even more novel iGeology 3D (launched mid-July 2012), which 'paints' a geological map over any landscape that you can see around you through your phone's camera. It uses the phone's GPS for location, the compass for direction and other clever features such as an accelerometer to produce these remarkable augmented views.

The BGS development team are looking at ways to generate cutaway vertical sections for viewing of the subsurface geology. So far this is only available for Android phones and tablets but according to a BGS spokesman it should be available for iPhones etc in a year's time. BGS are also developing other 'add-ons' for iGeology, such as 'push notifications', whereby users can be alerted to geological events such as earthquakes and, if they experienced it, provide feedback on that experience, which would then be stored on a data bank for research purposes.

On a more international scale there are other very well produced and useful apps, such as Columbia University's Earth Observer (for iPhone, iPod touch and iPad), which allows detailed scanning of the whole of Earth's topography, both above and below sea level, along with a wealth of geological information and imagery, such as plate boundaries and the velocity of their motion, gravity and magnetic anomalies. However, the generation of applications (apps) for such devices requires a whole set of new skills both technical and design and has serious cost implications (ie. it is very expensive!).

“WE OUGHT TO TALK LESS AND DRAW MORE. I PERSONALLY SHOULD LIKE TO RENOUNCE SPEECH ALTOGETHER AND, LIKE ORGANIC NATURE, COMMUNICATE EVERYTHING I HAVE TO SAY IN SKETCHES”

J W Goethe (Italian Journey, 1786-1788)

► NHM EVOLUTION

I have just spent a year writing and generally being involved in the creation of an app called ‘NHM Evolution’ (for iPad), which, as the title suggests is co-published with London’s Natural History Museum. Even though the app is built around the central artwork first created for a book (which I wrote and was published by Mitchell-Beazley and the University of California Press in 2009), it still took a full year’s worth of very hard work by several people to transform this book into a viable ‘app’ - which has to be so much more than ‘just’ an e-book, to make any significant impact.

The whole purpose of an app of this kind is that it should extend beyond ‘mere’ bookish words (all 200,000+ in this instance) and use multimedia resources of video, sound and images, which the viewer/reader can manipulate digitally – in the original sense of the word, ie., move by the finger.

In the NHM Evolution app, the basic image source consists of 100 watercolour reconstructions (by natural history artist Peter Barrett) of specific fossil sites from around the world, many of which are lagerstätten and some of which are World Heritage Sites. I chose them to best illustrate over 600 million years of the history and evolution of life from the Ediacaran to the present. The illustrations form a continuous strip (the original artwork totalled 50m in length) with an associated moving timescale, which can be scrolled through, and is populated by some 900 named fossil organisms. Descriptions and classification of all these fossils can be recovered by tapping the individual image. And, a description of each site can be recovered, along with links to its position in geological time and space.

The latter link is, I think, one of the most innovative features of the app as plate motion over the last 600 million years is presented on a satellite view of Earth. The ‘blue marble’ can be

‘digitally’ spun, expanded and, by dragging a cursor along the geological column, seen to reveal the changing disposition of the continents and oceans. The data has been provided by Dr Alan Smith of the University of Cambridge and is generally familiar to geologists. Normally this information has to be reproduced in a series of two-dimensional whole-Earth projections. But, in my view, the opportunity to manipulate such a wealth of data in your own time and way, can make a considerable difference to the learning experience, especially for anyone new to the subject.

However, fossils are the core illustrative material of the app and, as a palaeontologist by training, I have always been interested in the problems of illustrating fossils. I have often thought that until recently, not much progress has been made in the quality of interpretive depiction, essentially drawing and its reproduction, since the work of the best of the 17th Century Italian Renaissance masters, such as Scilla and Fabio Colonna, who first engraved fossils so accurately.

However, an important innovation was the 19th Century development of reconstructed prehistoric scenes, such as those generated for August Goldfuss’s *Fossils of Germany* (1826-44), which were executed to a very high standard by an unknown artist in the Düsseldorf lithographic firm of Arnz. Likewise, by the 1840s Franz Xaver Unger’s *Flora of the Former World* was beautifully illustrated by Josef Kuwasseg (1799-1859), a well known landscape painter in Graz.

HORRIBLY STIFF

While modern computer generated images (CGI) have become the norm today and are generally expected as a mode of

illustration, especially for reconstructions of the past, so many of the results are still horribly stiff, simplified and set against totally inappropriate modern landscapes.

There is no doubt that with ‘deep’ technical and financial resources,



Geological Timen globe



A ‘blue-marble’ view of modern distribution of the landmasses and oceans with present day topography

0 MYA



Showing the convergence of the Indian plate on South-East Asia. Present day coastlines and topography are purposefully retained because it helps the non-expert viewer to recognise the continental plates even back into Early Palaeozoic times

18 MYA

Screengrab showing the skull of *Thrinaxodon*, an Early Triassic cynodont from South Africa. The top of the skull retains part of the sagittal crest and the pits in the snout region may have housed whiskers in life



Using the iPad, this image can be rotated to show the double occipital condyle at the back of the skull, characteristic of mammals



A cast of *Tiktaalik roseae*, a Late Devonian lobe-finned fish from Ellesmere Island in the Canadian Arctic





Shows the Tethyan Ocean separating Africa from Asia and the Indian plate at the beginning of its northern motion away from Africa



Shows the Tethyan Ocean and the breakup of Pangaea with the opening of the Central Atlantic



Image courtesy of the Natural History Museum, London

Discovered in 2004, detailed study of the fossil's pectoral fin and shoulder girdle suggests that the animal could lift its head and shoulders clear of the substrate

such as those available to the computer games industry, CGI will greatly improve and probably become the favoured and perhaps the best mode of illustration.

But until the costs come right down, few publishers will be able to afford the best. Meanwhile we have to put up with a lot of very mediocre and misleading illustration of the life of the past. Until then, reconstructions largely depend upon traditional illustrations produced by excellent contemporary artists, such as John Sibbick, Luis Rey, Steve Kirk, Douglas Henderson and, in the case of the NHM Evolution app, Peter Barrett.

Perhaps more important for academic palaeontological communication and education is the illustration of the fossils themselves, still largely by photography or some electronic imaging, such as SEM. These days the quality of the original images is just about as good as it can get; but is often let down by the reproduction process of digitisation for printing. Costs are again high, especially if any images have to be bought in, and there is still no completely satisfactory and simple means of representing the 3D form of many fossils for popular or semipopular educational books, without recourse to additional 'kit' in the form of 3D glasses or stereoscopes. Such techniques were successfully introduced some 50 and more years ago, especially in publications like *The Stereo-Atlas of Ostracod Shells* (1973-98); but these were primarily research publications and not widely available. Certainly for the researcher this is an invaluable tool which is now being used with computer generated images of fossils and could be more widely available but not cheaply.

However, again the ipad / tablet is providing a new and greatly improved mode of presentation with images, which can be rotated through 360 degrees. These give a remarkably effective pseudo-3D effect, probably because the eye and brain are fooled by the changing shadows to think that it is a genuine 3D image. The technique is easy and relatively cheap, as each 'spinnable' image is based on a sequence of 72 photos, taken at 5° intervals, and a clever piece of software that links them together to give an apparently continuous view. This technique could be applied to any rock, mineral, crystal model etc, which can be rotated and photographed.

For NHM Evolution, the Natural History Museum generated a number of these images, mainly of skulls, especially those of dinosaurs and hominins, and again for me these work very well. The

same technique is used in the very popular and successful 'The Elements' app by Theodore Gray, which has the added benefit of Tom Lehrer's famous song. If only there was a similarly appropriate and amusing song about evolution – perhaps there is and I just don't know about it.

NEAR FUTURE

I suspect that apps are going to be an increasingly important part of scientific communication in the very near future. Schools are buying ipads but are finding that there are still very few apps that are sufficiently targeted for the National Curriculum. Part of the problem is that making a content-rich app is not cheap (many tens of thousands of pounds) but the app itself has to have a low price-point – less than a paperback book.

Fortunately our major Earth science institutions, such as the British Geological Survey and the Natural History Museum, are in the vanguard with the new medium and helping to broadcast the message to a new generation of 'wannabe' geologists. If you have already got the message, why not take a look and see what you think? ■

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APPLICATIONS

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- Gray, T (2011) The Elements

Tannatt William Edgeworth David was born at the Rectory in St Fagans, near Cardiff, on 28 January 1858. In 1876 he entered New College Oxford to read Classics and graduated 1880. Following his studies he returned to Cardiff, where he became interested in geology. By 1882 he was considered sufficiently expert to present papers on the glaciation of South Wales. A year later his results were published by the Geological Society of London.

In 1882 David took a post as Assistant Geological Surveyor in the New South Wales Geological Survey. He discovered the coal seams in the Hunter Valley, which are still producing coal today. By 1891 he was Professor of Geology at the University of Sydney - then a department of just one! Soon, his course became very popular and the department grew. He also gave public lectures on geology and took science to the ordinary people of Sydney. His field trips were well attended and attracted scientists from other fields. It was during these years that the brown felt hat he always wore became famous among his students. The "Prof" was hardly ever seen without it!

In 1907 he persuaded Ernest Shackleton to let him take charge of the scientific aspects of his Antarctic expedition. By this time David was 50; but he managed to survive the rigours of a long Antarctic expedition with much younger men. He was an active member of the team leading the first ascent of Mount Erebus, an active volcano - and what geologist could resist that? Also, he was one of a party of three to reach the vicinity of the South Magnetic Pole. For these exploits he was made a Companion of the Order of St Michael and St George and awarded the King's Polar Medal.

RETURN

Following his return from Antarctica David's fame as a public speaker grew. He was by now Australia's most famous scientist; already known by academia worldwide, the

Right: David's Attestation Papers, from when he 'joined up'. Birthplace: St Fagan's. Occupation - 'Teacher'

Left (clockwise from top): The 'Catterpillar' Crater, Hill 60

Sir Tannatt William Edgeworth David 1858-1934

David's original geological note on the German Mine at 'The Pimple', or Hill 120, at the northern extremity of Vimy Ridge. Vimy escarpment lies about five miles northeast of Arras on the western edge of the Douai Plains

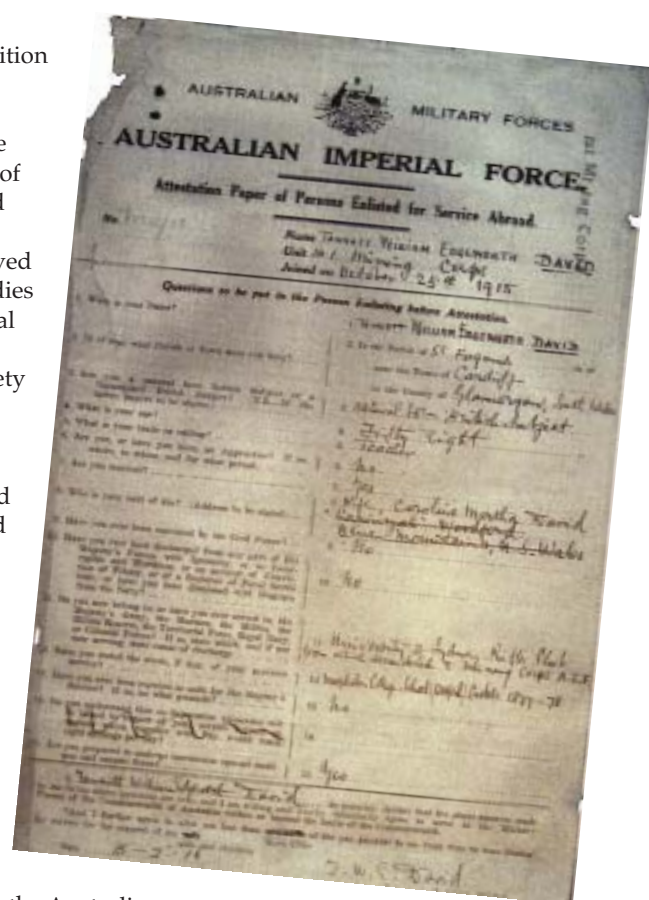
Antarctic expedition raised him to celebrity status. Nevertheless, he never lost sight of his teaching and research, and remained involved with august bodies such as the Royal Society and the Geological Society of London.

At the outbreak of the Great War David was 56 years old and no-one expected him to become involved with matters military. But he not only wanted to be involved - he wanted to make a real contribution. He suggested to the Australian Minister of Defence that a Tunnelling Battalion be formed for service in Europe. As a geologist who had worked in mining, he saw the usefulness of both in the war. His idea was approved and he recruited men capable of being tunnellers (managing to land himself a commission as Major in the process).

On arrival in France, the battalion was restructured leaving David without a job. The officer in charge admitted that he had no idea how useful a geologist could be in spite of the fact that the British Army already had one geologist working on the front - Captain W B King of the Royal Welsh Fusiliers. David was given a free-ranging role along the front, reporting to the Inspector of Mines and working closely with King.

GROUNDWATER

David studied groundwater levels in areas of offensive mining and produced charts and tables predicting its occurrence. This helped to make mining more direct, efficient and safer. He noted the delay between



storms and the changes in level of groundwater so that he predicted when miners should be taken out of galleries that were likely to become flooded.

An investigation into a well that had suddenly dried at Vimy on 25 September 1916 nearly brought David's war to an abrupt end. He was being lowered down the well by windlass when it broke. He plunged 70 feet, bouncing off the sides of the well as he went. He suffered a head wound as well as internal injuries, but remained conscious and was able to hail an officer at the top and ask a bandage be sent down to him. A doctor attended him at the bottom of the shaft before he was lifted. David wrote:

"He bound up my head, and helped to fix me on the rope, and then just as they were about to start to pull me up I sung out to them to pull me up slowly so that I might have the chance of examining the chalk in the sides of the well. As a matter of fact, this was rather bravado on my part because I wasn't at all sure but what I might suddenly become unconscious and drop off the rope." ►

► His bloodied state attracted attention from soldiers in the trench with queries such as "Shrapnel?" to the stretcher bearers but on hearing he had fallen down a well there was little interest – the infantryman of 1916 had seen too much death and destruction to give an aged officer who had fallen down a well a second thought.

When David returned to the Front he worked on the Messines mining operations, General Harvey crediting him with their success. However, David always maintained that Harvey was responsible for the concept and planning of the mines. David was involved in some of the major decisions for later mines, such as

the Boyle's Farm mine, where problems caused by a fault were resolved by him, thus allowing the mine to be finished on time. David's energy, knowledge of geology and experience in mining had pushed the project forwards fast enough to ensure success.

The success of the mining at Messines prompted the Germans to order all their geologists over 40 back to Berlin and all those under 40 to the front. General Harvey is recorded as saying "The moral perhaps is that it is better to employ two first class geologists like our own than 20 second-class or German ones".

Following Messines David was kept busy demonstrating how best to build dugouts in clay soils

Below: David's diagrams of the craters blown in Hill 60, about three miles SE of Ypres. Hill 60's prominence above a low-lying region meant it was continually fought over from late 1914

David's geological cross section at Wytschaete, Lille. Known to troops as "Whitesheet", this village lies about a mile north of Messines, on the main N365 road from Ypres to Armentieres

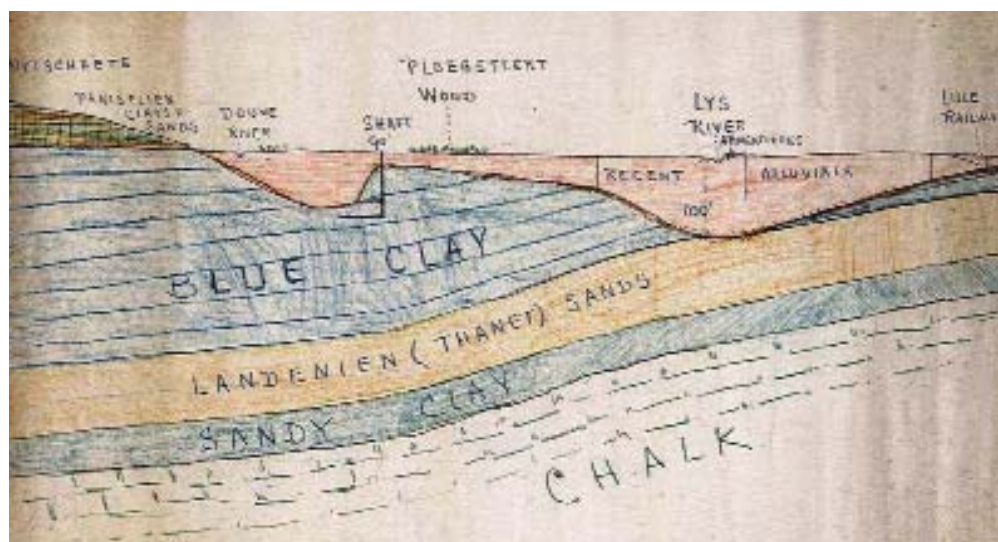
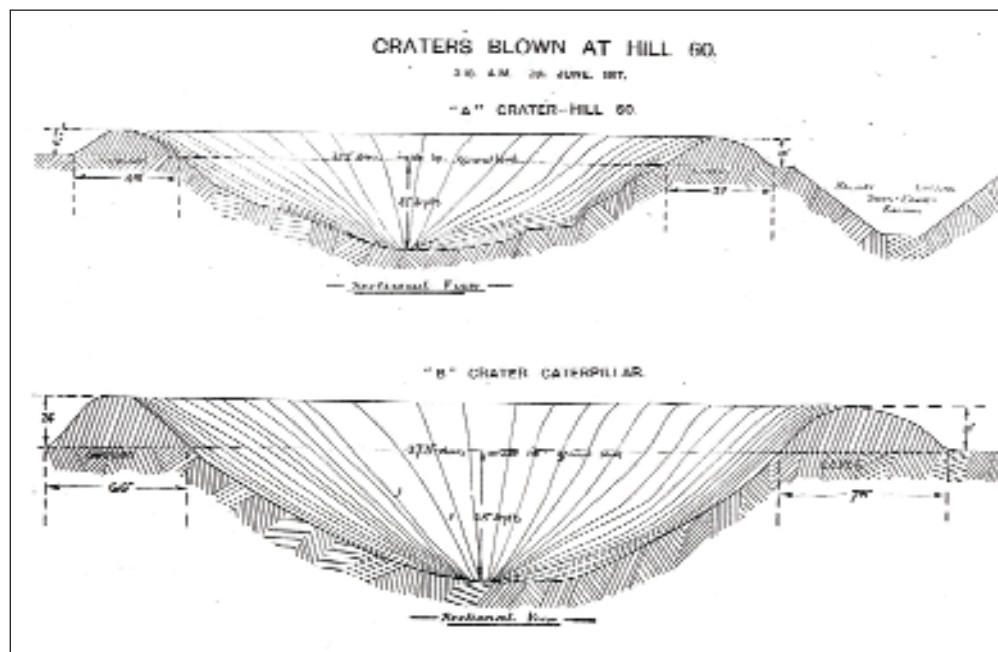
around Ypres and identifying aggregates for making concrete. During the final advance, both David and King - with the help of Tasmanian geologist Loftus Hills - were kept busy finding water for the advancing troops and ensured its supply.

ROYAL ENGINEERS

At the end of the war David and King compiled *Work of the Royal Engineers in the European War, 1914 -1919; Geological Works on the Western Front* which was completed in 1922. This volume carries no authors' names but it is generally identified now as being the work of David with a significant contribution from King. For his service in the Great War David was awarded the Distinguished Service Order (DSO), Mentioned in Despatches on three occasions and created KBE. The work unseen by the troops and understood by only a few 'in the know' was certainly appreciated at the highest level.

Following the war David, now 61, returned to academic life in Sydney. He was still involved in Antarctic exploration and collaborated with Sir Douglas Mawson on his later exploits. By 1934 he was actively researching his massive work *The Geology of the Commonwealth of Australia* when he slipped and fell getting off a tram in Sydney. He never recovered and died shortly afterwards. There followed a State funeral. In the press reports that followed one journalist affectionately coined the phrase "The knight in the old brown hat". ■

* Dr John Dixon is Principal Geotechnical Engineer, Mining, Coffey Geotechnics Limited



FURTHER INFORMATION

More information on the battlefields referred to, including Messines and Hill 60, may be found at www.ww1battlefields.co.uk

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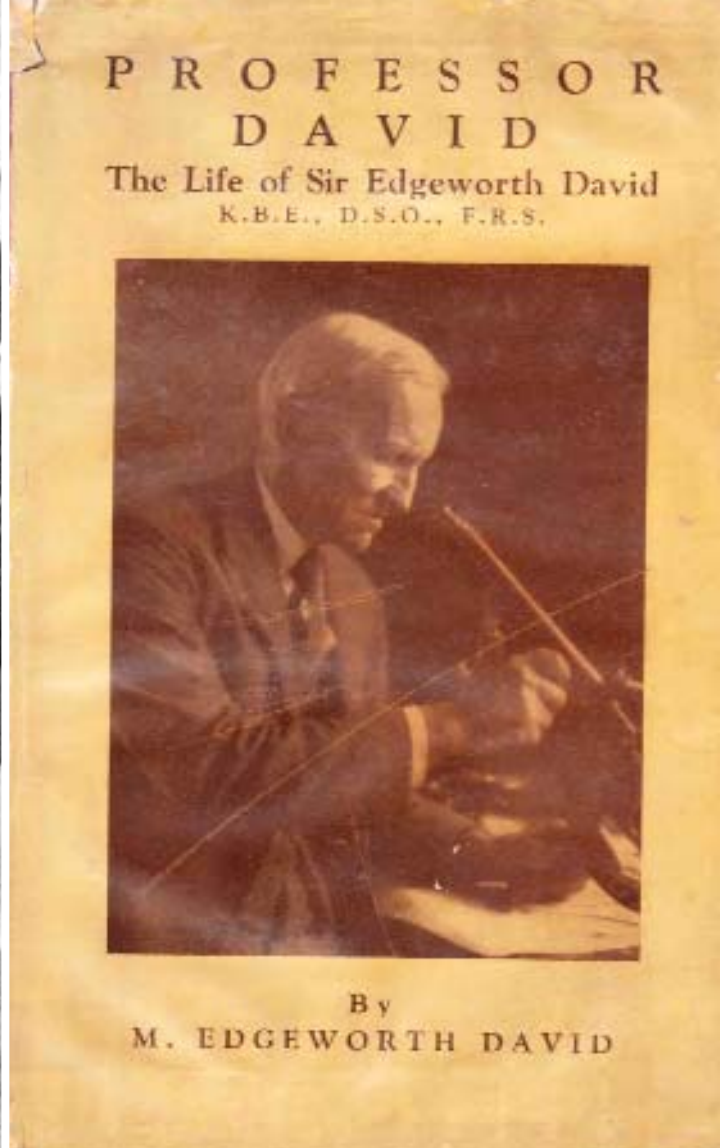
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Right: British Antarctic Expedition 1907-09: Camp of the Western Party on the Ferrar Glacier

Far right: Dust jacket of Mary Edgeworth David's 1937 biography of her father

Image: Ernest Shackleton, 'The Heart of the Antarctic' Vol. II, William Heinemann, London 1909 via Wikimedia Commons



The 'Pool of Peace' Crater. This was the largest mine blown, at the start of the assault on Messines Ridge. Work on it commenced 1 January 1916, and was completed by 26 June. It was detonated nearly a year later. The mine was 88 feet deep, containing 91,000 lbs of ammonal. The crater was 250 feet wide (with a 90 feet wide rim) and 40 feet deep



Revolutions That Made the Earth

This book is a 'MUST' read! It tells the strange and fascinating story of the entangled histories of life and the planet, from the perspective that a very few profound revolutions have made the Earth as we know it. Most of these revolutions happened in the Precambrian, but we are now living through a new one by transforming the planet ourselves.

Each of these revolutions is a transformation of the entire system of life, coupled to the planetary environment. Together, that life and its environment comprise the 'Earth System' - the many processes that interact to set living conditions, and to sustain life - which we can only fully understand by studying all its parts as a whole; so not surprisingly the book ranges through fields as disparate as astronomy, geology, geochemistry and biology. The key to understanding how this system works is understanding positive and negative feedbacks.

Following the Introduction in Part I, the book moves to Theory in Part II, exploring the properties of an Earth system dominated by feedbacks. Part III focuses on the first great transformation of the Earth system by the development of the creators of oxygen and its abrupt accumulation in the atmosphere. Part IV tackles the transformation that started with the evolution of a new type of cell and ended with the appearance of complex creatures in the Cambrian explosion of life. Part V deals with the history of the planet from the Cambrian to the present, illuminating it through the laser beam of Earth System science and exploring how feedback processes conspired to make that history what it is.

Finally, Part VI examines how unrestrained economic growth and our undervaluing of the environment are polluting the planet by dumping greenhouse gases into the atmosphere and unused nutrients into the ocean. This Human Revolution is creating a

'Tragedy of the Commons' through unregulated use of resources held in common, leading inexorably to the disbenefit of all.

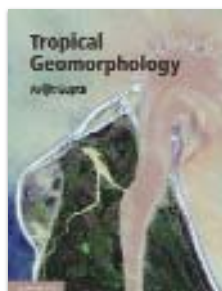
Despite the appeals of environmentalists, business is proceeding much as usual. Can we sustain the increasing use of energy by an increasing population? Lenton and Watson do not share the apocalyptic vision of their mentor James Lovelock. We can use more energy, provided we put in the massive efforts required to minimise the use of coal, gas and oil; to maximise the use of dense energy sources like the sun, nuclear fission and, ultimately, nuclear fusion; to extract carbon dioxide from the air; and to minimise waste by recycling everything. Just as in the banking industry, economic activity must be balanced by regulation - as pointed out long ago by Adam Smith in the 'Wealth of Nations'.

Reviewed by Colin Summerhayes

REVOLUTIONS THAT MADE THE EARTH

TIM LENTON & ANDREW WATSON, Published by Oxford University Press, 2011. ISBN 978-0-19-958704-9. 440 pp.

List price: £29.95, www.oup.co.uk



Tropical Geomorphology

Tropical Geomorphology is an immense subject, but well covered by this book. Many of the basic processes, being more or less common at least in basic terms to environments found all over the globe, will be familiar to British geologists, but here readers will find them presented with an interesting tropical twist. The difference of course is mainly that geomorphic processes operating in the tropics do so at different rates and intensities compared with elsewhere. Weathering, erosion, slopes and hydrology are also considered.

The book describes both the humid

and arid tropics. It is up to date and talks of the use of geomorphology in the management and sustainable development of the tropics. It talks of geology, landforms and processes and the movement of water and sediments from the mountains (some of which include glaciers) to the sea.

The author looks at weathering in detail, considering both its effects on rocks and minerals. It looks at rivers in the tropics some of which are very large (e.g. the Amazon) and alluvial valleys, deltas and coasts. The author also looks at particular land types, including volcanic and karstic landscapes. Among other things, precipitation, wind circulation and temperature are described, as are tropical disturbances such as cyclones, and the effects of tropical vegetation.

The author reviews the Quaternary rocks found in the tropics briefly, and considers how the ice ages affected them. He then focuses on anthropogenic effects on geomorphic processes and urban geomorphology (giving examples of geomorphic hazards and their amelioration in Singapore, Kingston and Bangkok). He then moves on to consider human effects on processes including, of course, climate change.

The geomorphology of the future will reflect three factors; the normal pattern of landform and processes, their anthropogenic modification, and the effect of climate change - particularly on rainfall and tropical cyclone activity. At the very end of the book Gupta acknowledges that the combined effects of these three are difficult to determine in any particular location, or across a large geomorphic system.

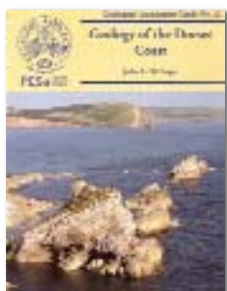
In summary, this book is well written, in an interesting and easy-to-read style. It is a hardback, well printed and solidly bound, with many informative diagrams, excellent plates and useful satellite images. Sets of questions mark the end of each chapter, which will encourage readers to explore the subject further. It is suitable as an advanced undergraduate textbook, or as a handy reference for someone practising geomorphology in tropical regions and constitutes excellent value at £45.

Reviewed by Steve Rowlett

TROPICAL GEOMORPHOLOGY

AVIJIT GUPTA, Published by: Cambridge University Press. 2011 ISBN: 978-0-521-87990-3 Hardback. 386pp

List price: £45.00, www.cambridge.org



Geology of the Dorset Coast

I have often wondered what the Geologists Association – of which I am a proud member – means by its occasional strapline ‘The True Spirit of Geology’; but after reading this excellent addition to its suite of Guides, I think I know. Local geology is not just for local people, because ‘local’ is not the same as ‘parochial’. The ‘true spirit’ lies in the fact that your local geology is as important as anyone else’s; because from the local, you can glimpse the global – and that is where the joy of geology, for me, always lay.

In revising the previous edition by Michael House, the author was following a tough act; but even the best guides date, and nobody knows the geology of Dorset better than John Cope. His approach is rigorous and structured, beginning with a concise summary of the succession, including unexposed rocks; an analysis of the County’s surprisingly complex structure, and a special section on the habitat of oil. Then follow three classic excursions covering West, South and East Dorset/Purbeck. There is a copious reference list and index.

The handbook is produced in the series’ now standard spiral binding with soft cover, which is highly practical, allowing the book to lie flat or to be folded back on itself without damage. Production values are high, with lovely colour maps, sections and excellent photographs. The author’s experience as the leader of countless Dorset field excursions is everywhere evident, with up-to-date and practical guidance on footpaths, lunch spots and access to beaches and quarries.

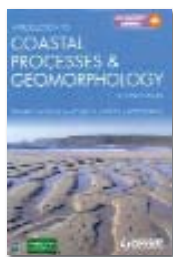
For a practical field guide, 232 pages is probably the upper limit; which perhaps explains why space could not be found for seismic sections, which can be so helpful in explaining deep structure, or diachronism in the Bridport Sands for example. But there is always more to say, and Cope is to be commended all the more for not neglecting other subjects of interest to visitors, such as Thomas Hardy,

or the archaeology of Maiden Castle. (Though referring to Sir Thomas Masterman Hardy, 1st Baronet, Captain of the *Victory* at Trafalgar, later First Naval Lord at the Admiralty and Vice-Admiral of the Blue as “Nelson’s henchman” seemed, even to me, to take journalistic shorthand a little far!)

Reviewed by Ted Nield

THE GEOLOGY OF THE DORSET COAST

JOHN C W COPE, GA Guide #22. Published by: Geologists’ Association 2012 ISBN: 9780900717611, 232pp **List price: £14.00 (Members £11.00)**, www.geologistsassociation.org.uk/GAGuideSales.html



Introduction to Coastal Processes and Geomorphology

The new edition of this book provides comprehensive coverage of undergraduate-level coastal themes. This well structured paperback, also available as an e-book, uses numerous black and white diagrams and images that are based on international and UK-based case studies, giving the reader a wide experience of coastal geomorphological features.

Focused on physical processes, the book is an excellent guide to natural coastal dynamics, particularly tides and waves, sediment movement, tide- and wave-dominated coasts, geologically-controlled coasts and the climate-coast relationship. The new climate-oriented chapters venture into the human impacts of coastal and sea level change, leaving the reader wanting to research deeper into the subject. For example, the Intergovernmental Panel on Climate Change (IPCC) 2007 projections and the regional UK Climate Impact Programme 2009 probabilistic projections of climate change are introduced, but more information could have been provided about projection outputs and potential impact.

Although the book is aimed primarily at undergraduates, there are elements that challenge the reader and promote the development of critical, academic thought.

In this respect the book is very accessible and provides a solid baseline for advanced lines of enquiry. The references have been partially updated since the release of the First Edition in 2003, and include a number of essential handbooks; but there was perhaps scope for more updating in the very dynamic areas of climate change and sea level research.

Undergraduates who read this book will benefit from the reflective questions that are posed at the end of each chapter. These excellent revision aids are coupled with the online materials; extended case studies, worked examples, multiple choice questions and MP3 format answers to the questions.

Some aspects would have benefited from a little more care and attention to updating. For example the isostatic maps of the UK presented are based on a 23 year-old paper, rather than on more recent studies. Some of the case studies could have been developed further. For example, the Porthcawl (South Wales) case study ends in the early 1980s and shortly after this the foreshore at the foot of the seawall was covered in an asphalt-concrete layer with a bitumen-grouted toe. The authors’ opinions on this effective, but unsightly, coastal defence method would have been enlightening.

INTRODUCTION TO COASTAL PROCESSES & GEOMORPHOLOGY (2ND EDITION)

GERHARD MASSELINK, MICHAEL G HUGHES AND JASPER KNIGHT, Published by: Hodder Education, 2011 ISBN: 978-1-444-122-404. 432 pp **List price: £34.99**, www.hoddereducation.com

REVIEWS: COPIES AVAILABLE

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

- **NEW! South of Scotland – British Regional Geology (4th Edn.)** Stone *et al.* British Geological Survey (NERC) 248pp
- **Fundamentals of the Petrophysics of Oil and Gas Reservoirs** Leonid Buryakovskiy, George V Chilingar, Herman H Rieke & Sanghee Shin. Wiley/Scrivener 374pp.
- **Disaster Deferred – a new view of Earthquake Hazards in the New Madrid Seismic Zone.** (2012) by Seth Stein. Columbia University Press pbk, 282pp
- **Continuum Mechanics in the Earth Sciences** by William I Newman Cambridge University Press
- **Theory of Reflectance and Emittance Spectroscopy (2nd Edn)** by Bruce Hapke. Cambridge University Press.

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

GEOLOGY TEACHER TRAINING IN THE UK



Teaching remains a great career option for graduate geologists

Images: Waveform media / Shutterstock.com

Sir, You may already be aware of the current situation:

- 45% of the applicants for undergraduate geoscience courses in the UK in 2010 (UCAS data) had either A-level Geology or Scottish Higher Geology.
- Last year A2 Geology entries increased by 10%, AS-level Geology entries by 2.5% and GCSE Geology entries remained steady.
- Normally around two to three geology teaching jobs are advertised each year, but last year seven jobs were advertised, and two more have been advertised so far this year.
- Keele University is the only provider in the UK training geology teachers (they are trained as science teachers with a geology specialism, alongside other trainees who are trained as science teachers with biology, chemistry or physics specialisms).
- The Teaching Agency allocates six science/geology teacher training places each year to Keele (and plans to do so for the foreseeable future).
- Last year Keele managed to recruit two geoscientists to its course (the numbers in the previous two years were four and four).

Professor Iain Stewart has recently written: 'Interestingly - I heard the Deputy Director of the USGS attribute the geoscience skills shortage in the States to the lack of exposure to geology in schools. She was definitely of the opinion that getting rid of geology as a specific subject was a backward move.'

In view of this very difficult situation for geology teacher training, I hope that lecturers in HE Geoscience Departments across the UK, together with Careers

Departments in universities with Geoscience Departments, will be proactive in publicising teaching as a career for geoscientists. This is vital to the maintenance of post-16 geology in schools and colleges and to the 'pipeline' of students to undergraduate courses.

Anybody who would like to know more is most welcome to contact me.

Chris King, Professor of Earth Science Education
E: c.j.h.king@keele.ac.uk
T: 01782 734437.

BLACK MARK

Sir, Fifteen years ago I was part of the group 'Women in the Geological Society', convened to look at whether the GS was sufficiently welcoming to women geologists, or whether it still retained some aspects of a London 'gentlemen's club'. As I recall, we disbanded reasonably satisfied.

It was with dismay and disbelief that I read the 4 October email newsletter advertising the Founders Day Lecture and Dinner 2012. It is good to see an interesting lecture by a leading woman geologist. But the Society advertises the dinner as "Dress, black tie", "ticket

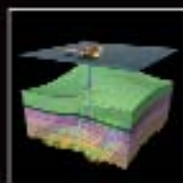
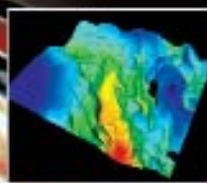
price £80" and "[midnight] carriages".

Why does the Geological Society choose to celebrate its inauguration with an elitist, snobbish old-fashioned function, or to tell its members what to wear? And what on Earth are women expected to wear: a ball gown? or just a strategically arranged black tie?

Does this not reinforce the old prejudices that this Society is a club for well-to-do London gentlemen?

Sue Treagus





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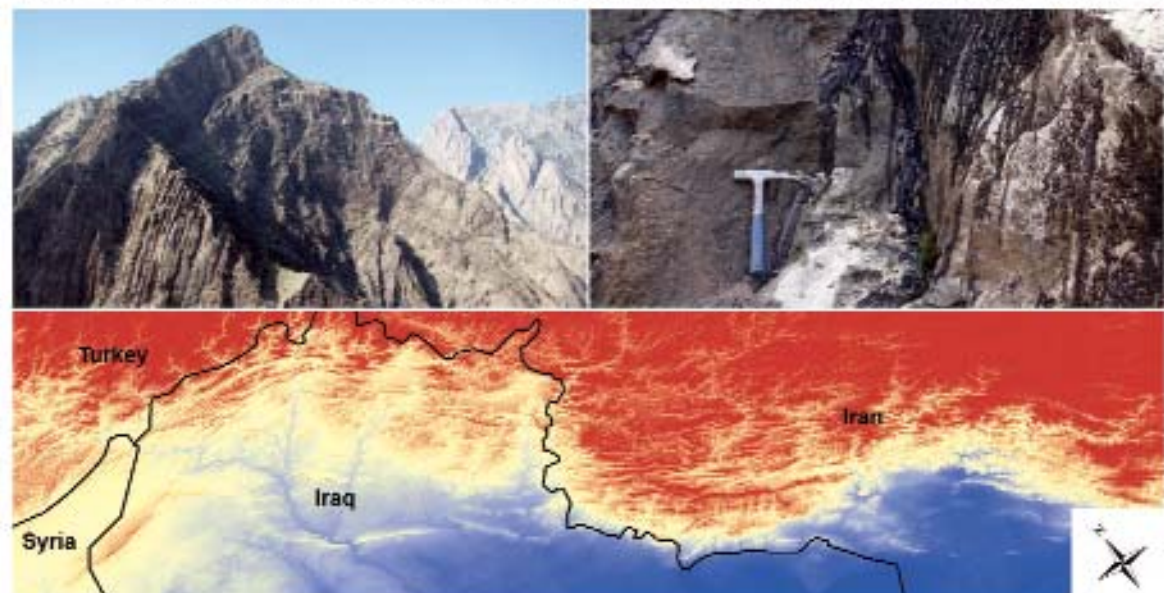


Registration Now Open

Hydrocarbon Exploration in the Zagros Mountains of Iraqi Kurdistan and Iran

23-25 January 2013

The Geological Society, Burlington House, Piccadilly, London



The Zagros Mountain range extends from Iran in the SE through the Kurdish regions of NE Iraq into SE Turkey. In Iran it has been a prolific petroleum province for many decades; however it is only recently that exploration has recommenced in Iraqi Kurdistan.

This conference will provide a forum where experience from the mature petroleum province of the Iranian Zagros can be combined with new understanding and knowledge from the exciting early days of Kurdish exploration.

It will be of interest to academics and industry professionals active in the region and will cover all aspects of the geological evolution and hydrocarbon resources of the Zagros Mountains.

Session topics will include:

Petroleum Systems
Sequence Stratigraphy
Reservoir Geology
Biostratigraphy
Regional Structure
Recent Structure
Exploration Strategy
Exploration History

Confirmed Keynote Speakers:

Max Bordenave (Consultant)
Roger Davis (Neflex)
Andy Horbury (Cambridge Carbonates)
Janice Weston (RPS)
Eric Blanc (Statoil)
James Jackson (Cambridge University)
Nils Bang (DNO)
David Mackertich (PetroCeltic) &
Adnan Samarrai (Ministry of Natural Resources, Kurdistan)

For further information and registration, please contact:

Steve Whalley, Event Co-ordinator: +44 (0)20 7432 0980 or email: steve.whalley@geolsoc.org.uk



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PEOPLE

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

CAROUSEL

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

■ ANTHONY J BARBER

Anthony J Barber, Emeritus Reader in Geology, SE Asian Research Group, Dept. of Earth Sciences, Royal Holloway, University of London, has been awarded the 2012 Island Arc Award jointly with co-author Michael J Crow for their paper *Structure of Sumatra and its implications for the tectonic assembly of Southeast Asia and the destruction of Paleotethys*. The paper received the highest number of citations of all *Island Arc* papers published in 2008-2009.



■ BOB PANKHURST



Bob Pankhurst has been awarded a 'Dr Luis Federico Leloir' prize for 2012 by MINCYT (the Ministry of Science, Technology and Innovation of Argentina). The prize is named after the Argentine biochemist who received the Nobel Prize for Chemistry in 1970 and is for foreign experts who have contributed to the enrichment of international cooperation with Argentina. The prize will be awarded by the Minister in the Palacio San Martin, Buenos Aires, on 23 November.

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Bailey, Kenneth	Chesterman, Jonathan Patrick
Barker, Peter F	Middleton, John *
Bowler, Christopher Michael Lance *	Scott, Robert A
Chapman, W T *	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.



STICKS AND STONES



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HELP YOUR OBITUARIST

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

DISTANT THUNDER

Card Trick

Geologist and science writer Nina Morgan explores a green alternative to Christmas cards

In the 19th Century Christmas cards became all the rage. As early as 1822 the fashion for sending home-made Christmas cards in the US put such a strain on the postal service that 16 extra postmen had to be taken on and the Superintendent of Mails in Washington, DC petitioned Congress to limit the exchange of Christmas cards by post. But the tide was unstoppable.

When Sir Henry Cole, who went on to arrange the Great Exhibition in 1851 and oversaw the inauguration of the Victoria and Albert Museum, commissioned John Calcott Horsley in 1843 to produce a printed Christmas card, the idea of commercially produced Christmas cards really took hold. The rest is history. Christmas now ranks top of the pops in the commercial card industry.

ARCHIVES

Surprisingly, the idea of exchanging Christmas cards doesn't seem to have taken off among the early geologists. There don't appear to be any Christmas cards from mid-19th C members of the Geol. Soc. in the archives. And it's only in the last few years that the Geol. Soc. itself has produced its own set of Christmas cards for sale (but not this year!).

Nevertheless, the exchanging of handmade Christmas cards was not entirely unknown within the geological community. For example, F J North (1889-1968), Keeper of Geology at the National Museum of Wales from 1915-1958, distributed Christmas cards in 1944 made using fragments of a William



Smith map (see *Distant Thunder*, January 2011). Another who took up the idea was the geologist J V Harrison (1892-1972). Harrison spent 20 years exploring vast tracks of country in Persia (now Iran), Central and South America, Borneo and the West Indies for the Anglo-Persian Oil Company, the fore-runner of BP, before joining the Geology Department at Oxford University in 1938.

Although Harrison's cards, produced in the 1930s and illustrated with his own photographs taken in the wilds of Persia (now Iran), were not exactly seasonal, they did reflect Harrison's great passion for carrying out geological fieldwork in remote places and as Harrison's entry in the Dictionary of National Biography puts it 'under the most arduous conditions that could be arranged'. At Oxford Harrison's capacity for rugged fieldwork

remained legendary. Former undergraduates recall arriving for a field trip on Arran and seeing Harrison, then in his mid-40s, tall, thin, bearded and wearing a kilt, rise out of the mist like an Old Testament prophet, and then proceed to out-walk them all.

Harrison's production of Christmas cards seems to have ceased after he arrived in Oxford, but his Christmas communications did not. They just took on another form. Instead of sending cards to his colleagues, he arranged the delivery of Christmas trees cut from his own woods at his home in Kennington, Oxford to the children of Department staff. This green alternative must have delighted the recipients. And as the trees were probably delivered by hand, overburdened postal workers must have been delighted too!

Season's greetings to all.

ACKNOWLEDGEMENT

J V Harrison's Christmas cards can be found in the Special Collections section of the BGS GeoScenic website <http://geoscenic.bgs.ac.uk/asset-bank/action/viewHome>; I'm grateful to David (E A) Vincent and Philip Powell for sharing their personal recollections of Harrison. Other sources of information include the Geological Society librarians, Wendy Cawthorne and Michael McKimm; the Geological Society Archivist, Caroline Lam; the entry for John Vernon Harrison by E A Vincent and information about the history of Christmas Cards available from the website www.ideafinder.com.

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

OBITUARY



RICHARD WILLIAM HEY 1917-2011

Quaternary geologist and geomorphologist who inspired students and colleagues at Cambridge for over 30 years

Both Richard Hey's parents came from families running successful manufacturing businesses in Yorkshire, but he was sent south to school. He always enjoyed returning to west Yorkshire, where he developed a taste for wild country, and the science of the natural world. At the age of 18, he went to Trinity College, Cambridge and read Natural Sciences. Such was the flexibility of the system that he was able to sample different science subjects before eventually specialising in Geology, and graduating in 1939. In Geology he was supervised by Maurice Black, one of the first university geologists in Britain to teach a wide range of research topics on sedimentary rocks.

GEOMORPHOLOGY

World War Two then took centre stage, and Richard joined the Royal Air Force and was trained in aerial photograph interpretation. For much of the war he worked widely across North Africa, before landing in southern France and continuing up into Germany. This gave him a life-long feel for geomorphology, particularly of deserts, rivers and coasts.

After the War, Richard became involved with geomorphological, and archaeological research in North Africa, particularly in Libya, and in 1951 Cambridge awarded him the degree of PhD. The Head of the Geology Department in Cambridge at that time was Professor W B R (Bill) King who had been carrying out war-related geological work on landscapes, the geology of the English Channel, and

even the properties of the Normandy beaches. Richard Hey was appointed to the first of a succession of teaching posts that continued until his retirement in 1982, on the basis of his Quaternary interests and his teaching flare.

Lecturing, running practical classes, and leading student field trips were the main activities of a conscientious holder of a teaching post in those days, and research was generally regarded as a secondary, somewhat personal, matter. Richard's lecturing on Quaternary problems and sedimentary rocks was enjoyed by his student audience because of its clarity and gently humorous asides. He clearly enjoyed unhurried discussions with students during practical classes, and was marvellous company in the field, where

he took a succession of memorable day trips around the English Midlands and East Anglia during the summers. In March and April, for many years, he also relished the joint leadership of a 10-day trip to south west Wales.

QUATERNARY

All this time his national and international standing in Quaternary Geology was developing, particularly in the world of Mediterranean coastal studies, where he undertook a monitoring role in many conferences. He also made key advances in the study of the history of British rivers particularly the River Thames, involving widespread field sampling for the heavy mineral and pebble lithologies that indicated provenance.

Richard never married, and devoted much time and effort on his students and the life of the new Churchill College which he helped to set up and develop after his early days in Trinity College. At weekends, he would relax by making sorties into the countryside around Cambridge on the horse that he kept near College. In addition to his scientific work, he devoted himself to the playing and enjoyment of music, and the fine-art and religious life of the College.

► By Peter Friend

Richard Hey (left)



ENDORSED TRAINING/CPD

Course	Date	Venue and details
Ground Models	3-7 December	University of Sussex. Fees apply; Fellows' discount. See website for details and registration. Or apply online at www.sussex.ac.uk/geography/pgstudy
Geomorphological Processes	28 January – 1 February	University of Sussex. Fees apply; Fellows' discount. See website for details and registration. Or apply online at www.sussex.ac.uk/geography/pgstudy
Lapworth's Logs	n/a	'Lapworth's Logs' are a series of e-courses involving practical exercises of increasing complexity. Contact: info@lapworthslogs.com . Lapworth's Logs is produced by Michael de Freitas and Andrew Thompson

DIARY OF MEETINGS DECEMBER 2012 / JANUARY 2013

Meeting	Date	Venue and details
Recent Work in Archaeological Geophysics Near Surface Geophysics	4 December	Burlington House. Contact: Paul Linford. E: Paul.Linford@english-heritage.org.uk Pre-registration: W: www.nsgg.org.uk/meetings/
SWRG GeoCareers Fair, South West Regional	5 December	University of Plymouth. Contact: Danielle Pullen E: swrg@geolsoc.org.uk
Social Evening and AGM, Solent Regional	5 December	Venue TBC: see website for details. Contact: Karen Allso E: karen.allso@ramboll.co.uk
ProGeo 2012 South West Regional	5 December	Venue: Lakeside, Roadford Lake, Broadwoodwidge, Lifton, Devon PL16 0JL. See website for details. Contact: Danielle Pullen E: swrg@geolsoc.org.uk
Frontiers Meeting 2012 Petroleum Group	10 December	Burlington House. Free, but pre-registration essential. See website for details. Contact: Steve Whalley T: +44 (0)20 7432 0980; F: +44 (0)20 7494 0579; E: steve.whalley@geolsoc.org.uk
SEAS Postgraduate Conference University of Manchester	11 December	Venue: University of Manchester. See website for details and registration.
Poster Competition with the SGG Central Scotland Regional	11 December	Venue: University of Strathclyde. Contact: Lesley McLellan E: Lesley.McLellan@ls.glasgow.gov.uk
Monitoring and Managing the Earth's Resources Engineering Group, GSRG	11-13 December	Burlington House. See website for registration and details. Contact: Jason Manning E: secretary@grsg.org.uk
Radon, Health and Natural Hazards UNESCO / IUGS / IGCP Project 571	11-12 December	Venue: Bath, UK. See website for registration and details. Contact: Gavin Gilmore E: g.gillmore@kingstone.ac.uk
Remote Sensing in Engineering Geology Engineering Group	12 December	Burlington House. See website for details. Contact: David Entwistle E: dce@bgs.ac.uk
Pitldown: 100 Years On Geological Society, History of Geology Group	18 December	Burlington House. Fees apply. See website for registration and details. Contact: Steve Whalley T: +44 (0)20 7432 0980; F: +44 (0)20 7494 0579; E: steve.whalley@geolsoc.org.uk
Incoming! - Learning to Love the Meteorite Geological Society, Shell UK	19 December	Burlington House. A Shell London Lecture. See advert, p.7
Antarctica and the Scotia Arc Tectonics Climate and Life	27 December - 20 January	Venue: Scotia Arc, in the 92-meter ice ship, M/V Marina Svetava, an in-depth 22-day voyage in the Southern Ocean to celebrate the GSA's 125th Anniversary Charges apply. See website for details.
TSG Annual Meeting Tectonic Studies Group	2013 3-5 January	Venue: Queens Hotel, Leeds. See website for details. Contact: Richard Phillips E: r.j.phillips@leeds.ac.uk
24th Colloquium of African Geology CAG24 Geological Society of Africa	8-14 January	Venue: UN Conference Centre, Addis Ababa, Ethiopia. For further information and to register, visit www.cag24.org.et/ .
Silurian Life, Environments, and Tectonics in the Midland Valley of Scotland Central Scotland Regional	15 January	Venue: BGS Common Room, Edinburgh. Time: 1745 for 1800. Speaker: Euan Clarkson. Contact: Lesley McLellan E: Lesley.McLellan@ls.glasgow.gov.uk
Anomalous Depressions in London Clay Engineering Group	16 January	Burlington House. See website for further details. Contact: David Giles T: 023 92842248 F: 23 92842244 E: dave.giles@port.ac.uk
Geophysical Studies of an Active Landslide South Wales Regional	23 January	Venue: Room 1.25, Earth Sciences, Main Building, Cardiff University. Time: 1730 for 1800. Speakers: Dr Peter Brabham & Alessia Taboga (Cardiff University). Contact: Gareth Farr E: swales.rg@geolsoc.org.uk
Hydrocarbon Exploration in the Zagros Mountains of Iraqi Kurdistan and Iran Petroleum Group	23-25 January	Venue: Burlington House. See website for registration and details. Fees apply. Contact: Steve Whalley T: +44 (0)20 7432 0980; F: +44 (0)20 7494 0579; E: steve.whalley@geolsoc.org.uk

OBITUARY



GLASCOTT EYRE DAWSON-GROVE 1924-2012

Consulting petroleum engineer and keen sportsman who grew up in China and spoke fluent Mandarin

Born in Bishop's Waltham, Hampshire, England, Glascott Eyre Dawson-Grove ('D-G') lived in China until the age of 10, with his parents Hermann and Ethel (Betty Symes) Dawson-Grove, his father a Government Official for the Chinese Customs. D-G learnt to speak fluent Chinese from his amah

(nanny). Taught by his parents and missionaries in China, he attended Rugby School in England, and then King Edward VII School in Hong Kong. At 16, he won the prize for highest marks in his final year and a scholarship to Massachusetts Institute of Technology (MIT), USA. Since the minimum age of 17 prevented him from attending MIT that year, D-G

enrolled in Geology at Hong Kong University.

INVASION

The Japanese invasion in December 1941 delayed his formal studies - he was a POW in Hong Kong with his parents for the next four years. Following the War, he attended Imperial College Royal School of Mines, London, for his BSc in Oil Technology and continued his studies at Cambridge for his MSc in Structural Geology.

An avid ballroom dancer and judo enthusiast, he rowed for Emmanuel College, Cambridge, in the eights and double sculls. He also met lifelong friends and business associates at university, with whom he kept in touch for more than 60 years. D-G contracted polio at age 27, and then met and became engaged to his physiotherapist, his future wife, Elizabeth.

“D-G WAS KNOWN FOR HIS INNOVATION AND INTEGRITY IN WORK AND PLAY, AND HIS INCREDIBLE DETERMINATION TO NEVER GIVE UP”

Qualified as a Petroleum Engineer, D-G began his career in the oil business with Shell Oil in California (1953-61), immigrated to Canada where he was employed with Home Oil in Calgary (1961-

77), and then established his own consulting business, Petrophysical Consultants International Ltd. As a founding member of the Calgary Rowing Club in 1967, D-G became known as an outspoken advocate and resource for the sport. He loved rowing and kayaking, as well as mentoring and coaching new members of the club and competing in numerous regattas. He was last on the water at age 77 in 2002, and continued rowing on the indoor training tank until after his 87th birthday.

INNOVATION

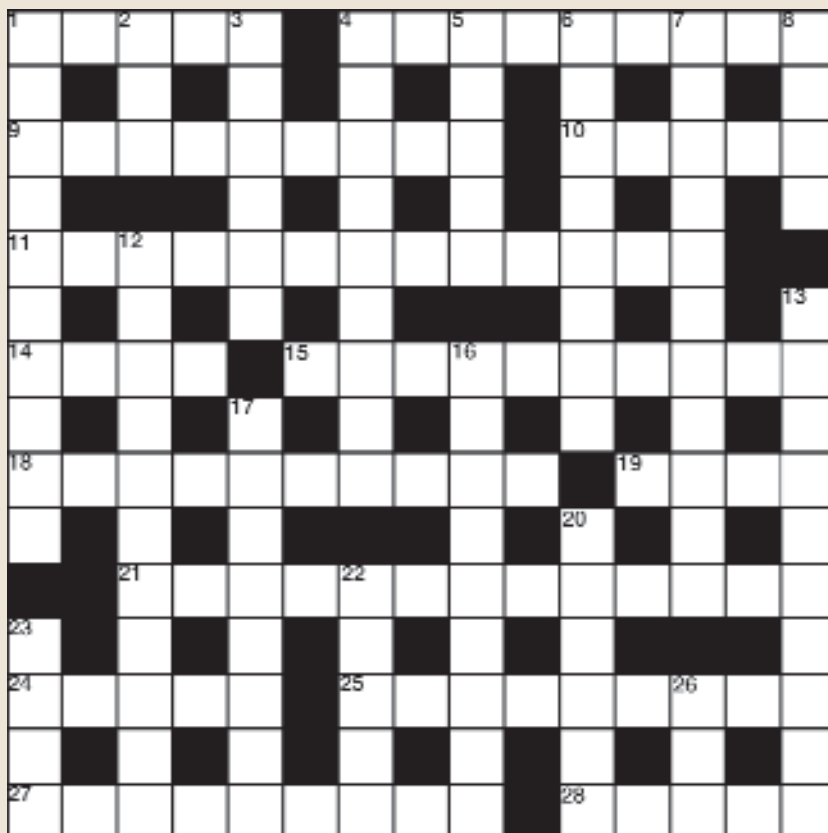
D-G was known for his innovation and integrity in work and play, and his incredible determination to never give up. Beside his loving wife of 57 years, D-G is survived by his two daughters and a son-in-law, Louisa and Bill Chapman of Williams Lake, BC, and Lucy Forster of Calgary; five grandchildren, Laticia, Oleh and Roman Chapman of Williams Lake, and John and Claire Forster and their father, Paul Forster, all of Hong Kong.

Glascott Eyre Dawson-Grove, P.Eng, P.Geol, MSc, ARSM, FGS ('D-G'), beloved husband of Elizabeth (Liz), Born 9 September 1924 - died Thursday 16 February 2012 in Calgary aged 87.

By Elizabeth Dawson-Grove, Louisa Chapman and Lucy Forster



CROSSWORD NO. 164 SET BY PLATYPUS



ACROSS

- 1 Ferromagnesian minerals (5)
 4 Of or pertaining to marble (9)
 9 Flat, elevated terrain (9)
 10 Outdo oneself (5)
 11 Mining method in flat-lying deposits whereby part of the deposit is left behind to support the roof (4,3,7)
 14 Reservoir structure or fossil lava flow (4)
 15 Cytoplasm plus nucleus (10)
 18 State the lower series finds itself in when a thrust sheet passes over it (10)
 19 Between mud and sand(4)
 21 Pertaining to machine-based calculation (13)
 24 The third Kingdom (5)
 25 Surprising, having one's collar felt (9)
 27 When the younger series rests on progressively older members of the underlying series (9)
 28 Process ore by heating and reduction to obtain pure metal (5)

DOWN

- 1 Process whereby organic matter is naturally processed to become oil and gas (10)
 2 Little untruth (3)
 3 At the same time (6)
 4 What the river did before the Oxbow was formed (9)
 5 Lines from the centre of a circle to its circumference (5)
 6 Relationship of progressively younger beds in an upper series formed during a transgression (8)
 7 Removal of the skin: a flaying, stinging critique (11)
 8 Quiet interlude (4)
 12 Play of changing colours caused by interference along planes of voids within a mineral (11)
 13 A phosphorescent or fluorescent mineral does this (5,5)
 16 Thematic dictionary invented by GSL Fellow Dr Peter Mark Roget (1779–1869) (9)
 17 The eggs in the 'basket of' (8)
 20 Inherent factors tending to influence an experiment's outcome (6)
 22 The way things, such as words, for example, are employed in practice (5)
 23 Big frizzy haircut, popular in the 1970s (4)
 26 Wrath (3)

WIN A SPECIAL PUBLICATION

The winner of the October Crossword puzzle prize draw was Alison Dunnachie of Southampton.

All correct solutions will be placed in the draw, and the winner's name printed in the February 2013 issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - January 20.**

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

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SOLUTIONS OCTOBER

ACROSS:

1 Dykes 4 Exfoliate 9 Nullarbor 10 Nepal
 11 Derived Fossil 14 Tide 15 Timepieces
 18 Oncologist 19 Pier 21 International
 24 Shell 25 Oxidising 27 Egyptians 28 Amour

DOWN:

1 Denudation 2 KCL 3 Starve 4 Embedding
 5 Ferro 6 Landslip 7 Appalachian 8 Eels
 12 Reductively 13 Astrologer 16 Ecstasies
 17 Platelet 20 Silica 22 Rioja 23 Isle 26 Iso

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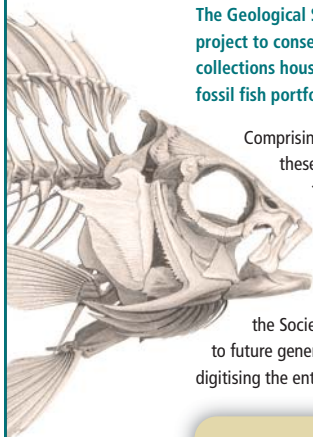


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Comprising nearly 2,000 watercolours and drawings, these images of fossil fish, dating from the 1830s-1860s, were copied from private and public collections around Europe, principally by the German artist Joseph Dinkel. For many years the drawings were kept in a trunk in the Museum and later in different places around the Society. We would now like to make them accessible to future generations of researchers by conserving and digitising the entire collection.

*Agassiz gained international recognition as the leading figure on fossil ichthyology after the publication of the five volume *Recherches sur les Poissons Fossiles*, lavishly illustrated with 400 lithographic plates of fish (1833-1843). In 1836 he was awarded the Geological Society's Wollaston Medal.*

How you can help

If you would like to help the Library and Archive in this project, a small contribution of £20 will allow us to carefully clean, conserve and digitise one fish. The names of all sponsors will be included in a roll of honour in the Archive and on our website. If you would like to make a more substantial contribution please contact us to discuss the options.

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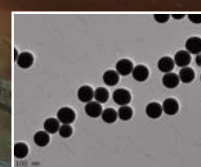
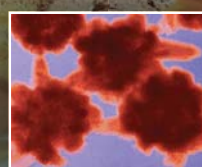
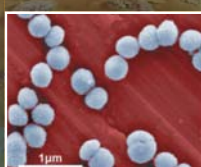


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Nanogeoscience: a new frontier in science and technology for Earth and environmental systems



10 December 2012

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Abstract Submission Deadline: 28 September 2012

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

For further information about the meeting, or to submit an abstract, please contact:
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