

The magazine of THE GEOLOGICAL SOCIETY OF LONDON

Geoscientist

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Wadia and Nanga Parbat
Nuclear and present danger
Watson Lecture Theatre



Heroic age

Ted Nield reflects on the heroes of the geological past, and why we envy them.

In this issue of *Geoscientist* we celebrate the 90th anniversary of the publication of one of those books that are rarely written these days (and if they are written, hardly ever by one author). The book in question is *Geology of India*, by Darashaw Noshawan Wadia.

D N Wadia exemplifies the sort of world-bestrident hero that could perhaps only have existed in the dream-time of Earth sciences; men like Alex du Toit (1878–1948) who between 1903 and 1920 mapped in detail over 50,000 square miles between the Cape and Natal, of which 43,000 square miles were published as maps. Du Toit did it from a donkey-wagon (his mobile home while in the veldt) from which he would venture daily on a push-bike. Moreover, he would carry with him a plane table – which he would use to make the base-map onto which to map the geology. So, in reality, he mapped that enormous area *twice*. What is more, if present-day geologists going over the same ground find a conflict between their observations and his, it isn't usually they who turn out to be correct.

People like Wadia and du Toit did what they did without satellite images, GPS, motor vehicles, air conditioning, mobile phones or air transport. They enjoyed little or no logistical support either. It is easy to see why they might have envied us our comforting and labour-saving gadgets, but why is it that we envy them?

Freedom. As pioneers they had little or no literature to mug up. Nobody else was doing what they were doing. They tended to be given enormous jobs when they were in their mid to late twenties, and were – by and large – left to get on with them. No manager looked over their shoulders, asking where their next paper was coming from, or when the next sheet would be finished. No bean-counter totted up citations or did cost/benefit analyses of research output to satisfy the latest government fad. It was just them, and the rocks.

Life cannot be that way now. Every age has its peculiar freedoms and oppressions; and the two are intimately linked. The more we, in our age, rely on technical fixes and motorised transport, the more everything costs, and the more we rely on the work of others. Similarly, not being pioneers means we can no longer stay at the forefront of everything ourselves, whereas Wadia could write about tectonics with one hand and vertebrate palaeontology with the other.

The more we rely on others, the more we must defer to them. The more we cost, the more we must answer to paymasters. The freedom enjoyed by our heroic forebears was bought, at least in part, at an enormous cost in time and inconvenience. How many of us today would be prepared to pay it, even if we could? Ultimately, what we envy in the likes of Wadia and du Toit is a self-reliance that history and pensions conspire to render us too small, dependent and frightened to deserve. ☞



Front cover: **Per Kirkeby** *The Siege of Constantinople* 1995
Oel auf Leinwand 400 x 340 cm
Tate Copyright: the artist. See reviews, p.17

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Bottling the wind

Dr William Stanton has a suggestion for making the wind blow when we need it, and not just when it wants to.

Peak Oil is here and our Government, very belatedly, is thinking about replacing fossil fuels with renewable energy. Wind energy is the current favourite. Ambitious proposals are being aired, like generating 15% of our energy (not just electricity) from wind by 2020. This would involve erecting many thousands of wind turbines (several every day) on- and off-shore, although they are in short supply; and producing their steel components requires massive amounts of fossil fuel.

The problems associated with wind energy are well known. Wind speed is so variable that, according to German and Danish experience, a turbine rated at 2 megawatts typically produces little more than 0.5 megawatts when averaged over a year. Seriously large amounts of electrical energy can only be stored in exceptional circumstances (such as when pumped storage like Dinorwig in Snowdonia is available) in spite of experiments with compressed air and giant flywheels. So the vital, and in my view fatal, drawback to wind energy proposals is that conventional power stations must be available, ticking over, ready to cut in and supply the nation's electricity when the wind fails. Moreover, the National Grid cannot easily accept the huge slugs of electricity that wind power produces at unpredictable intervals.

Electricity storage on a grand scale is required. It occurs to me that hydrogeologists might be able to help. Steam from geothermal boreholes can drive turbines when temperature exceeds 150°C. Natural groundwater temperatures in UK experimental boreholes fall far short of this figure (Southampton, 1.8km deep, 76°C; Eastgate, 1km deep, 46°C). But why not store wind energy as superheated water at the bottom of a deep borehole? When powerful immersion heaters are available, using intermittent input from a wind farm, water could be injected into a suitably permeable stratum at, say, 2km depth and heated until it and the country rock reach 200°C or more. Steam could then be released and used to drive turbines. I visualise one or more boreholes, cased as necessary, carrying the heaters and cold water input down to the permeable stratum. Steam extraction would be from an adjacent borehole, in much the same way as oil can be mobilised by heat and removed from tar sands.

In this way, one of the great disadvantages of wind energy could be overcome. No doubt much energy would be lost in changing electricity to heat and back again, but set against this would be the huge advantage of reliable continuous energy supply, removing the need to have conventional power stations as backup for when the wind stops blowing. The mimic geothermal borehole would differ from 'hot dry rock' ones in the UK in that their sources of heat gradually cool down, whereas that of the mimic would be topped up indefinitely.

No doubt there are practical problems with this scheme, such as steam leakage to surface; but the advantages, if after comprehensive research it could be made to work, would surely be worth the effort. ☞



Feel like a tilt?

If you do, and can do so entertainingly in 500 words, we would like to hear from you. Write to ted.nield@geolsoc.org.uk to contribute to Soapbox.

Windmills at Tobosa, Spain, where Cervantes envisaged Don Quixote taking on the giants. Photo: Ted Nield.

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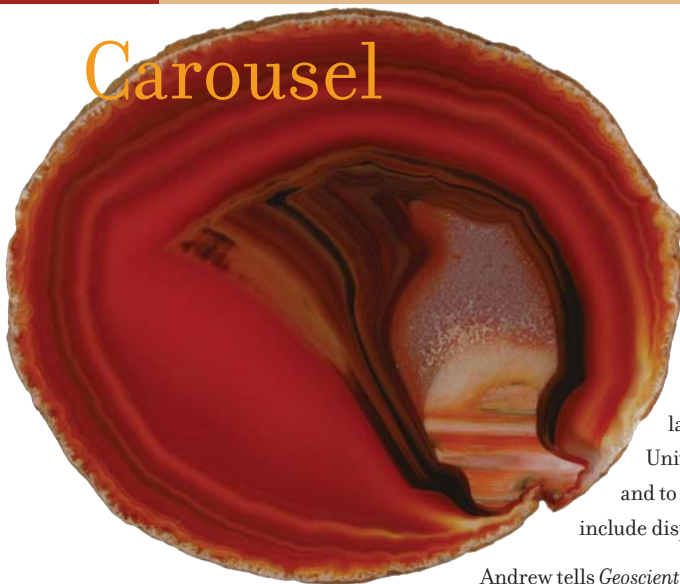


18 Feature -

Walking the roofbeam - by Geoff Glasby



Carousel



Andrew Hurst (University of Aberdeen) is co-organising an art exhibition entitled *Fabric of the Land*, based in the Department of Geology & Petroleum Geology, Aberdeen University, later this summer (25 August - 11 September 2009 - see www.abdn.ac.uk/geology/events/fol/index.php).

Fabric of the Land (FoL) aspires to build a bridge between art and geoscience through an understanding and appreciation of the landscape. Underlying this aspiration is a drive to open part of the University to the public during a period when student numbers are sparse and to provide an insight into some aspects of geoscience. The exhibition will include display of geological specimens.

Andrew tells *Geoscientist*, "The response from the art world has been very good and we have ambitions to make this an annual event. This year FoL will be the centrepiece of the Department's contribution to the University's Open Day, hosting visiting groups that attend both our MSc seminar days. We hope to use the exhibition to raise profile for art and geology during Offshore Europe." The Department has other artistic ambitions, Hurst explains – including supporting an artist in residence and a scientist in residence in Gray's School of Art.



Bruce Yardley (University of Leeds), Coke Medallist 2009, has been granted a Humboldt Research Award after having been nominated by the German scientists Prof. Dr. Wilhelm Heinrich, Helmholtz-Zentrum Postdam, Deutsches GeoForschungsZentrum, Postdam, and Prof. Dr. Rainer Abart, Free University of Berlin, Fachbereich Geowissenschaften. This award is conferred in recognition of lifetime achievements in research.



David Shilston, former Professional Secretary of the Society has been appointed an Affiliate Member of the NERC's Peer Review College. David says he applied because he had noticed there was little if any representation from industry in the college. The appointment will run for three years. 

All Fellows of the Society are entitled to entries in *Carousel*. Please email ted.nield@geolsoc.org.uk, quoting your Fellowship number

Deaths

• Read obituaries online at www.geolsoc.org.uk/obituaries.

The Society notes with sadness the passing of:

Baumer, A*
 Bishop, Richard*
 Johnson, George A L*
 Mills, Anthony B*
 McKinlay, Alex C M*
 Truss, Stephen

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and collects them once a year in its *Annual Review*. The most recent additions to the list are in shown in bold. Fellows for whom no obituarist has yet been commissioned are marked with an asterisk (*).

If you would like to contribute an obituary, please email ted.nield@geolsoc.org.uk to be commissioned. You will receive a guide for authors and a deadline for submission. You can also read the guidelines 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 in the next available *Annual Review*.

Help your obituarist

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

DISTANT THUNDER

Bottom line

Science writer and geologist Nina Morgan weaves a tale about lost collections, Devonian rocks and the Gentlemen's loo*

In 1830 the geologist and mining consultant Thomas Weaver (1773-1855), already famous for his work on Irish geology and involvement in Irish metal mining, dived into the great Devonian debate when he published the first of his many papers discussing the age of rocks in Devon – a controversy that ultimately led to the naming of the Devonian system by Roderick Murchison and Adam Sedgwick in 1839.

Although Weaver had already donated many fossil and mineral specimens to the Geological Society and the Yorkshire Philosophical Society during his lifetime, after his death in 1855 there still remained a substantial collection to be disposed of. Part was sold at auction in July 1855. What remained, reportedly, was used to form the hardcore for a urinal at Bewdley, Worcestershire.

A sad end, but perhaps an appropriate one. Coprology – or the study of fossil faeces – attracted serious attention in the 1830s

from fossilists and luminaries ranging from Mary Anning and the Misses Philpott to William Buckland. Work on this topic even formed the subject for such verses as:

Approach, approach, ingenuous youth

And learn this fundamental truth

The noble science of Geology

Is bottomed firmly in Coprology

Had he lived on into the 1860s when the Society moved to its current home in Burlington House, Weaver – a member since 1820 – might well have built on this theme by taking the opportunity to augment his Devonian field observations every time he visited. The two urinal stalls in the Gents – reportedly known affectionately as “Darwin” and “Huxley” – are composed of a deep red Upper Devonian (Frasnian) Griotte Marble, taken from quarries west of the River Meuse in Belgium, and beautifully embellished with stromatactis structures (large irregular cavities filled with calcite cement) and concentrations of fossils. ☞

Acknowledgments

Sources for this vignette include the entry for Thomas Weaver (1773-1855), geologist and mining consultant by Hugh Torrens, in the Oxford Dictionary of National Biography; with additional reporting by Ted Nield at the Geological Society, and Philip Powell of the Oxford University Museum of Natural History.

* Nina Morgan lives in Oxfordshire.

If the past is a key to your present interests, why not join the History of Geology Group (HOGG).
For more information visit the HOGG website at: www.geolsoc.org.uk/HOGG

Pet awards

Each year the Petroleum Group makes awards in recognition of achievements and talent of individuals within the hydrocarbon sector. These prestigious medals are awarded at the Group's Annual Dinner, which this year was held on the 18 June at the Natural History Museum.

Before over 700 guests, the Petroleum Group Silver Medal, was presented to Bruce Levell of Shell, while the Young Explorers Medal went to Barnaby Roome (BP). DR ☞





George Tuckwell (foreground, right) and the team in Kazakhstan.

Nuclear and present danger

As uncertainty over North Korea's nuclear intentions raises international fears once again, STATS geophysics' team leader and Society VP George Tuckwell (picture) recounts his recent role in one of the most important nuclear non-proliferation projects in history.*

When the Comprehensive Nuclear-Test Ban Treaty (CTBT) comes into force, it will make any kind of nuclear explosion an illegal act. One hundred and eighty states are currently signed up to it and 145 (including every European nation) have ratified it. Only North Korea, Egypt, India, Indonesia, Iran, Israel, Pakistan and the United States have yet to commit by signature or ratification. But if his campaign rhetoric is to be believed, US president Barack Obama has plans to ratify the treaty in the near future, which will surely increase pressure on the rest.

While the Treaty itself remains idle, the "Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization" (CTBTO) has been anything but – establishing a global monitoring system across over 300 worldwide locations, ensuring that any sign of nuclear deviance will be met with a swift investigative response.

Once the CTBT is active, the UN may be requested to investigate on behalf of a member state whenever suspicious activity is recorded. After final data analysis at the International Data Centre (IDC) in Vienna a decision may be made to instigate a site inspection. This would be carried out by a 40-strong team, assembled from the CTBTO's global

network of seismology, hydroacoustics, infrasound and radionuclide monitoring experts.

The site investigation team would then deal with four specialist components: visual observation, micro-seismic monitoring, radionuclide monitoring and continuation phase technology (CPT – in other words, geophysical site investigation). This is where the expertise of my company, STATS, comes in.

Last year, our geophysics team was contracted by the United Nations (UN) to write the CPT's standard operating procedures, and I was appointed as the field team's lead geophysics inspector. And so it came about that in September 2008, I was asked to do my duty in the CTBTO's first ever Integrated Field Exercise (IFE08) – since hailed as one of the most ambitious projects in the history of nuclear non-proliferation.

Taking the form of a "role-playing" exercise on the biggest scale imaginable, IFE08 entailed spending three weeks at the former Soviet Union nuclear test site of Semipalatinsk, (Kazakhstan) which was recast for the purposes of the exercise as the fictitious state of "Arcania" (with its 'representatives' played by CTBTO staff and other international organisations).

A magnitude 4.0 earthquake, accompanied by an inexplicable release of the radioactive substance Caesium 137 was recorded – and the inspection team was duly engaged. Once the other teams had narrowed the search area to a manageable size, we had our cue.

Wearing overalls and outer disposable coveralls at all times, together with the most important piece of protective equipment of all – the dust mask – each day we had to design, negotiate, implement and then report on field activity, all within the non-scientific terms of the treaty. This entailed short bursts of intense, time-constrained activity.

Although the other teams found no clear evidence of recent underground nuclear testing, we had plenty of leads to follow up. First, we acted on data from the microseismic monitoring team and conducted an aerial magnetic survey to define the geology of any suspicious areas. Nothing untoward was found.

Then it was on to one particular borehole site that had not been declared during the initial negotiations with the Arcanian State Party, and was not obvious from the surface. There's no hiding from magnetic and electrical resistivity tests though, and the borehole was





soon located beneath some hurriedly placed soil and vegetation. The radionuclide team was called in, but found no evidence of a recent test.

Other investigations concentrated on sites with underground nuclear test histories stretching back decades. The geophysical signature of these boreholes was broadly similar to the undeclared site implying that it could be adopted for underground test-use in the future.

One of the boreholes used for actual testing some 30 years ago provided a stark warning of the enduring aftermath of a nuclear explosion, with groundwater chemistry and hydrogeology impacts still noticeable in the electrical and magnetic properties of the subsurface.

The end of the simulation came when we handed over the preliminary findings report – which concluded that the information gathered did not support the assertion that “Arcania” had conducted an underground nuclear explosion. All the tell-tale signs were absent, as were the relevant radioactive substances.

Contribution of geophysics

The geophysical techniques we used for IFE08 are the same as those used, for example in reducing the risk of unforeseen ground conditions to engineering and construction projects. The activities of a rogue state seeking to conceal an underground nuclear explosion are likely to result in detectable disruption to the shallow and deep subsurface.

It also requires substantial effort to prepare, instrument and undertake a nuclear test. Although it is likely that a rogue state would try to remove or conceal any above-ground evidence, rig foundations, cable trenches, vehicle tracks, waste and contamination, excavations and other ground disturbance are

likely to remain in the upper few metres. These remains should be readily detectable using such techniques as ground penetrating radar, EM ground conductivity and magnetic gradiometry, and others.

The test itself would be expected to modify the density, and to some extent the chemistry, of the rock at depth. Because of the heat released, one would also expect that the groundwater table would be disrupted. Changes to groundwater chemistry may also be detectable. The cavity formed by the explosion may be imaged directly, as may the immediate zone of influence within the rock and groundwater. Tunnels, shafts or other excavations created to place the device at depth may also be detectable.

Depending on the specific case, any combination of microgravity, deep electrical imaging or active seismics would be appropriate techniques to use. They are used in mining and mineral exploration, as well as possibly during underground coal gasification projects or in the geological disposal of nuclear waste.

The inspected state may put forward its own explanation for the suspect event - a natural earthquake, for example, or an induced event caused by mining or a natural void collapse; and indeed it is perfectly possible that no illegal activity has occurred (as in our exercise). If the official line is that the area under investigation is an old industrial site, the tell-tale geophysical signatures (service runs, pipelines, foundations, storage tanks, buried waste, contamination, etc.) are something we have become very familiar with in our work on brownfield sites across the world. Such experience is crucial; since drilling is not allowed until the final phase of the inspection process (if at all) the correct and careful application of geophysical techniques is critical to the success of an inspection.

In the months to come, State Signatories and the CTBTO will revisit the exercise by sifting through the many reports, assessments and documents that were produced. Future exercises will be conducted to determine how much has been learned from the lessons gained at the Integrated Field Exercise 2008 in Kazakhstan. [CR](#)


**George Tuckwell is a director of the Geophysical division at STATS Ltd (RSK Group), and is a Vice President of the Geological Society. The views expressed herein are those of the author and do not necessarily reflect the views of the CTBTO Preparatory Commission.*



Society Business

PERC code endorsed

The Society, with the Institute of Geologists of Ireland, the Institute of Mining, Mineralogy and Materials and the European Federation of Geology has been active in promoting a Pan-European Reserves and Resources Reporting Code, the first edition of which was issued in 2001 and has now been updated as PERC Code 2008.

As a sponsoring organisation of the Code, all Fellows of the Society who work on reserve and resource reporting are bound by it under the Society's Code of Conduct. Council has now endorsed the code (at its meeting on 17 June 2009) which is now binding on all Fellows of the Society. The 53-page code, first described by Stephen Henley in these pages in September last year (see www.geolsoc.org.uk/gsl/geoscientist/atlarge/page4232.html) and last month by Sarah Day (*Gold Standard*) can be downloaded from <http://www.vmine.net/percreserves>. 



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


Watson in M

Prof. Lynne Frostick officially inaugurated the Janet Watson Lecture Theatre on 28 May, during a special meeting to celebrate Watson's work.

Speaking before delegates at the end of the day, she said: "Those of you who are familiar with this building may have noticed as you walked into this Meeting Room that its familiar doors now bears the title in gold lettering "JANET WATSON LECTURE THEATRE", and that this wall is now adorned by a newly commissioned painting of Janet, in acrylics, by renowned portrait artist Alice Hesketh.

"When I became President, the idea of naming this room for Janet was not new; but I always felt strongly about it, and following a test of opinion among the Fellowship, decided to proceed with the idea. The response, in letters to the Editor of *Geoscientist*, was overwhelmingly positive; though one I remember particularly - not because it was unusual in being negative, but for the correspondent's reason. While praising Janet's geological researches, he made the point that "we would surely not be naming the Theatre after her *had she not been a woman*".

"This seemed to me to be a worthy addition to the annals of "not seeing the big picture", and it amused me very much. And I can confirm that no, we wouldn't! The fact that Janet was a woman is *exactly* what this commemoration is all about. I hope that in doing so we send a signal that this Society changed irreversibly when it elected a woman President who was such a magnificent role model, inspiration and mentor for other women Earth scientists."

Prof. Frostick then introduced three guest speakers: Dame Jocelyn Bell Burnell FRS, Visiting Professor of Astrophysics at the University of Oxford, former President of the Royal Astronomical Society and current President of the Institute of Physics; Professor John Cosgrove of Imperial College, and Professor Rick Sibson FRS, of the University of Otago, New Zealand. 


Prof. Jocelyn Bell Burnell



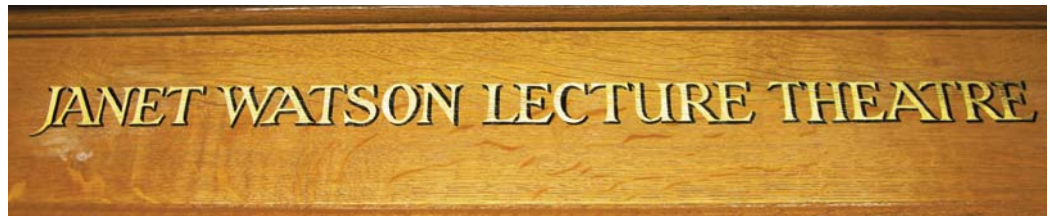
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ayfair



Female scientists take inspiration



Prof. John Cosgrove

All photos: Ted Nield



Prof. Rick Sibson



Janet Watson's research students (l to r) Richard Lisle, Rick Sibson, John Myers, Rod Graham.

Semiseptuacentennial appeal open

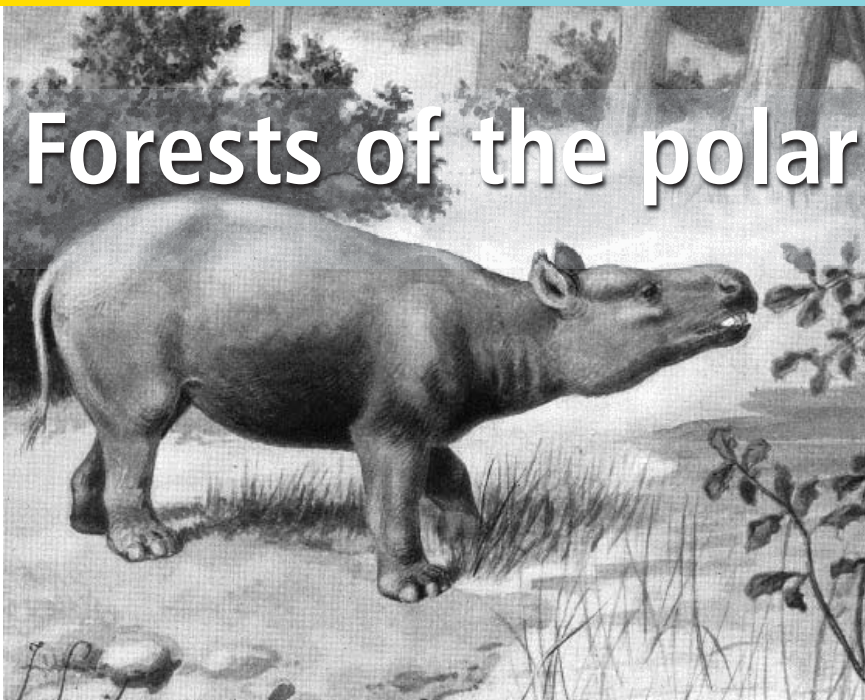
As that great British institution, Marks and Spencer, celebrates its 125th birthday this year, Dawne Riddle takes some time off from the High Street to draw your attention to a little known club on the Mall.

You may be forgiven for growing a little sick of centenaries, bicentenaries, sesquicentenaries and the like by now. But the big one is yet to come. The Royal Society of London for Improving Natural Knowledge was set up by kingly decree 350 years ago next year.

Now styling itself "the national academy of science of the UK and the Commonwealth", the Royal Society has now officially launched its 350th Anniversary campaign to raise £100 million. You can help by visiting their talking web page at <http://royalsociety.org/campaign/index.htm>. Here such scientific luminaries as Sir Martin Rees, David Attenborough and Gordon Brown will try to persuade you to open your wallet.

The Society is working with the Royal to coordinate geological events on the South Bank. 

Forests of the polar night



Hippo-like mammal Coryphodon was one of several ancient mammal groups that endured twilight winters in the high Arctic 53 million year ago. Isotopic studies of Eocene mammal teeth reveal a world of semi-darkness, where huge prehistoric mammals roamed a lush and swampy Arctic, writes Sarah Day.

It is difficult to imagine the Arctic as anything other than a world of ice and polar bears. During the Eocene epoch, however, alligators, aquatic turtles, giant tortoises, snakes and even flying lemurs all made their home there, in a landscape of lush, swampy forests.

They were joined by a wide variety of larger mammals, some as heavy as 1,000 pounds. A study led by Jaelyn Eberle, curator of fossil vertebrates at the University of Colorado Museum of Natural History, has revealed detailed information about the diet of some of these creatures, which in turn helps to deepen our understanding of the Arctic climate.

Eberle and her team analysed the carbon and oxygen isotopes extracted from the fossilised teeth of three mammals living on what is now Ellesmere Island near Greenland; a hippo-like, semi-aquatic creature called a *Coryphodon*, an ancestor of today's tapirs, and a rhino-like creature called a brontothere. Teeth from the high Arctic are particularly valuable to palaeontologists, because they are hard enough to withstand the freeze-thaw conditions that happen every year.

Results from the carbon isotope analysis of tooth enamel, which forms in sequential layers during tooth eruption, provided information about what types of plants the mammals were eating through the seasons. This demonstrated that their diet was gleaned from the high Arctic all year round. "We were able to use carbon signatures preserved in the tooth enamel to show that these mammals did not migrate or hibernate", said Eberle. "Instead, they lived in the high Arctic all year long, munching on some unusual things during the dark winter months".

During the summer, the mammals appear to have lived on a diet of flowering plants, deciduous leaves and aquatic vegetation, while during the dark months of winter they seem to have switched their diet to such delicacies as twigs, leaf litter, evergreen needles and fungi.

By analysing the oxygen isotopes from the teeth, the researchers were able to look in more detail at the nature of the drinking water

available at the surface, providing information about precipitation and temperature. Results suggest that summers were warm and humid, while winters were mild, with temperatures overall ranging from just above freezing to near 21°C.

Today, Ellesmere Island enjoys temperatures ranging from -38°C in winter to +9°C in summer, making it the coldest, driest environment on Earth. Tree stumps from warmer days can still be seen, some as large as washing machines; but vegetation is now sparse, and the few mammals that survive are small.

The region is sunless between October and February, and enjoys constant sunlight from mid-April through to the end of August. Eberle believes that the large Eocene mammals ability to survive in the high Arctic all year round was a "behavioural prerequisite" for their eventual migration across the land bridges which are thought to have then linked Asia and Europe with North America. The idea that they took part in long, seasonal migrations to escape the dark winter months is unlikely, she argues, because of information we have on their diet, size, and the fossil evidence for babies and juveniles in the Arctic.

"In order for mammals to have covered the great distances across land bridges that once connected the continents, they would have required the ability to inhabit the High Arctic year-round in proximity to these land bridges" Eberle suggests.

She believes it is more likely that the animals gradually moved south in small increments over millions of years, in response to shifting climates. Such behaviour may provide information about the future response by Arctic plants and animals to current global warming. With temperatures in the Arctic rising twice as fast as those in mid-latitudes, conditions are edging closer towards those of the Eocene epoch.

"We are hypothesising that lower-latitude mammals will migrate north as the temperatures warm in the coming centuries and millennia", says Eberle. "If temperatures are ever warm enough in the future to rival the Eocene, there is the possibility of new intercontinental migrations by mammals".

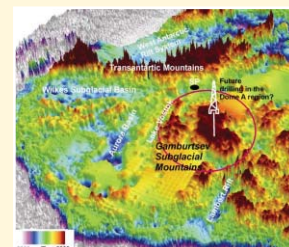
IN *Brief*Smith
Building
opened

The new science building at the British Geological Survey, complete with a bust of William Smith (picture), was opened by Princess Anne on Thursday 25 June. Prof. Lynne Frostick, President, and Mr Edmund Nickless, Executive Secretary, attended.

The William Smith Building is the largest wooden-framed open plan office building in the UK, forming the newest addition to the BGS headquarters in Keyworth, Nottingham. Built in two years with a £7m budget, the building has been designed to the highest environmental standards, including cedar and terracotta cladding, sheep's wool insulation, under-floor heating and an atrium that re-uses plastic panels previously sported by the Eden project domes in Cornwall. *SD*

Buried mountains

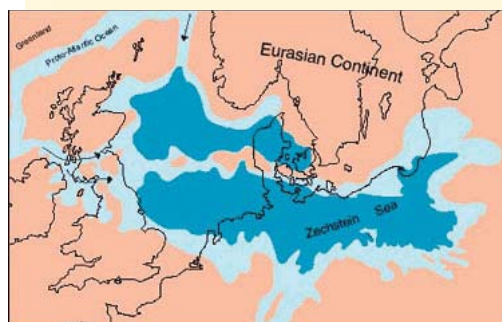
A very important article in *Nature*¹ reports on an extensive radar investigation of the Gamburtsev Mountains beneath the East Antarctica ice sheet. The team led by Sun Bo from China travelled 1235 km by tractor train during the survey. The area surveyed was 30 km x 30 km. The radar waves bounce back and the two-way travel time is measured, giving you the ice thickness. The ice is up to 3 km thick and the peaks in the topography below rise to 1 km depth².



Ice sheet development in Antarctica was the result of significant and rapid global climatic change commencing about 34 million years ago, during the Oligocene. The cause is believed to be a major natural reduction in atmospheric carbon dioxide ("greenhouse gases") coupled with development of the Circumpolar Current, though orbital changes of the planet may have also been involved. The ice covering the mountains started to form ~14 million years ago. The study focused on Dome A, the centre of the ice sheet, at 4093m above sea level. The radar information revealed Alpine topography beneath the ice, with pre-existing river valleys deepened by valley glaciers when the main summer temperature was ~3°C, a landscape that developed in the initial phases of the Antarctic glaciation. There was a second cooling phase with a summer temperature of 6-7°C, when the ice cover started to form. *JMcC*

References

1. Sun Bo, Siegert, M J Mudd, S M *et al.* 2009. The Gamburtsev mountains and the origins and evolution of the Antarctic Ice sheet. *Nature* 459, 690-693.
2. <http://news.bbc.co.uk/1/hi/sci/tech/8079767.stm>



Old salt's tale

Did volatile halogenated gases from giant salt lakes contribute to the mass extinction at the end of the Permian, the biggest in the geological record? Researchers from Russia, Austria, South Africa and Germany have found that in both Russia and South Africa microbial processes in present-day salt lakes naturally emit highly volatile halogens such as

chloroform, tri- and tetra-chlorethene. They then applied their results to the Zechstein Sea, which covered 600,000km² 250 million years ago. The hypersaline sea was exposed to a dry continental climate^{1,2}: climatic considerations, under the global warming at that time created, according to these authors, at least 1.3 million tonnes each of tri- and tetra-chlorethene, 1.1 million tonnes of chloroform and some methyl chloroform being produced - with a potentially catastrophic effect on life.

It should be borne in mind that at this time Pangaea existed, surrounded by Panthalassa, according to Plate Tectonic theory^{3,4}, and any climatic modelling would have to take this into account. These authors sensibly accept that this new toxic agent may well have contributed to the mass extinction, alongside other causes^{5,6} - rather than being the sole cause. *JMcC*

References

1. Weissflog, L, Elanskii, N F, Kotte K, Keppler, F, Pfennigsdorff, A, Lange, K, Putz, E, Lisitzina, L V 2009 O wosmojnoui roli galogenerjaschtschaich gasow w imenii sostojanija atmosferi I prirodnoi sredi w posdnni permskii period Dokladi Akademii Nauk, 424, 1-6 (in Russian)
2. Weissflog, L, Elanskii, N F, Kotte K, Keppler, F, Pfennigsdorff, A, Lange, C A, Putz, E, Lisitzina, L V 2009 Late Permian changes in conditions of the atmosphere and environments caused by halogenated gases Dokladi Earth Sciences, 424(6), 818-823 (in English)
3. McCall, G J H 2008 All at sea (Panthalassa) *Geoscientist* 18(10), 3
4. McCall, G J H 2009 (in the press) Panthalassa, the ocean of ignorance *Earth Science Reviews*
5. Hallam, A 2004 *Catastrophies and lesser calamities* Oxford University Press, 274 pp
6. McCall, G J H 2009 Half a century of progress on terrestrial impact structures: a review *Earth Science Reviews* 92, 99-116

From the *regions*

Derby Day

Sarah Day travels beyond the encircling Chalk and discovers life in the East Midlands - and Wales

We've all been there. You make a friend, things are going great, then they move to London and you never hear from them again. Yet they expect you to shell out to visit them because why would anyone want to be anywhere else? It's a story that seems to be applicable in geology, too. The Society apparently lives in Burlington House, although geologists live all over the country. Keen to explore the Society's real heartland (and having had my suggestion for a Regional Group of the Bahamas turned down) I took myself off to Derby instead.

Here, the East Midlands Regional Group, chaired by Vanessa Banks, was holding a careers day at the University. EMRG are one of the Society's most active

Regional Groups. Their careers day featured speakers from a number of professions, as well as an exhibition featuring various employers and groups – including the Geological Society. Also present were representatives from the University's careers service, who demonstrated that it wasn't just the students who were learning more about geology careers.

"Everyone in my office said I'd recognise the geologists because they'd have beards and home-made jumpers" said Vanessa from the Careers Service. "But I haven't seen a single beard all day". I had actually spotted a couple of beards towards the back; but in general, the stereotype was challenged by the wide range of speakers. Among the career paths highlighted were teaching, industry and academia, as well as STEMnet volunteering.

The most effective presentations were those that highlighted specific areas where geological expertise will be needed in coming years, providing a powerful incentive to enter the profession. In particular, John Black's talk about radioactive waste management demonstrated more powerfully than any just how important geologists are, and how much more important they are likely to become. Many of the students seemed enthusiastic about a careers event tailored to a specific subject, and were able to learn a lot about their post-university options. "I was unsure about what I wanted to do", Lauren told me, "but after coming to Careers Day, I'm thinking about becoming an oceanographer".

Third year geology student Kirsty agreed. "It's been really good. Especially the talk about education, because I've never really considered being a teacher before. I'm thinking about a PhD but it's good to keep my options open." Kirsty is President of the University's Geological Society. "We've been going for a few years now" she told us. "We have our own talks and field trips, which is great because not all students can get to Keyworth for the Regional Group meetings." And it's not just budding geologists that benefit from the Society. "We have about 40 members. They're mostly Earth or environmental Earth scientists, but we have some English and Business Studies students too."

The East Midlands also boast the first branch of the Society's new Young Geoscientists Group, aimed at helping budding geoscientists with the early stages of their careers, from



• Most GeoNews appears first in Geoscientist Online •

graduation to Chartership. Established early last year, the Group provides a forum for discussion, networking and socialising. It is hoped that other Regional Groups will use the YGG model to establish similar groups in their own areas.

"I don't think the Society does enough outside London" says Martin Culshaw, Vice President for Regional Groups. "Until quite recently, the Regional Groups have been often left to their own devices with the hope that they will "do something" he told me.

Wild Wales

To test this theory, I later ventured to the Welsh Assembly in Cardiff. Now in its fifth year, "Science and the Assembly" ('Gwyddoniaeth a'r Cynulliad') provides a chance for scientists and members of the Assembly to develop closer links. The day saw a series of scientific presentations, held in the Wales Millennium Centre, and an exhibition of scientific organisations in the Senedd. The theme of this year's meeting was "science and Health" ('Gwyddoniaeth ac Iechyd', in case you were wondering). What at first sounds a fairly specific topic attracted a wide range of speakers, one of whom even succeeded in dragging in Darwin.

Although a good opportunity for a wide variety of sciences to meet and discuss progress in both science and policy issues, there was low attendance from ministers themselves. The First Minister, Rt. Hon. Rhodri Morgan, did send a special message to attendees, in which he boasted of Wales's "outstanding research in health and health-related fields". Not everyone was so sanguine, however. Many speakers pointed to the worrying trend of young scientists leaving Wales, and low numbers taking up places on science courses at Welsh universities. From the geologist's point of view, this is particularly disappointing, since Wales boasts some of the most impressive geological features in the British Isles. One of the strongest messages to come from the meeting was the general agreement for there to be a permanent Chief Scientific Adviser post at the Welsh Assembly. Such a post exists in both Westminster and the Scottish Parliament, and would demonstrate a commitment to science and technology and its importance for policy making. Science and technology will have a large part to play in the recovery of the Welsh economy. Investing

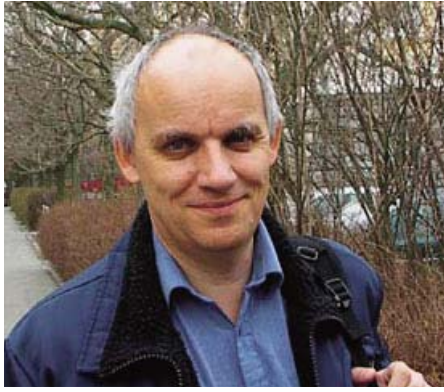
in the past would, its proponents maintain, demonstrate a long-term commitment to improving the economy of the Principality.

For Martin Culshaw, the variety of regional events taking place is important. "Overall, I think that we need to continuously review the activities of the Regional Groups to identify the good ideas that come out of them and share them around, to give them a feeling of really being part of the Society".

"It depends on how much we value the Regional Groups, and see them as part of the future. Most Fellows do not live in London. If we don't do more for our members outside the Capital, there is a real risk that they will drift away."

Sadly for me, most fellows don't live in the Bahamas either. Nevertheless, the work of regional groups is vital, not just in making sure fellows feel in touch with the Society, but in building up a healthy community of young geologists to follow in their footsteps. Two things which are essential if we want to ensure the future of geology in the UK is a sunny one. ☀





If we carry on using and throwing away metals at our current rate, important elements will become scarce remarkably quickly, says Harald Sverdrup (University of Lund). Sue Bowler asks how he knows, and what we can do to avert the technological and political fallout of peak metal.

Peak oil – the time when we are extracting oil at the highest rate, after which resources dwindle – has become a familiar term in the public mind, driving interest in conservation, efficiency and alternative energy. But hydrocarbons are not the only resources that will peak in this way. Many common metals will also reach their peak production rates on human timescales. Harald Sverdrup (Department of Chemical Engineering at the University of Lund, Sweden) is one author of a report* suggesting that some key elements will become scarce far earlier than might be expected – with significant consequences for how societies think about and use our natural resources. One thing's for sure – we can't continue to imagine that any natural resources are limitless if we carry on using them the way we do now.

Recycle or

“People tend to think about peak oil, but peak metal is just a couple of decades behind,” says Sverdrup. The 20 most important metals will move into scarcity in the next hundred years. Some of these are metals where there is absolutely no shortage at all, at the moment. But we have to wake up and take serious thought about how we are going to manage this situation.”

Sverdrup, along with Deniz Koca (also at Lund) and Karl-Henrik Robért of consultants the Natural Step in Stockholm, extrapolated from known and estimated resources, together with current and expected future extraction rates, to find out when we can expect metals to become scarce. There are a lot of uncertainties in this, Sverdrup admits, but they are confident that their estimates hold water. “We considered the resources we know to be left in the ground, both low grade and high grade, as well as the deposits we believe to be accessible” says Sverdrup. “And we looked at how long they will last at current and projected extraction rates. We combined three different mathematical methods to get our estimates: straight burn-off, the Hubbard curve and some dynamic modelling including the effects of changing the price, which have similar results to the Hubbard curve.”

Straight burn-off is the name given to extraction and use of all a resource, with no holding back for environmental aesthetics or when the price is low – the sort of situation, the report suggests, that applies only under a dictatorship or in a truly unregulated marketplace. The Hubbard curve is that established by M King Hubbard to model oil resources and works well – as does the dynamic modelling for a market where price affects demand.

Sverdrup, Koca and Robért combined these methods to find out when key metals will become scarce, and when production is likely to peak. They considered metals in three categories: those needed for infrastructure and technology, those essential for human subsistence, and those used for energy generation. The first and third of these can be considered: Running out of the first group could hold back technological development, as would, in a less direct way, the third. Running out of the second group would hold back development in a more fundamental way, but is unlikely to happen on the sort of timescale that matters.

So, what runs out first? “Helium, silver, gold, zinc, tin and indium will become scarce within 30 years”, says Sverdrup, if we carry on as at present. These metals offer a snapshot of the change of focus that Sverdrup and co-authors advocate if we are to manage resources effectively in the future. We think of silver and gold as precious metals, and their price means that they are to a large extent recycled, although not completely. But zinc, and tin?

Galvanised buckets are not yet considered precious, and are more often thrown to landfill than recycled. Indium is one of the elements that play key roles in electronics and the new technologies being developed for energy, to cope with peak oil and the atmospheric load of greenhouse gases. Platinum, lithium and gallium also have important functions in electronics, and they will reach their peak within 200 years – more quickly if they are used substantially more than they are today, perhaps driven by legislation addressing climate concerns.

die?

“Precious metals are recycled because we know of old that we have to recycle them – and it pays for itself, like a bonus,” says Sverdrup. “You don’t throw gold, or platinum, or silver away. That same logic applies to other metals. Once nickel, say, gets to £80 or £100 per kilo, you don’t throw it away because that’s throwing away money. That these metals are too valuable to throw away has not sunk in yet.”

It’s not only metals that we can consider valuable now, but also elements that are abundant and widely used that will end up in short supply. “There’s supposed to be enough aluminium in the globe to last for ever” points out Sverdrup; “but the easy-to-extract ores will last less than another hundred years. There will still be plenty of aluminium, but it will exist in granite and extracting it is not an easy thing to do. You could do it, but it would take so much energy that you’d need an atomic plant for the job – and aluminium would no longer be a cheap metal. It would be like gold.” In other words, anyone wrapping their sandwiches in aluminium foil in 2150 would have to be seriously rich – and decidedly ostentatious.

Awareness of the imminent scarcity of metals will change behaviour, which in turn will alter these outcomes. “We need to realise that we have tough challenges ahead. We need to focus and be aware of the changes to come, and we have to be especially clever in closing the resource cycles by recycling – it’s good economic sense anyway.” And major boosts to recycling would significantly lengthen the ‘lifetimes’ of these resources; for example, getting recycling rates up to 90% means we use only 10% of the fresh resources we would have needed. But it is precisely for these strategic metals that recycling rates are pitifully low, typically around 30% for aluminium and ferrous metals. And elements used within electronics, in batteries and as alloys are more often not recycled at all, as you find when you try to get rid of an old computer.

The perceived reward of recycling will need to increase before it will be seen as worthwhile to separate out the many components of an old washing machine, for example, and this could take place via a shift in values. Manufacturing goods in such a way that these components can be recycled easily would increase the initial cost, but would give the final article more intrinsic value, suggest Sverdrup *et al.* But there’s also the associated costs of recycling, notably the energy use. Here, too, there is hope, but at the cost of significant change. Uranium used for conventional nuclear reactors is in the tranche of metals that will become scarce over the next century or so. “We will end up using the uranium very quickly, because the way that we use it is so poor” says Sverdrup.

“Only 0.7% of the uranium we get is burned for energy in conventional nuclear reactors. We can burn thorium in the same way and get the same very low rates of use as for uranium, and in 250 years it will all be gone, with an immense amount of waste. But if we were to use thorium in an alternative way in a new type of nuclear reactor, as is proposed by researchers in Canada, we would use 100% of it. There’s enough thorium for nuclear power plants worldwide for 25,000 years.” There’s a long way to go to develop this technology, but it does highlight the possibilities – and changes for the better – that can come about if resources are seen as finite, and worth making the most of, rather than limitless.

That is Sverdrup’s key message: “metals are not like confetti – they are much too valuable to throw away. But we have to think about these things.” Recycling rates far in excess of current dreams and vastly improved efficiency of use will bring many of these metals out of scarcity and give them effectively infinite lifetimes in use in modern life and technology. And, not incidentally, recycling metals better means we run less risk of being poisoned by our own metal waste – a nasty scenario Sverdrup and his co-authors summarise as “wading in our own dirt”.

It is easy to see some very gloomy prospects for the future, on the basis of today’s trends. As national oil and gas reserves fall, international supply and demand has already become a political weapon, for example in recent European winters. Strategic metal resources are also not distributed evenly round the globe, and will change international relationships, boosting the power of countries with the key deposits, whether currently rich or poor. The jockeying for position around regions such as the Arctic Ocean, where the hydrocarbon rights of the seafloor are in dispute, seems likely to get worse when mineral rights could mean controlling the supply of a strategic metal. Sverdrup is reasonably optimistic about the prospects for the future: “It’s not all doom and gloom – we can think of ways around these challenges, and there are good business possibilities ahead.”

However, it should be pointed out that this report is taking quite a long view. The authors limit their considerations to the current interglacial, reasoning that the next ice age will expose new accessible deposits and, anyway, result in a world that can support only one hundredth of the current world population – which would solve most resource problems. This interglacial is likely to be longer than usual, they think, given that the warming arising from greenhouse gases released by burning fossil fuels will prevent the inception of an ice age in a few thousand years, but there won’t be enough fossil fuels left to stop the next one. ☞

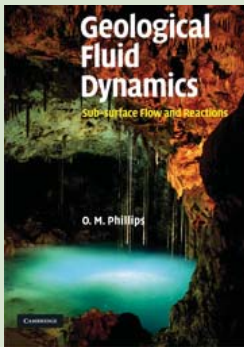
** Towards a world of limits: Long term global supply perspectives for strategic metals and substances. H Sverdrup was speaking at the Goldschmidt Conference 2009, held in Davos this June.*

Reviews

Books available for review:

- Benton, M.J. & Harper, D.A.T. (2009), *Introduction to Paleobiology and the Fossil Record*, Wiley-Blackwell.
- Hewitt, C.N. & Jackson, A.V. (eds) (2009), *Atmospheric Science for Environmental Scientists*, Wiley-Blackwell.
- Holland, C.H. & Sanders, I.S. (eds) (2009), *The Geology of Ireland (2nd Ed)*, Dunedin.
- Shearer, P. M. (2009), *Introduction to Seismology (2nd Ed)*, Cambridge.
- Yafeng, S. (2008), *Collectanea of the Studies on Glaciology, Climate and Environmental Changes in China*, China Meteorological Press.

Interested parties should contact the **Reviews Editor, Dr. Martin Degg 01244 392749; m.degg@chester.ac.uk**, only. Reviewers are invited to keep texts. **Review titles are not available to order from the Geological Society Publishing House unless otherwise stated.**



Geological Fluid Dynamics

O M Phillips

Published by: Cambridge University Press

Publication date: 2009

ISBN: 978-0-521-86555-5

List price: £40.00

285 pp

www.cambridge.org

Geological fluid dynamics (GFD) is not a new field, but there is a scarcity of books on the subject. Owen Phillips's volume fills this void with an excellent text that will likely become a mainstay in graduate courses in environmental fluid mechanics, hydrogeology, geophysics and petroleum geology. The sub-title 'Sub-surface Flow and Reactions' is more representative of the content of the book than the title. Rather than covering diverse GFD topics such as turbidite flows, CO₂ sequestration, and dynamics of volcanic eruptions, the text focuses on groundwater flow (constant and variable density) and reactions. This said, it is definitely not a 'typical' hydrogeology text.

With an obvious emphasis on fluid mechanics and mathematics, the reader requires a good understanding of engineering mathematics to comprehend the subject matter. This is an area where Phillips's style and clarity of writing are especially apparent, with lucid explanations of the basic physical principles of groundwater flow. Coming from a hydrogeology background I found some of the terminology confusing. Phillips refers to 'surface aquifers' – I wasn't sure if this meant a shallow aquifer or an unconfined aquifer. In other places there is redundant terminology where Phillips refers to the 'unsaturated vadose zone' (unsaturated zone) and the 'water-saturated region' (saturated zone). This confusion probably stems from the interdisciplinary nature of GFD, with each interest group having its own language.

This text places more emphasis on the fluid dynamics than the geology, and as such its readership will lean towards numerically minded Earth scientists and modellers. If you have Jacob Bear's *Dynamics of Fluids in Porous Media* on your bookshelf, you will welcome this new text next to it. For those readers coming from a more traditional geological background I suggest starting with *Groundwater in Geologic Processes* (Steven Ingebritsen, Ward Sanford and Christopher Neuzil).

Graduate students and researchers will benefit most from this book, which contains the distilled knowledge of a lifetime's work of one of the leading practitioners in this field. Given the subject matter

(environmental fluid mechanics, hydrogeology, geophysics and petroleum geology), it is apparent that this text is a cross-disciplinary work that will benefit and be well received by a wide audience. The quality of the paper, printing, and binding is excellent, and at £40 it is reasonably priced. If this book is purchased for a graduate course, I see no reason why it should not survive a lifetime of use.

Matthew Waterman 

Natural Climate Variability and Global Warming: A Holocene perspective

Richard W Battarbee and Heather A Binney (eds)

Published by: Wiley-Blackwell

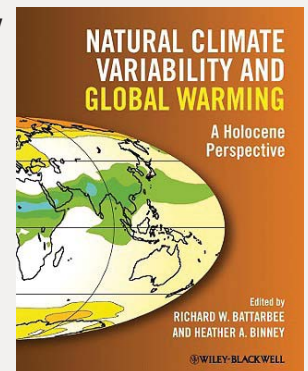
Publication date: 2008

ISBN: 978-1-4051-5905-0

List price: £55.00

276 pp

www.wiley.com/wiley-blackwell



'Prediction', as Neils Bohr once said, 'is very difficult, particularly about the future'. This beautifully produced collection of papers might have been assembled to prove his point. From Milankovitch cycles to solar variability, volcanic activity, the ocean-atmosphere system and the impact of man, this volume documents the bewildering complexity of the Holocene climate. Although aimed at 'researchers and advanced students', this layman found the book perfectly accessible.

John Birks offers us a potted history of Holocene research, which demonstrates that change has been the norm over the past 11,500 years. Frank Oldfield reminds us that people are part of the climate system, not passive recipients. But although major changes in land use began at least 8000 years ago, man's impact on climate prior to the 20th Century remains controversial. Michel Crucifix outlines the challenges for climate models, including stochastic events that could produce sudden changes with no identifiable cause. He is less reticent than Oldfield about man's impact, making the intriguing suggestion that anthropogenic activity may have delayed the next ice age! Jansen *et al.* link the Holocene thermal maximum to orbital forcing, and identify multi-century to millennial internal variability in the climate system. Beer and van Geel demonstrate the importance of solar forcing amplified by positive feedbacks. Standard climate models may underestimate this forcing.



Per Kirkeby *The Siege of Constantinople* 1995 Tate
© The artist. Oil on canvas 400 x 340 cm.

Verschuren and Charman note that changes in rainfall have a profound impact on human welfare. They show that hydrological changes may be correlatable over large distances. Martin Claussen shows that subtle forcings can produce dramatic changes in land cover; the rapid expansion of the Sahara about 5500 years ago being the prime example. Summarising, Raymond Bradley notes that people do not experience mean climate conditions, they are subject to regional climatic variability. Models for predicting such potentially catastrophic variability are urgently needed.

Despite the high quality of individual chapters I have two reservations about the book. First, it doesn't really do 'what it says on the tin'. The claim that it 'provides the groundwork for making critical decisions about the Earth's future' is not substantiated by the content - the book has nothing specific to add to current projections of 21st Century warming. Secondly, the insistence that recent decadal-scale global temperature rise has been definitively explained is unsubstantiated and somewhat 'forced' in a volume that scarcely addresses this period. However, the rehabilitation of the Medieval Warm Period and Little Ice Age will delight traditionalists, and give some comfort to critics who doubt climate-science's capacity for self-correction.

Joe Brannan, *The Hague* 

Per Kirkeby

Tate Modern

17 June – 6 September

Sunday to Thursday, 10.00–18.00. Friday and Saturday, 10.00–22.00

Last admission 17.15 (Friday and Saturday 21.15)

£9.80 (Concs £7.80/Senior £8.80/Family £24.50 concessions)

For as long as nature has appeared in art, geology and painting have had a close relationship. Leonardo da Vinci, the ultimate polymath, made detailed observations of his geological surroundings, reproduced in some of his most famous paintings, while the Pre-Raphaelites took careful note of the most fashionable science of their time.

There are far fewer examples of things working in the other direction. Considering geologists are famous for their colouring-in abilities, this is perhaps surprising. Per Kirkeby, who has been called one of Denmark's most 'internationally acclaimed artists today', is a notable exception. Having studied for a masters in Arctic geology at the University of Copenhagen, Kirkeby has gone on to embrace numerous fields, including painting, sculpture and writing, in a career outlined in a new exhibition at Tate Modern.

Kirkeby's influences are as diverse as his background. Ranging from pop culture to the Byzantine Empire, they rarely result in paintings that depict nature directly, as might be expected. Instead, there are huge canvases of abstract shapes and scribbles, scrawls on blackboards, bronze architectural sculptures. His constant theme seems to be a search for patterns, suggesting that something coherent might exist among the apparently random lines and brush strokes. It is here that the influence of a geological training seems to have lingered.

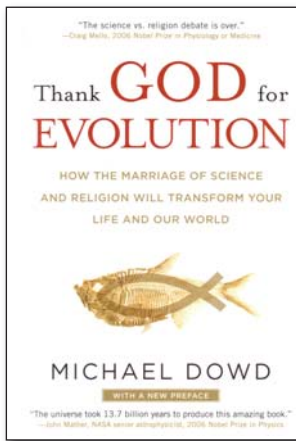
Kirkeby's palette, too, reflects his interest in nature - predominantly greens and browns and greys, these may not be the kind of paintings you would necessarily want in your home. To me, the most conventionally attractive are also the least abstract – a series of watercolours painted on field trips to Greenland depicting fleeting impressions of coastlines, glaciers and mountains. Here, the exhibition notes make much of Kirkeby's 'scientific eye': "While rooted in his scientific training, they are ultimately structured by their own painterly logic of colour and line". The implication seems to be that this side of the works remains unscientific, because it is less apparently controlled.

Other text in the exhibition also suggests division between these two sides of Kirkeby's training, proclaiming that he approaches his diverse range of subjects with a "sense of curiosity and enquiry, whose near-scientific rigour can be traced back to the artist's original university training as a geologist". His 'painterly response' to nature is thus contrasted with the apparently simple act of observation.

In Kirkeby, the art world has found an unusual subject – a scientist – and reacted as one might expect, by searching for aspects that can be labelled 'scientific'. Kirkeby, we are told, struggles to reconcile these two ways of seeing. This may be true, one can't help thinking that the argument might be more convincing had he originally trained as a physicist. Geologists are quite used to dealing with apparent chaos. Their observations are rarely untouched by (constrained) imagination. And, as examples like da Vinci demonstrate, rigorous observation of nature is not only of use to, or characteristic of, scientists.

It seems unnecessary to draw attention to the distinction. Kirkeby's art, while occasionally monotonous and overworked, provides a fascinating insight into how science and art can work together to reflect on nature and our place in it. As the painter himself writes: 'the world is a material of which one makes art'. A statement that is equally true of science.

Sarah Day 



Thank God for Evolution

Michael Dowd
Published by: Plume
Publication date: May 2009
ISBN: 978-0452295346
List Price: £7.99
410 pp

This book carries the intriguing subtitle 'How the marriage of science and religion will transform your life and our world'. Both the title and the many pages of commendations are promising but I fear that many readers will find this a curious and frustrating work. The general tone is that of a religious book from the folksy American tradition: there are abundant references to 'God', 'Gospel', 'salvation', a self-help section and even short passages of testimony. Yet in reality this is an unashamedly atheist tract. After a complex theological pilgrimage, Michael Dowd has now come to hold beliefs which might be summarised as New-Age mysticism married to an outright atheism. Dowd makes it clear that, for him, God, in the traditional sense of a supreme personal being outside of the cosmos, doesn't exist: the only ultimate reality is the evolving universe. Where Dowd differs from other vocal atheists of our age that while they propose a secularisation of the sacred, he wishes to do the opposite and through a new evolution-based creation myth, produce a sanctification of the secular.

The actual scientific components of this book are relatively slender and are all drawn from existing popularisations. I was troubled by the fact that Dowd seems to see science primarily as raw material for his creation myth rather than truth in its own right. This may explain his surprising (and somewhat alarming) tolerance of young Earth creationism.

Notwithstanding the many commendations of this book, two major criticisms can be made. The first is specific and theological. Dowd is damning of many aspects of religious belief, terming them 'flat-earth thinking' or 'night language.' Unfortunately the criteria for such negative features seem to be simply that these are things he doesn't agree with. Christians with any sort of traditional belief will find Dowd's ruthless reinterpretation of the faith unacceptable. To take merely one example, whatever the Cross means, it is not 'the path of vertical integrity.' Although Dowd

only briefly engages with other faiths, we can be reasonably certain that he will not be touring Saudi Arabia in the near future.

The second criticism is general and logical. In this book Dowd takes post-modern liberties with language. Words, especially theological ones, are used without any regard for their meaning so that although God does not exist, 'God language' continues to be used. So we find a dedication to 'the glory of God', enthusiastic references to the 'sacred evolutionary perspective' and 'the Gospel according to evolution'. Here we must surely protest. Words have to have meanings; although theological language may be frustratingly imprecise, it means something. Having rejected the concept of a supernatural god, you surely cannot talk of the universe as a product of 'divine grace and creativity', mention a 'Holy Trajectory of Evolution' or even give 'thanks to God'. This book holds out the tantalising promise of a *rapprochement* between science and faith. Unfortunately the price it demands, the sacrifice of language and meaning, is too high.

Christopher Walley 



Letters

Geoscientist welcomes readers' letters, and every effort is made to publish them as promptly as possible. You can help by keeping letters to around 300 words or fewer. Please write to **Dr Ted Nield**, Editor, at The Geological Society, Burlington House, Piccadilly, London W1J 0BG or email ted.nield@geolsoc.org.uk

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Motherhood and apple pie

From William Hume (Rec'd 10 June; Pub'd 17 June)

Sir, Reading with interest your Editorial (*Geoscientist* 19.6 June 2009) I was struck by the balance needed for science to thrive in a progressive society. You would seem to suggest that scientists are the best and only people to choose how to spend the public's money, with society effectively handing the process a blank cheque to pursue 'what science needs doing'.

The history of science that has become dislocated from the wider concerns of society is not glorious and here we come again to the need for balance. Like it or not the world of politics represents the opinion of society in a liberal democracy and your examples of pre WW2 Germany represent a flaw in society, rather than the method of funding science.

As I see it, the formulation of these questions may come from one of two principal sources. First, the slow march of progress along a line where one kernel of information raises a further question that deserves additional study. In this case the principle has already been established and the questions form a progression towards a known general goal.

The second source of questions derives from a more adventurous, 'what if' starting point; including issues that are 'off the radar' – fascinating and worthwhile but possibly less connected with an immediate advantage to society. Yet with either of these starting points, if society is the paymaster, the principles behind the questions should also come from society. (I would argue that the same also applies even if society is not the direct paymaster.)

The bottom line is the balance of action where society forms the broad field of scientific question; not merely with respect to funding alone but including the wider social context as well. Science should, however, answer the questions in freedom and in an atmosphere of clear light which clearly shows as far as possible the bias and viewpoint of the scientist. Communication is therefore a key issue; society (principally the media and the politicians) need to understand science, its strengths and limitations, and science needs to know and understand where it comes from and that scientific purpose comes from society rather than the funding package.

If scientists do not like concepts such as 'multidisciplinary' as conceived by politicians, then we should address this with society and the body politic rather than seeking a divorce. More strength to your elbow in the field of communication then.

Loo paper threat

From Stephen Dulson (Rec'd 10 June; Pub'd 17 June)

Sir, I was annoyed to read in "Society Business" in May's *Geoscientist*, that those of us who wish to continue receiving our journals in the normal way will be charged an extra £10 in addition to our (in my opinion) already substantial subscription fees.

Surely, in the current economic climate, the reasonable thing to do would be to offer a £10 discount to those who are joined at the hip to their laptops (like some nerdy Teletubbies) and insist on living their virtual lives online. I don't recall being asked if I agreed with this proposal, but if I am sure that many people would have expressed similar views. Many of my geological acquaintances admit to rarely reading the journal as it stands and if it is online then I am sure even more will "forget" to keep themselves up-to-date with research etc.

I only really find time to read my professional literature at two locations. The first (and most obvious) I will not detail here and the second is on the train to and from work. Even if I did have possession of a laptop, the wisdom of flashing this around in South London is somewhat questionable, given the usual lateness of my journey home from the office. There are many other reasons which I won't go into now. Is this proposal still under debate or will Fellows be stung regardless of their views?

Editor asks: Do many Fellows feel this way? Most complaints on this issue have historically arisen from the Society's erstwhile insistence – soon to be abandoned - that all Fellows receive paper copies, thereby imposing intolerable strains upon shelves, garage space and marriages. Please write to ted.nield@geolsoc.org.uk.

Electoral dysfunction

Reply to Rick Brassington from Robert Freer (Rec'd 9 June; Pub'd 17 June)

Sir, A low turnout for the Council election is disappointing but does not necessarily mean something is wrong with the Society - perhaps the opposite!

I did not know any of the candidates, nor as second best, their supporters, but I thought their election statements were all very similar and therefore whoever was elected it would be "business as usual". No one was preaching revolution so there was no one to strongly oppose or strongly support.

If the system is changed in any way I would not agree with a standardised form. Age is irrelevant for the Council (Pitt was Prime Minister at 24, Gladstone at 84). It is unlikely that any candidate will not give full weight to their relevant experience and express it in their own words. The more varied their experience the better.

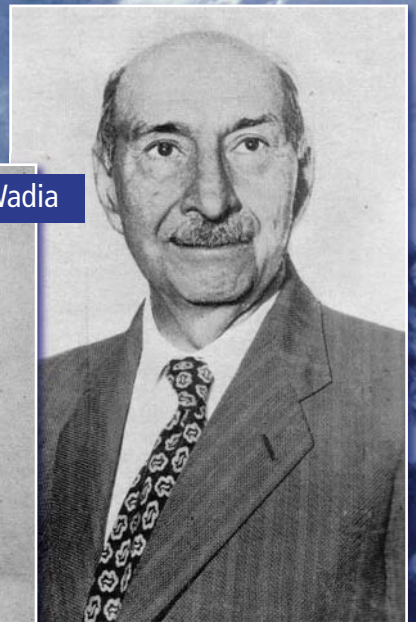
The Society appears to be functioning well. Turnout at elections may be disappointing but I do not see it as a sign of a dysfunctional Society.

Walking the

*Geoff Glasby celebrates the life of D N Wadia, pioneer of Himalayan geology, on the 90th anniversary of the publication of his monumental book *The Geology of India*. Himalayan geologist Mike Searle (Oxford University) presents a modern perspective on his work.*



D N Wadia



The summit of Nanga Parbat. Photo: Mike Searle.

roofbeam

Darashaw Noshawan Wadia was born in October 1883 in Surat in Gujarat State. In 1894, in order to get a better education for their son, the family moved to Boroda (also in Gujarat) and he attended a private Gujarati school and then the Sir J J English School. Here he developed his love of science and devotion to knowledge. At the age of 16, Wadia went to Baroda College, which was then part of the University of Bombay. There he took a BSc in Botany and Zoology (1903) and a second Bachelor degree in Botany and Geology in 1905¹. At that time, geology was only taught in Calcutta and Madras, which means that Wadia was therefore largely self-taught as a geologist.

In 1907, at the age of 23, Wadia had the good fortune to be appointed Professor of Geology at the Prince of Wales College in Jammu in the southernmost part of the State of Jammu and Kashmir¹ and stayed there until 1921. From there, he set his eyes on the distant Himalaya. His early life among the mountains of Kashmir inspired much of his later work on the structure and stratigraphy of the North-West Himalaya².

Wadia's main task as a lecturer in Geology was preparing the students for the Punjab University Examinations. However, he experienced great difficulty teaching the geology of India because of the lack of suitable textbooks. He therefore took the extreme solution of writing his own. The first edition of *The Geology of India for Students* was published in 1919 and the sixth edition, *The Geology of India*, was published in 1966¹¹. *The Geology of India* is a remarkable book. The sixth edition is 536 pages long and divided into three main sections, the first, relatively short, on the physical features of India, the second a huge contribution on the stratigraphy of India from the Archaean to the Pleistocene and Recent and finally a relatively short section on the Economic Geology of India. This book had a profound influence on generations of students of geology in India and is still in use today.

During his time in Jammu, Wadia used to take his students on adventure trekking and investigative field trips in the Siwalik Hills of the Jammu region. Among the fossils he collected during these years were a 10 ft-long long tusk and skull fragments of an elephant-like mammal, *Stegodon ganesa*, which he found in the Upper Siwalik Formation six miles north of Jammu. In 1928, Wadia subsequently identified a skull of *Actinodon risinensis*, collected from the Lower Gondwana beds near Zewan in Kashmir. These two fossil discoveries were of great import.

Geological Survey 1920-38

In 1920, the Geological Survey of India received authority to increase its complement of scientific officers from 20 to 32. Wadia was appointed to one of these positions at the relatively late age of 37 in 1921. He was the first Indian to be appointed to the GSI whose degrees came from an Indian university¹. At that

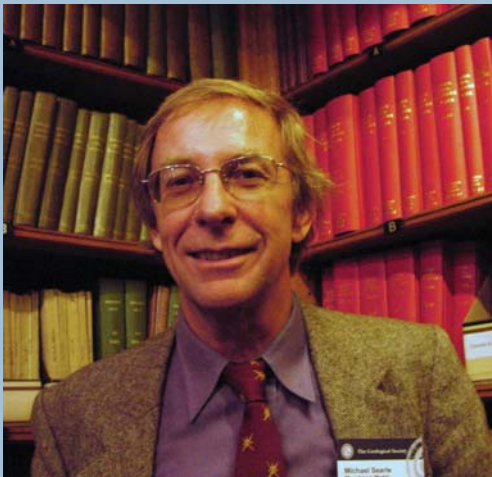
time, the GSI was mapping in some Himalayan areas where topographic maps at one inch to the mile had become available. Wadia began his career at the GSI by mapping 2000 square miles of the mountainous Poonch State in the Lesser Himalayas and an additional 2100 square miles in the adjacent parts of the Punjab. This formed the basis of his first substantial memoir for the GSI in 1928³. One of the principal findings of this study was his explanation of the unique knee-bend of the mountain chains around the knot called Nanga Parbat, as the result of the interaction of the Himalaya with the tongue-like projection of the Archaean Shield^{1,2,4}. The tectonics of the Nanga Parbat Syntaxis have recently been the subject of a Memoir of the Geological Society⁵. For his work there, Wadia was awarded the Back Award of the Royal Geographical Society in 1934 and the Lyell Medal of the Geological Society in 1943².

“A giant among geologists, Darashaw Noshawan Wadia was a great visionary who not only shaped our understanding of the geological making of the Indian subcontinent but also set the national agenda of geological activities when India won freedom.”

K S Valdiya

In 1930-31, Wadia continued mapping the high ground around Nanga Parbat (peak at 8126m) with only old ½ and 1 inch topographic maps available to him^{1,2}. He described the mountain as “a peak of arresting grandeur...Its southern flank exposes a rock face whose buttressed cliffs, 12,000ft high, pierce the sky almost in one leap”. Its surrounding slopes were concealed under many square miles of uninterrupted snow fields. Wadia described the Nanga Parbat mountain mass, the central and most commanding feature of the whole district as above 15,000ft (4572m) and “almost inaccessible to the single field geologist, unequipped with elaborate mountaineering outfit, parties of carriers, etc.”⁴. However, Wadia was able to

Nanga Parbat – an uplifting tale



Mike Searle reflects on Wadia's Nanga Parbat work in the light of modern discoveries.

Darashaw Noshawan Wadia was a field geologist in the great tradition of early 20th Century observation-driven exploration geology. As Geoff Glasby explains, he mapped thousands of square miles for the

Geological Survey of India throughout Kashmir, particularly in the provinces of Poonch, Chilas and Gilgit. His 'adventure treks' for students took him into the remotest corners of Kashmir. In the days of pre-1947 partition of India and Pakistan, he roamed through much of what is now the disputed border region along the Kashmir cease-fire line. Due to the numerous conflicts and border wars in Kashmir since independence, many of the regions that he explored and mapped have not subsequently been visited by geologists, to this day. Wadia had widespread interests, his work ranging from Pleistocene fossils in the Siwalik molasse to the Archean basement gneisses.

Wadia was the first to identify the great Western 'Syntaxis' of the Himalaya or the 'Nanga Parbat bend', where a great tongue-like projection of lower crust gneisses projected north of the main Himalayan axis. Wadia's '*Geological Map of Part of the Gilgit District*' at a scale of one inch to four miles included all the territory around the peak of Nanga Parbat (8125 metres). This work included the first cross-section across the Nanga Parbat massif from the Indus valley in the west to the Rupal glacier in the east. Wadia recognized that the massif was composed of gneiss with interbedded 'Salkalla Series' surrounding a central summit region composed of 'granitoid gneiss'. He assumed, quite reasonably for the time, that these crystalline rocks were part of the Archean basement of India.

Wadia would be amused to know that now, the Nanga Parbat gneisses show the *youngest* metamorphic event dated by U-Th-Pb anywhere in the world! These Precambrian basement gneisses and migmatites have tourmaline, garnet and sillimanite-bearing granite melts with U-Pb monazite, xenotime and zircon ages ~900 ka, and some cordierite and tourmaline bearing melts as young as 700,000 years. Cordierite-bearing leucogranite seams and veins record Pleistocene crustal melting at depths of ~17-10km. Exhumation (uplift of rock) rates of about 13mm/year in the core of Nanga Parbat are phenomenally high for continental crust. Leucogranitic rocks that now form the summit region of Nanga Parbat massif were formed by high-temperature biotite dehydration melting of Precambrian crust at depths of ~17-10km beneath the Earth's surface.

Wadia's legacy to Himalayan geology is unique and spectacular. His book *Geology of India*¹¹, published in 1919 and reprinted six times, is still widely used to this day. He was undoubtedly one the greatest of Indian geologists, whose name lives on in the Wadia Institute of Himalayan Geology in Dehra Dun, renamed in his honour from the Indian Institute of Himalayan Geology, which he founded. His name will always be intimately linked to the snows of Nanga Parbat, surely one of the most spectacular of all Himalayan mountains.

deduce the geology of the higher parts of the mountain above the snow line by examining the moraine deposits. On this basis, he considered the geology of the mountain to be "rather simple": to which his Director replied that it must be rather pleasant to possess the philosophical temperament to regard such complexity as simple'. Nonetheless, fieldwork in this barren area undertaken at the age of 50 would have required great tenacity².

A decade later, in 1937, he contributed two papers on the tectonic relations of the Himalayas with the North Indian Foreland, and on palaeogeography and climate during the Permo-Carboniferous, at the International Geological Congress in Moscow, though he was unable to attend in person.

Fossils and soil

Wadia's interests were very broad however, and from 1926-1927 he extended his studies of vertebrate fossils from the Siwalik (Neogene) strata of Potwar and Kashmir at the British Museum (Natural History), and at geological institutions in Germany, Austria and Czechoslovakia¹. In 1938, he also published a catalogue of fossil primates discovered in the Tertiary deposits in India². Wadia's contribution to the soil science in India was also highly significant⁶. Wadia bemoaned the neglect of soil science in India and showed the way for improvements. As a result, in 1935 Wadia (jointly with M S Krishnan and P N Mukherjee) published India's first soil map. Wadia thereby exerted considerable influence on agricultural development in his country and represented India at the 3rd International Congress of Soil Science held at Oxford in 1935 and also participated in an excursion arranged by the Congress to study the soil profiles in England, Wales and Scotland.

In 1938, Wadia reached the GSI retirement age (55). In that year, he gave the Presidential Address to the Geology Section of the Indian Science Congress during its Jubilee Meeting in Calcutta¹. He also provided a chapter dealing with geology and geography to the Congress Volume entitled Progress in Science during the



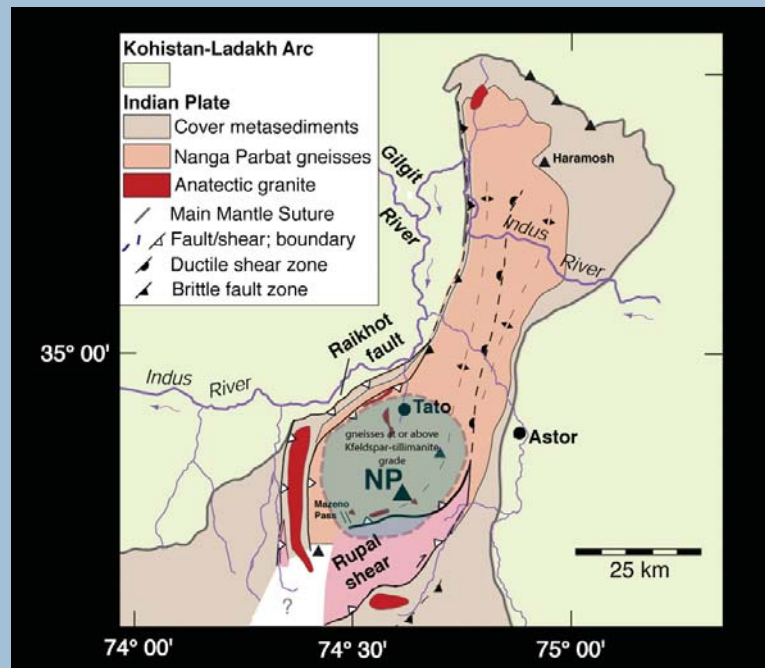
last 25 years and gave a president's address on the Himalayas to the Geology Section.

Ceylon 1938-1945

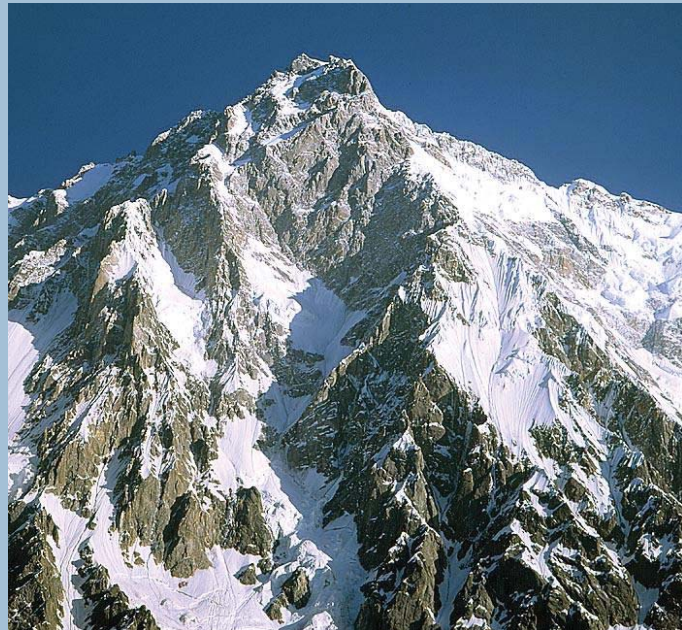
On his retirement, Wadia accepted an offer from the Government of Ceylon to become its Government Mineralogist. His main recommendation was that a systematic survey of the island should be undertaken in order to prepare an accurate geological map of the island. This work was impeded by lack of qualified staff, but he managed to produce a number of reports on water supply, peat, glass sands, gem gravels and minerals of economic value¹. He also produced accurate geological maps of the island and geological investigations concerning water supply, dam-sites and other engineering projects⁶. His transfer to Ceylon was to bring other, more personal benefits. In 1940 Wadia, already a widower, met and married his second wife Meher Medivala (Colombo, 1940). She was

“Fortunately for India, it found in Wadia an eminent geologist of its own, who would enthuse generations of Indian geologists... clambering up and down the Nanga Parbat area of the Himalayas, at the height of twelve thousand feet, when he was fifty.”

Biman Nath



Simplified geological sketch of the Nanga Parbat showing how the Himalaya bends around it like a pivot. Nanga Parbat is 8126.3m (26,660ft) high and is located in the Suppatt Region of the Himalaya Mountains in northwest Kashmir in Pakistan-held Azad Kashmir.



Nanga Parbat, (Naked Mountain, in Hindi), boasts one of the highest mountain faces in the world. The Rupal Face rises 4600m (15,000ft) above its base. To the north, the complex, somewhat more gently sloped Raikhot Flank rises 7000m (22,966ft) from the Indus River valley to the summit in just 27km, one of the greatest elevation gains in so short a distance on Earth. It is also known as the killer mountain.

a mineralogist and graduate of the University of Bombay and was his constant companion for the rest of his life. An established scientist in her own right, she published her *Minerals of India* in 1966⁷.

In 1942, Wadia became General President of the Indian Science Congress. At its 1943 meeting in Calcutta, Wadia spoke on *Minerals' share in the war*⁸. He pointed out that this was the first time in the four millennia of India's recorded history that an enemy had assaulted the eastern frontiers of the country, and reported on India's response, through its munitions factories, its electric, chemical and technical plants and industrial research laboratories. He also pleaded for a justly planned international minerals policy, to preserve peace and goodwill among countries¹. This speech, published in *Science*, was an impressive and far-sighted contribution, especially for having been made in a time of war.

Into the sixties

In 1945 Wadia was appointed Geological Adviser to the national government of Jawaharlal Nehru and asked to initiate and formulate a mineral policy for India⁶. He realised that the estimates of raw mineral resources needed reassessment¹. Following Independence in 1947, supplies of some minerals (salt and gypsum) were indeed

found to be in short supply with the passing of territory to Pakistan. In 1947, he announced the setting up of a Mineral Advisory Board to advise on mineral development. In 1948, Wadia became the first Director of the Indian Bureau of Mines, where he was assisted by two officers. The Bureau drafted the *Mines and Minerals Act* (1948), the *Mineral Concession Rules* (1949) and the *Petroleum Concession Rules* (1949). In 1949, Wadia left the Bureau to serve on the Atomic Energy Commission. Under his leadership the Indian AEC grew into a well-knit unit of 470 geologists and geophysicists, mining and drilling personnel. Thus Wadia had a hand in establishing almost all of India's postwar minerals policy. In 1948, Wadia attended the London International Geological Congress, presenting a paper on the fluvial sediments of NW India¹. As head of the Indian delegation, Wadia also conveyed an invitation on behalf of the Indian Government to host the XIXth Congress in New Delhi to coincide with the centenary of the formation of the GSI. However, on that occasion the conference was awarded to France, and it was not until 1964 that India was able to host the IGC (the XXIIth International Geological Congress) in Delhi - with Wadia as its President.

In 1963, Wadia gave the Meghnad Saha Lecture⁹ on *The Himalaya Mountains: Their age, origin and sub-crustal relations*, in which he essentially summarised his ideas on the formation of the Himalaya developed over a lifetime. In 1965, a D N Wadia Commemorative Volume, containing 60 separate articles, was published by the Mining, Geological and Metallurgical Institute of India¹⁰.

Wadia was also heavily involved in founding the Indian Institute of Himalayan Geology in Dehra Dun of which he was made the first honorary director. The institute was named the Wadia Institute of Himalayan Geology after his death.

Wadia was a field geologist through and through. For months on end, he would leave his camp at day-break for a good 20 miles traverse on foot in trackless mountain or on a much longer ride on mule or horseback, a late lunch his first meal of the day. 'The best work is done with the least amenities' was his favourite dictum. He died on June 15, 1969 at the age of 86. He was without doubt the best geologist India has produced.



The Raikot Face of Nanga Parbat. Photo: Mike Searle.



Raikot face of Nanga Parbat taken from the old flight from Rawalpindi to Skardu. This flight had to circumnavigate the peak, which was too high to fly over. Photo: Mike Searle.

Honours and awards

Wadia received many prestigious honours and awards. In 1957, he was elected a Fellow of the Royal Society of London⁶. He was also President of the Geology Section of the Indian Science Congress (1921 and 1938); General President of the Indian Science Congress (1942 and 1943); President of the National Institute of Sciences of India (later renamed as Indian National Science Academy) during 1946-47; Honorary DSc from Delhi University (1947), Inaugural President of Indian Society of Soil Sciences (1949); President of the Geological Society of India (1951-52); President of the Mining, Geological and Metallurgical Institute of India (1951-52); President of the XXII International Geological Congress at Delhi (1964) and Chairman of the Indian National committee for Oceanic Research. In 1962, he became the first geologist to be made a National Professor by the Indian Government.



Glacier descending from Nanga Parbat. Photo: Mike Searle.

References

1. Stubblefield, C J 1970 Darashaw Noshewan Wadia 1883-1969 Biographical Memoirs of the Fellows of the Royal Society 16: 543-562
2. West, W D 1965 D N Wadia – Commemorative Volume Mining, Geological and Metallurgical Institute of India Feb: 1-9
3. Wadia, D N 1928 Geology of the Poonch State (Kashmir) and adjacent portions of the Punjab Mem Geol Soc India 51 (2), 185-370
4. Thakur, V C 2003 Research contributions of D N Wadia Resonance 8: 65-75
5. Khan, M A , Treloar, P J , Searle, M P and Jan, M O 2000 Tectonics of the Nanga Parbat Syntaxis and the Western Himalaya Geological Society Special Publication 170: 485 pp
6. Vigyan Prasar (undated) Darashaw Noshewan Wadia Pioneer of Geological Investigations in India
7. Mrs Meher D N Wadia 1966 Minerals of India Edited by D N Wadia National Book Trust, New Delhi, 199 pp
8. Wadia, D N 1943 Minerals' share in the war Science 98: 351-356
9. Wadia, D N 1963 The Himalaya Mountains: Their age, origin and sub-crustal relations Meghnad Saha Lecture, National Institute of Sciences of India, New Delhi 17 pp
10. Jhingran, A G (Ed) Dr D N Wadia Commemorative Volume Mining, Geological & Metallurgical Institute of India 833 pp
11. Wadia, D N 1966 Geology of India Sixth Edition Macmillan, London 536 pp (first edition 1919)



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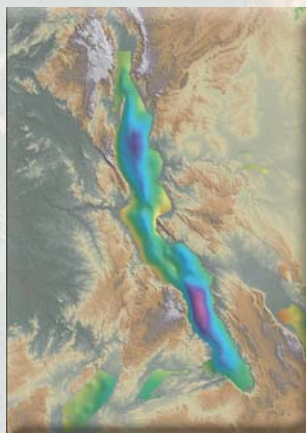


Image courtesy of Fugro NPA and Surestream Petroleum : Lake Tanganyika, Neogene rift basin exploiting Permian rift trends and PanAfrican lineaments, composite topographic and satellite gravity image

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The Geological Society



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- 9 - 13 September: Conference Field Trip

SESSION THEMES

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- Beyond Rodinia: evidence for, & reconstruction of, older supercontinents
- Palaeogeography of Supercontinental Transitions
- Supercontinents, superplumes & True Polar Wander
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For further information about the conference or field trip, please contact:

Alys Hillbourne Tel: 020 7432 0981 Email: alys.hillbourne@geolsoc.org.uk
Or visit our website at www.geolsoc.org.uk/events www.geos.ed.ac.uk/rodinia2009



The Geological Society



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•**11 December - Fugro Engineering Services** - *Cone Penetration Testing (CPT)*. Free 1-day CPD course (see above). Venue: Glasgow. **Contact:** Steve Poulter T: 0870 4021423 E: s.poulter@fes.co.uk **W:** www.fes.co.uk.

A Professional School in Ground Engineering at the Building Research Establishment (Watford), First Steps Ltd. For reservations and information contact Christine Butenuth, info@firststeps.uk.com, 0207 589 7394, www.firststeps.eu.com.

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SEPTEMBER 2009 AUGUST 2009



•**31 August-2 September – Micro-Analysis, Processes, Time (MAPT)**. The meeting will be held in Edinburgh and the lead convener is Professor Simon Harley of Edinburgh University. There are field trips before and after the meeting and workshops on quality assurance in microanalysis and ion microprobe techniques and applications. For full details visit: www.minersoc.org/pages/meetings/MAPT/MAPT.html. **Contact:** Simon Harley. E: simon.harley@ed.ac.uk



•**2-4 September – Biogeochemistry of Marine Waters and Sediments, Present and Past**. Venue: Burlington House. Register now online at www.geolsoc.org.uk. **Contact:** Georgina Worrall, The Geological Society, Burlington House, London W1J 0BG. T: 020 7432 0983 F: 020 7494 0579 E: georgina.worrall@geolsoc.org.uk



•**6-13 September – Fermor Meeting 2009: Supercontinents, Superplumes and Scotland**. Conference & field trip. The 2009 meeting and field trip will focus on the formation, configuration and break-up of Rodinia. The meeting will be hosted in Edinburgh from 6-9 September 2009, followed by a four-day field trip to see some fabulous and classic geology in the Western Highlands of Scotland. Full details and registration: www.geolsoc.org.uk/gsl/events/listings/page4772.html **Contact:** Alys Hilbourne E: alys.hilbourne@geolsoc.org.uk



•**8 September – Contaminated Land (Provisional) – Meet** 6pm for 6.30pm Venue: Bell Inn, Godstone, Surrey. **Contact:** Sarah Cook T: 01342 333119 E: scook@southernstesting.co.uk



•**9 September – Shell London Lecture Series: The fossil record since Darwin**. Speaker: Richard Fortey. Venue: Burlington House. Matinée performance 3pm. Evening at 6pm – please note that if you would like to attend, the 3pm performance generally has more availability. **Contact:** Alys Hilbourne, Geological Society, Burlington House, London W1J 0BG T: 020 7432 0981 F: 020 7494 0579 E: alys.hilbourne@geolsoc.org.uk.



•**16 September – Tasting of Wines from France - a Geological Perspective**. Venue: Boniface Centre, Crediton, 7.00pm. (Parking available. Venue close to public transport links from Exeter) **Contact:** E: swrg@geolsoc.org.uk.



•**16 September – Exploration Managers' Lunch Series**. Venue: The Napoleon Cellar (Berry Bros. & Rudd), St James's St., LONDON. Arrive from 12.00 for lunch at 12.30. **Contact:** Steve Whalley, Geological Society, Burlington House, London W1J 0BG. T: 020 7432 0980 F: 020 7494 0579 E: steve.whalley@geolsoc.org.uk



•**16 September – Contamination**. Venue: The Adelphi, Leeds. Buffet at 6pm for 6:30pm. **Contact and speaker:** Katie Dunn E: katie.dunn@WorleyParsons.com



•**19-26 September – Field Trip to Brittany, France**. Led by Dr John T Renouf. Must be pre-booked – please **contact** marcgreg@breathe.com.



•**21-23 September – William Smith Meeting 2009: Environmental Pollution and Human Health**. Venue – Burlington House. The meeting may also act as a forum for research projects supported under the joint NERC *Environment and Human Health* programme. Full details and registration: www.geolsoc.org.uk/gsl/events/listings/page4598.html **Contact:** Alys Hilbourne E: alys.hilbourne@geolsoc.org.uk



•**24 September – Contingent Resources: Will they ever make it to Reserves?** Venue: Burlington House. 6.00pm for 6.30. Register online at www.geolsoc.org.uk. **Contact:** Steve Whalley, Geological Society, Burlington House, London W1J 0BG. T: 020 7432 0980 F: 020 7494 0579 E: steve.whalley@geolsoc.org.uk

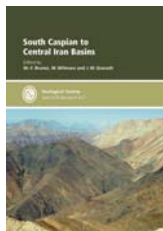


•**28-29 September – Nuclear Waste Management: Research Challenges for the Future**. Venue: Fitzwilliam College, Cambridge. Convener contact: Ian Farnan (University of Cambridge) E: ian.farnan@esc.cam.ac.uk Office **contact:** Georgina Worrall E: georgina.worrall@geolsoc.org.uk



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South Caspian to Central Iran Basins

Edited by M.-F. Brunet, M. Wilmsen and J. W. Granath

This book combines interdisciplinary research results using structural geology, geophysics, sedimentology, stratigraphy, palaeontology, palaeomagnetism and subsidence modelling obtained through the MEBE (Middle East Basins Evolution) Programme and other groups in the South Caspian as well as in Northern and Central Iran.

A great part of the volume is devoted to Northern Iran (Alborz, Binalud and Koppeh Dagh belts), dealing mainly with the Late Palaeozoic and the Mesozoic Era. Two papers present subsidence models of the South Caspian Basin since the Jurassic and three papers focus on Central Iran.

The data and models in this compilation of papers present a detailed picture and a very comprehensive understanding of the Late Palaeozoic to Cenozoic evolution of the South Caspian and North to Central Iran basins. Geodynamic evolution and sedimentation pattern were mainly controlled by the closure of the Palaeo-Tethys due to collision of Cimmerian blocks with South Laurasia, the opening of the South Caspian Basin, and the Neo-Tethys ocean closure associated with Arabia-Eurasia collision.

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Edited By D. J. Evans and R. A. Chadwick

The UK became a net importer of natural gas in 2004 and by 2020 will import up to 90% of its requirements, leaving it vulnerable to increasing energy bills and risk of disruption to supply. New pipelines to Europe and improvements to interconnectors will meet some demand, but Government recognises the need for increased gas storage capacity: best met by the construction of underground storage facilities. Energy security has also raised the likelihood of a new generation of coal-fired power-stations, which to be environmentally viable, will require clean-coal technologies with near-zero greenhouse gas emissions. A key element of this strategy will be underground CO₂ storage. This volume reviews the technologies and issues involved in the underground storage of natural gas and CO₂, with examples from the UK and overseas. The potential for underground storage of other gases such as hydrogen, or compressed air linked to renewable sources is also reviewed.

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Future Conference and Events Programme of the Petroleum Group of the Geological Society of London

24 September 2009	Contingent Resources evening lecture	Burlington House
6 October 2009	Silverpit evening lecture	Burlington House
21-23 October 2009	Sediment Body Geometry & Heterogeneity	Burlington House
1-2 December 2009	Glaciogenic Reservoirs & Hydrocarbon Systems	Burlington House
11 December 2009	HPHT Arena: A One Day Workshop Dedicated to the North Sea's Hottest Plays	University of Aberdeen
20-21 January 2010	Salt Tectonics, Sediments & Prospectivity	Burlington House
21-23 April 2010	Best Practices in Basin Modelling	Burlington House
4-5 November 2010	Advances in Carbonate Exploration	Burlington House

For sponsorship opportunities, to submit an abstract, to register or for further information on any of the events listed please contact:

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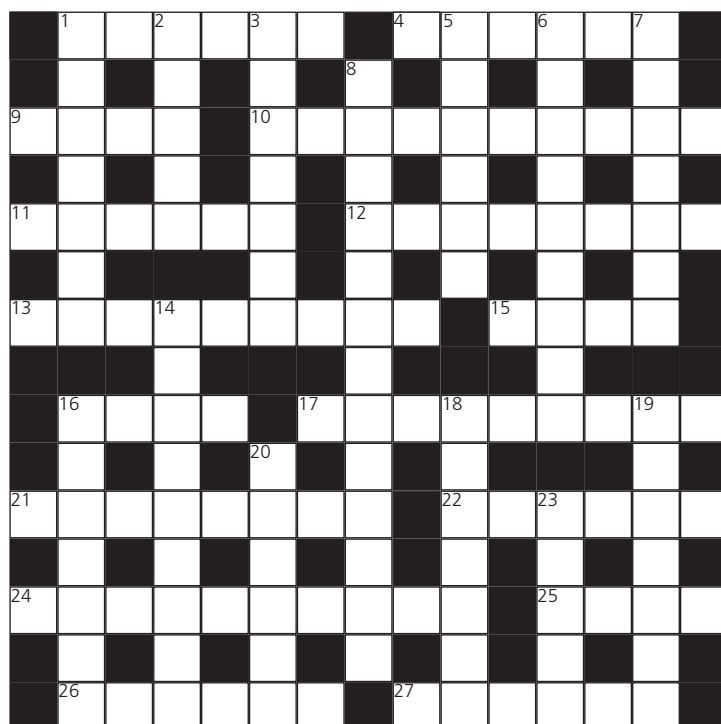
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Crossword no. 126 set by Platypus



Solutions June:

Across: 1 Cannel 4 Fabric 9 Avon 10 Ignimbrite 11 Stream 12 Aquifers 13 Reversals
15 Pipe 16 Dyke 17 Aborigine 21 Charoal 22 Strain 24 Associated 25 Tool 26 Evenly
27 Aerobe

Down: 1 Cuvette 2 Nonce 3 Enigmas 5 Armour 6 Rarefying 7 Coterie 8 Infallibility 14
Eukaryote 16 Dehisce 18 Residue 19 Noisome 20 Social 23 Ratio

Across

- 1 Scintillating man of the counter (6)
- 4 Broad natural assemblages of plants and animals typical of particular habitats (6)
- 9 Thick smoke over the Mall? (4)
- 10 Of plants that love salt (10)
- 11 Eukaryotic algal phytoplankton (6)
- 12 Animal hoovers (8)
- 13 Throw light upon (9)
- 15 Influence (4)
- 16 Droop (4)
- 17 To determine the true values that relate to a subdivided scale (9)
- 21 Clay oven cookery (8)
- 22 Small concentric calcareous bead (6)
- 24 Where the bluestones went (10)
- 25 Ludwig, king of the eponymous nickel carbonyl process (4)
- 26 Stop the flow (6)
- 27 Takes rightful place (6)

Win a Special Publication of your choice!

The winner of the June Crossword draw was **Helen Craggs** of Maidenhead.

All correct solutions will be placed in the draw, and the winner's name printed in the September 2009 issue. The Editor's decision is final and no correspondence will be entered into. Closing date – 17th April.

The competition is only open to all Fellows and Candidate Fellows 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 enter by scanning the signed form and emailing it as a PDF to ted.nield@geolsoc.org.uk.

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.....

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Down

- 1 Awfully slow, ice (7)
- 2 Small bay (5)
- 3 Dug up again (7)
- 5 Attack, cast doubt upon (6)
- 6 Pilgrim vessel (9)
- 7 Deserving of beatification? (8)
- 8 Pictures in a book, for example (13)
- 14 Roman Scotland (9)
- 16 Evil Scots apparition (7)
- 18 Molecules with identical formulae but different shapes (7)
- 19 Lockjaw (7)
- 20 Of that very architectural East Germanic tribe (6)
- 23 Strepisirrhine "sprints of the night" (5)

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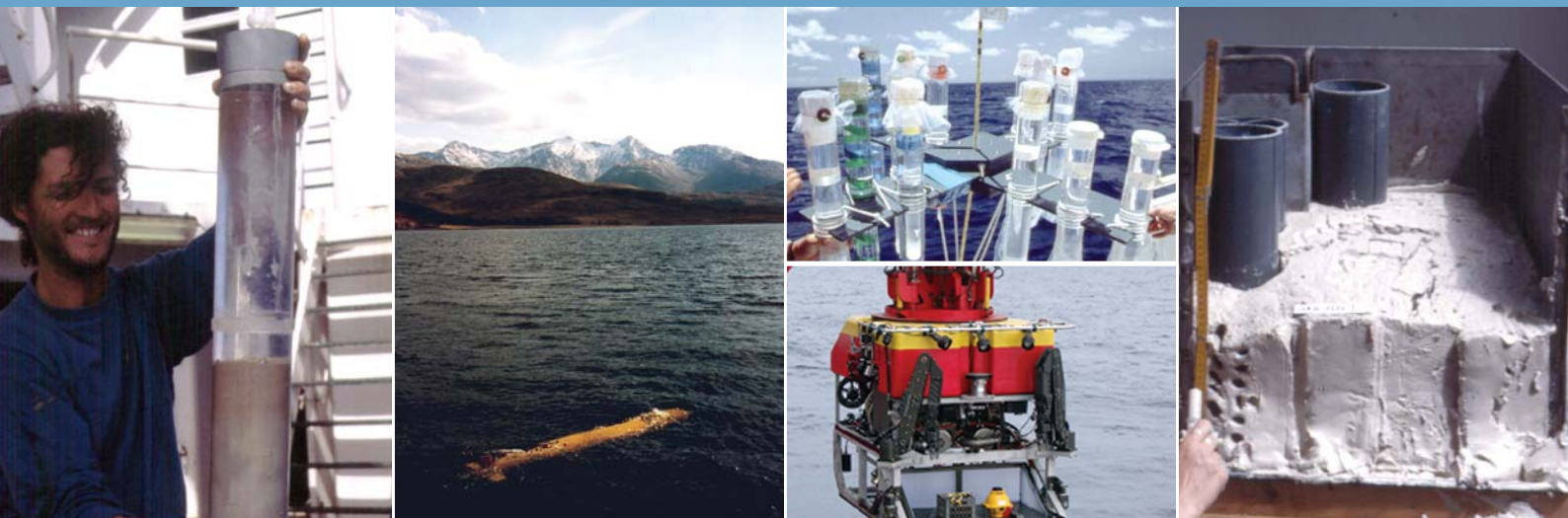
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THE GEOLOGICAL SOCIETY, LONDON



CONFERENCE OUTLINE:

This meeting brings together for the first time special interest groups in the Challenger Society for Marine Science (Marine Biogeochemistry Forum) and the Geological Society (Marine Studies). There is much overlap of areas of interest between the two societies, and this joint meeting will focus on topical and important areas including ocean acidification, palaeoproxies, particle inputs to the upper ocean (SOLAS) and polar biogeochemistry. There are also more general sessions, and there will be a poster event where students can present their work, with prizes for best posters and student talk. This meeting is the most recent in the series of Marine Studies and biennial AMBIO (advances in marine biogeochemistry) events.

KEYNOTE SPEAKERS:

Steve Archer, Plymouth Marine Laboratory - Dimethyl sulfide emissions from the oceans
Ian Hall, University of Cardiff - Multi-proxy approaches to past ocean conditions
Toby Tyrrell, National Oceanography Centre - Ocean Acidification
Derek Vance, University of Bristol - Glacial impacts on ocean chemistry

CALL FOR PAPERS

If you are interested in submitting either an oral or poster paper for this conference, then please email Georgina Worrall. Abstracts are to be no more than 500 words and are not to contain images. Please email your abstract as a Word file, indicating whether it is to be considered as an oral or poster presentation. The abstract deadline is **Tuesday 30 June 2009**.

BEST ORAL PRESENTATION AND BEST POSTER STUDENT PRIZES

There will be small cash prizes for the best student oral and poster presentations.

CONVENORS:

Peter J Statham,
(National Oceanography
Centre University of Southampton)

Leon Clarke,
(School of Ocean Sciences,
Bangor University)



FOR FURTHER INFORMATION ABOUT THIS CONFERENCE, PLEASE CONTACT:

Georgina Worrall Tel: 020 7432 0983 Email: georgina.worrall@geolsoc.org.uk Or visit our website: www.geolsoc.org.uk/events