Geoscientist

The Fellowship magazine of The Geological Society of London | www.geolsoc.org.uk | Volume 22 No 3 | April 2012

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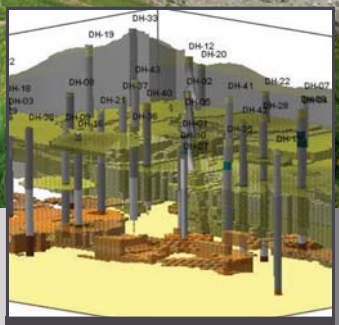

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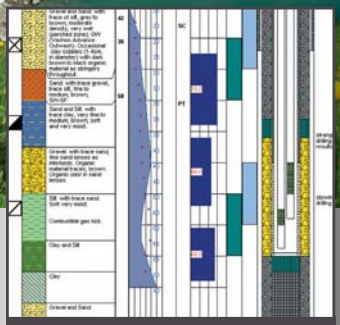

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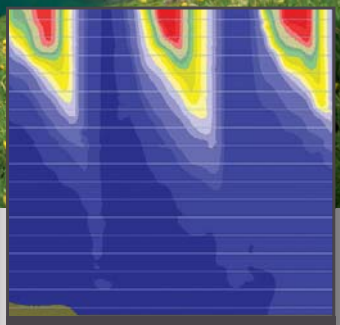

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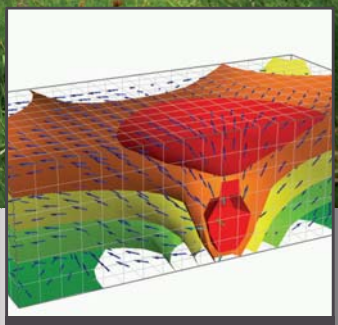

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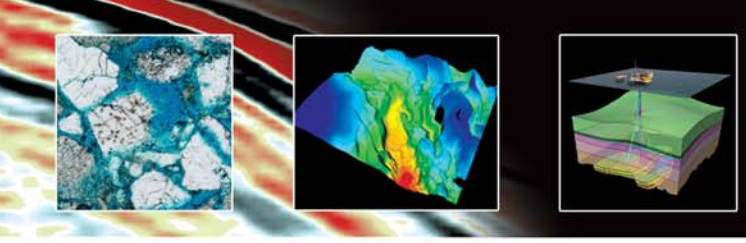

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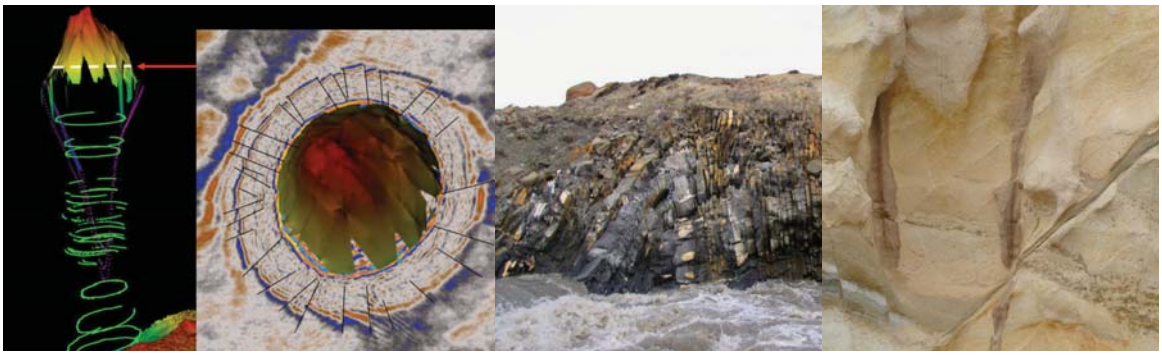

Structural geology is a crucial element in the Petroleum and Mineral Industries. It provides the framework within which we explore, appraise and develop assets, with a critical influence on their commercial success. Industrial activity provides a wealth of structural data to advance fundamental science, which allows theories to be tested through constantly evolving techniques. Ultimately structural geology is a key pillar in supporting the profitable generation of society's energy and mineral requirements, requiring research funding and offering rewarding careers to future geoscientists.

This conference provides an opportunity to review current best practices in structural geology as well as explore and define the relationships between industry and academic practitioners. In a commercial climate, where declining resources, the environment and safety are all fundamental issues, defining future trends and developments through better collaboration will help prepare us for the challenges that lie ahead.

This three-day conference will combine presentation, discussion and workshop formats. We invite contributions covering all practical aspects of structural geology with a commercial application, including: mapping and fault validation; fault seal, trapping and compartmentalisation; regional geology, including restorations and plate-scale reconstructions; risk, uncertainty and volumetric assessment; geomechanics, fracture prediction and (HPHT) production behaviour; unconventional resources; carbon storage; application of analogues; salt tectonics; data collection, synthesis and integration.

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Martin Jackson (AGL, BEG, University of Texas)
Steve Jolley (Shell)
Dave Sanderson (University of Southampton)
Richard Swarbrick (Ikon Science/Geopressure Technology)
John Underhill (University of Edinburgh)
John Walsh (Fault Analysis Group, UCD)
Nicky White (University of Cambridge)
Graeme Yielding (Badleys Geoscience)

For further information and registration, please contact:
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Front cover image

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BRICKBAT TIME

One of the mistakes that scientists frequently make whenever they turn their minds to matters of public awareness, is to think that all people at all times must do nothing other than fall on their rear ends in admiration. Anything less is so often taken as some kind of failure.

Now this would be all the more laughable if available evidence did not show that scientists are already among the more highly admired and respected of people in society. But heavens, let us not allow facts get in the way of a good prejudice, especially if it allows us to whimper alone in our rooms, which after all in this adolescent fantasy is the next best thing to being invited to parade through London on elephants. No, take it from me - the sure way to know you've made it is to find yourself attacked for never being off the telly. I am happy to say that such evidence is emerging.

First, the Guardian's TV critic Sam Wollaston (no relation, we assume), offering his view on BBC's *Super Smart Animals*, wrote of its presenter Liz Bonnin on 8 February: "She could have done more to show off her (genuine) science credentials as well as her lovely smile; but then it is a nice change to have a science programme that isn't some Scottish bloke banging on about rocks." Ahem. I think we all know who you mean, Wollaston. And he's from Glasgow, so I'd watch it if I were you.

Anyway, hardly had we stopped reeling from this piece of cheek when another BBC series *The Great British Countryside*, fronted by comedian Hugh Dennis and *Countryfile's* Julia Bradbury, elicited the following opening sentence in a review by the *Daily Telegraph's* Michael Deacon. Clearing his throat for a legitimate complaint about the little Englandism that so often overtakes popular lanscape-related programmes, he wrote: "You know Britain's in a bad way when we're reduced to bragging about our geology. Don't worry about recession or cuts or unemployment – we've got some first-rate granite, and don't let anyone tell you different.... On the soundtrack, strings soared majestically. It felt like the Last Night of the Proms, but with slightly more talk of magma."

Well, now that they're well sick of us on the telly, Nick Petford (no stranger to the box himself), urges us to spread our tedious dominion over the social networks too. Amen to that, say I. There can be no surer sign that one's head – or any other part of the anatomy – has begun to poke above the parapet than some nonentity or other should begin taking pot-shots at it. It is nothing to worry about. I look forward eagerly to being de-friended and unfollowed anytime soon.

DR TED NIELD EDITOR

Going Ga Ga

BY PROFESSOR NICK PETFORD

Professor Nick Petford ponders the communication potential placed at our fingertips by the new technologies

The story of scientific communication is not unique to geology, but geology is unique to science and it is in the spirit of our founding fathers that I promote the cause of our science above all others.

The Society was founded at a time of exceptional discovery, fuelled by controversies, excitement and professional skulduggery. At this time there were just a handful of professional geologists; but knowledge of geology was relatively widespread and 'men of culture and wide sympathies' developed the science. Many were Fellows of the Royal Society and also the Athenaeum, founded in 1824 – and still home to the Society Dining Club.

TAMBORA

The Geological Society had its origin at a dinner held at the Freemasons Tavern in Great Queen Street. Humphrey Davy wrote on November 13 1807 to WH Pepys "We are forming a little talking Geological Dinner Club, of which I hope you will be a member. I shall propose you today". So in the early years, geological communication was simple – talking, over dinner, in a convivial environment. Mass communication this was not.

In 1815, eight years after the foundation of the Society, Tambora erupted. Today, very few outside the profession have ever heard of Tambora. But who has not heard of Krakatoa (famously relocated East of Java by the Disney Corporation), which erupted in 1883?

What had happened in the 68 years after Tambora, an eruption many times more powerful, was mass communication - a new and revolutionary technology, the telegraph. It is wrong to imply that the Internet was the first to network the planet globally. It was the cable network linking Jakarta with Paris and London that allowed the news of a far-away volcanic eruption to make the front pages of the morning editions across Europe.

The wireless, Logie Baird's televisual device, beaming the face of Iain Stewart into every home... for the last 80 years such technologies have been the dominant tools of mass communication. But today, they are being challenged by new and disruptive technologies – the social network exemplified by facebook and twitter.

DARWIN'S I-PHONE

Lady Ga Ga has 11 million twitter followers. The Society must move to embrace these forms of communication to stay relevant in the 21st Century. Imagine if Darwin had taken an iPhone on the Beagle, or Hutton had reporting his observations at Siccar Point live on Skype. Sedgwick once claimed he would leave "no stone unturned" in his pursuit of his science. I suggest we, as a Society, leave no technology unturned in our pursuit to communicate the science we love to the widest of all possible audiences.

Professor Nick Petford was the first to embed a video in a Geological Society-hosted blog, (from Stromboli. He is Vice-Chancellor of the University of Northampton. This piece was taken from his address to the Founders' Dinner 2011 at Le Méridien, Piccadilly

SOAPBOX

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

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

Email your piece, and a self-portrait, to **ted.nield@geolsoc.org.uk**. 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).

> "I SUGGEST WE, AS A SOCIETY, LEAVE NO TECHNOLOGY UNTURNED IN OUR PURSUIT TO COMMUNICATE THE SCIENCE WE LOVE TO THE WIDEST OF ALL POSSIBLE AUDIENCES"
> **Professor Nick Petford**

Forests of the polar night

Antarctic forests (without the dinosaurs) may be about to make a comeback, according to new research from Royal Holloway, University of London, published this week

PALAEOBOTANY

A comprehensive database of fossilised Cretaceous forests has been compiled for the first time, allowing scientists to create maps of 100 million year-old forests. The maps have provided the most accurate picture yet of a world where atmospheric carbon was at levels of at least 1000 parts per million (ppm).

> WE COULD SEE A RETURN OF FORESTS TO ANTARCTICA. HOWEVER, IT'S UNLIKELY THAT DINOSAURS WILL BE MAKING A COMEBACK
> **Dr Falcon-Lang**

The Cretaceous Period, which lasted from around 145 to 65 million years ago, was one of relatively warm temperatures and high sea levels compared to the present day, and culminated in the famous K/T mass extinction, which saw off the dinosaurs as well as 77% of species.

Several thousand Cretaceous forest sites have been discovered, but their data have never before been brought together in one place. The research, published in the journal *Geology*, is led by Royal Holloway, University of London PhD student Emiliano Peralta-Medina, who is studying Cretaceous climates as an analogue for future global warming. It provides an insight into the effects of extremely high concentrations of atmospheric CO_2 on fauna.

"Our research shows that weird monkey puzzle forests covered most of the planet, especially in the steamy tropics" he told *Geoscientist*. "At mid-latitudes, there were dry cypress woodlands, and near the North Pole, it was mostly pines."

This changed towards the end of the Period, when "flowering trees similar to magnolias took off, bringing colour and scent to the world for the first time".

The study also looked at the width of tree rings from the period, revealing that Cretaceous trees grew at twice the rate of modern trees, with the fastest growth occurring at the poles.

Above: Forests of *Araucaria* covered most of the vegetated parts of the planet during the Cretaceous

"Some of our fossil trees from Antarctica had rings more than two millimetres wide on average" says co-author Dr Howard Falcon-Lang. "Such a rate of growth is usually only seen in trees growing in temperate climates. It tells us that, during the age of dinosaurs, polar regions had a climate similar to Britain today."

Atmospheric carbon levels are currently at 393 ppm – a long way off from Cretaceous levels. But the researchers estimate that it will only take us another 250 years to reach 1000 ppm, if concentrations continue to rise unabated.

"If that happens" says Dr Falcon-Lang, "we could see a return of forests to Antarctica. However, it's unlikely that dinosaurs will be making a comeback."

REFERENCES

- **Peralta-Medina, E, Falcon-Lang, H J,** 2012: *Cretaceous forest composition and productivity inferred from a global fossil wood database.* Geology 40 (3), in press

Fife catches the GeoBus

The University of St Andrews launched a new Earth sciences outreach project for secondary schools on 18 January 2012 at Buckhaven High School in Fife, writes **Dawne Riddle**

Photo courtesy of East Fife Mail

GEOEDUCATION

TV presenter Professor Iain Stewart (University of Plymouth) ceremonially de-pressurised a bottle of "Scotland's other national drink" to wish GeoBus on its way. The mobile Earth sciences resource will travel to secondary schools throughout Scotland and northern England, and has been designed to support secondary school teachers, particularly in Scotland where very few schools offer Higher Geology. The project is funded by NERC, EPSRC, Maersk Oil, Shell, Centrica, the Geological Society and the Mineralogical Society.

> GEOBUS AIMS TO SUPPORT THE CURRICULUM WITH HANDS-ON TEACHING PACKAGES

GeoBus was developed by Dr Ruth Robinson (Department of Earth Sciences, St Andrews) with the aim of supporting Earth science teaching by any science teacher. Kathryn Roper, a BSc Geosciences graduate of St Andrews, who also has a postgraduate teaching diploma and has taught for two years in secondary school, is the project coordinator. GeoBus aims to support the curriculum with hands-on teaching packages developed by staff from Earth sciences and other physical sciences researchers at St Andrews.

INNOVATIVE

Robinson told *Geoscientist*: "All teaching materials and resources are brought to the school, including microscopes, mineral, rock and fossil collections, small flumes, compasses, hand lenses and handheld GPS units." An innovative aspect of GeoBus is the way it involves early-career researchers, who will be helping to develop the teaching resources.

Above: Pupils identifying rock types as part of an indoor geological mapping exercise. From left to right: Ruth Robinson (develop and manager of GeoBus), Buckhaven High School pupil, Iain Stewart, and Kathryn Roper (coordinator of GeoBus)

Below: Iain Stewart launches GeoBus at Buckhaven High School. Present with Iain are members of the Department of Earth Sciences and pupils from Buckhaven High School

"The aim is to engage and inspire young would-be scientists by introducing them to hands-on practical exercises that cover a many exercises will be based on current research outcomes" Robinson says.

"A further benefit to schools is an emphasis on potential career pathways. The project will provide a bridge between industry, HEIs, Research Councils, and schools, and it is hoped that more young people will be encouraged to think about a career in geology or Earth sciences as a result."

Any school interested in booking GeoBus should visit the website (www.geobus.org.uk). The current funding for the project will support visits to schools throughout school term time until June 2014.

Photo courtesy of the University of St Andrews

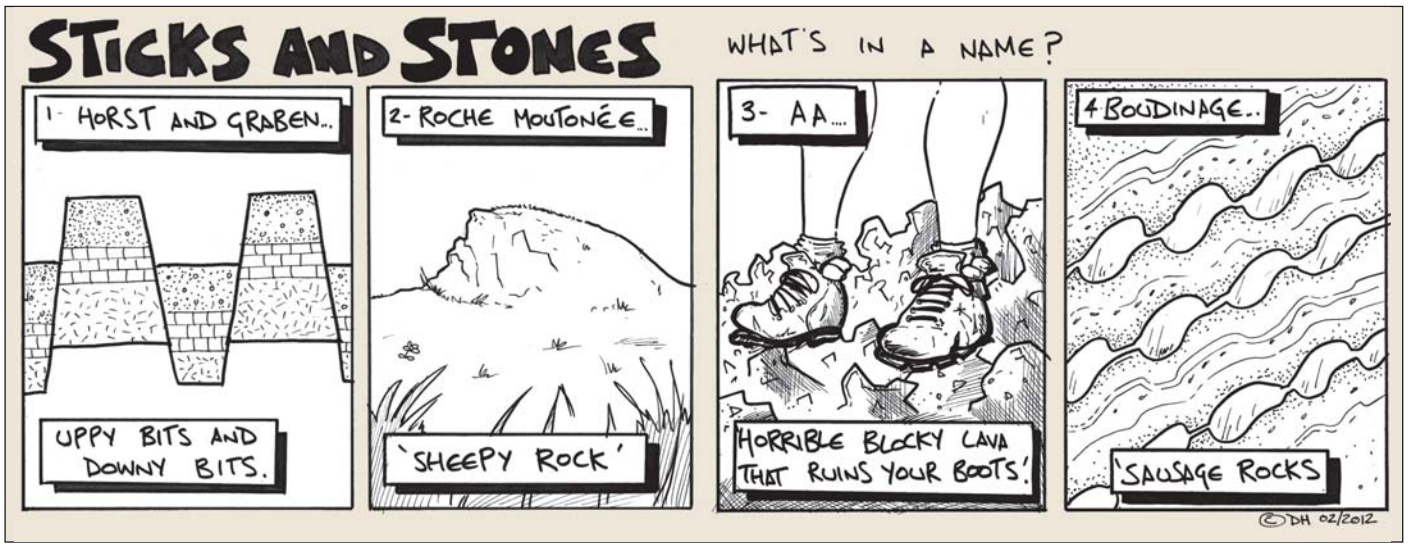
Heading here please

[FUNNY OLD WORLD]

Lucy Lawless, best known for her role as *Xena: Warrior Princess*, is taking on a new role as environmental campaigner and she has Shell in her sights. According to Greenpeace (picture) Lawless was one of six activists who on February 23 boarded a contracted drilling ship and climbed the derrick. The ship, bound for the Chukchi Sea off Alaska to drill three exploratory wells for Shell this summer, had its departure from Taranaki delayed by the action, according to Greenpeace. Hydrocarbon companies had better hope that, with her comeback firmly on track in 2012, Miss Piggy doesn't also turn environmental activist. Then they'd really be finished.

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

Former Warrior turns activist - over the hill maybe, but not yet over rainbow



SOCIETY NEWS

FERMOR FUND

Sir Lewis Leigh Fermor (1880-1954), Director of the Geological Survey of India

Applications under the Fermor Fund are invited by 25 June this year, writes Edmund Nickless.

In 1991 the Society received a significant bequest from Lady Francies Mary Fermor, who died in November 1990. The terms of the bequest were to support "furtherance of research into those branches of geology that deal with the study of the principles governing ore deposition the occurrence of minerals and of mineral bearing rocks and fundamental research into the origins of Precambrian rocks including extra-terrestrial occurrences." The first award under the Fermor Fund was made in 1992.

To commemorate the 20th anniversary of that event, the Society is inviting bids against the following headings:

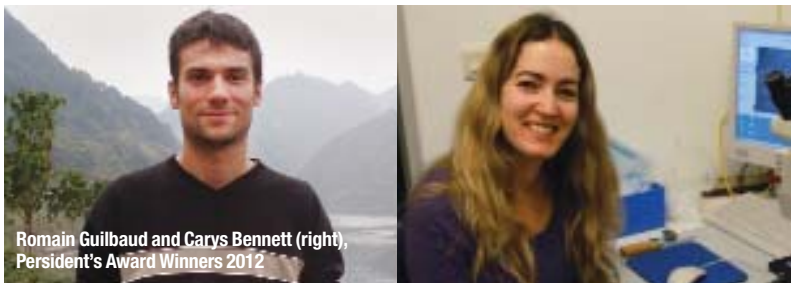
- Small research grants, travel awards to support attendance at a major conference in the UK or overseas; funds for research workshops designed to promote networking
- A 'Fermor Prize' to be awarded to the best, second and third undergraduate independent projects on the basis of nomination by each student's supervisor.

Applications, to be received by **noon Monday, 25 June 2012**, must be submitted electronically using the relevant proforma downloadable from the website (Awards, Grants & Bursaries, in the Society section). The application must clearly state how the proposal meets the terms of the Fermor bequest. A total of £25k is available. It is unlikely that any award will exceed £5k in value. Judgment will be based on excellence, timeliness and achievability.

FUTURE MEETINGS

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

- **2012:** 11 April, 27 June, 26 September, 28 November
- **2013:** 6 February, 10 April.



Romain Guilbaud and Carys Bennett (right), Persident's Award Winners 2012

President's Day 2012

Earlier in the year, the Society announced the winners of its medals and funds 2012. Now, mark your diaries for the Society's gala day – 13 June!

The award winners this year are: Christopher **Hawkesworth** (Wollaston Medal); Eric **Wolff** (Lyell Medal); Frank **Spear** (Murchison Medal); William **Aspinall** (William Smith Medal); Richard **Aldridge** (Coke Medal); Robin **Strachan** (Coke Medal); Geoffrey **Duller** (Bigsby Medal); Cherry **Lewis** (Sue Tyler Friedman Medal); David **Ward** (R H Worth Prize); Bridget Wade (Wollaston Fund); Jamie **Pringle** (William Smith Fund); Daniela **Schmidt** (Lyell Fund); Russell **Wynn** (Murchison Fund); Ian **Jackson** (Distinguished Service Medal); Simon **Winchester** OBE (Distinguished Service Medal).

To these can now be added the recipients of two President's Awards, namely: Carys **Bennett** (Université de Lille 1 - Sciences et Technologies) and Romain **Guilbaud** (School of Civil Engineering and Geosciences, Newcastle University).

Awards will be presented at President's Day, to be held this year on 13 June. On that day (full details in the May issue), as well as the Presidential Address, four senior medallists will deliver short research talks. Titles have yet to be confirmed, but indications are that Chris Hawkesworth (University of St Andrews) will speak on *The generation and destruction of continental crust*; Eric Wolff (British Antarctic Survey) on *Ice cores and interglacials* , Frank Spear (Rensselaer Polytechnic Institute) on *Thirty years of metamorphic P-T-t paths: what we have learned about orogenesis*, and William Aspinall (University of Bristol) on *A restless volcano and restive volcanologists: uncertain judgements and uncertain risks*.

All Fellows are welcome to attend the events of President's Day, though Lunch with the Award Winners will incur a charge. Full details of this, and instructions as to how to register, will be published in the May Issue, which will be distributed together with the *Annual Report 2011*. *Edmund Nickless*

GIS a donation

Yvonne Drummond, Marketing Manager for Exploration Geosciences, writes: A bit of good news! Based on the sales of The Millennium Atlas GIS version in 2011 we have recently sent cheques for £10,395.00 to both Water Aid and Practical Action (formerly Intermediate Technology Development Group). We have also sent a cheque to The Geological Society for £4725.

Further information: **www.wateraid.org ; www.practicalaction.org**

[LECTURES]

Shell London Lecture Series

Reconciling Past and Future Worlds - geology and ground engineering

Speaker – Jackie Skipper

18 April

Planning for and constructing our built environment and infrastructure for today and for the future is an immensely complex process - but 'the ground' is still what keeps our buildings up, and is what we cut or tunnel through to construct roads, train networks, fuel, water and sewage pipelines. We ignore it, and its future behaviour at our peril – it can also fail, be washed away, slip, collapse or erode.

Jackie Skipper is Senior Geologist at the Geotechnical Consulting Group and a Scientific Associate at the Natural History Museum London. After a first career in the NHS, she became a mature student and gained a first in Geology at Greenwich in 1993. Her PhD at Imperial College London was on the stratigraphy of the complex Lambeth Group sediments of SE England, from which she went on to work as a geological consultant in the engineering industry.

- **Programme** – Afternoon talk: 1430pm 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

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Rare map of the month

General sketch of the physical and geological features of British India by George Bellas Greenough. 1854

Visitors to Burlington House will be familiar with George Bellas Greenough's '1819' (actually 1820) geological map of England and Wales, which hangs in the entrance hall next to the more famous 1815 map by William Smith. Perhaps less familiar to them will be Greenough's map of India, which was the major achievement of his later years and the first geological map of the entire Indian subcontinent. Printed on nine sheets, with a complete measurement of 3.2 x 2.7 metres, the map is very detailed, particularly in the foothills of the Himalayas.

Greenough did not visit India, but rather, through written correspondence with fellow geologists and military figures, he created the map using their observations from the field, alongside information from his extensive library (much of which now forms the Society's rare books collection). There was a specific necessity for the map: the East India Company had begun to build the first railways in India in 1850 and good geological information was vital.

The map was published by the Geological Society in 1854, one year before Greenough's death, and copies were distributed to geological societies around the world. One copy was kept for the Society, but tucked away in the basement are four other copies. Why do we have these? Well, because they were originally destined for countries with which Britain was then at war!

Historical Map Prints for Sale! - **www.geolsoc.org.uk/mapsale**

If you would consider sponsoring the restoration of this map please contact **Paul Johnson E: paul.johnson@geolsoc.org.uk**

Sponsor-a-Book update

The Library wishes to thank Mr Damon De Laszlo and The De Laszlo Foundation for recently sponsoring the restoration of Richard Owen's A history of British fossil reptiles (1849 – 1884). The very generous donation allowed us to restore all four volumes, removing rotten sewing while preserving the original buckram cases.

For more information on the Sponsor-a-Book Appeal, please visit **www.geolsoc.org.uk/sponsorabook**

SOCIETYNEWS...

CSI, NCIS, JAG... IUGS?

IUGS IFG Committee Members at the IFG inaugural meeting, Rome, 19 September 2011

Earth science's world organisation opens the case on Forensic Geology – reports Laurance Donnelly.

The International Union of Geological Sciences (IUGS) launched its Initiative on Forensic Geology (IFG) was officially launched during the 62nd Executive Committee Meeting of the IUGS, at UNESCO headquarters, Paris, on 22 February last year. This became named the 'Initiative on Forensic Geology (IFG)'. On 18-19 September, the IUGS-IFG and its newly formed committee members became formally established and launched at an inaugural meeting in Rome.

This was an interesting conjunction because forensic geology was well known by the ancient Romans who, according to Latin writers, were able to locate the camps of their enemies by observing the soil types adhering to the hooves of captured horses. More recently, in 1978, following the kidnap and assassination of Italian Prime Minster Aldo Moro, forensic geologists were involved in analysing soil from his clothing.

RENAISSANCE

Throughout the early 1980s forensic geology developed in Rome; but (as in many other parts of the world) forensic geology seemed to be put on hold and had to await the millennium for further progress. This new Italian renaissance was helped by the development of a Soil Laboratory within Rome's Servizio Polizia Scientifica. In recent years sampling and analytical techniques have improved and Italian geologists have taken part in numerous high-profile cases and assisted police with a variety of criminal investigations.

The meeting was attended by 19 committee members from around the world (picture), organised by Rosa Maria Di Maggio, (formerly of the Servizio Polizia Scientifica, now Geologia Forense Roma) with support from Laurance Donnelly (Chair, IUGS-IFG & Wardell Armstrong).

Further information on IUGS-IFG can be found at: **http://forensicgeologyinternational.org** or **http://forensicgeologyinternational.com**

[REPORT]

Micropalaeontology at NHM

A wind of change is blowing through micropalaeontology at the Natural History Museum, reports Dwain Eldred

The change began with the recruitment of two new members of staff, Tom Hill & Steve Stukins, in December 2011 and January 2012 in the new - and unique - role of 'Museum Scientist'. They will focus effort on enhancing the profile of micropalaeontology by identifying ways in which the NHM's collections can benefit the wider micropalaeontological and geological community.

These activities will be underpinned with 'stakeholder engagement' - in other words, talking to people with a vested interest in the future direction of micropalaeontology. Hill and Stukins's remit also includes advising on collections development needs, training and education opportunities, income-generation potential and research priorities.

At this early stage the new recruits say they "want to make all *Geoscientist* readers aware that of their presence at the NHM, and how to get in touch if they have any queries or suggestions" – see below. They hope to develop a 'stakeholder engagement strategy' in coming months, and promise to keep *Geoscientist* abreast of progress.

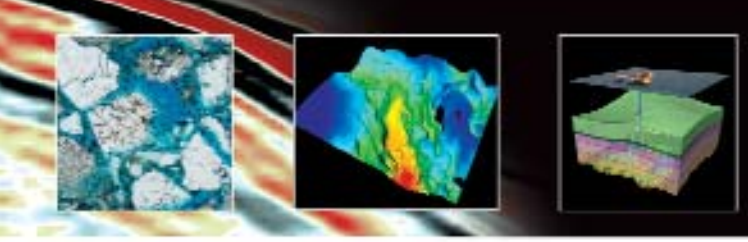
For further information: **E: Thomas.hill@nhm.ac.uk; s.stukins@nhm.ac.uk**

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.

2012 11 April (Burlington House); 23 May.

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



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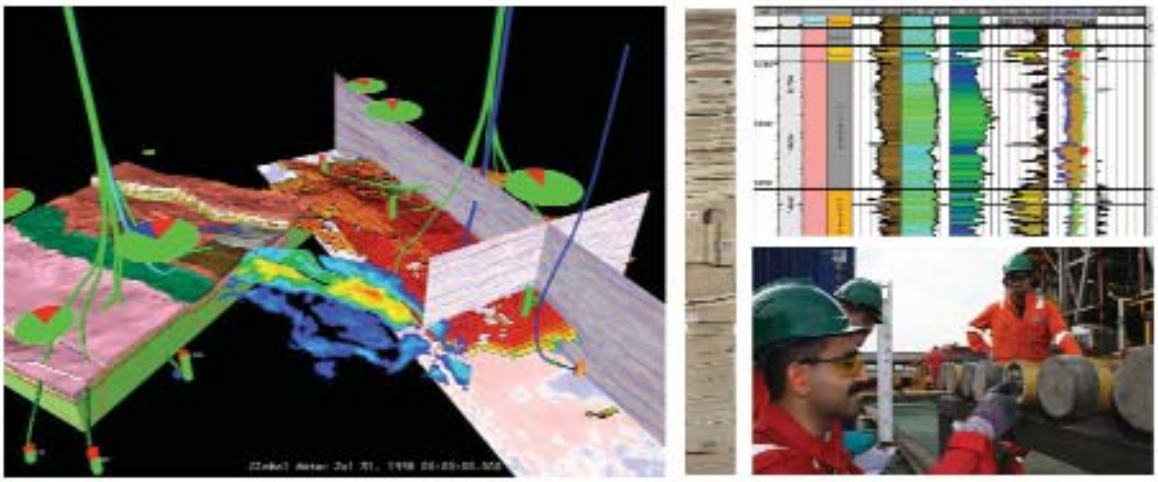

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Operations geology is a critical function in the continuing wealth and health of the hydrocarbon industry. This conference aims to highlight the importance of the discipline of operations geology in the industry today. The conference will provide an opportunity to share best practices through case studies and in doing so will demonstrate the central role that the operations geologist plays as an integrating link between drilling engineers and geoscientists. The conference will promote operations geology as a viable long term career path and demonstrate its value to the industry.

- **NEW AND EMERGING TECHNOLOGIES** - including remote operations, geosteering techniques, visualisation and integration tools
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CALL FOR ORAL AND POSTER ABSTRACTS:
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OFFICERS WITH MAPS

Ted Rose* on how groundwater prospect and engineering geology maps compiled for the Western Front pioneered militarily applied geology in the British Army

Steve Matthews (*Geoscientist 21.6*, July 2011) recently described one way in which the modern British Army makes operational use of geologists. Another is by the compilation of specialist geotechnical maps to help guide military planning. Such maps for recent operations are not yet in the public domain, but the principles that still guide them were established during the First World War and developed in the Second. Long clouded in secrecy, details of that process are now being progressively revealed, especially in recent publications of the Geological and British Cartographic Societies.

Some military applications of geology have been apparent for over 200 years. Napoleon Bonaparte was the first general to take geologists as such on a military operation (the invasion of Egypt, 1798). The future British Geological Survey was founded in 1835 and financed until 1845 under military (Board of Ordnance) auspices, and geology was taught intermittently during the 19th Century at all army officer training institutions in the UK. However, not until World War I were geologists deployed as such to serve on a battlefield: the Western Front.

For most of the 1914-18 War, the Western Front extended from the North Sea coast south across Belgium and northern France to the frontier of Switzerland: some 740 km. A British Expeditionary Force (BEF) deployed to its northern sector from August 1914. Its front line position fluctuated with the ebb and flow of battle, but once the Front had largely stabilised into a zone of trench warfare in late 1914, the BEF held the ground approximately from Nieuport on the Belgian coast south to Amiens in France, a distance of about 130 km.

TERRAINS

Geologically, the BEF occupied land of three terrains. The first was a coastal zone of contemporary sand dunes, and Quaternary sediments reclaimed (as 'polders') from the sea. The second consisted of the Flanders Plain, mostly underlain by a bedrock sequence of alternating (mostly Lower Eocene) mudrocks and weakly cemented sandstones (similar to the London and Hampshire Basins in England). The third comprised the plateaux of Picardy and Artois, underlain by bedrock of Upper Cretaceous Chalk (similar also to that of southern England).

The scale and intensity of largely static warfare on the Western Front stimulated many technical innovations. The German Army was quicker than the British to make use of geological expertise, beginning in 1914. By 1916 it had developed a military geological organisation as such, with 29 teams of geologists, one for each section of the 'military mapping and survey' service as then constituted. The British Army made slower use of geologists, as two particular problems became evident.

WATER SUPPLY

The BEF expanded progressively from one to five armies. At its peak in 1916 it comprised some 1.5 million men and 500,000 horses / mules (mostly to transport stores forward from railheads, ▶

Image © Vaughan Sam / Shutterstock

Preserved trenches dating from World War One, Belgium

rather than as mounts for cavalry!). As numbers of men and animals increased, water supply became a problem. Each man/animal was calculated to require 10 gallons (45 litres) of water per day to meet all requirements. However, near the front line both surface and ground waters were vulnerable to pollution by munitions, ordure, dead bodies of men and animals, while pipelines were vulnerable to damage. Water from civilian wells was usually insufficient to support the high concentration of troops.

The problem was solved by innovations that included mobile rigs, bought from the USA, to drill deep boreholes; air lift pumps raised water quickly and in quantity from these depths; Well Boring Sections in the Royal Engineers (one per army) were formed to operate the new drilling equipment; and a geologist was appointed to serve as a staff officer at BEF General Headquarters to guide drilling for potable water. His name was Lieutenant (later Captain) W B R King.

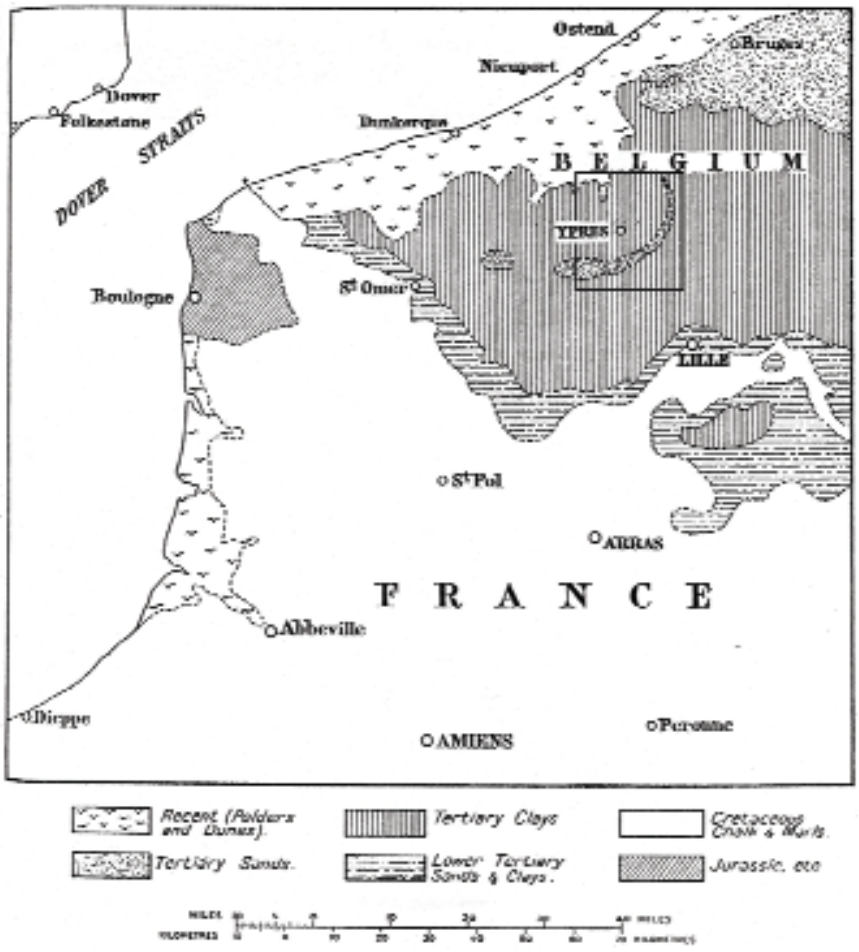
Born in Yorkshire in 1889, 'Bill' King had graduated from the University of Cambridge with 1st class honours in geology in 1912, and joined the Geological Survey of Great Britain. On the outbreak of war he was undertaking fieldwork in Wales, but volunteered for service as an infantry officer in the British reserve forces (the Territorial Army). He was commissioned as a 2nd Lieutenant in the Royal Welsh Fusiliers in September 1914.

When the Survey's Director (Aubrey Strahan) was asked by the BEF engineers to nominate a geologist to provide 'expert' advice on water supply, King was thus an obvious choice: young, physically fit, enthusiastic, and of proven geological ability. In April 1915 he was appointed to the War Office in London, to assist and be trained by Strahan in war-related hydrogeological work, before joining the staff of the BEF Chief Engineer (later re-titled Engineer-in-Chief) in France.

He served with the BEF from June 1915 until hostilities ended, in November 1918. His role during this time was (where feasible) to supervise and direct the drilling of boreholes to supply drinking water to British forces, and to develop specialist water supply maps to be used by military planning staffs, or by water supply engineers in the many cases where it was impracticable for him to be present in person.

King compiled maps that included:

- From 1915, a set of 14 water supply



Near-contemporary geological sketch map of Belgium and northern France centred on the British-occupied region of the Western Front in World War I: area of map on opposite page outlined

Photo courtesy of his daughter, Professor C. A. M. King (from Rose & Rosenbaum 1993)

Lieutenant Bill King, at Versailles in France, September 1915

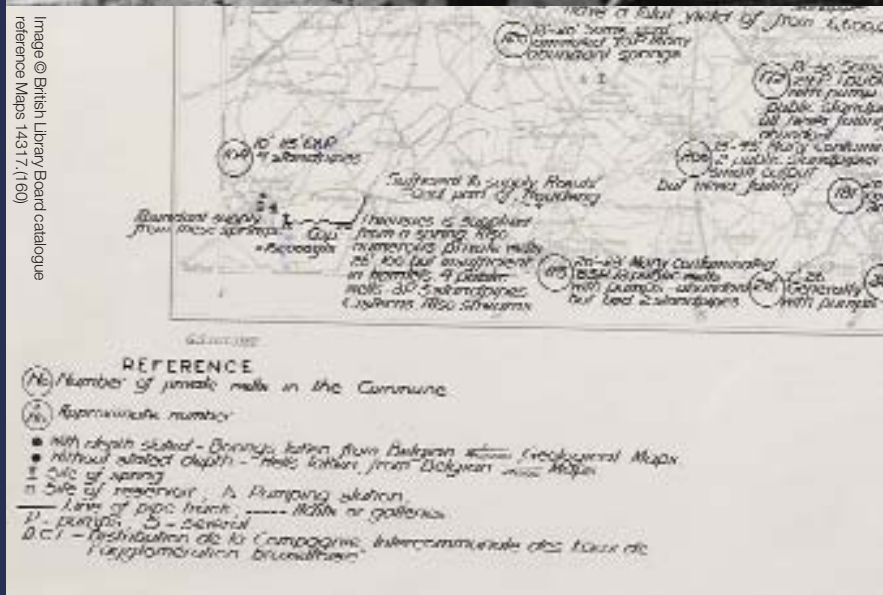
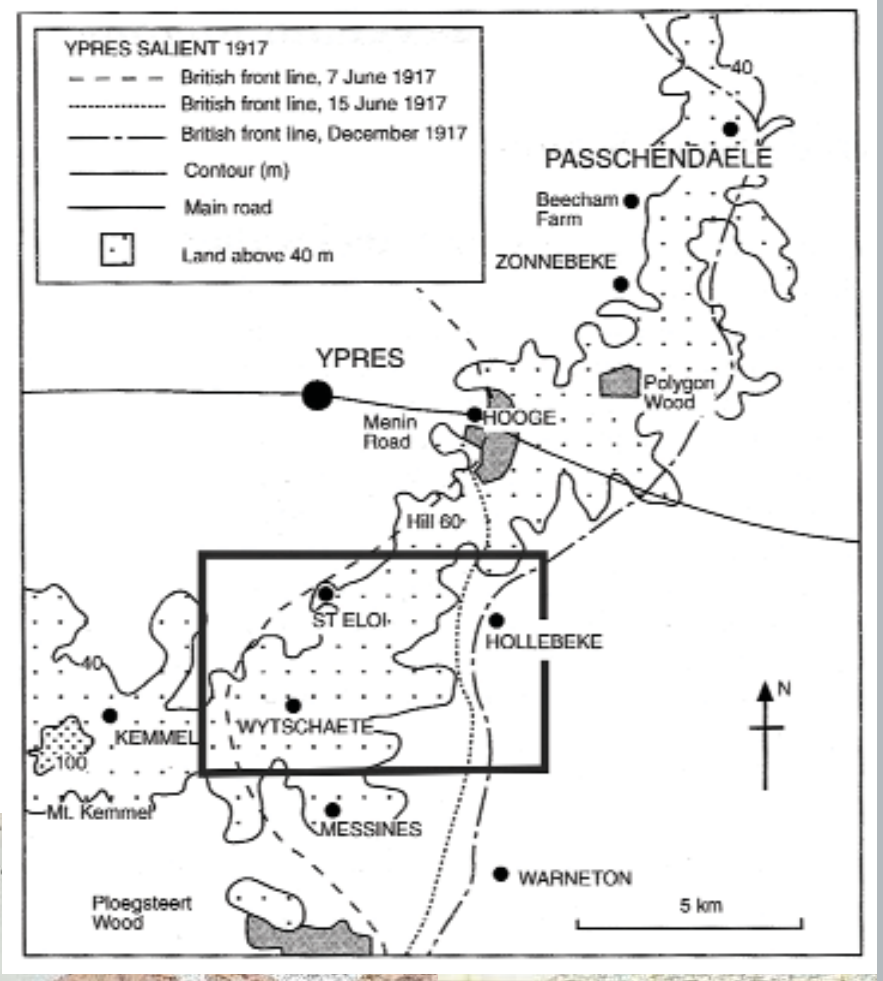
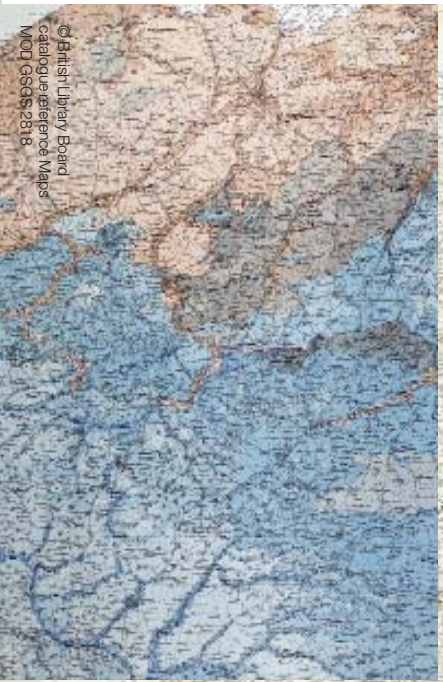


Image © British Library Board catalogue reference Maps 14317.(160)

Part of World War I water supply map of Belgium, 1:100 000 scale series showing information about existing civilian supplies derived from sources including topographical and geological maps



Simplified topographical map of the Ypres Salient of the Western Front during 1917, showing the position of the town of Ypres (now Ieper) relative to the high ground that forms the Wytschaete-Passchendaele Ridge, and the advancement of the British front line eastwards from June to December 1917; Wytschaete area outlined



Left: Part of map at 1:250 000 for Belgium and northern France showing the region divided into areas according to the probable sources of water supply and the type of engineering plant required

Far left: Part of map at 1:250 000 for Belgium and northern France showing the relative abundance of water in the summer months

Topographical map at 1:250 000 for the Somme region of France overprinted with contours for the surface of a marl horizon relatively impermeable to water

maps at 1:100 000 for the whole of Belgium and the enemy-occupied territory of northern France, plotting all the information about existing civilian water supplies that could be gleaned from a variety of sources, including geological maps published before the war.

- In May 1916, a map at 1:250 000 for Belgium and northern France showing the relative abundance of water in the summer months: quality indicated by colour type (blue = good, purple = fair, red = poor), quantity by colour intensity (dark = abundant, medium = moderate, light = scarce).
- In 1918, another map at 1:250 000 for Belgium and northern France showing the region divided into 15 areas according to the probable sources of water supply and the type of engineering plant required.
- Also in 1918 and at 1:250 000, a map for the Somme region of France (the southern region contested by the BEF, underlain mostly by Cretaceous Chalk, in which most British military boreholes were emplaced), showing contours of the surface of a marl horizon relatively impermeable to water as well as topographical contours – since to get a good yield from boreholes in this region, it was calculated that the bore penetrate not less than 15 m of water-bearing Chalk. Potential drilling depths could be calculated from the map.

King guided emplacement of at least 470 British military boreholes during the war. Some of his maps (particularly at 1:40 000) assisted development of a water supply infrastructure within areas already occupied by the British armies. Other maps, such as those illustrated here, assisted planning and procurement of equipment for advance into new areas, e.g. that by the British Third Army, when between 21 August and 11 November 1918 some 300 000 men and 100 000 horses/mules crossed a zone about 20-25 km deep with almost no surface water to sustain them.

TUNNELS & DUGOUTS

By 1915 the opposing forces were massively entrenched and the front line increasingly fortified. Mining was therefore developed by both sides on an unprecedented scale as a means of breaching fortifications. Tunnels were driven forward beneath enemy positions, charged with explosives, and detonated prior to infantry attack – thus effecting ▶

optimum surprise.

In the British sector, such mine and countermine warfare reached a peak in 1916. The BEF raised nine Royal Engineers tunnelling companies in 1915, expanding these to a total of 25 plus three companies from Canada, three from Australia, and one from New Zealand, by the end of June 1916. The BEF thus had about 25,000 British and Commonwealth troops actively engaged in military mining. This phase of the war culminated in the Battle of Messines: an attack on German troops occupying the southern part of the Wytschaete-Passchendaele Ridge, to the SE of the town of Ypres (Ieper in Flemish).

The attack was planned for the summer of 1916 but postponed to 7 June 1917. Near simultaneous discharge of 19 mines, whose tunnels in total contained nearly 450,000 kg of high explosive, across a front of 16 km, prior to massed infantry assault, ranks as the greatest and most successful operation ever carried out in mine warfare.

Thereafter, mining activity gradually declined. Mining was effective only against a strongly held front line, and by the close of 1917 the front was held more by artillery firepower than infantry manpower. As mining declined, so BEF tunnelling companies were increasingly diverted to the construction of dug-outs to shelter troops from artillery bombardment. To guide excavation, between September 1917 and June 1918 a series of twelve specialist geological maps was compiled and widely distributed to troops of the British Second and Fifth Armies.

In total, these maps covered the whole of the Wytschaete-Passchendaele Ridge and adjacent areas, an area of about 500 km^2, at a scale of 1:10 000. Printed in England by the Ordnance Survey at Southampton, they were the first series of relatively large-scale engineering-environmental geology maps to be published for British use, and arguably the first published large scale engineering geology map series *per se*.

EDGEWORTH DAVID

The maps were primarily the work of Major (later Lieutenant-Colonel) Tannat William Edgeworth David. Born in Wales in 1858 and educated at the University of Oxford, David had emigrated to Australia and achieved considerable academic distinction. Professor of Geology and Geography at the University of Sydney, he arrived at the Western Front in May 1916 with the Australian Mining 'Battalion' he had helped to raise: a white-haired grandfather 58 years of age.

Initially David served as the geological adviser to guide BEF mining operations, but generated the new maps when military priorities changed. Using data transcribed from Belgian geological maps published before the war, which distinguished rock units according to their inferred geological (i.e. chronostratigraphic) age, and data from c. 1000 British and Belgian boreholes, he compiled maps that classified the ground strictly according to its suitability for dug-out construction. Lithostratigraphical units were coloured primarily in shades of red to indicate relatively 'good' (dry) strata, contrasted with 'bad' (wet) units coloured in shades of blue-green.

About 180 British dug-outs were constructed in the Ypres region, of many types but typically with some six metres of cover to be proof against heavy howitzer or mortar fire. Geology proved to be a significant influence on the depth of their construction along the whole of the Wytschaete-Passchendaele Ridge.

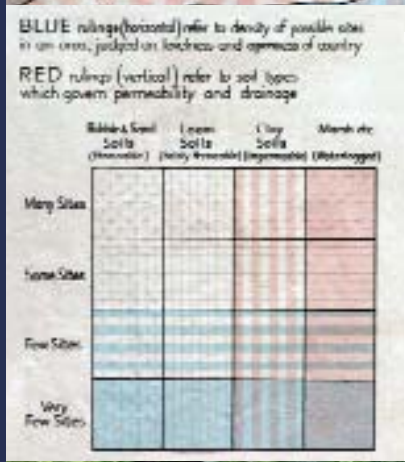
LEGACY

At the end of hostilities, Edgeworth David returned to Australia. He died in 1934 and was accorded a state funeral in recognition of his many accomplishments: a rare (perhaps unique?) honour for a geologist. Bill King returned to employment by the Geological Survey in the UK, before appointment in 1920 to a teaching post at the University of Cambridge, and in 1931 promotion as Professor of Geology at University College in the University of London.

King rejoined the British Army at the start of World War II, in September 1939. After distinguished service once more in France, he was evacuated with the new British Expeditionary Force via Dunkirk in 1940. Back in the UK, he was later to generate new types of geotechnical maps for military use. As the Staff Officer (Geologist) at 21st Army Group headquarters, helping to plan for the Allied liberation of Normandy, he influenced the decision not to invade via Cotentin, but through Calvados, since the geological conditions there were more favourable for the rapid construction of temporary airfields deemed necessary to provide area superiority over the bridgehead. A simplified map compiled in mid 1943 using essentially the red/blue and

Geological map of Wytschaete, Belgium, original at scale of 1:10 000, showing classification of ground according to its suitability for the excavation of dug-outs: shades of red indicate relatively 'good' (dry) strata, 'bad' (wet) units are coloured in shades of blue-green

Part of World War II airfield construction probability map of NW Europe at scale of 1:1million: areas of pale colour are 'good', intense colour 'bad'



Key to airfield construction probability map

Image: Ted Rose

Mine crater, Belgium

Image from University of Sydney Archives, courtesy of Peter Davies (from Rose & Rosenbaum 1993)

Major Edgeworth David, photographed prior to his arrival at the Western Front in May 1916

colour intensity contrasts pioneered in water supply and dug-out suitability maps of World War I, made the distinction clear.

King was released from the Army (as a Lieutenant-Colonel) in October 1943 to become Woodwardian Professor of Geology at Cambridge. By then he had guided foundation of the Geological Section of the Inter-Service Topographical Department: an 'intelligence' unit that was to generate numerous geotechnical maps and reports during the rest of the war. Also, he had groomed one of his pre-war undergraduate students at Cambridge, Fred Shotton, to be his successor at 21st Army Group HQ. There Shotton compiled a wide range of specialist maps (notably for beach trafficability, suitability for rapid construction of airfields, and groundwater prospects).

Even after release to Cambridge, King helped to compile a series of groundwater prospect maps that assisted the Allied campaign eastwards across northern France and the Low Countries to victory in Germany. Postwar, he became the geological adviser to the UK War Department (later Ministry of Defence), and helped to create a small pool of geologist reservist officers to maintain geological expertise for the British Army. He died in 1963, but the recent work of Steve Matthews in Afghanistan reveals that successors of his 'pool' still exist, in the Territorial Army.

King's World War I experience generated an enduring legacy. He recognised that as a geologist advising non-geologists tasked with decisions involving the best use of ground, his advice had to be clearly relevant to the specific problem in hand (e.g. sites for boreholes to abstract potable groundwater, excavations for dug-outs, or rapid construction of temporary airfields); that it made more impact to communicate initially with simplified illustrations (e.g. maps) than technical words; and that in the military context at least, non-geologists seeking advice were interested fundamentally in just two concepts: 'go' and 'no-go'. It might be necessary to introduce a third (intermediate) category of 'slow-go', but anything more complex was likely to lose impact. These principles still apply. ■

* **Ted Rose** Honorary Research Fellow in Earth Sciences, Royal Holloway, University of London

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WINE ON THE ROCKS

Jenny Huggett* admires some rocks - and the odd beaded bubble – among the developing wine-growing industry of the Eastern Mediterranean.

Exactly where wine was first made is lost in the mists of time, but archaeological research has confirmed that the blushful Hippocrene has been made in the Eastern Mediterranean since around 3200 BCE. Although the spread of Islam from the 6th Century CE onwards diminished demand, the Christian communities of the region have kept wine culture alive. An exciting new project to create a wine museum of the Levant in Lebanon's Bekaa Valley will include a substantial section on the geoviticulture of the region; and it was this that led me out there.

The climate of the upland regions of Lebanon is particularly well suited to winemaking, with almost continuous sunshine in the summer, and heavy rainfall from late autumn through early spring to recharge the aquifers. Most vineyards are in the Bekaa Valley, where temperatures are typically ten degrees cooler than at sea-level; though in summer they still hover around a scorching 35°C.

TERROIR

Factors linked to geology that influence wine quality are water availability, nourishment and topography. The much-abused term 'terroir' approximates to the sum of these factors, together with aspect and climate.

Lebanon is divided into three main geological and topographic units: the Mount Lebanon range, which rises from the sea to 3083m, the Bekaa Valley, which despite the name lies at 800-1200m, and in the east, the Anti Lebanon range, with its highest peak at 2814m. The country's geological structure consists of two large NNE-SSW trending anticlines (the two mountain ranges) separated by a large syncline (the Bekaa). The Yammouneh Fault, the northern continuation of the Dead Sea transform fault, is responsible for dramatic slopes on the western margin of the Bekaa Valley.

Most of Lebanon comprises lower to middle Cretaceous sandstones and limestones, though early Jurassic limestones occur in the cores of the anticlines, and the southern up-thrust of the Yammouneh Fault. In the Early Tertiary, folding uplifted the Mesozoic rocks as Arabian and African plates collided. The sea retreated from the Bekaa depression, and Miocene-Pliocene conglomerates and lacustrine limestones were deposited. In the Pleistocene, the Bekaa was sporadically submerged beneath a large lake. In the last 10,000 years as the climate has warmed up, the lake has receded leaving rich fertile soils that have been farmed since the dawn of agriculture.

The limestones of the Mount Lebanon range extend north into western Syria and south into Israel and western Jordan. Extensive basaltic plateaux (of probable Miocene age) spread across much of central Syria, and to the south into Jordan.

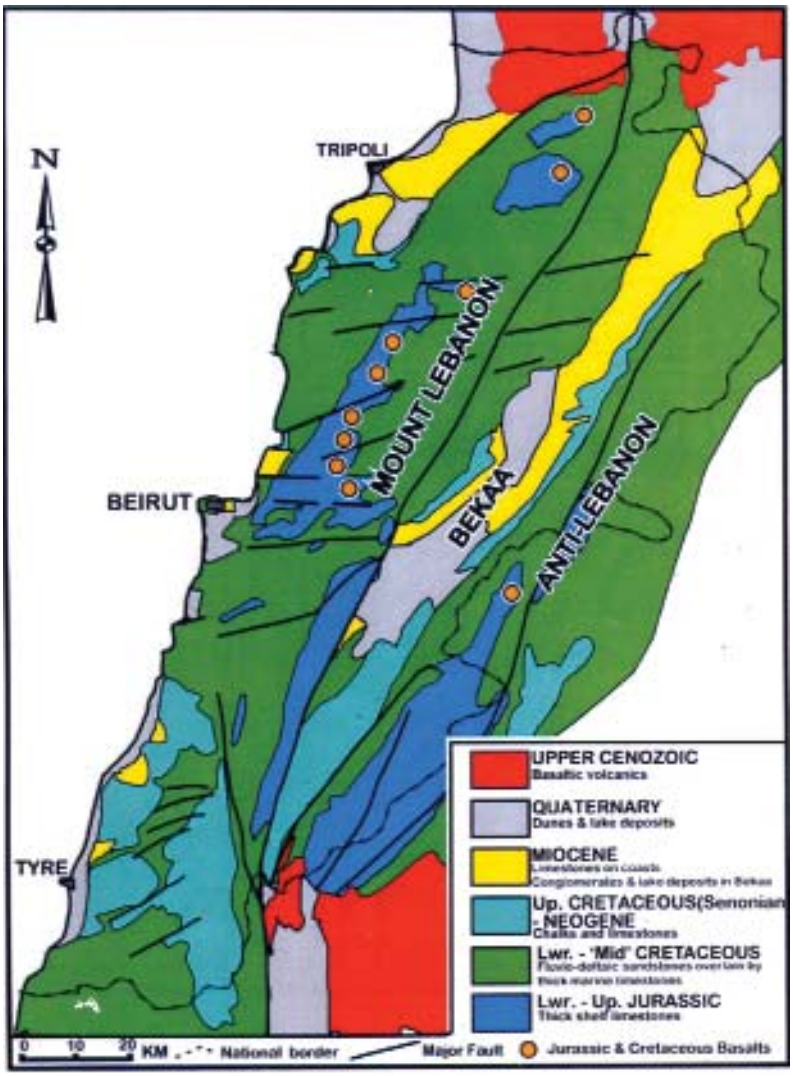
Left (clockwise from top): Marsyas vineyard in the Bekaa Valley. This vineyard is ideally sited on an outlier of Cenomanian limestone on the alluvium-rich plateau. The soil here is rocky and low in humus, producing well structured elegant white and red wines. In the distance the Mount Lebanon range can be seen on the far side of the Yammouneh Fault.

St Georges vineyard, Mafraq in Jordan. Rich clay-rich soil on basalt, with limestone rock fragments derived from the nearby hills of Cretaceous limestone

Cretaceous limestones exposed in nearby hills

Solution hollows in karstic Cenomanian-Turonian limestone at Bargylus vineyard, Syria

Right: Geological Map of Lebanon



TERRA ROSSA

Throughout the region the soil on limestone is *terra rossa*, the classic Mediterranean climate soil of limestone areas. This largely comprises the limestones' insoluble residue, with a highly variable proportion of loess (sand blown from North Africa and Arabia) and rock fragments. Almost mystical properties are attributed to the perceived richness of this soil, here and in other parts of the world, such as the Coonawarra of South Australia. There is no clear reason why *terra rossa* should yield better wines that other soils; perhaps the significance is that *terra rossa* is only associated with the Mediterranean climate.

Most soils contain all the chemical nutrients that vines require for healthy growth in abundance. However on soils rich in organic matter, vines grow fast and the fruit lacks intensity of flavour. This is why quality wines are grown on what are described as 'poor' soils, though they are only deficient in organic matter, and not the elements derived from rock. ▶

What is apparent from the Bekaa Valley is that the best wines are made on shallow, stony *terra rossa* soils poor in organic matter. Soils that fit this pattern occur close to the western margin of the plain, and on outliers of limestone and conglomerate in the valley. Higher up the slopes there is almost no soil at all, while in the deep, also rubified, alluvium of the central part of the valley there is so much humus that it is better suited to growing potatoes than vines.

The ideal scenario for viticulture is a high porosity low permeability rock overlain by a well drained soil. This is particularly true where rainfall is highly seasonal, as in Lebanon and western Syria. Vines hate to have their roots water-logged; they need good drainage, which is easily achieved by a balance of sand, clay and rock fragments in a soil overlying porous rock. A rock of fairly low permeability has the advantage that the water table does not become excessively lowered during the summer months. Although the Mesozoic limestones of Lebanon, Syria and Jordan are fairly well indurated, deep karstic weathering and faulting allow water to percolate deeply.

Above left: **Chateau Marsyas vines, Bekaa Valley, Lebanon**

Inset: **Some of the product awaiting the bottle**

Above right: ***Terra rossa*** **soils may be poor in organic matter but not in rock-derived minerals**

WATER

In the past it could be said that Lebanon's greatest natural resource was water. However excessive abstraction here and elsewhere in the region has resulted in the water table being lowered by as much as 100m. In the mountains of western Syria, (Cenomanian-Turonian limestone and dolomite) the water table now lies at 250m, while in the Bekaa Valley it is at 150m depth.

The wholly organic vineyards owned by the Saadé family - Bargylus in western Syria and Marsyas in the Bekaa - are both on karstified limestone with a stony *terra rossa* soil 30-100cm thick. In these vineyards the young vines are encouraged to root deeply by planting, between the rows, crops that tend to open up fractures in the deeply weathered rock immediately beneath the soil. This has successfully avoided the need to irrigate vines over two years old - a practice that will become more common as water becomes ever scarcer. Excellent wines are also made on the geographically lowest portion, of the east-facing slopes of Kimmeridgian limestone in the Bekaa Valley. Here the soils are very stony and produce well structured wines that are less full-bodied than those grown where the soil is deeper.

In Jordan the St Georges vineyard has been planted fairly recently by Omar Zumot. He freely admits that many thought he was crazy to do so, but his wines demonstrate otherwise. He has planted two areas - one on basalt on the northern border with Syria, the other on Cenomanian limestone close to Madaba, where wine was made in Biblical times.

The basalt landscape is desert, with around 75mm rain/year, and a water table at 300m, from which water is pumped to irrigate the vines (vines cannot survive here without irrigation). The soil however is 5-7m deep, stony (due to inclusion of limestone from the surrounding Cretaceous hills) and rich in inorganic nutrients derived from the basalt. This soil is much more clay-rich than the *terra rossa*, a fact that is undoubtedly advantageous in this climate as the clay can absorb what little rain may fall, and hold it in for longer. Typically for basalt soils, the clay is smectite. This is further good news for the vines as smectite gives up its interlayer cations to nutrient seeking plants more readily than do other clays. ■

* **Dr J M Huggett,** Petroclays, The Oast House, Sandy Cross Lane, Heathfield, Sussex TN21 8QP United Kingdom.
E: info@petroclays.com

FURTHER READING – ACKNOWLEDGEMENT

For further information on the geology of Lebanon see the excellent documents by **Chris Walley** readily available on the Internet. He is thanked for permission to use the map featured here.

READERS' LETTERS

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

INSENSITIVE – AND UNWISE (CONCLUDED)

Sir, I was saddened to see this picture (*Geoscientist 21.11, p07*) depicting a person crouching adjacent to the vertical sidewall at the base of an unsupported trench of at least four metres' depth. At best, what is shown is plainly bad practice; at worst your journal is apparently condoning a potentially life-threatening situation.

The law on such issues reflects common sense, that any such work must be risk-assessed by a competent person, to ensure a safe system of work to control the risk of trench collapse. As an absolute minimum, for the protection of themselves and others, geoscience companies and individual geoscientists should be familiar with the basic legislation:

- Health and Safety at Work etc Act 1974, Sections 2 & 7
- Management of Health and Safety at Work Regulations 1999, Reg.3
- Construction (Design and Management) Regulations 2007, Reg.31

The offending image shows the reddish-brown Upper Triassic Branscombe Mudstone Formation with its green-grey reduction interbeds. In geotechnical terms, these lithologies might reasonably be described as moderately competent. But a journal with the professional standing and responsibilities of *Geoscientist* should take much more care to ensure that such images – editorially of interest for scientific reasons – do not depict examples of operational bad practice.

Procedures should be in place to ensure that every such image in every issue is vetted by a person with competence in practical health and safety. I look forward to safer issues of '*Geoscientist*' in the future.

Martin Isles
Director, H&S, MPA President,
The Institute of Quarrying

Editor writes: The Editorial Board is pleased to welcome its latest recruit, engineering geologist Mr Steve Branch CGeol, who in future will have the special responsibility of advising the Editor on any photograph depicting people at work and specifically whether it contravenes, or might appear to contravene, any current H&S codes.

WATERY MARS ATTACKS IRONS

Sir, After I completed the second on-line note, published in February 2012, a major new article on the subject appeared in *Meteoritics and Planetary Science* (Fairén and 18 co-authors 46(12), 1832, 2011). This article claims that the existence of six iron meteorites found by Opportunity could be explained by impact into a soft, wet Mars surface, sometime during the Noachian or Hesperian epochs; that they may have been buried, as I have previously suggested (McCall, *Geoscientist* 15.7,p 14, 2005), and later exposed by differential erosion. They exhibit signs of some chemical weathering in the form of cavernous features. During the Amazonian epoch, surface water almost completely disappeared and there was induration of the sediments, differential erosion and deflation.

In my view, the problem in taking back the aqueous erosion of the meteorites (which surely is only incipient) to the Noachian or Hesperian is that it involves taking the fall back many millions - even billions - of years. From my considerable experience of iron meteorites, the reduced iron would decompose rapidly in such an aqueous environment, and the meteorite could not possibly survive in its present state through the Amazonian and still be found littering the Martian surface. Indeed this seems to be the conclusion of Schröder et al. (*Journal of Geophysical Research* 113 PTEO6S22, 2008) who say that reduced iron will oxidise in the presence of water on Mars, even if no additional oxygen I available.

I am not arguing against aqueous conditions on Mars in the early epochs, but I think that to take the time of fall of these irons back to the Hesperian or Noachian is self-defeating, because in no way could the iron meteorites survive the millions or billions of years involved if exposed so early on.

Joe McCall

KNOW YOUR LIMITS!

Sir, In his Soapbox piece (*Geoscientist 21.11, p11*) Martin Lack pointed out that we live in a finite world and commented on the limitations of exponential growth and suggests that we should act accordingly to control the growth rate in order ensure that we do not exceed certain limits in the future. I have recently written a lengthy paper on the inevitability of continuing environmental degradation strongly endorse this view.

According to my calculations the world population will increase from 6272 in 2000 to 8400 in 2100 based on an average increase in world population of 0.92% pa. Per capita GDP will increase from $19,532 dollars to $105,432 at a rate of increase of 2.83% pa.

World GDP will increase from $164,885 to $627,067 at a rate of increase of 3.12% pa and total wealth created will increase from $5877 trillion to $22,972 trillion in 2100. In addition, atmospheric CO_2 will increase from 367 ppm in 2000 to 513 ppm in 2100.

These potential increases in human consumption and atmospheric CO_2 contents look formidable. It would appear to me that, if these increases take place on the scale suggested, they will greatly undermine the attractiveness of planet Earth as a place to live. Perhaps we should do something about it!

Geoff Glasby

Reference: Glasby, G P 2010. The inevitability of continuing environmental degradation. Advances in Energy Research, v1, Ch5. Nova Science Publishers, Inc., pp 183-201.

A CYCLEPATH WRITES...

Sir, Re. Cycle pathology (*Geoscientist 22.01 p07, February 2012*). Who was it said: 'All sedimentation is cyclic, some is more cyclic than others'?

Dick Selley

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.

ANDY BARNICOAT

Andy Barnicoat has recently been appointed as Chief of the Minerals and Natural Hazards division at Geoscience Australia. The division was created as part of an agency restructure in late 2011. Andy has been in several other roles at Geoscience Australia since moving to the organisation in 2003.

MALCOLM HART

Malcolm Hart has been elected Chair of the International Sub-Commission on Cretaceous Stratigraphy (ISCS), which is affiliated to the International Committee on Stratigraphy (ICS) and the International Union of the Geological Sciences (IUGS). He takes over from the current Chair (Professor Isabella Premoli Silva of Milan University).

JULIAN HATHERALL

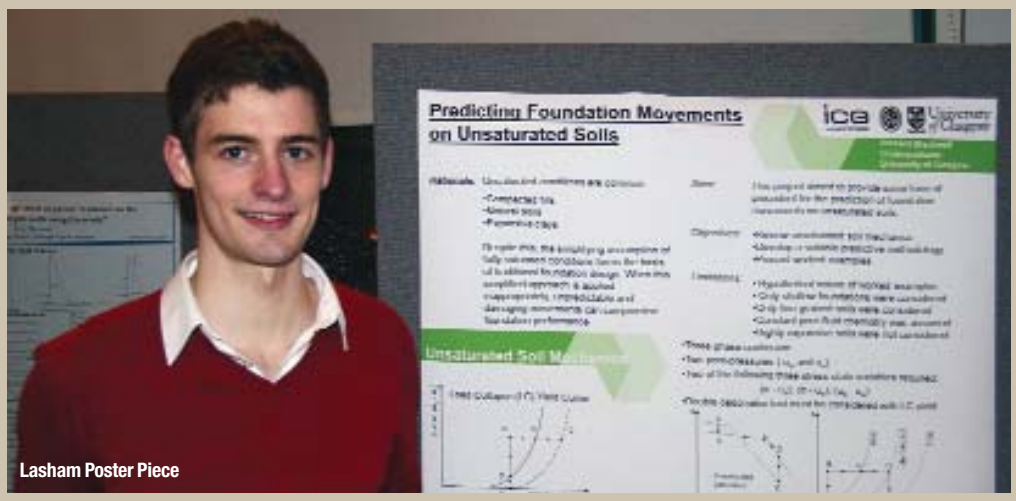
Julian Hatherall has recently moved to Earth Systems who have opened an office in Bristol, UK. As an experienced hydrogeologist Julian will be working with the team to augment their water capabilities and help build a team of environment and water specialists serving the UK, Europe and beyond.

GRANT RICHARDSON

Grant Richardson has moved to Patrick Parsons (Newcastle, Chester and Huddersfield) as Director with responsibility for developing its new Environment & Energy Division. Grant holds a PhD in Hydrogeochemistry from Newcastle University and has worked for over 15 years in environmental and geoenvironmental consultancy.

Poster boy

Central Scotland Group and the Scottish Geotechnical Group (ICE) hosted the annual poster competition at Strathclyde University on 13 December 2011



Lasham Poster Piece

Caroline Lasham writes: Despite very stormy weather a full audience and six posters were entered, on a diverse range of topics. Each candidate first presented a poster to a panel of judges. Four finalists were then selected to give oral presentations, including: Stephanie Zimms (University of Strathclyde) on *Thermal Remediation*, Daniele Bertalot (University of Dundee) on *Seismic Liquefaction* and Richard Allan (URS) with *Pipeline Expansion in Azerbaijan*.

However, the overall winner was Richard Blackwell (University of Glasgow, pictured) who scored consistently highly with his undergraduate project on *'The Prediction of Foundation Movements on Unsaturated Soil'*.

The poster competition is aimed at giving environmental geologists and engineering geologists under the age of 30 the chance to present a project or research topic. So if you feel inspired, we look forward to seeing your poster submission next year!

Contact E: **caroline.lasham@woodmac.com**

Unwanted Journals

Andrew Hobson would like to hear from anyone able to relieve him of *QJGS* - Nos. 430, March 1953 to 504, March 1971. Numbers 496, 501and 502 are sadly missing. He also has issues of *JGS* complete from 1971 to 1976, volumes 127-132. He also has some other documents, only partly sorted, including Society circulars, proceedings and newsletters.

These are of various dates starting in about 1953 ending in the 1970s. The collection is in Fulham.

Contact E: **agfhobson@btinternet.com**

HELP YOUR OBITUARIST

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

Seismograph appeal

Scott Upton, Vice-Principal at Sandwell College (West Midlands) writes: "In March 2012 we are moving to a new £80 million campus in the centre of West Bromwich. We intend to exhibit items celebrating the history of the six towns of Sandwell, because the college can trace its history back to the mid-1840s.

"For the town of West Bromwich we have chosen to celebrate the life and works of J J Shaw, co-inventor of the Milne-Shaw seismograph. I would like to appeal to Fellows for the loan of a Milne-Shaw seismograph (in whatever condition or state of repair!) to form part of this exhibition. We would of course take all appropriate environmental and security measures."

Contact E: **scott.upton@sandwell.ac.uk**

IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

THE SOCIETY NOTES WITH SADNESS THE PASSING OF:

Allen, Anthony William*
Cockett, Alan Stanley*
Coope, G R *
Edwards, Wilfrid
Thomas*
Egerton, Robert*
Friedman, Gerald M*§
Fuller, John
Hepworth, Barrie*
Hepworth, John
Hey, Richard *
Humphreys, Adrian *
Oates, Francis *
Orme, G R*
Price, Ivor C*
Radhakrishna, B P
Robson, J Gordon *
Uko, Suzuki*
Young, Roger Andrew*

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. The most recent additions to the list are shown in bold. Fellows for whom no obituarist has yet been commissioned are marked with an asterisk (*). The symbol § indicates that biographical material has been lodged with the Society.

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

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

DISTANT THUNDER

Help your obituarist

Geologist and Science writer Nina Morgan provides some tips on how not to be forgotten

Each month a notice appears in *Geoscientist* encouraging Fellows to deposit their biographical material with the Society in order to help their obituarists 'ensure that the Fellow's lives are accorded appropriate and accurate commemoration'. Although a similar notice was not included in an equivalent members' magazine in the early days of the Geological Society, this exhortation seems to have been one that Roderick Murchison took very seriously.

According to Murchison's biographer, Archibald Geikie, 'For many years he [Murchison] was in the habit of keeping a record of the events which he witnessed, or in which he took part. In the belief that the story of his life might have some interest and usefulness for those who should succeed him, he used now and then during his later years to devote his spare hours to the task of reading over his early journals, and superintending their transcription.'

Not only that, but once Geikie accepted the job of biographer, he found that 'there existed a vast mass of miscellaneous letters and papers going back even into the last century. It appeared that Sir Roderick for many years of his life had never destroyed any piece of writing addressed to him, - notes of invitation to dinner, and acceptances of invitations given by himself, being abundant among the papers.' Combine that with Murchison's correspondence generously furnished by the original recipients, including geologists Charles Lyell and John Phillips, and you have a truly voluminous amount of information. It must have taken Geikie considerable time to read through it all, let alone, digest and organise it. But it was certainly time well spent. The resulting obit ran to two volumes and more than 400 pages.

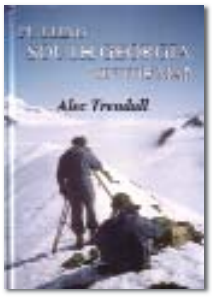
Sir Roderick Murchison, by Stephen Pearce

Before you too feel tempted to swamp your future obituarist with materials documenting every aspect of your professional life, bear in mind that no matter how illustrious your career or how monumental your achievements, your obituary in Geoscientist will never run to more than 500 words!

ACKNOWLEDGEMENT
The source for this vignette is *Life of Sir Roderick I Murchison based on his journals and letters* by Archibald Geikie, In two volumes, John Murray, London, 1875.

If the past is the key to your present interests, why not join the History of Geology Group (HOGG)? For more information and to read the latest HOGG newsletter, visit: **www.geolsoc.org.uk/hogg**, where the programme and abstracts from the Conference on Geological Collectors and Collecting are available as a pdf file free to download.

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



Putting South Georgia on the Map

The line "South Georgia rising out of the ocean, like a misplaced section of the Alps" epitomises this book, which it was intended should be written by Duncan Carse, who organised and led three private expeditions to South Georgia in the 1950s. On his death the task devolved on Alec Trendall. This is an important record, which otherwise might have been lost, of the island named by Cook, visited by Bellingshausen, and made famous by Shackleton's epic boat journey and overland traverse.

The book commences with a historical introduction, leading on to a summary of Duncan Carse's early life as an apprentice on *Archibald Russell, Discovery II*, RNVR service (WW2) and his 'master plan' to be a polar explorer and lead a trans-Antarctic Expedition. It covers the 1949 attempt to organise a small South Georgia expedition and its fruition (with RGS and SPRI support), leading to the 1951-52, 1953-54 and 1955-56 expeditions, with a primary object to map the entire island.

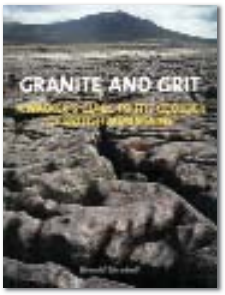
The next section is written by Walter Roots (pp38-66) and covers the 1951-52 expedition. It is emphasised that in such a little-known area, geological survey work had to be kept simple: recording information of rock composition and structure, in as much detail from as many localities as possible. The basic tools were hand-lens, compass, clinometer, notebook, camera, geological hammer. Collecting samples for laboratory study was important, especially fossils for dating. At the time, rock-dating meant superposition and biostratigraphy: radiometric methods were not yet available.

The second expedition (pp71-90) was bedevilled by Duncan Carse's deterioration, due to the failure of his marriage and worries about the Trans-Antarctic Expedition, as well as his quarrel with Gordon Smillie. Keith Warbuton was ill and never contributed. But Alec, though still lame, performed much valuable geological observation - especially in the complicated developments at Wirik Bay. By the end of the second season they established that the island was largely composed of Mesozoic (Cretaceous) turbidites (greywackes); though there are also granitic rocks, gabbros, lavas and two sets of dykes cutting everything else in the south east. Trendall's geological map contributed to the decision of the British Antarctic Survey to begin a detailed geological study of South Georgia in 1969.

The third expedition is described at second hand: the party completed the topographic survey of the island with no acrimony. Appendices cover 'The men of the South Georgia Surveys'; sources; glossary; Shackleton's route. This is a splendid, superbly illustrated, book and should be widely read.

Reviewed by ***Joe McCall***

PUTTING SOUTH GEORGIA ON THE MAP
ALEC TRENDALL (WALTER ROOTS), Published by the author, 2011. ISBN: 978-9870614-0-9 (hbk) 978-9870614-1-6 (pbk). 216 pp
List price: Hbk A$50 in Australia (A$60 elsewhere). Pbk A$40 (A$50 elsewhere). Signed copies: A$80 in Australia (A$90 elsewhere). www.alectrendall.com.au



Granite and Grit

The large format of *Granite and Grit* and the quality of its colour illustrations make this book deserving of a place on anyone's coffee table. Equally, the objective of giving the lay-walker a taste of the geology that he or she might encounter as they are striding out across Britain's mountain wilderness is an admirable one. However, that commendable aim is only partially satisfied as the book ultimately is neither a walking guide nor a geological field guide. But it does say a lot about the foundation that provides such *terra firma* beneath the battalions of walking boots that cross hillsides and scramble over such famous rocky icons as the Great Slab of Langdale and even the Etive Slabs.

Therein lies the real substance of this work, for Turnbull pays homage to the umpteen types of rock that serious walkers will encounter during their upland explorations. From granite to gneiss, sandstone and shale, limestone, lava and grit - all are dealt with in Turnbull's knowledgeable and sometimes humorous prose, drawing on his own walking experiences throughout the UK and around the world.

Along the way the geologically uneducated will learn why Cuillin gabbro is such a pleasure to clamber over, what befell the landscape when the volcanoes of Borrowdale and Glencoe were spewing out their molten innards, and which continents collided to crumple the metamorphic strata of the Southern Highlands. But rather than providing a *step by step* geological account, Turnbull gives us a broad sweep of the lithological brush, province by province, and colours his account with references to the mountains he has climbed – and there have been many – and the routes he has taken.

As a purist, I was a little disappointed that the telling is so geologically general; I wanted more detail and I suspect that much of the GSL readership will feel the same. After all, the underlying theme of the meeting of continents to bring England/Wales together with Scotland, and that new land's subsequent geologic evolution is not new to most members. However, to the lay-person, and especially the lay-walker, for whom this guide was written, it is something new to add to the countless conventional guides and maps now gathering dust; something to inspire a new perception of Britain's high ground perhaps.

Reviewed by ***Sean Mulshaw***

GRANITE AND GRIT – A WALKER'S GUIDE TO THE GEOLOGY OF BRITISH MOUNTAINS
RONALD TURNBULL, Published by: Frances Lincoln Limited, 2009 (pbk 2011). ISBN: 978-0-7112-3180-1. 208 pp.
List price: £16.99, www.franceslincoln.com

REVIEWS: NEW CHAPTER

Dr Martin Degg, who has served as *Geoscientist's* book reviews editor since the first part of volume 5 (January/February 1995) has decided to take a well-earned rest and will be stepping down from the role this year. For this reason there is no current list of titles available for review. Reviewers are encouraged to visit the online version of the Books & Arts section, where past months' lists are still displayed and where new instructions for reviewing books will appear shortly.

The Editor-in-Chief and the whole Editorial Board would like to take this opportunity to thank Martin for his 17 years' service in this demanding role – perhaps the most demanding of any on the Board. In future, book reviews will be run from Burlington House. Publishers are invited to address volumes for review in future to Dr Ted Nield, Editor, *Geoscientist*, The Geological Society, Burlington House, LONDON W1J 0BG. **E: ted.nield@geolsoc.org.uk**.

CAN'T FIND YOUR MEETING? VISIT WWW.GEOLSOC.ORG.UK/LISTINGS FULL, ACCURATE, UP-TO-DATE

ENDORSED TRAINING/CPD

Course	Date	Venue and details
Introduction to Micromine	10-11 April	Burlington House, 0930 – 1730. Includes Introduction to Micromine (Day 1) and Introduction to Exploration (Day 2). **Fee:** £100 pp. See website for course details and application form
Lapworth's Logs	n/a	'Lapworth's Logs' are a series of e-courses involving practical exercises of increasing complexity. 'Lapworth's Logs' provide training in applied geology for civil engineers, engineering geologists, environmental engineers, hydrogeologists, and anyone interested in ground modelling. **Contact:** info@lapworthslogs.com. Lapworth's Lgs is produced by Michael de Freitas and Andrew Thompson. Price dependent on number of users/duration of licence.

DIARY OF MEETINGS APRIL 2012

Meeting	Date	Venue and details
Skittles Evening South Wales Regional	3 April	The Halfway, Cathedral Road, Cardiff, 1800. Entry £5 for indivs., £30 per team. **Contact:** Karl Llewelyn **E:** kllewelyn@srk.co.uk
In the Footsteps of Sir Archibald Geikie HOGG	13 April	Haslemere Educational Museum, Surrey. See website for details and registration. **Contact:** Dick Moody **E:** rtj.moody@virgin.net
Engineering Geology & Railways SE Regional, ICE	17 April	Gatwick Manor Hotel, Lowfield Heath, London Road, Crawley, West Sussex RH10 9ST. **Time:** 1800 for 1830. **Speaker:** Graham Birch, Network Rail **Contact:** Roger Smith **E:** rsmith@southerntesting.co.uk
Cairn Energy Talk Central Scotland Regional	17 April	**Venue:** Post Grad Centre, Herriot Watt University. **Speaker:** Murray Flemming. See website for details. **Time:** 1845. **Contact**: Caroline Lasham **E:** caroline.lasham@woodmac.com
A Grounding in Forensics The life and times of a expert engaged for civil and criminal litigation Southern Wales Regional	18 April	**Venue:** Room 1.25, School of Earth & Ocean Sciences, Cardiff University. **Time:** Refreshments 1730 for 1800. **Speaker:** Robin Sanders (Capita Symonds)
Gold Panning near Totnes Solent Regional	April – Date TBA	**Venue:** University of Portsmouth. **Speaker:** Dr Andrew Haggart (University of Greenwich) **Time:** 1800 for 1830. See website for details. **Contact:** Karen Allso (Secretary) **E:** karen.allso@ramboll.co.uk
Reconciling Past and Future Worlds - geology and ground engineering Geological Society, Shell UK	18 April	A Shell London Lecture. For details see p.11
Geohazards in the UK North West Regional	19 April	**Venue:** University of Manchester. **Speaker:** Prof. Martin Culshaw. **Time:** 1830. See website for details. **Contact:** Chris Berryman **T:** 01925 291111 **E:** geologicalsociety.northwest@gmail.com
Lime Stabilisation of Soil – New Mineral Nucleation, Growth and Stability, East Midlands Regional, East Midlands Geotechnical Society	19 April	**Venue:** Loughborough University. **Time:** TBC (Evening meeting). **Speaker:** Paul Beetham. See website for details. **Contact:** Andrew Brown **E:** andrew.brown@opusjoynespike.co.uk
Geomicrobiology and its Significance for Biosphere Processes, Mineralogical Society Environmental Mineralogy Group, Society for General Microbiology, Geological Society , British Mycological Society	19-20 April	**Venue:** University of Manchester Interdisciplinary Biocentre. A two-day meeting, aimed at supporting a UK-Geomicrobiology. See website for details. **Contact:** Mineralogical Society **T:** +44 (0)208 891 6600 **E:** info@minersoc.org
The Olympics and Paralympics 2012 Thames Valley Regional, Engineering Group, BGA, ICE	26 April	**Venue:** Eton College Rowing Centre, Windsor. To highlight geological studies and ground engineering undertaken at UK Olympic venues. See website for details. **Contacts:** Alison Barmas **E:** alison.barmas@arup.com; Alex Carbray **E:** acarbray@globalskm.com

OBITUARY

MICHAEL COLLIE 1929-2011

Polymath who spanned the arts and sciences and turned to the history of geology late in life

Writer, professor, bibliographer and historian of science, Michael Collie, was born 8 August 1929, in Eastbourne, Sussex. His early years were spent in Edinburgh and Nottingham, and from 1939-47 he boarded at the Ashby-de-la-Zouch Grammar School where he received a thorough education and captained the cross-country and cricket teams. Summers were spent working on the Watson family farm in Granby, Leicestershire, where he learned, among other skills, how to drive a team of plough horses. He served two years in the British Army Intelligence Corps (1947-49) and was based in Egypt and Greece. In 1949, Michael matriculated at St. Catharine's College, Cambridge University, where he earned a BA (1952) and later an MA (Cantab).

EDUCATOR

Michael's career as an educator of English began in 1953 at Selwyn College and Trinity Hall, Cambridge, and included posts at Cambridgeshire Technical College (1955-57), the University of Manitoba (1957-61), University of Exeter (1961-62), Mount Allison University (1962-65), before settling at York University, Toronto (1965-1990), where he attained the rank of Professor and also served as chair of the Department of English (1967-69) and Dean of the Faculty of Graduate Studies (1969-73). While at York University, Michael supervised numerous PhD candidates and his ability to pose challenging research questions was legendary.

> WRITER, PROFESSOR, BIBLIOGRAPHER AND HISTORIAN OF SCIENCE

Michael's wide-ranging and extensive publishing career began in 1956 and it steadily grew to include 23 books and more than 60 articles, addresses and dictionary entries. In addition to books of poetry, Michael wrote critical theory essays, bibliographies and biographies on subjects ranging from George Meredith, George Gissing and Jules Laforgue to George Borrow. Beginning in the mid-1980s Michael became interested in the history of science and wrote several books in that field including: *Henry Maudsley: Victorian Psychiatrist* (St. Paul's Bibliographies, 1988); *Huxley at Work* (Macmillan Press, 1991); *Murchison in Moray: a Geologist on Home Ground* (American Philosophical Society, 1995); *George Gordon: an Annotated Catalogue of his Correspondence* (Scolar Press, 1996); *Murchison's Wanderings in Russia* (British Geological Survey, 2004); and *Science on Four Wheels: the Continental Travels of Roderick Murchison* (1840-45) (Academica Press, 2010).

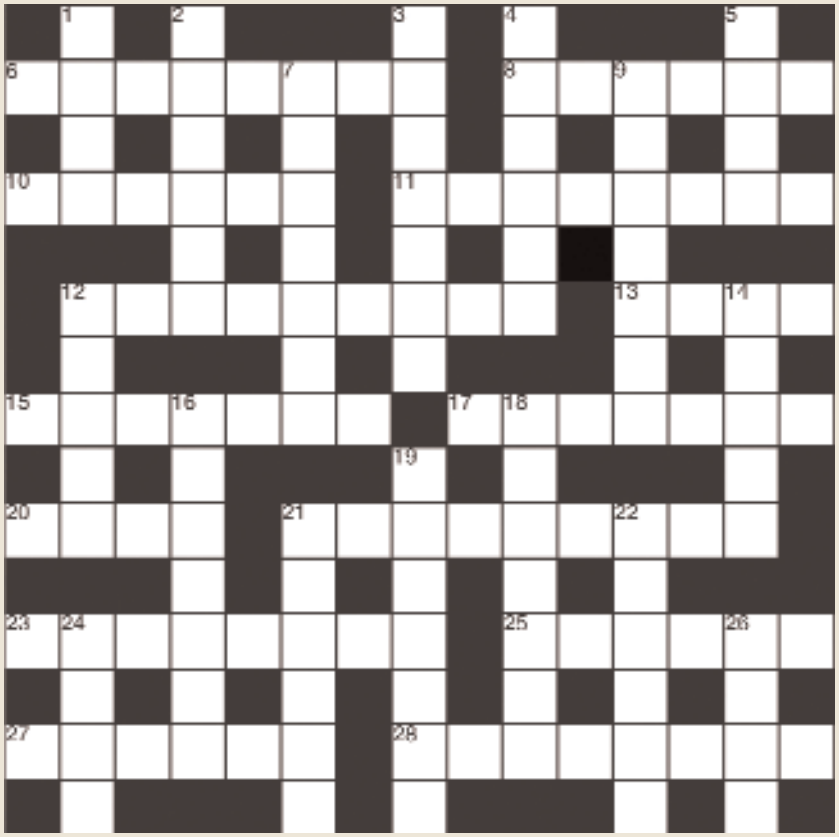
Many of those books included annotated editions of previously unpublished correspondence and journals of eminent scientists which provided context for his analysis of the development of science during the 19th Century. It was his work in the history of geology that led him to become a Fellow of the Geological Society in 1992. He also was elected a Fellow of the Royal Society of Canada in 1987. Michael continued to work on several bibliographic and history of geology projects up to the time of his death.

INDEFATIGABLE

Michael Collie was an indefatigable correspondent, keen investigator, generous collaborator, hospitable host, avid fell walker, and devoted family man. He is survived by his wife Joanne L'Heureux Collie, five children, Peter of Sydney, Kate of Edmonton, Jeremy of Narragansett, Ursula of Scorton, Nick of southern Spain, and five grandchildren. Michael died peacefully in the company of Joanne, Ursula and Nick at Nottingham City Hospital on 21 July 2011.

By John A Diemer

CROSSWORD NO. 156 SET BY ZIRCON



ACROSS

6 Steely engineer (8)
8 Right skilful (6)
10 Destress, or recombine DNA (6)
11 Hard enveloping shell, as in tortoise (8)
12 An aid to the shot-firer (9)
13 Beach, generally Italian (4)
15 Line touching a curve (7)
17 Thera, for example (7)
20 Carbon ore? (4)
21 Study of freshwater bodies (9)
23 Typically calcareous grassland soil (8)
25 Spiky water (6)
27 Algonquian lunchpack (6)
28 Pressurised acquifer (8)

DOWN

1 Sign gas (4)
2 Bronowski's, rather than Darwin's view of 'Man' (6)
3 Sometimes fibrous magnesium mineral (7)
4 Miner's friend (6)
5 Hot or cold, it's not riveting but galvanizing (4)
7 Pigment of hair, skin and eyes (7)
9 Bears small, more or less parallel ridges (7)
12 Severe Athenian legislator (5)
14 Austen's Mr hydrogeologist? (5)
16 Space shot to Jupiter (7)
18 Plant espousing asexual reproduction (7)
19 Magma and Aluminium alloyed? (7)
21 Zambian city (6)
22 Futile and superfluous (6)
24 Coin younger than 12d, six to the drachma (4)
26 Rover's favourite metal? (4)

WIN A SPECIAL PUBLICATION

The winner of the February Crossword puzzle prize draw was Christine Brown of Redondo Beach, California, USA.

All correct solutions will be placed in the draw, and the winner's name printed in the June issue. The Editor's decision is final and no correspondence will be entered into. **Closing date - 15 May**.

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

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

Name .....

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Membership number .....

Address for correspondence .....

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Postcode .....

SOLUTIONS FEBRUARY

ACROSS:
6 Phengite **8** UNESCO **10** Gneiss **11** Sericite **12** Wrenching **13** Eddy **15** Fluvial **17** Erratic **20** Afar **21** Biologist **23** Antimony **25** Isomer **27** Daphne **28** Ohmmeter

DOWN:
1 Thin **2** Incise **3** Seismic **4** Tuareg **5** Scut **7** Insecta **9** Excreta **12** Wulff **14** Drift **16** Varnish **18** Rhodium **19** Polygon **21** Boomer **22** Ironed **24** Noah **26** Eden

The Geological Society
serving science & profession

Rock deformation from field studies, experiments and theory:

A meeting in honour of the work of Prof. E.H. Rutter

30-31 May 2012
The Geological Society, London

This meeting will be held in honour of Professor E.H. Rutter. His significant contribution in the field of Rock Deformation has inspired a wide range of geoscientists. He has made seminal contributions on a range of topics, including the rheology of calcite rocks, pressure solution, grain-size sensitive flow, the interrelationships between deformation and metamorphism, the structure and properties of the lower crust, the rheology of partially molten rocks, and the structure, microstructure and properties of brittle fault zones. We wish to focus particularly on the marrying of field studies, experimental studies and modelling in the field of rock deformation, as that has been Professor Rutter's approach throughout his career. This multidisciplinary approach has provided numerous new insights into how rocks deform and continues to do so. The meeting will have aspects of reflecting on where we have come over the past 40 years, and where approaches in the field should go in the future.

Confirmed speakers:

Professor Rick Sibson *(Otago, New Zealand)*

Professor Chris Spiers *(Utrecht, Netherlands)*

Professor David Mainprice *(Montpellier, France)*

Meeting conveners:

Dr. Dan Faulkner *(Liverpool)*

Dr. Julian Mecklenburgh *(Manchester)*

Dr. Betty Mariani *(Liverpool)*

Dr. Steve Covey-Crump *(Manchester)*

Special Publication

There is a planned Special Publication of the Geological Society of London for this meeting.

Contact details

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W: www.geolsoc.org.uk/rockdeformation
Twitter: #rockdef12

Thames Tunnel

Creating a cleaner, healthier River Thames

Speaker: Phil Stride

Head of London Tideway Tunnels,
Thames Water

Date: Tuesday, 15 May 2012

Tea: 17:30

Lecture: 18:00

Reception: 19:00

Venue: The Geological Society
Lecture Theatre, Burlington House

Burlington House

Admission is free but by ticket only available from the Conference Office, Geological Society on 020 7434 9944
or email: registrations@geolsoc.org.uk

Royal Academy of Arts

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Society of Antiquaries of London

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