The GEOLOGISTS’ ASSOCIATION does not accept any responsibility for views and opinions expressed by individual authors in this magazine.

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FROM THE PRESIDENT

Dr Colin Prosser

I hope you have had an enjoyable and suitably stimulating summer and are now ready to start thinking about attending indoor lecture programmes, the GA Annual Conference in Cardiff, and of course the Festival of Geology at UCL. I managed to enjoy a week walking in Snowdonia in July in amongst what has been a busy, rewarding and at times challenging few months for GA Council since the last newsletter landed on your doormat. Once again, it has been wonderful to see how the GA pulls together when the need arises.

In May, I attended the very successful and uplifting GA Student Symposium at Burlington House. The theme of the meeting was Geology and societal change: what difference does your research make?, and the students that presented their research to address this theme were outstanding in terms of the quality of their presentations and their enthusiasm for their work. Professor Iain Stewart’s presence throughout the day, and the support of the Geological Society and a number of other sponsors, including Elsevier, was greatly appreciated, and I would like to thank Becky Bell, Liam Gallagher, Roger Lloyd, Nick Pierpoint and other members of the organising committee for such a successful and enjoyable event which undoubtedly raised the profile of the GA amongst all the ‘up and coming’ geologists present.

Another piece of good news is that Professor Malcolm Hart, an experienced editor and Member of the GA for more than 50 years, has agreed to become the new Editor-in-Chief of the PGA. Malcolm will take over from Professor Jim Rose through a seamless managed transition over the next few months, and will take full responsibility for the journal from January 2018. I would like to welcome Malcolm and to thank Jim for his help in easing Malcolm into the role. Another personnel change is that after 13 years as our UK Field Meeting Secretary, Geoff Swann has decided to step down from the end of 2017. Many of you will have met Geoff and I would like to thank him for playing such an important role in the life of the GA for so many years and for arranging field meetings that so many of us have participated in and thoroughly enjoyed. Council is currently seeking a replacement for Geoff.

Some sad and unexpected news that we received around the end of June, is that our long standing print provider, City Print (Milton Keynes) Ltd, who have printed both the GA Magazine and our field guides for many years, have ceased trading. David Vaughan the owner, and his staff, have been incredibly helpful to the GA over many years, and the demise of David’s business has been upsetting to everyone involved. Even after the bad news broke, David was extremely helpful, making sure that we (thanks to Nick Pierpoint and Haydon Bailey) could rapidly retrieve 4 vehicle loads of guides that were stored on his premises. On behalf of the GA, I wish David and his colleagues well at this difficult time and for the future. In the meantime, we are actively seeking new solutions for our printing needs.

In terms of other activities, Di Clements, Jonathan Larwood and I visited the Wren’s Nest National Nature Reserve in June, to present a GA Special Award to the four wardens at the Reserve, who, between them, have spent more than 80 years managing the site to enable scientific research, educational visits and many GA trips to take place, as well as providing safe recreational open space for the local community. Also in June, on a very hot summer’s day, I represented the GA at the opening of a new Ironstone Geotrail at Irchester Country Park, Northamptonshire. Created as part of the ‘Protecting and interpreting a real Jurassic Park’, Heritage Lottery Funded project, the trail makes the links between geology and the industrial heritage of the area, including a new and innovative viewing platform built in the form of one of the draglines that were used to extract the ironstone. Also present at the opening, was Dr Diana Sutherland who has provided geological input to the project. Diana, like Malcolm Hart mentioned above, is a long-time Member of the GA as well as being the author of my favourite book on building stone, Northamptonshire Stone, which was published in 2003 and is both extremely informative and beautifully illustrated. It was very nice to catch-up with her and do please visit the new trail if you get the chance.

Finally, the Annual Conference at Cardiff is nearly upon us and promises to be a really interesting couple of days including lectures, field trips and a chance to explore the National Museum of Wales. I am a strong believer in moving the conference around the country and hope that many of you will take the opportunity to visit South Wales and to learn about past, present and future climates, both through the lectures and the planned field visits to Gower and to the Fforest Fawr UNESCO Global Geopark in the Brecon Beacons. If you cannot get to Cardiff in October, I hope to see you at the Festival of Geology in November.
REPORT FROM COUNCIL

By: Diana Clements

At our June Council meeting we welcomed three new members, Graham Hickman, Shaun Lavis and Tom Phillips. Nick Pierpoint joined the Executive in place of Haydon Bailey whose term of office has ended. We are delighted that Haydon will remain on Council. At that meeting we confirmed committee members for the following year. A full list can be found on the GA website under About Us/GA Council.

We were pleased to learn that the GA Student Symposium in May had been a big success. A subsequent survey of participants was very positive. This initiative was supported by the Geological Society and at the joint Presidents’ meeting in July they confirmed that they would be happy to repeat the format in 2018. With that encouragement Council agreed to look for a date next May.

I was privileged to accompany our President and Jonathan Larwood to the Wren’s Nest Dudley to present the Award of £500 and certificates to the wardens in recognition of excellence in geological conservation and the facilitation of field work as detailed in the June issue. The wardens and Graham Worton then took us on a walk around this very special site. We wish them every success in their bid to become a UNESCO Global Geopark.

I was also invited to the 40th anniversary celebrations of the Reading Geological Society along with Nikki Edwards, Haydon Bailey and Nick Pierpoint. It was a lovely occasion in an attractive old barn with impressive displays of past activities of the Society, including a map with 17 flags representing trips in 2017. We were amused by challenging geoquiz images though we were possibly at a disadvantage being non-members. Many thanks to RGS for inviting us to join them and for the excellent walk close by to probably the best section I have seen of the Chalk/Paleogene boundary.

Our GA website is in the process of being redesigned to make it compatible with mobile phones and other new technologies. It will not lose any of its current content. Council members have been busy discussing design and testing out links both on PCs and mobiles and we are confident that everything will work satisfactorily when it goes public. Please let the office know should you find any glitches that we have missed.

The new GA Guide to the South Devon Coast by John Cope arrived just in time for the July meeting and sales were brisk. John also wrote our best-selling guide to the Dorset Coast. Details of the new Guide (No.73) can be found in the GA Shop on the website, along with the other forty three Guides to different areas of the UK and overseas currently available. John will lead a trip for us along the South Devon Coast on 7th -8th October 2017 to coincide with the publication of the Guide (details in Circular).

Figure 1: Wardens at the Wren’s Nest, Dudley received their Awards from Colin Prosser followed by a group photograph with the Black Country flag.
We are trying to get our Guides displayed locally, if you know of any possible outlet please contact the office. Colin Prosser has mentioned that our long-term printers, City Print, who printed the Guides as well as the GA Magazine has sadly gone out of business. They will be a very hard act to follow as they helped us in so many ways including the storage of our Guides. Council is now working on getting quotations for both printing and storage. By the time this goes to print we may have been successful but any suggestions would be welcome in case we are still researching.

After 13 years as UK Field Meetings Secretary, Geoff Swann has decided to retire at the end of the year. Council is working on finding a replacement who can take over fairly soon to help organise a programme for 2018. Very many thanks to Geoff for doing an excellent job for such a long time.

It has been a hectic three months but during August we will all have had a chance to relax before our busy autumn. If you have not already booked up for the conference in Cardiff on 21-22 October Climate past, present and future? there is still time to do so. A flyer with the details can be found in this issue of the GA Magazine and the booking form is on the GA website under Events/Conferences. Details of the Festival of Geology are also available. The date is Saturday 4th November with Festival trips on Sunday 5th November (see flyer on p.48). The deadline for entries for the photographic competition is 15th September. An extra trip has been added to the Circular: Mike Howgate will lead a group around the Dinosaurs from China Exhibition in Nottingham on 14th September. He will also lead a building stones walk from Burlington House to Green Park for the London Open House Day on 16th September. All the societies in Burlington House will be open to the public and the GA will also run a workshop in the building that day on the stones and fossils of the Geological Society Reception Desk as well as taking bookings for Mike’s walk (one an hour). The Geological Society’s website will host on their website a full list of events taking place during Earth Science week (7th-15th October).

Looking ahead to 2018 our Overseas Field Excursions officer, Ian Sutton has arranged trips to Morocco and Shetland. Details are in the Circular along with details of the activities of our Local Groups and Affiliated Societies for the next 3 months. Do please keep us informed of your events so that we can add to the Circular and on our website. We are here to help!

**Deaths**

During the past three months we have been made aware of the death of the following members:

**None reported**

Please notify us of any members that have died that you are aware of. We are always keen for short obituaries and/or a photograph - so if you feel you would like to write one, please get in touch with the office.

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**We welcome the following new members to the Geologists’ Association:**

**Elected June – September 2017**

- Clive Bloxham
- Timothy Burnhil
- Ron Collier
- Jasper Cook
- Adam Cowin
- Ben Dixon
- Kirsty Edgar
- Peter Floyd
- Rellie Goddard
- Charles Gook
- Susan Jones
- Geoffrey King
- John MacDonald
- Angela Melvin
- Frances Noble
- Russell Pope
- Mark Turner
- Christopher Woodward

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**GA Magazine Advertising Charges**

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## GA COUNCIL

### September 2017

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<td>Dr Colin Prosser</td>
<td><a href="mailto:president@geologistsassociation.org.uk">president@geologistsassociation.org.uk</a></td>
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<td>Senior Vice-President</td>
<td>Nicholas Pierpoint</td>
<td></td>
</tr>
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<td>Vice Presidents</td>
<td>Professor David Bridgland, Nikki Edwards</td>
<td><a href="mailto:president@geologistsassociation.org.uk">president@geologistsassociation.org.uk</a></td>
</tr>
<tr>
<td>Treasurer</td>
<td>Dr Graham Williams</td>
<td><a href="mailto:gatreasurer@geologistsassociation.org.uk">gatreasurer@geologistsassociation.org.uk</a></td>
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<td></td>
</tr>
<tr>
<td>GA Magazine Editor</td>
<td>Dr Liam Gallagher</td>
<td><a href="mailto:gamagazine@geologistsassociation.org.uk">gamagazine@geologistsassociation.org.uk</a></td>
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<td>Co-opted: Field Meetings Secretary</td>
<td>Geoff Swann</td>
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<td>Professor Susan Marriott</td>
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<tr>
<td>Co-opted: Awards Panel Secretary</td>
<td>Barbara Cumbers</td>
<td><a href="mailto:awards@geologistsassociation.org.uk">awards@geologistsassociation.org.uk</a></td>
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### NON-COUNCIL POSTHOLDERS

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<td>Executive Secretary</td>
<td>Sarah Stafford</td>
<td><a href="mailto:admin@geologistsassociation.org.uk">admin@geologistsassociation.org.uk</a></td>
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### ORDINARY MEMBERS OF COUNCIL

Anthony Brook, Rhian Kendall (Conference 2017), Roger Lloyd, Gerald Lucy (co-opted: photo competition & fliers), Shaun Lavis, Graham Hickman & Thomas Phillips (co-opted: student representative)
Climate: past present and future?
The Geologists' Association Annual Conference
Cardiff 21 - 22 October 2017

Programme
Saturday 21st October
Reardon Smith Lecture Theatre, Amgueddfa Cymru - National Museum of Wales
Lathbys Park, Cardiff, Wales CF10 3NP

Lectures:
Colin Summerhayes - Earth's climate evolution - a new geological perspective
Ian Fairchild - Snowball Earth
Udiann Edwards - The impact of pioneering colonisers of the land on the biosphere, lithosphere and atmosphere
Chris Berry - Devonian
Chris Cleal - Come visit the jungles of south Wales - the Carboniferous coal-swamps
Andy Newell - Triassic
Hugh Jenkyns - The Cretaceous greenhouse climate
Carrie Lear - Descent into the Icehouse: A Cenozoic perspective on climate change and ice sheet stability
Suzanne Bevan - Quaternary
Jan Zalasiewicz - the Anthropocene

Conference dinner at the Park Plaza Hotel, Greyfriars Road, Cardiff

Sunday 22nd October - Field excursions
The last glaciation of Wales - John Hiemstra
Recent work has cast serious doubt on the supposedly established number, timing, style and extent of glaciations that have affected the Gower peninsula in south Wales. These new insights have potentially far-reaching implications. During this visit we will address some critical questions: if not at Rothersdale, where was the western limit of LGM ice? Are there any exposures of in situ subglacial till on Gower? Is the Pembrokeshire moraine really a moraine? If so, is it as old as proposed in the literature?

Fforest Fawr Geopark - Alan Bowring
Visit the former industrial hamlet of Penyffalt (quarrying and firebrick manufacture) set on the edge of Ogof Ffynnon Ddu National Nature Reserve designated for Britain's deepest cave and the most accessible surface elements of this karst area. And we'll take a closer look at the Variscan anticline of Cribarth, a limestone and sandstone ridge which overlooks the Geopark on its western side; it too has significant karstic and industrial archaeological interest.

Building Stones in Cardiff - Welsh Stone Forum

Pre-conference Events include:
Tours of the Evolution of Wales exhibition and behind the scenes at Amgueddfa Cymru - National Museum of Wales, Friday 20th October, beginning at 3pm

Get together for a meal / drink with the conference organisers, on the evening of the 20th October at The Crockerton pub, Greyfriars Road, Cardiff

For more information and to register visit:
www.geologistsassociation.org.uk
or email: conference@geologistsassociation.org.uk
The speaker has spent 9 years as a researcher in palaeontology, mainly on ichthyosaurs and he presented some of the results of his research.

The first ichthyosaur brought to the attention of the scientific world was discovered by Mary Anning (1799-1847), who lived in Lyme Regis, at the age of 11 or 12. This discovery kick-started the science of palaeontology and put Lyme Regis on the map for palaeontology. The skull was found by her brother and Mary later found the rest of the skeleton. Earlier finds had been thought to be giant fish or crocodiles and isolated vertebrae had even been thought to be the remains of humans killed in Noah’s flood. Mary’s find was described by Everard Home (1814, Philosophical Transactions of the Royal Society).

What is an ichthyosaur?

Ichthyosaurs are not swimming dinosaurs, crocodiles, dolphins or sharks, they are marine reptiles (the name means “fish lizards”). They are secondarily aquatic, like several groups of modern marine reptiles – saltwater crocodiles, marine iguanas, turtles and sea snakes. They are viviparous, bearing live young, unlike crocodiles, turtles and iguanas, which lay eggs on land. Several specimens with embryos inside were thought to represent a species which was cannibalistic on its young but the finding of a specimen of Stenopterygius quadriscissus with embryos inside and one in the process of being born showed their true nature.

The Ichthyopterygia, the group to which ichthyosaurs belong appears in the Triassic at 248Ma and becomes extinct in the Cretaceous at 90Ma. De La Beche & Conybeare (1821) made the first mention of the name in print, describing Ichthyosaurus communis based on a series of measurements of a specimen. However, it had no unique features and there was no illustration of the specimen. It is regarded as the holotype but the specimen cannot be located.

Ichthyosaurus became a waste-basket taxon with over 50 species described before 1900 and more later. The genus had a global distribution, a long stratigraphic range and was widespread. There were many new discoveries and new species described before 1900 and more later. The genus had a long stratigraphic range and was widespread.

McGowan (1974) determined that only 4 species were valid (less one misidentified) and assigned a neotype for I. communis, and distinguished the species based largely on ratios. All Lower Jurassic examples of Ichthyosaurus had a wide paddle and anterior digital bifurcation (finger splitting), with many having multiple digits in the forefin. McGowan suggested there were 2 populations of I. communis that differ in forefin structure.

The speaker’s research

As an 18-year old, the speaker travelled to the USA and was involved in the excavation of the forefin of a pliosaur in Wyoming, where he had the good fortune to meet ichthyosaur specialists, including Judy Massare and Bill Wahl. As a Doncaster resident, the speaker had visited the Museum and Art Gallery, which had no display of geology or fossils and no geologist. However, on asking the museum’s archaeologist if they had any fossils he was shown the collection in store of 12,000 specimens, including an ichthyosaur that had been misidentified as a cast and transferred to the education department. On examination, it proved not to be a cast and resulted in the speaker’s first peer-reviewed paper. There was no information on its provenance but a belemnite in the matrix is unique to the Dorset coast (Pliensbachian stage of Jurassic) and there were fish scales and hooks from the arms of squid inside, which revealed its diet.

The speaker was back in Wyoming in 2009 and in 2010 and joined forces with Massare in a plan to describe the Doncaster ichthyosaur in detail and tackle the taxonomic nightmare. They examined several thousand specimens and rediscovered hidden gems in museums both large and small. One specimen in the Sedgwick Museum, Cambridge, which was found by Mary Anning and purchased by Sedgwick in 1832, proved to be the largest and most complete known I. breviceps and had the first pelvis found of this species.

Ichthyosaurs were often not examined for scientific detail as collectors sought them as natural pieces of artwork. As a result, many are composite specimens or have parts made of plaster, one even being a composite of parts from Dorset and Germany.

After examination of the humerus, and other parts of the skeleton, the Doncaster ichthyosaur was determined to be a new species - I. anningae. 5 specimens of this species may show sexual dimorphism in the humerus.

The largest Ichthyosaurs have been found to be >2m for I. communis, <2m for I. breviceps, <1.5m for I. conybeari and <2m for I. anningae. However, an isolated forefin with a humerus that is 12cm long was found, by looking at the ratios between humerus and skulls in 25 specimens, and between the humerus and vertebral column, to represent a specimen with a total length of around 3m.

A new study has compiled all known specimens of Nottinghamshire ichthyosaurs (67), including the first definitive occurrence from the county, resulting in a paper in the Proceedings of the Geologists’ Association.
Originally, Lydekker (1888) defined a species called *I. conybeari* based on a small skeleton with a long delicate snout and notching on the forefin. McGowan (1974) referred another specimen to this species based on ratios of snout length. However, Massare & Lomax found that the characters used to define the species overlap and it was felt that *I. conybeari* needed re-evaluation. The Museum of Wales purchased a small ichthyosaur skeleton that was collected during the 1980s from Doniford Bay, Watchet, Somerset. This specimen was identified as another example of *I. conybeari*. This was the first report of the species from outside Dorset. This specimen helped with the review of the species as it possessed the skull, humerus and pelvic features that were found to be unique for the species. Examination of other specimens has, after two centuries of work and hundreds of specimens from Somerset, enabled the identification of two new species, *I. larkini*, the type specimen for which was formerly in the collection of Joseph Channing Pearce, was sold to Bristol Museum in 1915 and transferred to Bristol University in 1930, and *I. somersetensis*, probably collected at Glastonbury in the 1840s, sold to the United States and donated to Philadelphia’s Academy of Natural Science in 1947. The skull and humerus are very different from *I. communis* and all other species. Some controversy arises over McGowan's (1974) suggestion of synonymy regarding the two species described by Conybeare (1822), *I. communis* and *I. intermedius*. He suggested the two species, which were original distinguished on tooth form, are the same species. It was found that tooth form varies ontogenetically and apparent morphology varies with orientation and degree of preparation of the specimen. A study by Massare & Lomax (2017) agrees with this synonymy.

Communication with journalists on ichthyosaurs can be difficult since they will always want to describe them as swimming dinosaurs but experience has shown that even without that erroneous description, scientific papers can still feature in the popular press.

**Conclusions**

The speaker is involved in a continuing ongoing revision of ichthyosaurs which has enabled *I. communis* to be no longer a waste-basket taxon. Three new species have been described and *I. conybeari* has been re-defined (in parts). The size of Ichthyosaurus has also been re-established.

The next item to be considered is to identify composite ichthyosaurs, which may lead to the resurrection of another genus from the early Jurassic.

**Dr David Brook OBE**

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**The Ice (and after) in the Eastern Counties**  
**Saturday 18th November 2017**  
**Hills Road 6th Form College, Cambridge**

- Prof Nick Ashton, British Museum
- Dr Steve Boreham, University of Cambridge
- Prof. David Bridgland, Durham University
- Prof. Sanjeev Gupta, Imperial College, London
- Prof. Danielle Schreve, Royal Holloway, University of London
- Dr Colin Summerhayes, University of Cambridge

**Geology, Landscape, Life and Man: A one-day conference**

To register, please go to [www.geo-eastevevents.org.uk](http://www.geo-eastevevents.org.uk) or: Email: naomi.stevenson@naturalengland.org.uk
Geologists’ Association Student Symposium 2017 (GASS2017): May 19th 2017

Geology & Societal Change; what difference does your research make?

By: Dr David Brook OBE

On 19 May 2017, 95 people gathered at Burlington House for GASS2017, the Geologists’ Association Student Symposium on Geology and societal change. Organised by the Geologists’ Association and supported by the Geological Society, the symposium was sponsored by Atkins, the Micropalaeontological Society, Shell and Elsevier. This new initiative aimed to offer undergraduate and post-graduate students (and those that have graduated in the last 2 years) the opportunity to present their work in a friendly, informal setting. Participants were invited to consider what difference their research makes to society.

11 universities were represented in the 13 oral presentations in 4 themed sessions and 13 poster presentations, which covered a diverse range of subjects, from continental break-up to ore mineralisation, the completeness of the fossil record of non-avian theropods, carbon capture & storage and the Black Death. Those presenting posters were given their “2 minutes of fame”, in which to give a brief introduction to their posters in the first 3 sessions. In addition, there were presentations from the Geologists’ Association, the Geological Society and Policy Connect and a keynote presentation by Professor Iain Stewart.

Session 1 Geohazards had 3 oral presentations and trailers for 4 posters. Tom Phillips (Imperial College London) used 2D and 3D seismic reflection data to analyse the geometry of ancient faults in the North Sea and compared them to those observed in the present day in an attempt to understand the geometry and seismic hazard associated with active fault systems. Zoe Mildon (University College London) examined the long historical record of earthquakes in central Italy, assigning them to the capable faults based on the distribution of shaking, observations of surface ruptures and palaeoseismic trenching to model the transfer and build-up of static Coulomb stress to help identify those faults most at risk of movement. Melissa Gray (Imperial College London) used high-resolution images of the physical properties of the fault zone to derive an acoustic velocity model in areas of shallow slow slip earthquakes offshore North Island, New Zealand, to understand the effect of fluids on seismic behaviour in shallow slow slip earthquakes and to map the subduction fault zone to aid in drilling safety for the IODP drilling expedition set in 2018.

Session 2 Offshore had 4 oral presentations, trailers for 4 posters and two explanatory presentations by the Geological Society and Policy Connect. Kingsley Nwozor (University of Aberdeen) analysed data from high-pressure, high-temperature wells in the central North Sea to build a 4-layer model of overburden stress to help achieve safer drilling and potentially serve as an exploration tool. Amy Tuck-Martin (Royal Holloway University of London) used joint inversion of sea-floor spreading data to present a plate kinematic model as an input for dynamic stress modelling enabling analysis of plate tectonic changes during opening of the north-west Indian Ocean on sedimentary basin formation and the development of petroleum systems. David Riley (University of Southampton) reviewed potential socio-economic impacts of Arctic gas hydrate exploitation on health and wellbeing, land use and access, services and infrastructure, population, employment opportunities, income and lifestyles. Murray Hoggett (University of Birmingham) presented a geological, seismic and statistical analysis of oil and gas shows associated with igneous sills from offshore north-west Scotland, which indicates that either sills do not control hydrocarbon occurrences by focussing fluid flow or their effect is not detectable at the resolution of the data available.

Nick Bilham, Director of policy and communications at the Geological Society presented a whistle-stop tour of the Geological Society from its foundation as the oldest geological society in the world in 1807 by 13 gentlemen at dinner to its current membership of 12,000, 20% of whom are overseas members from 88 countries and 21 regional and specialist groups. As well as being a learned society, it is the professional body for geologists, with 20% of its members being chartered. It is not a lobbying organisation advocating policy outcomes but provides science for policy by communicating geology relative to the economy, the provision of resources, infrastructure protecting the environment and improving the quality of life.
While recognising that geology does not have all the answers it provides responses to government consultations and parliamentary inquiries and reports, briefing notes and public meetings on a range of themes including climate change, radioactive waste, carbon capture and storage, strata gases and environmental policy/ecosystem services.

Claudia Jansch of Policy Connect presented an introduction to this not-for-profit organisation, which is independent of government and cross-party, which aims to inform and improve UK public policy by bringing together parliamentarians with public and private organisations to tackle the big issues and providing policy-focused independent research leading to evidence-based recommendations. A diverse range of independent groups – all-party parliamentary groups, select committee inquiries with 2 parliamentary co-chairs and science sector experts and academics work with a range of cross-sector organisations in a 9-month research process with a launch event in Parliament and a post-publication engagement programme. Current activities include the Future gas inquiry, a 3-part report looking at the gas distribution network and local storage, production and bulk storage of low-carbon gas and consumer issues and the development of compatible appliances; Water in housing, where next? and Brexit issues – a sustainable future for Britain looking at waste and resource sustainability, energy and climate change and built environment and infrastructure.

**Session 3 Climate & geomechanics** included 3 oral presentations, trailers for 5 posters and an explanatory presentation by the Geologists’ Association. Cherry Newsam (University College London) presented calcareous nanoplankton assemblage data from the North Atlantic and examined the relationship between plankton evolution and palaeoclimatic and palaeogeographic change across the Palaeogene greenhouse to icehouse transition, an understanding of which is vital to predicting future responses in a rapidly warming world. Marcelo Augusto de Lora Mota (University of Birmingham) related isotope data from a continuously cored continental shelf section of Yazoo Formation clays on the US Gulf Coast to changes in microfossils and palynomorph assemblages during a local/regional increase of continental freshwater influence due to potential global sea level drop and a second step possibly related to the Eocene – Oligocene transition. Rebecca Coats (University of Liverpool) carried out universal compressive experiments on a suite of both natural and synthetic samples and found that magma strength and viscosity depend on porosity, crystal content and temperature, governed dominantly by complex pore/crystal interactions, which were further illustrated by high-temperature compression experiments on synthetic magmas imaged by x-ray tomography.

Colin Prosser, President of the Association, gave a brief introduction to the Geologists’ Association from its foundation in 1858 with 30 members to its current membership of about 1,200 and its 89 local and affiliate groups. It has an inclusive diverse membership including professional geologists, enthusiasts and the public with activities involving lectures in London and nationwide, an annual conference, the Festival of Geology, field trips in the UK and overseas and it produces a peer-reviewed journal, a quarterly magazine and field guides. It has annual prizes for students as well as research awards and grants through the Curry Fund. For those of younger age, it provides rock-boxes for schools and has a junior branch in Rockwatch, which runs public events and field trips for children accompanied by their parent(s) and its own Magazine.

**Session 4 Geomechanics & geo-economics** included 3 oral presentations and the keynote address. Giuseppe Provenzano (University of Southampton) presented research exploiting the potential of shallow marine seismic reflection as a remote sensing tool that can be a faster and more cost-effective alternative to geotechnical direct sampling in marine areas prone to shallow landsliding. Danny Powell-Thomas (University of Bristol) presented the trial and evaluation of a GIS methodology of risk assessment for ground instability associated with historical mineral workings in Bristol involving the collation of geological and interdisciplinary sources, enabling a targeted multi-method geophysical survey to refine the assessment. William Smith presented his research in progress on the Cornubian ore province, which aimed to resolve the timing and origin of magmatism in the South Devon granites using detailed geochemistry and U-Pb zircon geochronology. He made the crucial point that the public concerns about contentious science and technology issues are not really about the science and the science information which has little or no influence on those concerns.

Participants in the symposium were invited to vote for their top 3 (in order) oral and poster presentations, the winners being Rebecca Coats for her presentation on “The importance of understanding complex magma rheology” and Amy Jones for her poster on “Coccolithophore diversity and palaeoecology across the Eocene-Oligocene boundary of the Nanggulan Formation, Java, Indonesia”.

**Thoughts on the day** Having attended and enjoyed this symposium, my conclusion is that it was an excellent innovation that should be continued. It was excellently organised with a full book of abstracts of both oral and poster presentations and the talks were of a high standard. There was particular merit in the “2 minutes of fame” for those presenting posters, who can otherwise feel a little excluded from the mainstream of a symposium. My only quibble was that it was a very long and very full day and the opportunity to network between the various universities represented and those who had simply attended out of interest could perhaps have been extended.

All in all, an enjoyable and very worthwhile exercise.
GASS2017 POSTER PRIZE WINNER

Low latitude coccolithophore response to dramatic climate shifts during the Eocene- Oligocene Transition

By: Amy Jones

Fossil coccolithophores are ocean-dwelling organisms that are used to understand and reconstruct Earth’s past climates. They are also known as calcareous nannofossils and have been present globally within our oceans for over 200 million years. Nannofossils are photosynthesising microscopical phytoplankton that inhabit the surface waters of the ocean and are an important component of the carbon cycle. They are highly sensitive to changes in climates, such as: changes in ocean acidity or atmospheric CO₂, and this makes them excellent indicators of climate change. They react to these changes by either adapting, flourishing or going extinct. Assemblage data can easily be recorded as different species react differently to even slight environmental changes.

The Nanggulan Formation, Java, is a new low latitude locality of the latest Paleogene in age (~33.9Ma) and yields well-preserved nannofossils. Samples for this study were collected from an onshore site in south-central Java and analysed for nannofossil content. Diversity and ecological changes were documented throughout the assemblage by recording species richness and testing various statistical analyses. During this abrupt transition, the Earth’s climate dramatically shifted from warm, high atmospheric carbon dioxide (pCO₂) conditions in the Eocene into a glacial low pCO₂ Oligocene. Rapid global cooling during the Eocene-Oligocene Transition (E/OT) is recognised by the positive isotope excursion of δ¹³benthic foraminifera and an ocean wide increase in δ¹³C (Zachos et al. 2001), causing a major perturbation of the carbon cycle, creating strong turnover signals and species decline in nannoplankton assemblages. Using statistical analysis, documenting nannofossil diversity and abundance of species from the site provides evidence of increased productivity associated with the Eocene-Oligocene boundary. However, the cause of global cooling during this time remains under debate. It is argued to be the result of either new ocean passages opening, resulting in permanent glaciation on Antarctica or the lowering of pCO₂ (Zachos et al. 2001; Pianço et al. 2014). The glaciation on Antarctica caused global environmental changes such as: lowered sea level due to increased continental ice volume and changes in ocean circulation through the initiation of the ACC (Antarctic Circumpolar Current). Both factors could have contributed as a combined effect on the climate shift during the E/OT.

Eutrophic assemblages are those with increased nutrient levels within surface waters and are of low species diversity, which is seen within the nannoplankton communities of the Nanggulan Formation. The increasing glaciation on Antarctica would have lowered sea levels and therefore, increased run-off, thereby directly impacting communities on the continental slopes of Java.

With the number of extinctions outweighing inceptions leading up to the boundary, a clear progression in faunal turnover is observed, therefore, the nannofossils show a prominent biotic response to climatic changes. Specific nannofossils such as: Discoaster, Sphenolithus and certain Reticulofenestra express relative abundance fluctuations and/or extinctions due to the regionally elevated nutrients, therefore, this is assumed to be the main cause of nannoplankton decline and extinction in this region.

This research is important within society as this core hosts well preserved nannofossils within a time period where preservation or sediment recovery is previously known to be poor. This site enhances data collection for this crucial time in Earth’s history. The Nanggulan Formation is positioned within the Indian Ocean; an ongoing studied region of the world for the EO/T with high potential for promising finds. This study provides comparative data for diversity and ecology of nannofossils from the EO/T with those at higher latitudes and from other oceanic provinces. Additionally, a greater understanding of the Earth’s atmospheric changes can be understood as a result of the nannoplankton communities observed. Reconstruction of the regional surface water ecology can be used to help piece together and comprehend the substantial climate shift. More importantly, in today’s society, it can help infer modern and future climate patterns.

This was my first GASS conference and I certainly wasn’t disappointed. Under the theme of, “Geology and societal change: what difference does your research make?” I absolutely had to submit an abstract! Not only was the conference was an excellent opportunity for all attendees to present research to peers, academics, industry professionals and members of the Geological Association it was a truly enjoyable day ending with an inspiring talk by Iain Stewart. Everyone who presented did so with passion and it was clear to see how even some of the most unlikely topics could be so relevant to societal change - an eye-opening experience! I was honoured to receive the best poster award, as well as being a bit shocked, it was the cherry on top for the whole day. I am certainly looking forward to next year’s conference and hope to see everyone again! With many thanks to the Geological Association and all the convenors.
Presenting at GASS was a great opportunity, the event was well organised and all presenters were given plenty of support to make sure everything ran as smoothly as possible. The symposium was held in Burlington House which is an iconic location, steeped in history, both human and geological. During the oral presentations the room was filled with scientists at all stages in their career from universities from across the UK and further afield. The science delivered was broad, from earthquakes in Italy to coal mines in Bristol, and there was something for everyone. All involved did an excellent job in communicating their research, and saying I learned a lot would be an understatement. Professor Iain Stewart delivered the Keynote lecture and discussed how we all must communicate our science to the hardest to reach in society. His speech has since influenced me to get more involved in outreach, and now, thanks to contacts I made at the Symposium, I will be exhibiting at Camp Bestival with the Jurassic Coast Trust.

For a volcanologist it is often easy to engage people with our science, as volcanoes are one of the more glamorous geological topics. However, as we no longer have active volcanoes in the UK, it is harder to justify why we should fund research into this geological phenomenon. As one of the richest countries in the world, it is our moral duty to use the excellent research resources we have at hand to understand the complexities of volcanic eruptions, in order to help those less able to help themselves. An estimated 600 million people live in close enough proximity to a volcano to have their lives affected by an eruption. Furthermore, during a volcanic eruption, tens of thousands of people can be evacuated at any one time, only to return after no hazardous activity has ensued. For evacuations to be more effective, the style and progression of volcanic eruptions also need to be forecast, but in practice, no such methods exist. For an effective prediction, the fluid dynamics of volcanic liquids need to be fully understood.

Rheology is defined as the study of the flow and deformation of materials under applied forces. Magmas are complex liquids by nature, and understanding their rheology is key in forecasting their eruption style. Transitions in flow dynamics can be linked to changes in porosity (amount of bubbles), crystallinity (amount of crystals) and melt chemistry. Physical interactions due to the presence of both crystals and bubbles in a volcanic melt can influence its rheology by causing variations in viscosity (the resistance of a liquid to flow) and deformation dependent flow behaviour, shifting eruption style, often in ways difficult to predict. It is therefore essential to gain an insight into the manner in which crystalline, porous magmas flow and fail. My PhD focuses on understanding the role crystals and bubbles play in the rheological evolution of volcanic melts. Using a combination of both natural and synthetic magmas we can get an insight into how these materials behave in volcanic conditions.

My experiments involve uniaxial compressive tests on both natural and synthetic materials, which allow measurements of strength to be taken as well as the computation of the viscosity of the sample. We use variably porous (9-32 vol.%) and highly crystalline (> 50 vol.%) dacites from Mt. Unzen, Japan as the natural material. For the synthetic samples, sintered glass with air filled pores (<3, 20 and 30 vol.%) and TiO2 particles (0-50 vol.%) were created in house at the University of Liverpool.

So far, we have found that the strength of a magma and its viscosity have a dependence on porosity, crystal content and temperature, from which we surmise that complex pore/crystal interactions are the dominant factors. We recently undertook a series of high-temperature compression experiments on the synthetic magma imaged by x-ray tomography in-situ at the Diamond Light Source, the results of which will shed light on these complex interactions.

This work has the potential to change the way we understand volcanic fluids by providing numerical thresholds of where magmas flow and fail. I have created a two-minute YouTube video on magma rheology for those who want to find out a bit more, it can be found on my channel ‘Becky Coats’ (https://www.youtube.com/channel/UCyBgZxXuoLaWTcGjbyynyEy).
Geologists’ Association Guide No. 73

Geology of the South Devon Coast
from the Dorset county boundary
to the Brixham area

John C. W. Cope

Available now - contact the GA Office for pricing and delivery details
Geologists have always been interested in the impact of geology on viticulture in general and in the myth of ‘Terroir’ in particular. It was the late great geo-viticulturalist Professor Jake Hancock (GA President 1986-88) who described the concept of ‘Terroir’ as a blend of medieval mysticism and second-rate French science. And it was Professor Hancock who demonstrated the nonsense of ‘Terroir’. Jake Hancock thought it odd that the quality of brandy decreases in concentric circles centred on the town of Cognac. Reportedly this is due to variation in the ‘chalkiness of the soil’. This is demonstrably nonsense because the sedimentary rocks, chalky and other, strike diagonally through Cognac and across its hinterland. Jake Hancock traced the origin of this fable to a practical joke by Henri Coquand, President of the Geological Society of France, in 1857.

It was against this background that ‘anti-terroiristes’ of the Mole Valley Geological Society decided to begin an ambitious project to survey the geology of England’s vineyards from youngest rocks to oldest, with all the collateral conviviality that such demanding research necessarily entails. On a warm sunny Saturday in June 24 members commenced the project led by Dr Mark Eller, MVGS Vice-President: Field Trips, with a visit to Thorncroft vineyard, near Leatherhead. Thorncroft is famous both for its wine made from schonburger grapes, and for its popular elderflower cordial. The vineyard is planted on a Pleistocene Ice Age raised river terrace. River terraces produce the fine wines of Bordeaux and of the River Thames and its tributaries. Cores of the soil were taken with an augur and the pH of the soil measured and the results discussed learnedly. The group then drove to Painshill Park, Cobham. Here the Head Gardener took the group to the vineyard on a south-facing slope of Palaeogene Bagshot Sands. This vineyard was originally planted in the 18th century by the Honourable George Hamilton. After lying fallow for many years the site was replanted in 1992 with grape varieties similar to those of its genesis. Further auguring and sampling was followed by a tutored tasting of the sparkling Painshill wines whetting the appetite for luncheon in the restaurant.

After a spell for retail therapy the group moved down section from the Tertiary to study a Cretaceous chalk vineyard. It was decided not to visit Denbies at Dorking. Most MVGS members were familiar with it and had seen the new film with a “polychromatic geophantasmogram” of the deposition, uplift and erosion of the Weald accompanied by the pontification of a notorious local geologist. Instead it was decided to study Albury Organic Vineyard. This is planted on a south-facing slope of chalk, the bed rock of Champagne. Vineyards such as Nyetimber and Denbies were planted on chalk in the last century and have established a reputation for producing quality sparkling white wines. These are ‘Champagne’ in all but name being made from the Holy Trinity of Pinot noir, Pinot meunier and Chardonnay. Albury is one of a new wave of chalk vineyards planted by both English

Figure 1: Dr Mark Eller explains to MVGS members the origin and viticultural significance of the Thorncroft river terrace.

Figure 2: MVGS members practical work shop tasting the sparkling wines of Albury organic Vineyard
and, now French vintners, across southern England. MVGS members were given a tour of the vineyard during which the vineyard manager explained the soil chemistry and the strict regulations that must be obeyed to maintain Albury’s organic status. Apparently it is not true that to qualify for organic status the grapes must be picked “by naked virgins of the parish in the light of a full moon!”. Afterwards the group enjoyed a practical workshop sampling Albury’s four wines, at the end of which the group had metamorphosed into a party. Following a vote of thanks to Dr Mark Eller the party dispersed into the bucolic Surrey countryside.

Dorking’s summer social season opened on 15th June then the MVGS held its traditional Summer Soirée. This provided an opportunity to compare the Palaeogene Bagshot wines of Painshill Park with those from the Cretaceous chalk of Albury organic vineyard. Differences which seemed obvious to begin with became first subtle and then indistinguishable as the soiree progressed. It was concluded that wine is best judged on a case by case basis.

The Quaternary to Upper Cretaceous traverse was the first of a series of projected geo-viticultural study tours. In 2018 the MVGS plans to research the geology of the Lower Cretaceous vineyards of the Weald, then year by year, to descend the rock sequence ending up studying Pre-Cambrian vineyards in Cornwall in about 2025.

References
The 50th ESTA ANNUAL CONFERENCE
29th September – 1st October 2017
at Keele University

Conference theme: Education and Geoconservation

For further information contact: ESTA Conference Manager: conference@esta-uk.net
Flint; a sea floor formation

There is now little room for doubt that the Paramoudra in the eastern cliff, North Landing, Yorkshire originated on the Cretaceous sea floor, as evidenced by sediment built up against the south side (see Figure 1 on the right) while the increasing weight of the bio-structure sunk into and deformed the strata below. The outer ‘Protoflint’ stayed soft to enable the movement and release of sponge larva through the silica gel (Mesohyl) but rough conditions, have here, removed and laid it flat as two seams of tabular flint to the North, while what was beneath the seafloor remained as a smooth surface.

Tabular flint breaks in a square manner quite distinct from the anticipated conchoidal fracture just as Flint cortex will crack in a columnar or starch fracture showing disparity in the properties of inner and outer flint. Tabular flint has a jumble of sponge body parts within, plucked from the sea bed as the strong tide passed. It can also contain chalk pellets removed by the same process.

Also of a sea floor origin is the Cretaceous sponge reef at West Runton, Norfolk. The rims of in situ Paramoudra and next generation placement there evidence a benthic North East tidal flow. See Magazine of the Geologists’ Association. Volume 16 No.1 March, 2017 Page 21. Type ‘A’ nodules, being the initial stages of paramoudra/sponge development, are abundant close to the reef while the shape, colour and surface detail characterise further types of flint nodules as sponges. Being adjacent to their ‘source’ they are found intact and classifiable. At Weybourne, as on most beaches, the sea has rounded the flints into cobbles, obliterating surface features.

Looking further into Flint.

A profusion of sponge spicules can be found within flint, single ray monaxon, three rayed triaxon being the most common and in Figure 3; sections of hexactine, six rayed spicules form the skeletal framework of a Hexactinellid sponge. This skeleton can appear as raised detail on the Pinacocyte (outer skin cells) of sponges now lithified to type A nodules.

(Search: Richard Howey, sponge spicules for amazing micro images).
Preserved in considerable numbers are sponge larvae, some were for release through the osculum of the parent sponge, while others moved through the mesohyl to emerge from the pinacocyte forming a bump or protuberance on the surface of nodules and paramoudra.

Often preserved are the trails as the larvae moved through the gel, debris stretching behind like an umbilical trace. (Figures 4 & 5) This process was 'frozen', instantly fixed in the flint. Such delicate detail would not survive if chalk had converted to flint by a chemical replacement process as the Chalk was extensively bioturbated. (C. Clayton. 1986).

From the osculum of developing larvae can be seen a spurt of spicules (Figure 6) showing the young sponges were functioning in the gelatinous matrix.

A cessation of the required flow of water through a sponge, caused by a smothering of chalk sediment, would have initiated the rapid petrification, preservation and subsequent lithification to Flint by further de-watering.

Also found in Flint are Gemmules (survival cells), produced in their thousands when a sponge was dying or under stress these cells lay dormant and regenerated when conditions improved. In Figure 1; the sponge had built a tapering 'roof' or tecta to raise the gemmules high above sedimentation. In calmer waters regeneration was a continual process resulting in tall paramoudra columns and 8/9m high cones of paramoudra magna as in the western cliff at North Landing and on the wave cut platform at West Runton.

All these sponge inclusions affect the fracture of flint. Larvae give a nubbly texture or flakes and their trails will form a ridge. Gemmules will often stay whole, standing proud of the surface, black spicules will show in the same manner on freshly broken flint.

Organic characteristics of sponge reefs, paramoudra and flint nodules also sponge procreation detail within Flint substantiates Primary Flint formed on the sea-floor from dewatered sponge mesohyl.

Further information can be found at http://www.flint-paramoudra.com/

Figure 4: Paramoudra typica from Caistor, larva within protuberance, larva trail and gemmules in central mesohyl. FOV. 150mm

Figure 6: knapped type A nodule, reveals a deluge of single ray spicules emerging from larva top.
We met at Leicester Square Station on a sweltering June evening, seeking shade from every available wall. Round the corner in St Martin’s Court we were asked to suggest the most common stone used in London. It was, of course, the one we were standing on and indeed walked on for most of our excursion, and that was “York Stone”. It does not come from York, but the name is given to the Carboniferous Lower Coal Measures water-lain sandstones mostly from Yorkshire and Lancashire that are split or sawn into these ubiquitous paving slabs. Closer examination revealed interesting sedimentary features such as ripples and pits possibly from the removal of mud flakes and occasionally, though not here, made by rain drops! One slab showed particularly good convoluted bedding laminations and the characteristic post-depositional iron staining in bands and rings.

Nudging our way through people homeward bound or out for the evening, we came upon a wonderfully preserved shop front to Waterstones in Garrick Street. Framing the glass are polished pillars of Cornish Serpentine from the Lizard. It became fashionable in 1870s, championed by Prince Albert following a visit to Cornwall. If you go to the Lizard yourself, do not expect to see old quarries as the stone was worked by peeling back the peat on the moors, digging out lumps of stone, back-filling with debris and rolling back the peat. These beautiful red and green rocks were once ocean floor and mantle thrust up in the Variscan orogeny to form an ophiolite complex.

Nearby in St Martin’s Lane was more serpentine, but this time in a much poorer state, weathered and dull, green in colour with white calcite veneering. Ruth told us that this was much newer, foreign “Verdi Alpi” from the Italian Alps made from ocean floor obducted during the Cretaceous.

Adjacent to an outcrop of pizza(!), we saw the first of many granites used to front pubs and ex-pubs in the area. Peterhead and Cairngall types were used along with lanterns and etched glass to provide the lure to, in Ruth’s words, “detach the working man from his money”! No fancy marbles, but easily hosed-down granite and larvikite. We saw several examples and were finally lured into one ourselves at the end of the walk!

The Quaker Meeting House is clad in Cornish granite and we were shown the subtle differences in colour, mineral content - muscovite - and alignment of the feldspars that enabled the distinction from Scottish granite.

We nearly got caught up in the Bat Out Of Hell premier at the Coliseum, but we didn’t have our biker’s gear, so we looked at the chocolate coloured granite of the theatre’s façade from the other side of the road. This is very ancient 1.5 bya Vånevik granite from the east of Sweden. It contains blue/violet opalescent quartz which has been strained and stained with iron oxide to produce the distinctive colour. Closer examination would have to wait for another day when the theatre, originally built as a music hall, reverts to its more recent status as the home to the English National Opera.

From the Bat Out Of Hell to Vivaldi, advertised on the posters outside St Martin’s in the Fields, we looked at the new circular entrance to the Crypt which is made of an interesting textured “bush-hammered” Nero Impala gabbro from South Africa. It looks black when polished, but here is a muted grey and is the oldest building stone in London at 2 billion years old.
Its extensive use is due to being the overburden for the rich platinum deposits of the Merensky Reef. It was shipped to Aberdeen for cutting and polishing. The dark colour is due to a high magnetite content together with feldspar and pyroxene.

The church itself is made of Portland Stone and was once literally “in the fields” next to the village of Charing. The stone comes from the fossiliferous Whitbed section which is part algal reef, revealed in the cauliflower structures and intricate banding that are thought to represent seasonal growth. We saw examples of these Solenopora portlandica together with oysters and burrows of Thalassinoides and other enigmatic Y-shaped burrows that elicited much discussion. This time Ruth had to compete with a loud Yoga commentary from across Trafalgar Square, but we all got the message that Portland Stone is more interesting than you would think and worthy of close examination to identify Whitbed from Roach, which contains so many weathered-out fossils of gastropods and bivalves to make one question its strength as a building stone. “Fancy Beach” Whitbed is a coquina (shell shoal or beach) and displays a wonderful array of oysters and other shells.

Granite abounds in Trafalgar Square and we saw examples of pillars made of Aberdeen granite with interesting xenoliths of biotite that metamorphosed from sandy country rock. This is Dancing Cairns Granite. Paving and plinths are of Cornish granite, Nelson’s column itself is of Foggintor granite from Dartmoor and the fountain rims are of Cairngall granite. All the stones used in the construction of the Square were well documented at the time of its building so Ruth’s dedicated detective work was not so necessary here. The red and white paving at the north end is Permian dolomite-cemented sandstone from Mansfield and Portland Whitbed respectively, and the paving alongside the National Gallery is brown Yorkstone from Halifax.

Finally, we were reminded that going down the short slope of the Square and into Whitehall, several Thames terraces are traversed – Hackney, Taplow and Kempton Park gravels have been identified and when the Namibian embassy was built in the 1960s many vertebrate remains were found – lion, elephant and a hippo tooth. Perhaps there should have been a hippo on the 4th plinth instead of the rather vulgar pointing digit!

All these details and more can be found on the London Pavement Geology website set up by David Wallis and Ruth Siddall and now available as an app. All are welcome to add locations where interesting building stones can be seen – even if you don’t know what the stone is yourself, Ruth will undoubtedly help out with its ID.

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Geologists' Association

Geology Photographic Competition 2017

Please note the closing date of Friday 29th September 2017

A great opportunity for imaginative photography! Geology is all around us impacting on our daily lives. It’s in our shopping baskets, our homes and our streets as well as on mountains, volcanoes, beaches and quarries.

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Entry forms are also available on the GA website (click on the link on the homepage). www.geologistsassociation.org.uk or by telephoning the GA office on 020 7434 9298.
Circular No 1013 September 2017

SAFETY IS TAKEN VERY SERIOUSLY should you be unsure about either the risks involved or your ability to participate safely, you must seek advice from the GA office before booking. Please make sure that you study any risk assessment or safety briefing and that you have all the safety equipment specified. You must declare, at the time of booking, any disabilities or medical conditions that may affect your ability to safely attend a field meeting. You may be asked to provide further information on any prescription drugs etc that you may use whilst attending a field meeting. In order to ensure the safety of all participants, the GA reserves the right to limit or refuse attendance at field meetings.

EMERGENCY CONTACT If you are lost or late for the start of a meeting, an emergency contact is available during UK field meetings by calling the GA mobile phone 07751 123290. The mobile phone will only be switched on just before and during field meetings. For routine enquiries please call the GA office on the usual number. TRANSPORT is normally via private car unless otherwise advertised. If you are a rail traveller, it may be possible for the GA office to arrange for another member to provide a lift or collect you from the nearest railway station. This service cannot be guaranteed, but please ask before booking. Please indicate when booking, if you are able to offer a lift.

PUBLIC LIABILITY INSURANCE for field meetings is provided but personal accident cover remains the responsibility of the participant. Further details are available on request from the GA office. TRAVEL REGULATIONS are observed. The GA acts as a retail agent for ATOL holders in respect of air flights included in field meetings. All flights are ATOL protected by the Civil Aviation Authority. Field meetings at more than 24 hours duration or including accommodation are subject to the Package Travel Regulations 1992. The information provided does not constitute a brochure under these Regulations.

Geoff Swann arranges UK field meetings and Ian Sutton is responsible for overseas excursions. Website for further details www.geologiansassociation.org.uk/ukfield.html • www.geologiansassociation.org.uk/overseasfield.html

BOOKINGS AND PAYMENT: These should be made through Sarah by email: fieldmeetings@geologiansassociation.org.uk phone 020 7434 9298 or through the GA website. Please give an email and emergency contact number. Unless otherwise stated the cost is £5 per day for members. Locations and timings of field trips will be given nearer the time and once payment has been received. Field meetings are open to non-members but subject to a £5 surcharge on top of the normal administration fee. Cheques should be made out to Geologists’ Association. Where places are limited, a system of first come, first served will operate so do book early. Some meetings may have restrictions on age (especially for under 16s) or be physically demanding. If you are uncertain, please ask.

GA UK FIELD MEETINGS 2017

GEOLOGY OF THE SOUTH DEVON COAST WEEKENDER Leader: John Cope Saturday 7 - Sunday 8 October Centre Torquay or Paignton (full of hotels and B&Bs).

This fieldtrip is timed to follow the publication of the Association’s guide to the Geology of South Devon (GA Guide 73, 2017). The aim of the trip is to examine the Devonian succession in the Torbay area and its relationship to the Permian-Triasic cover which will also be seen farther to the east. The Devonian rocks of south-west England are in marine facies and contrast greatly with the Old Red Sandstone facies present over more northerly areas at the UK; they are overlain unconformably by red beds of Permian age that mark the beginnings of an era of desert conditions that persisted throughout the Permian and Triassic periods (an interval of close to 100 Ma) over the British area. Saturday will be spent examining the Devonian succession in the Torquay and Paignton areas where slates and limestones in the Devonian have a rich fauna dominated in the latter by corals and stromatoporoids. The unconformity between the Devonian and Permian will also be seen. On Sunday the succession of Permian and Triassic rocks, exposed in magnificent cliff sections for this to the east, will be examined. Rendezvous: Meet Saturday 10.00 am at the eastern end of Meadfoot Beach (SX 935 633). Do not park in the expensive Pay-and-Display car-park there, as there should be free parking in small lay-bys on the north side of the road to the west of this point. A packed lunch is recommended for the Saturday. The trip will end around 4.00 pm on the Sunday to allow the participants to return home that day. A helmet is essential but there is no need for a high-vis jacket.

Accommodation: there is abundant accommodation available in the Torbay area (Torquay-Paignton) in all price ranges. As this will be out of season there should be a good choice geology: Marine Devonian, Variscan structures and post-Variscan cover. Cost and Booking: Please register with Sarah £15 per person.

The Lost Gardens of Ediacara Leader: Eddie Bailey

Postponed until 2018

An afternoon visit to the ‘Dinosaurs from China’ exhibition in Nottingham
Leader: Mike Howgate Saturday October 14

This will be an afternoon visit to the ‘Dinosaurs from China’ exhibition from a viewpoint sceptical of the Dinosaur-Bird link consensus which prevails within the palaeontological community and popular science journals. As key specimens which are seen as backing the dino-bird link will be on display it will be an ideal opportunity to see the alleged proto-feathers on Sinosauruspteryi and the supposed dinosaurian features of the ‘four-winged flyer’ ‘Microptoraptor gui’ which are used to place it among Dromaeosaurus on dinosaur cladosgrams.

Members will then have both sides of the debate as the exhibition will inevitably be skewed towards the dino-bird theory. We will also look at the other less contentious exhibits which include the superb long-necked sauropod Mamenchisaurus.

Cost: £12 which will include the admission charge into the exhibition. Deadline for booking October 6th

GA OVERSEAS FIELD MEETINGS 2017

CHINA CENOZOIC EVOLUTION OF THE UPPER YELLOW RIVER AND ITS ENVIRONS September 10 - 26

Led by David Bridgland

OVERSEAS GA TRIPS FOR 2018

Geological Highlights of Morocco April 1 – 10 (note extra day)

Leaders Mohammed Segouei (Morocco-Geo-Travel) and Professor Dave Martill (University of Portsmouth) Provisional Itinerary

April 1 Arrive in Marrakesh. Overnight at the Tulip Hotel

April 2 Drive to Aïn F. This drive takes us over the Atlas Mountains (Col du Tizinta), through Ourazate and into the Jebel Sahro mountains. This is the edge of the Sahara. We go towards Zagora crossing the Col du Tizi Tiniffit, through the small town of Azgdz and into the Draa Valley. We then turn east toward

Nikob and Tazzarine, reaching our hotel in the early evening. En route we will examine Precambrian stromatolites in the Jebel Sahro.

April 3 Aïn F is the centre of tribolite collecting and preparation. Here is an excellent place to buy perfect examples of more than 50 species of tribolite. Some of the finest examples you will ever see and the most amazing preparation. After looking at the fossil shops in Aïn F, we will drive east and then detour towards Fezzou where we will examine strata (the Devonian Issoumou beds) that yield the tribolites. Many other fossils can be found there too, including crinoids and goniatites. We will spend the night at Merzouga next to the great sand dunes of Erg Chebbi.

April 4 Drive south towards Taouz and on to the oasis of Begaa. Here we will examine the Early Cretaceous Kem Kem beds and visit the dinosaur mines. There is a good opportunity here to examine the Mesozoic-Palaeozoic unconformity and perhaps find a few dinosaur teeth. The fossil miners may well have some exciting discoveries to show us.

In the afternoon we will visit the famous vanadinite mine near Taouz where excellent mineral specimens can be found.

April 5 The famous Devonian Mud Mounds near Erfoud and the even better known orthoceras limestone will be visited. Spectacular structures produced by hot under-water springs near a palaeoafault are another feature for this day. An extremely fossiliferous area with spectacular scenery. Overnight in Erfoud

April 6 Drive from Erfoud to Amelagous stopping at Asila to examine the Turonian ammonite, fish and reptile beds of the Akrabou Formation. Nodules with three dimensionally preserved ammonites and amazing fish. Also plesiosaurs and a small mososaur called Tethysaurus can be found quite easily here.

April 7 Leisurely drive through the spectacular rodgha gorge. Overnight in the Dades valley.

April 8 Explore the Jurassic dinosaur footprints at Dades. Afternoon examining the stunning geology and scenery of the Valley of the Roses around Bouqaghr.

April 9 Return to Marrakesh the pretty way. Taking in more of the Valley of Roses and the Col du Tichka in the High Atlas. Overnight in Marrakesh

April 10 Transfer to Marrakesh Airport. End of tour. Return Flights to and from Marrakesh are not included in the tour fee. You may book your own flights or we will be happy to arrange them for you. You must arrive.
The remaining days will be spent on Mainland
Booking form available on website or contact Sarah
strictly limited, particularly single rooms in Mainland.
These fees include 3 nights half board
arrangements for your overnight accommodation
of you who decide to fly will need to arrive in
met off the ferry on the morning of June 5. Those
for the start of the trip on June 5. You may wish to
exposure of a Devonian volcano in an Old Red
traversing the metamorphic and granitic rocks of
also include the Dalradian phyllites, meta-volcanics, a massive
sulphide deposit and Viking soapstone quarries.
meta-metamorphic rocks and Devonian basin sediments
in Marrakesh on the evening of April 1 so that the group
leaving Marrakesh early on April 2.
The package we have arranged includes nine nights half
board accommodation at good class hotels throughout
the tour on a half board basis. Travel in
vehicles. Your fee also includes leadership of the tour
by Mohammed Segaoui and Dave Martill and a tour
brochure. It is based on two people sharing twin or
double rooms. A single supplement of £200 is available for a very
limited number of rooms.
Cost and Booking: for the tour £880 (Single supplement £200). Please note these provisional fees based on
current exchange rates and may have to change with
any variation of sterling rates. Booking form available on
website or contact Sarah

GA LOCAL GROUPS (LG) & AFFILIATED SOCIETIES

Amateur Geological Society
http://amgeosoc.wordpress.com
starfield@tiscali.co.uk
September 12 The textures of peridotic rocks on sub-continental mantle origin – Dr Brian Tabor
October 10 Exceptional Cambrian Fossils, the
flowering of early life, and world heritage in

Yunnan – Prof Derek Siveter,
Nov 34 Connoisseurs of Minerals the Freeman and
Simmons collections – Dr Monica Price.
Nov 25 North London Mineral Gem and Fossil
Show. See advert in Magazine.
Association of Welsh RIGS Groups
www.wcwa.org.uk/members-partners/members-
search/detail?id=806675
Avon RIGS
http://avonrigsputroutrap.blogspot.co.uk/
Bath Geological Society
www.bathgeodosc.org.uk
September 7 Mountains in the Sea
Prof Tony Watts,
Belfast Geologists’ Society
www.belfastgeologists.org.uk
Black Country Geological Society
www.bcgcs.info
September 16 Field meeting: Geoconservation
Day at Wren’s Nest -Wardens of Wren’s Nest
September 18 On the move in pursuit of black
gold – highlights from three decades of
international oil and gas exploration – Graham
Hickman.
October 1 Field meeting: The South Malverns –
John Payne.
October 16 The Corsi collection of decorative stones: where geology meets the arts – Monica
Price.
November 4 Geoconservation day Barrow Hill
November 20 Cave Development - Tony
Waltham.
Brighton & Hove Geological Society
www.bgss.org.uk
October 14 Geoalab at Brighton Museum.
Bristol Naturalists’ Society
www.bristolnats.org.uk
British Micromount Society
http://britishmicromountsociety.homestead.com
Bucks Earth Heritage Group
www.bucksequity.org.uk
Cambridge Geology Society
www.cambridgegeology.org
Cambs Geology.
September 12 An insight into the economic
geology of Burwell.
October 10 Mass extinctions in Earth History –
Dr Stephen Kershaw.
November 14 The mass grave in the coal mine –
the giganoids of Bernissart – Franziska
Norman.
Carn Brea Mining Society
www.carnreaminingsociety.org.uk
September 19 The work of local photographer
WJ Bennets of Camborne – David Thomas.
Cheltenham Mineral and Geological Society
www.cmg.org.uk
Cumbrian Geology Society
www.cumbriangeology.org.uk
Cymdeithas Dyfodol gyda Ceip Cyffwr\dd
South Wales Geologists’ Association (LG)
www.swgos.org.uk
September 9 Field meeting Caerfall Bay and St
Nons, St David’s, - Nigel Clarke
October 14 Field meeting Geoconservation in
Swansea.
Leaders: Geraint Owen and Hazel Trembath
Cymdeithas Y Daearreg Gogfold Gymru:
North Wales Geologists’ Association (LG)
www.amwgs.org.uk/cdgc/cdgc.html
September 10 Aspects of the Carboniferous of
Flintshire - Keith Nichols
September 27 Fossil plants, the evolution of a
garden and it’s plants
Devonshire Association (Geology Section)
www.devonassoc.org.uk
Dinosaur Society
www.dinosaursociety.org
Dorset Group (LG)
www.dorsetgeologistsassociation.com
Dorset Natural History & Archæological Society
www.hantscountymuseum.org
Earth Science Teachers’ Association
www.esta-uk.net
East Herts Geology Club
www.ehgc.org.uk
East Mids Geological Society
www.emgs.org.uk
September 9 Field meeting: Kettewell Quarry – Ken
Nye
September 19 Field meeting: Major Dinosaur
Exhibition - Adam Smith.
Edinburgh Geological Society
www.edinburghgeoloc.org.uk
Essex Rock and Mineral Society (LG)
http://www.emrs.org/
September 9 Field meeting: Hadleigh Castle and
Country Park – Ros and Ian Mercer
September 12 Portland – the Greatest Stone on Earth?
- Barry Hunt.
September 17 Field meeting: Hannay Eschus – Bill
George.
October 10 Gregory, Bottley & Minerals – Ivor
Thurgood.
October 22 Field meeting: Crag sites of Suffolk – Bob
Markham.
November 14 AGM & Members’ Evening
Farnham Geological Society (LG)
www.farnhamgeosoc.org.uk
September 8 Geological evolution of the Wandle - Dr
David Gill.
October 13 Introduction to microfossils - Dr Adrian
Rundle.
September 17 Field meeting Hengistbury, Hordle &
Hurst - Graham Williams.
September 30 – October 3 Field meeting Isle of Wight
- Graham Williams.
November 10 The biggest volcano in the World - Dr
Julie Prytulak.
November 19 Society’s Annual Lunch Frensham Pond
Hotel Friends of the Sedgwick Museum, Cambridge
www.sedgwickmuseum.org.uk/activities/friends.html
Geological Society of London (LG)
www.geolancashire.org.uk
Hunts Rock and Mineral Society (LG)
www.hastingsgeology.btck.co.uk
Hurst - Graham Williams.

Harrow & Hillingdon Geological Society (LG)
www.hhgs.org.uk
September 13 A brief history of life in 10 fossils
– Dr Paul Taylor.
November 8 Microfossils – Adrian Rundle
Hastings & District Geological Society
www.hastinggeology.com
September 17 Gideon Mantell: The Dinosaur
Hunter of Lewes - Ray Hale.
Hertfordshire Geological Society (LG)
www.hertsgeology.org.uk
September 14 Did the Earth move for you?
Great Earthquakes to silent slips – Dr Rebecca
Bell.
September 21-24 Field meeting to Ludlow area
– John Nicklin.
October 12 The evolution of land plants – Dr Paul
Kennedy.
November 9 Mount Emeus volcano Antarctica
- Dr Nial Peters.
Horsham Geological Field Club
www.hgfc.org.uk
September 13 please check website
October 8 40th Anniversary lunch.
October 11 Gales, greenhouses and global warming –
Ian Currie.
November 8 Lapis Lazuli – Dr Chris Duffin
Huddersfield Geology Group
www.huddersfieldgeology.org.uk
SPECIAL EVENTS

September 5-9
British Science Festival 2017
University of Brighton and University of Sussex.
britishscienceassociation.org

September 16
Open House, Burlington House, The
Geological Society will be open and
the GA will run workshops:
1. The stones in the reception desk
and associated fossils.
2. Building stone walk from Burlington
House to Green Park led by Mike
Howgate.

Yorkshire Fossil Festival
Rotunda Museum Scarborough.
yorkshirefossilfestival.co.uk

Earth Science Week
October 7-15
Sidmouth Science Festival
sidmouthsciencefestival.org

Geolabs October 14
Brighton Museum organized by
Brighton & Hove Geological Society
and GA
National Stone Centre
North Staffordshire Local Group and GA

October 21-22
GA Conference Cardiff
Climates Past Present and Future
conference@geologistassociation.org.uk

November 4 – 5
The GA Festival of Geology
University College London

November 25
North London Mineral Gem and Fossil
Show http://amgeosoc.wordpress.com

Magazine of the Geologists’ Association Vol. 16, No.3 2017 25
My interest in Rhomb Porphyry began a few months ago, after I was given a sea-worn cobble from the beach at West Runton, Norfolk. The beautifully polished, igneous rock in my hand wasn't anything I'd have expected from West Runton: where the beach sits on Cretaceous chalk and the cliffs are formed of Pleistocene sediments. So, it made perfect sense when the friend who'd found my cobble explained it was a glacial erratic from Norway. Things only started getting complicated, after I discussed my rock with a few other people. I was told, there's no evidence that Norwegian ice-sheets ever reached as far as Norfolk. Others said, my rock must be Viking ballast, thrown from the deck of a marauding longship, in exchange for an equal weight of Anglo-Saxon booty. What was I to believe? Either way, it sounded like a great story that demanded further investigation.

It's correct that pieces of Rhomb Porphyry (RP), some up to 250kg, are occasionally found on Britain's east coast, from Orkney down into Suffolk. In Norfolk and Suffolk, finds are less common than in some more northerly locations. For example: I'm told it's a frequent find on Flamborough beach, Yorkshire; and a survey conducted by the East Riding Boulder Committee notes RP at 13 of the 19 sites it investigated.

Fortunately, for a rock that wanders so far from home, RP is easy to identify. Its fine-grained, reddish-brown matrix is punctuated by large crystals (phenocrysts) of anorthoclase feldspar [see Figure 1]. It's these rhomb-shaped phenocrysts that give the rock its name. Although, just as often, the phenocrysts are wedge- or lens-shaped – and there's even one 'sub-species' in which they're elongated rectangles.

Undoubtedly, my cobble was RP; and the other thing I could be certain of was the parent bedrock from which it was derived. RP is a rare rock, associated with continental rifting. It's only found in three locations: the East African rift, including Mount Kilimanjaro; the Mount Erebus region of Antarctica; and the Oslo Rift in Norway. In Norway, RP and its plutonic counterpart, Larvikite, formed during a period of tectonic activity, 295-275Ma ago, which created the Oslo Graben. Today, a sequence of lava flows and exposed dykes, occupy an area of roughly 10,000 Km² to the southeast of Oslo [see figure 3].

However, what I really wanted to know, was how and when my cobble had made its unlikely, almost 1,000km crossing from Oslofjord to West Runton.
295 – 2.6Ma ago: Freak Finds and Freakish Explanations

Of course, it may not always have been 1,000km from Oslofjord to West Runton. Prior to rifting in the late-Palaeozoic and early-Mesozoic, the North Sea basin was probably somewhat narrower than today. Nonetheless, for the past 295Ma, a wide, deep basin has separated RP bedrock from the proto-British Isles. It's hard to understand how, without the help of ice, any rocky material could have made such a crossing. And yet, there's reliable evidence that small amounts of Scandinavian rock arrived in the proto-British Isles well before the onset of the Quaternary ice age.

Hawkes (1951) considers 388 pebbles and small rocks found embedded within the English chalk, from Yorkshire down into Devon. Each ‘erratic’ is minutely examined (105 in thin section) to establish its age, identity and parent bedrock. Based on this sample, Hawkes concludes that: “The erratics have been obtained from many and distant shores. The more specialised types among them indicate that the south-west of England and the Oslo Fjord-south-west Sweden region have contributed material.”

Even more mysterious is the case of the ‘Purley Giant’: discovered in Haling Limeworks quarry, Purley, Surrey, in 1857. The find consisted of one ‘giant’ granite boulder, several smaller boulders of decomposed labradorite porphyry and a quantity of sand, all derived from the Oslo region. Unfortunately, the workmen who made the discovery broke the large, granite boulder into pieces, before trying to burn it. However, judging from the remaining fragments (now held by the BGS, Keyworth), Hawkes estimates that the ‘giant’ must originally have weighed around 45lbs.

Figure 3: 10m thick RP dyke intruding through Silurian sediments; Ringerike, Norway

Figure 4: Section of beach at West Runton where several RP’s have been found
2.6Ma – 11,500 years ago: Ice-rafting and Re-working by British Glaciers

There’s a much greater body of information about how RP and other Scandinavian rocks may have entered Norfolk during the Quaternary period. For the most part, the authors are interested in piecing together the history of Quaternary ice movements and, in this context, far-travelled rocks serve as important ‘indicators’ of the direction in which ancient ice once flowed.

Attempts to establish an accurate history of glaciation are considerably impeded by the fact that each successive ice flow scours away evidence of its predecessors. And it’s this tendency of ice to cover its tracks that explains why the Happisburgh Formation in northeast East Anglia contains the oldest, undisputed till in Britain.

The Happisburgh till is widely regarded as dating from Marine Isotope Stage 12, meaning that it formed during the Anglian glaciation around 450,000 years ago. It has yielded in situ specimens of RP, larvikite and drammen granite, amongst a much larger mass of erratics from northern Britain. Such evidence has caused geologists to postulate a Happisburgh Ice Sheet that pushed down Britain’s east coast, picking up native rocks and re-working Scandinavian erratics that already lay in coastal and shallow marine deposits.

According to this scenario, my cobble had already arrived in northern Britain, before being picked up and carried south by the Happisburgh glacier. And, as for the identity of the ice flow that carried it to Britain in the first place – unfortunately, all trace of that is long gone!

Larkin et al. (2011) propose a different model for how and when RP may have reached West Runton. Their modelling is based on north British and Norwegian erratics found in the Wroxham Crag Formation (WCF), northeast Norfolk. The WCF pre-dates the Happisburgh Formation and formed in a marine environment, before the southern North Sea was engulfed by Anglian ice. For Larkin et al., the presence of far-travelled erratics in the WCF, provides evidence for, “at least one glaciation between ... 1.1-0.6 Ma”. During these earlier glaciations, that only reached the northern rim of the North Sea, icebergs calved from Norwegian and north British glaciers occasionally became stranded on beaches in present-day Norfolk, where they melted and added their contents to what would become the Wroxham Crag.

The authors cite the “clustered occurrence” of these erratics as strong evidence for their ice-rafting hypothesis. Thus, a single, stranded, block of ice, would have melted and discharged its rocks in a relatively restricted area. I’d been told, my cobble came from a small section of beach, close to where other pieces of RP had been seen. So, I was interested to read that part of the evidence for Larkin et al.’s ice-rafting hypothesis came from clusters of far-travelled erratics, including RP, found in situ in the WCF at West Runton and Sidestrand.

11,500 years ago – present: Anthropogenic Erratics

During the late-Holocene, humans have been busy creating a new class of erratics. In the present context, ships’ ballast and rocks used for sea-defences are of interest.

I’d hoped to discover a learned paper or two, linking known Viking landing-sites to accumulations of RP. But there’s nothing: and I’ve been forced to conclude that this popular and attractive idea is an urban myth. There is evidence of more recent ballast from East Anglian ports finding its way into the wider environment. Mercer (2014) suggests that RP and other Scandinavian rocks may have accumulated on the quay-side at Mistley, Essex, before being incorporated into a nearby, 19th-century wall.

Norwegian rock is frequently used in sea-defences along the Norfolk coast. There are a few blocks of Norwegian Larvikite protecting the slipway at Woman Hythe, West Runton. However, these are over 600m from the area of beach that yielded my cobble, and all the RP discovered at West Runton is too puny to have been brought there as sea-defences [see figure 4].

So, in the end, what do I know about the provenance of my cobble? My search had led me into some unexpected and fascinating areas. One of the things I’d found out is that, because my cobble wasn’t discovered in situ, it’s hard to be precise about its history. If I was forced to guess, I’d say it probably arrived in an iceberg that calved off a Norwegian glacier during a glacial advance ca 1.1-0.6 Ma ago. Although, who’s to say it didn’t get here in the belly of a sea-monster or, even, a dragon-prowed war-ship!

My thanks go to: Peter Hoare, for all his good advice; Bjorn Tore Larsen, for photo 3; and Russell Yeomans for photos 1 and 4.

Further Reading


A GEOLOGY FIELD TRIP TO THE HIDDEN KINGDOM OF BHUTAN

WHAT: Study the geology, natural history and culture of a very spiritual Himalayan Kingdom

WHEN: Saturday 17th March to Friday 30th March 2018

WHERE: Bhutan

TRIP SCHOLAR: Dr Danny Clark-Lowes - Geologist

Dr Danny Clark-Lowes is a geologist, educated at Cambridge and London universities, who has given industry training courses on geology at locations throughout the world, as well as publishing scientific papers and books. He is also a mountaineer who has climbed in the Swiss Alps and in the Himalaya. He will lead this tour to Bhutan which will look at aspects of the geology and geography of the spectacular Himalaya, and will help participants achieve an understanding of how mountain belts and their associated rock types are created through plate movements.

On this tour we will experience the rich culture of the country, with visits to Buddhist dzongs and monasteries, some perched on the edge of precipitous cliffs amply deserving the title ‘lurrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr
Any geologist with an interest in the regional geology of a Herefordshire should find space for this book on their bookshelf.

This is not a ‘dry guide’ detailing a series of geological sites, but it takes a step back, in that it elegantly dovetails together the geological history of the rocks in Herefordshire, and provides some background on the basic principles of geology, for those with just a passing knowledge of the subject or perhaps those who need reminding! It is almost two books in one cover.

A great deal of thought and consideration has gone into how the geological story has been woven together with the landscape we see today. This is a tribute to the Editor and contributing chapter authors. The driving force behind this book is the Geology Section of the Woolhope Naturalists’ Field Club which was founded in 1851. Incidentally early presidents included Reverend T.T. Lewis and R.W. Banks with formidable honorary members - Adam Sedgwick, Roderick Murchison and Charles Lyell.

This book is not intended to be a detailed description of every nook and cranny in Herefordshire; but aims to provide an understanding of the geology and the impact that has on the land use, landscape, flora and fauna and building stones. Site-specific or trail guides have been compiled by the Herefordshire and Worcestershire Earth Heritage Trust (EHT) and used in tandem with the BGS maps can provide the granularity for location specific detail that some may require.

The opening chapter details the history of the study of geology in the county and the contribution of significant figures such as Roderick Murchison on the Silurian of the Welsh Marches, which still provides the basis for modern descriptions of the county.

The county of Herefordshire (50 km x 75 km) has exposures of rocks dating from the pre-Cambrian (677Ma) to the Triassic (245Ma) to the Triassic (245Ma). In addition there is a Quaternary signature from the glaciations of the last 2.6Ma. On this geological journey, we do not dive straight into a chronologically arranged set of geological evidence and events that occurred in the county of Herefordshire. Instead the book starts with a wonderful vision of what can be seen from ‘Views from Five Hills’. Painting a picture of a wonderful landscape from five strategic elevated sites dispersed throughout the county. This is quite an hors d’oeuvre.

The next chapter is devoted to detailing basic geological concepts which also includes some Global Palaeogeography and the overwhelming impact of plate tectonics on the distribution of continental land masses. Approximately 700Ma proto England and Wales were 60° S and subsequently moved about 10,000 miles to 50° N of the equator – about 2 cm/year. The journey starts as Avelonia splits from the super continent Gondwana and moves northwards as the Iaptus Ocean closes. The Caledonian Orogeny during the Devonian and Carboniferous was followed by erosion, and the deposition of Old Red Sandstone which is very much associated with Herefordshire today, through the red/brown of the recently ploughed fields or the distinguished Cathedral in Hereford. Now north of the equator the formation of Pangaea super continent occurred. During the Jurassic and Cretaceous the Atlantic started to open up. From this time, whatever material had been deposited, has since been removed by erosion. This chapter also provides informed detail on rock composition, stratigraphy, and structural configurations.

Now the reader is equipped with topographic overview from five elevated vantage points dispersed throughout the county, and a background in geological principles. We are now taken step by step through time in a series of chapters each devoted to a Geological Period or Periods from the pre-Cambrian through to the Triassic. The oldest rock in southern England outcrop within the Malvern Complex; but of particular interest is the marine Silurian and how investigation impacted on the development of the science of geology. William Smith (1769-1839) had recognised relative age of beds of sediment and the use of fossils facilitate this correlation even if the sediment varied. For Murchison, a generation later (1792 - 1831), embarked on putting some order to the ‘Silurian’ rocks of Herefordshire following advice on specific locations to visit from William Buckland. He benefited from a relative abundance of well-preserved fossils some of which are beautifully photographed for this book.
Each chapter follows broadly the same format – with an introduction – a tectonic background on a regional scale and how this impacted on the geological processes on local scale, and what can be seen in the landscape and at outcrop. Of real value are the lithostratigraphic correlation tables providing a ‘translation’ between the nomenclature that has been used, currently used and should be in use!

In the closing chapter, the book ties in the impact of geology on people. In reality, there has been little in the way to exploit commercially, and consequently the county had been dominated by agricultural activities as the recourses which fuelled the industrial revolution were not present. Local stone has been exploited for building purposes and in the case of local limestone and marls have been fired to produce lime wash, mortars, and for agricultural purposes to reduce the acidity of the sand rich soils. Each chapter closes with information on further reading, and in the body of the text reference numbers tie into a reference section at the back of the book in chapter order; just after a useful glossary of geological terms.

The text is complemented by many beautifully clear photographs, some imaginative 3D block diagrams and annotations, (which are almost ‘Wainwrightesque’ in detail), and cross sections throughout the book. The series of drawings describing the Woolhope Dome are particularly effective. Detail - I do wish all the block diagrams had a ‘north arrow’ and a scale bar. Another feature I particularly like is the use of greyed-out text boxes; these were used throughout the book to describe, or introduce parallel themes, which may either explain or provide additional information. These ranged from a brief note on Roderick Imply Murchison (1792-1871) to the Herefordshire Lagerstatte.

The breadth of this book reflected by the references to geology and the Artistic Movements – the science of geology was evolving at the same time an appreciation of the landscape. Wordsworth wrote of Tintern Abbey and Revd William Gilpin of the beauties of the Wye Gorge – the elements of craggy rocks and moving water with lush vegetation where aesthetics to be valued by the Picturesque and Romantic Movements. These values underpin the concerns we still have today regarding the natural environment. There are delightful images of 17th/18th century countryside, one that caught my eye was by Joseph Incé (1806-1859) of Stanner Rock, Worsell Wood and Hanter Hill.

To my mind the aims of the book are achieved; which are to explain the how, where and when the rocks of Herefordshire were formed and the subsequent processes which have led to their current configuration of the quintessential English/Welsh boarder landscape we see today.

The text is wonderfully complemented by the photographs, 3D block diagrams and cross sections. John Payne and the co-authors have a deep knowledge and real passion for the history of geology, and the geology of Herefordshire, which is reflected in this thoughtfully and intelligently compiled book on the Rocks and Scenery of Herefordshire. A great book to read by the fire or have in your rucksack.

**Nick Pierpoint**

### Field Meeting Report: Italy - The Five Volcanoes Tour

**Leader:** Dr. Paul Olver

**By:** Daniel Stedman

March 30th - April 9th, 2017

After a previous tour of the five volcanoes in 2012, which was dogged by dreadful weather, strikes and local organisational difficulties, the 2017 tour was a great success. The trip was again led by Dr Paul Olver. Arriving at our hotel in the early hours of 30th March, our first day saw us visiting Vesuvius and Pompeii in beautiful weather. Our local guide from the Vesuvius observatory, Dr Luigi Maisto, took us by a little used tourist trail to the crater rim and we were able to look down into the great abyss of the 1944 crater. On the final part of the ascent we saw scoria deposits and huge volcanic bombs. In the afternoon we went to the legendary remains of Pompeii. Our local guide was able to give us an informative account of life in Pompeii. The plaster casts of the victims of the AD 79 eruption are a poignant reminder of the last moments of life in Pompeii as multiple pyroclastic flows overwhelmed a city already deeply buried in pumice. The volcanic rocks from the Somma cone used in the buildings, were vesicular tephrite lavas containing roundish phenocrysts of leucite. The nature of the lavas here is influenced by the interaction of magma at depth with Triassic limestone and the reaction results in silica being lost and the lavas being undersaturated with silica. Feldspatoids, such as leucite, develop instead of feldspar.

Our next day took us to the Campi Flegrei west of Naples, an area rich in volcanic features, new cones, craters, fumaroles and crater lakes. This area of active volcanism lies above a shallow magma chamber. Surprisingly heedless of any hazard, the city of Naples has spread right across this intensely active volcanic area. We first walked to the Roman Temple of Apollo on the shore of the beautiful Lake Averno. Here lavas from the 1538 Monte Nuovo eruption are piled up against the building. Lake Averno was once an arm of the sea prior to this eruption and it was from here that the elder Pliny set off on his ill-fated rescue mission during the eruption of Vesuvius in AD 79. In the afternoon we saw the active Solfatara crater, which is belching steam and fumes from high temperature geothermal areas. The high temperature gases precipitate arsenic, mercury, iron and sulphur in colourful deposits on the rocks. Solfatara is a remarkable spot with its fumaroles and lunar landscape of white pumice. A brick-built sauna allows one to experience the 120°C heat but no one wished to test that out!

From Solfatara we went to Pozzuoli where there is evidence of the uplift of the land in the remains of the Roman fish market. Lyell (1831) used these pillars as supporting of his theory of uniformitarianism and the gradualistic nature of geological events, but actually this coast is remarkable for its current configuration of the quintessential English/Welsh boarder landscape we see today.
of subsurface magma. The fish market was built at sea level but subsequently sank by several metres evidenced by the borings of the piddock Lithophaga but then the fish market was uplifted and the pillars were once again above sea level. The Pozzuoli area is still undergoing uplift and increasing activity at Solfatara indicates a renewal of magma intrusion.

On 1st April (day 4) we were able to investigate the continuing volcanism by visiting the island of Ischia on the north side of the bay. Good weather continued and we were able to see the volcanic cliffs of Capo Miseno and Procida Island with hundreds of feet of pyroclastic deposits including the Neopolitan Yellow Tuff. It is a mountainous island but not a straightforward volcano, the highest part of the island, Monte Epomeo (787 m), being uplifted sediments with the island appearing to act as a keystone above a shallow magma chamber which generates volcanism around its faulted margins. Our island guide took us to the south coast where pyroclastic deposits have become deeply weathered and have given rise to landslips and mudflows. Our guide showed us a deep canyon cut into the pyroclastic Epomeo Green Tuff by the waters from an active group of hot springs. The whole area is very unstable and subject to much mass movement. In the afternoon, we visited the citadel of Castello d’Ischia on the island’s east coast built on a trachyte lava rich in sanidine which is intruded along the major ring fault around the island.

The next day saw us transfer by coach to Sicily, a journey mainly by fantastically engineered motorways with viaducts, cuttings, embankments and tunnels. For much of the route the motorway has had to be engineered to cope with unstable Cenozoic sediments made up of limestones and marls caught up in the Apennine tectonic belt. For much of the route the motorway has had to be engineered to cope with unstable Cenozoic sediments made up of limestones and marls caught up in the Apennine tectonic belt. After days of fine weather a low pressure system moved in and we crossed the straits of Messina in a violent thunderstorm and torrential rain. Clearing weather followed as we journeyed down to Giardini Naxos and we saw the snow-capped Mount Etna wreathed round with cloud in the sunset.

The next day, 3rd April, was one of poor weather but fortunately we were visiting the lower slopes of Etna and coastal exposures of the earliest volcanic rocks rather than venturing up towards the summit. Our first stop of the day was near Linguaglossa where the effects of the active Pernicana fault on the road were clearly visible. The eastern slopes of Etna are unstable as the 2 km pile of lavas and pyroclastics are resting on weak soft marls and on the western side of Etna the mountain is buttressed by surrounding high ground, but on the east the land slopes down to the straits of Messina. Already in the past a large volcanic collapse feature, the Valle de Bove, has formed. This feature has funnelled lava flows down from the summit. At nearby Zafferana, one of these lavas in 1992 had reached the edge of town. Various efforts were made to stop the lava flow including explosives, building bunds and
using concrete blocks to divert the lava, but eventually it stopped at the edge of the town. The next geological stop was at Acicastello where there is a remarkable exposure of pillow lavas. One great slab of pillow lavas is found to be inverted, there was some discussion on the beach on how we could tell the correct orientation of the lavas. At Acitrezza we saw more igneous rock, this time in the form of sub-volcanic thin sills, dykes and laccoliths intruded into clays and sandstones. These intrusions form a series of remarkable rocky islets.

The following day introduced us to some of Sicily’s rich history with a visit to the Greek Temples of Agrigento and the remarkable Roman mosaics at the villa of Piazza Armerina. Not a day entirely without geology as we had splendid views from the motorway between Catania and Enna of Mount Etna in eruption. Mount Etna had been erupting steadily since March with new lava flows pouring down the southern and eastern slopes while clouds of steam and fumes rose from the summit craters. The new lavas were well seen against the brilliant white snowfields.

April 5th dawned bright and clear – time for our long-awaited visit to Mount Etna. We had a local guide from the Institute of Volcanology at Catania, Dr. Salvatore Gianmarco, who was very knowledgeable. Our route up the mountain took us up through the forests and lava fields to the Refugio Sapienza. The cable car then transported us up a further 200 m where a trudge through snow led to a viewpoint over the new lava fields. The eruptive vents were sending a great column of steam and lava clasts into the sky. Following a recent unfortunate incident involving a BBC film crew when a dangerous phreatic eruption had occurred as the lava exploded as it flowed over deep snow, we did not get too close to these vents. The afternoon was spent exploring the Silvestri crater row, a whole series of scoria and ash cones from the 19th century. We looked at scoria and pyroclastic deposits as well as volcanic bombs. Descending from the snows our guide showed us a remarkable geological exposure of a feeder dyke going into a lava flow.

The next morning saw us leaving Giardini Naxos for Milazzo on the north coast of Sicily and then a hydrofoil to the Aeolian islands, a series of volcanoes 16 miles off the coast. The hydrofoil called in at the smelly harbour of Vulcano before we reached Lipari. In beautiful fine weather, we spent the afternoon exploring Lipari. Paul Olver has done detailed research on Lipari and guided us round its varied coast and its remarkable variety of igneous rock from basic to acid rocks. Of note is the remarkable pumice mountain of Monte Pelato. The party was particularly interested in the obsidian lava flow in the north-east of the island (Colata del Roche Rosse). The lava shows amazing flow banding and features in the walls of the nearby Acquacalda village.

Our destination on the 7th April was a climb up to the crater of La Fossa volcano. We climbed this in 2012 but since then there has been intense gullying of the slopes so the climb requires finding a route through a maze of 12 to 20 ft deep gullies. At the
summit of the volcano we saw the main crater. Decreasing explosions at the end of the last eruption had left nested craters. This volcano is still very restless and extremely active fumarole field makes it look like a scene from hell. On the ground there is a delicate frosting of sulphur crystals. Later, the many volcanic features close to the port were examined including outcrops of sulphur and alum at the Faraglione, hot mud pools, marine fumaroles and hot springs coming up through the beach. There are colourful deposits of iron chlorides and sulphur and alum forming a remarkable cemented beach together with altered pyroclastics. The products of the first eruptions of Vulcanello in Roman times were then seen on the beach – boulders of tephrnite with zoned sanidine were very distinctive here.

The following day was the highlight of the trip; a boat out to the islands of Panarea and Stromboli. It was a beautiful sunny day with a mirror-smooth sea. We visited the lovely island of Panarea, a mountainous island with intermediate and acid volcanic rocks including trachytes, andesites, rhyolites and rhyodacite. We went to the south end of the island and had a picnic lunch in the idyllic setting of its Bronze Age village built on columnar-jointed andesite lavas erupted 125,000 years ago. In the distance we could see our next destination Stromboli. Leaving for Stromboli we saw more volcanic features as Panarea is part of the rim of a great undersea caldera. We passed offshore islands where volcanic gases bubble up from the shallow sea bed from submarine fumaroles. Our last stop was Stromboli, a spectacular volcano and one of the few volcanoes of the world in a state of permanent moderate activity. This is a dramatic island with a dark cone soaring from an azure sea. We had a local guide who showed us the black sand beaches and then up close to the edge of the Sciarra del Fuoco, the immense slope which channels any current lava flows towards the sea. From here there was a view of the high level main vents belching steam and fumes. In the evening our boat took us round the western side of the island, we had hoped to see an eruption but Stromboli was quiet just issuing clouds of steam which was a bit of a disappointment.

On Sunday 9th April, we left the Aeolian islands and headed for Milazzo on Sicily with a coach transfer to Palermo. This route by motorway skirted Sicily’s northern mountains. Inland the geology is mainly metamorphic rocks Alpine and pre-Alpine mica schists with Mesozoic sediments along the coast. The route from Milazzo to Palermo crosses the Tindari scarp a few miles west of Milazzo. This is a major lineament which aligns with the major faults along the west coast of Vulcano and Lipari.

The overnight ferry from Palermo took us to Naples arriving at dawn. It enabled us to do an early morning visit to Herculaneum, another Roman city entombed by the AD 79 eruption. This city is buried under 18 metres of lahar and pyroclastic deposits which are much denser and more solid than the initial pyroclastic deposits in Pompeii. Only a small part of the town is excavated as the modern town of Ercolano is built above the ruins. In the boat sheds along the original waterfront there are scores of skeletons where people waiting to be rescued died. The heat of pyroclastic flows here was not great enough to cause skull sutures to burst. We left Herculaneum just as the crowds were gathering and then headed north for a two day visit to Rome. Herculaneum was the last of our geological stops. In recent months, the Alban Hills south of Rome have shown renewed unrest with swarms of small quakes, uplift and carbon dioxide emissions - all indicating that the volcanoes around Rome are not entirely extinct, merely dormant.

In conclusion, we had a marvellous trip and were able to visit all the volcanoes and local experts greatly helped our interpretation as well as our assistant leader, Dr. Ian Sutton. We learned that the volcanoes and tectonics along this subduction zone are very complex. Vesuvius magma is contaminated by Triassic limestone creating undersaturated viscous lavas that are explosive. The Campi Flegrei are in a state of increased activity which may herald a new phase of volcanism. In Sicily, Mount Etna is a far from normal subduction volcano, its magma coming up from a deeper source than the subduction zone. In the Aeolian Islands, we saw very varied igneous rocks from acid to basic and learnt that Stromboli, rising from deep beneath the ocean, is really Europe’s most massive volcano larger than Etna. All in all a very interesting trip.

Figure 7: Vesuvius crater; Daniel Stedman watercolour
We woke up to a perfect day for a walk around Portland but as we were eating our breakfast, admiring the spectacular view across Chesil Beach to Weymouth, the clouds came rolling in and by the time we were due to set off fog had descended. Alan decided to reverse our trip so that our discussion on the view came at the end; a wise decision.

The Portland Heights, where the conference was held, and our start point, displays some of the important elements of succession on the island. We began by examining a fossilised tree, the first of several that we would see. Near the base of the Purbeck Formation, just above the marine Portland Stone, there seems to have been a forest of conifers bordering a lagoonal area. As the waters rose the conifers became swamped and stromatolites built up around the bases. Silica from the saline lagoon impregnated the wood, preserving it in silica. The texture of the surface was seen well in this tree and later on we would be able to observe the internal rings, and in places, holes in the surface where a branch had been.

Ammonites were built into the walls including the very large Portland Stone ammonite known as Titanites giganticus. The walls also gave us our first proper look at the Portland Roach where the aragonite shells of the snails and bivalves had dissolved leaving external moulds of the famous ‘Portland Screws’ (Aptyxiella portlandica) and the bivalve known to the quarrymen as ‘Ossies Eds’ (Myaphorella clavellata).

The first disused quarry we visited was Kingbarrow Quarry, now a nature reserve. Here the root bowls surrounded by stromatolites were well-displayed along a platform. Looking at the face from the opposite side we could see that the trees were rooted in a dirt band. Beneath, the Purbeck beds gave way to the Portland Roach at the top of the Portland Stone.

We crossed over the road to the disused quarry of Fancy Beach, and on into Bowers Quarry, operated by Albion Stone. We were able to survey the numerous blocks set out. Alan told us that each block is numbered so that prospective buyers can match blocks as well as the dimensions in cubic metres. Nowadays, the favoured building stone, termed the Whitbed is mined and we visited the mine entrance in Bower’s quarry. A handy marker at the entrance indicated the depth mined. They now...
employ circular saws to cut round the blocks and insert steel bags that they inflate by filling with water to release the blocks.

Before crossing the road to Bowers Quarry it was noted that the copula of the adjacent church spire was modelled on the copula of St. Paul's, London's most famous Portland Stone landmark. As we neared the coast Alan pointed out salt pseudomorphs and ripple beds from the Purbeck beds before we set off for our lunch spot beneath the cliff edge. By now the fog had lifted and we had a magnificent view of Chesil Beach with the sun shining out of a clear blue sky.

We were accompanied on the trip by Hannah Sofaer from the Portland Sculpture and Quarry Trust who is involved in promoting Portland Stone through its artistic potential. She took us to the Drill Hall where a sculpture workshop was in process. She introduced us to Geoff, who used to work in the quarries, and his marvellous model of one of the Portland quarries, complete with a mine and wooden cranes for lifting the carefully crafted blocks of stone. Apparently it took him a year to create, including the miniature tools used by the quarry workers. It is a masterpiece.

The afternoon concentrated on the sculptures, led by Hannah. We were shown the famous Anthony Gormley sculpture Still Falling and it was fun stumbling across others carved in the old quarry faces. The Fallen Fossil by Stephen Marsden was a favourite. In Tout Quarry many of the sculptures are free-standing. This is another location where sculpture courses take place. It is heartening to see these disused quarries brought back to life again in this way and the sculptures provide an opportunity for close examination of the stone. The day finished back near the Portland Heights Hotel with the group standing in a Circle on the site of the Portland Sculpture and Quarry Trust’s next project: Circle of Stones.

Very many thanks to Alan and Hannah for a very informative and fitting end to a stimulating GA conference on the Jurassic Coast based at the Portland Heights Hotel.
Opinion Article: Enigmas of the Himalaya
By: Dr Danny Clark-Lowes

An earlier version of this article appeared in Down to Earth magazine

Noel Ewart Odell, a British mountaineer and geologist, was on the 1924 expedition and is famous for having reported seeing Mallory and Irvine on the Second Step ‘going strong’ for the summit, the last to see them alive. Less well known is that he reported the presence of fossils in the Lower Palaeozoic limestones of the upper beds of the mountain and that these lay above high grade metamorphic rocks lower down the mountain, some of which he recognised as being transformed sedimentary rocks rather than metamorphosed igneous rocks. Fossils had been discovered high up in mountainous regions before, among the earliest reports being those of Darwin in the Andes. But Odell’s reports were of particular significance being on the highest mountain in the world, within the greatest orogenic belt of the world and from the highest sedimentary rocks in the world. The presence of unmetamorphosed sedimentary rocks within the axis of this orogenic belt was an important observation, being something of a surprise at the time, and perhaps even now!

In the 1930s another British mountaineer and geologist was to play an important part in helping understand the geology of the Himalayas, this time by way of Greenland. Lawrence Wager was on Ruttledge’s 1933 expedition where he had a reputation as a very competent climber, achieving the highest ascent without oxygen until this record was surpassed in 1978. But it was his work undertaken on contemporaneous expeditions to Greenland that made him famous.

Here he studied the Skaergaard Intrusion, a layered

Figure 1: South face of Everest. The South Tibetan Detachment lies beneath the Yellow Band, a dolomitised limestone.

Figure 2: Folded Tethyan sediments of the Tibetan Himalayan Series; a fault runs through the gully; near Jomsom, Nepal.
igneous body, becoming the first to understand the processes of differential crystallisation that led to the development of these bodies, and a leading authority on igneous intrusions in general, an example of which is present in the leucogranite of Lhotse, an igneous body that extends from Makalu in the east, through the lower beds of Everest and on to Cho Oyu in the west. These leucogranites are the culmination of the partial melting process and can be found throughout the Himalayas within the Higher Himalayan Series.

Both Odell and Wager went on to have distinguished academic careers; Odell taught geology at Cambridge and Harvard universities, whilst Wager was a professor of geology at Oxford University.

From 1936 onwards, following an eight month expedition to the Himalayas, Augusto Gansser-Biaggi, a Swiss geologist and mountaineer, became fascinated by Himalayan geological researches, publishing his seminal work ‘The Geology of the Himalayas’ in 1964. Among his many exploits he circum-ambulated Mount Kailash disguised as a pilgrim. He was Professor of Geology at Zurich for many years. Whilst Odell and Wager worked at a time when mountain belts were understood in terms of Geosynclinal models, Gansser (as he is usually known) interpreted the Himalayan Mountain chain in terms of the newly developed theory of Plate Tectonics in which the Alpine / Himalayan orogenic belt is seen as the continent–continent collision zone of a destructive plate boundary along which the ancient Tethyan Ocean had been subducted. He understood the mountain chain to lie above a northward subducting slab of the Indian plate beneath that of Asia. He recognised southward verging thrusts associated with this subduction, the most important of which were the Main Boundary Thrust and the Main Central Thrust. And he defined the following tectonic belts going northwards:

- Indian craton
- Indo-Gangetic Trough (foreland basin) filled with detritus derived from the Himalayas (the Siwaliks)
- Sub-Himalayas – folded and thrust Tertiary detrital sediments
- Lower Himalayan Series, bounded at the base by the Main Boundary Thrust and comprising low-grade metamorphic rocks
- Higher Himalayan Series, bounded at the base by the Main Central Thrust and comprising high-grade metamorphic rocks with some partial melting
- Tibetan Himalayan Series, bounded at the base by what is now known as the ‘South Tibetan Detachment’ and comprising highly folded and contorted Tethys-derived sedimentary rocks

It is the South Tibetan Detachment that placed the fossiliferous Ordovician Limestones (or Qomolangma sediments) that Odell recognised at Everest above metamorphosed rocks and granites lower down the mountain. These latter belong to the Higher Himalayan Series. The nature of the South Tibetan Detachment has been worked out by Mike Searle, another Oxford mountaineer and geologist who, in his book ‘Colliding Continents’ (2013), explains this detachment as an unusual low-angle normal fault zone which facilitated, together with the Main Central Thrust, the southward expulsion of highly metamorphosed rocks from deep within the mountain chain laterally upwards to the surface.

In the geology of Everest we see many of the phenomena that characterise the whole of the Himalayas. Furthermore, without the mountaineering world’s fascination with Everest we may never have had the geological observations of geologists like Odell, Wager, Gansser and Searle that have brought us to our present understanding of this greatest Mountain Chain. And in Mike Searle we see the continuation of a tradition of scientific research combined with mountaineering endeavour.

My thanks go to Indus Experiences on whose trips I have enjoyed learning about the Great Himalaya.

References

A new Jurassic Sea and Steel Town gallery opened its doors on Friday 30th June at North Lincolnshire Museum in Scunthorpe after a formal ribbon-cutting by Cllr Carl Sherwood with Jean Foster, aged 90+, who worked in the Scunthorpe Steel works during the Second World War. The fabulous new design was the brainchild of Rose Nicholson, the museum’s Collections Manager, with generous Arts Council England funding.

The new exhibits particularly explore life in the Jurassic Period, when North Lincolnshire was a marine environment with, amongst other rocks, the Frodingham Ironstone forming and ammonites, Ichthyosaurs and Plesiosaurs at large.

The new displays have brought out from the museum store many more fossils than previously exhibited, and attractive (and life-like) backdrops provide a good impression of what life actually looked like in the sea over 190 million years ago. Children can investigate the fossils in the Jurassic Sea gallery by delving into the discovery baskets and finding interesting things to explore them with. The gallery also features an interactive floor to entertain the whole family and visually demonstrate aspects of the Jurassic period.

Without the local Jurassic iron ore, Scunthorpe would never have developed its iron and steel businesses. Geology and local industry are now linked together with the new ‘Steel Town’ display, which explains the history of the steel industry in Scunthorpe from 1858 to the present day. The gallery concentrates on different themes such as the role of women in the steel industry, how working conditions have changed and the impact the steel industry has had in transforming Scunthorpe from a sleepy village to a large town. It came as a surprise to learn that most of the steel for famous structures like the Sydney Harbour Bridge and the new Wembley Stadium originated here. British Steel has generously donated many artifacts and images to the museum for this new exhibition.

The gallery will appeal to children and adults alike, and complements the existing displays which cover the local archaeology, natural and social history of North Lincolnshire.
Opinion Article: What can WE do?’ - How can we mobilise the geoscience community behind an outreach initiative?

By: Chris King & John Stevenson

In late 2016, the GA, along with a wide range of other geological groups, associations and societies, attended a meeting organised by Chris King and John Stevenson of the Earth Science Education Forum England and Wales to explore how more could be done to mobilise the geoscience community behind an outreach initiative. GA Members may be interested to read Chris and John’s article below which sets out how they hope the initiative will develop. Some of you, individually or in your local groups, may also wish to consider getting involved. If you have any questions or comments please feel free to contact Chris (or John) direct; Chris: chrisjhking36@gmail.com (John: esefew@gmail.com).

Some 4000 people graduate with geoscience-related degrees every year, so this means there must be 150,000 or more people in the UK with geoscience-related degrees. If we could encourage just some of these people in every region to get behind an educational initiative – we could open the eyes of the public to the world of geoscience all around them.

It can be done. On one day every May, in the Spanish ‘Geolodays’ project, more than 150 geoscientists lead nearly 10,000 members of the public on fieldtrips across Spain (Figure 1).

Meanwhile, on another day, also in May, volunteers ‘man’ the 19 geo-sites across the Canadian city of Ottawa, encouraging the public to visit as many of the sites as possible, to discover the geological wonders there (Figure 2).

With these success stories in mind, the Earth Science Education Forum (ESEF England and Wales) convened a meeting at Burlington House to explore the possibilities. The outcome of those and more recent discussions are that:

- 2017 and early 2018 will be used to build-up the initiative, aiming for …
- … a nine-day day ‘week’ in the summer of 2018 to run outreach initiatives around the country (dates to be decided – but chosen in the summer in the hope of good weather);
- some of the sites to be visited will be Earthcache sites, previously set up for their geoscience educational potential (the advantage is that the sites will remain after the visit week, and some people may be inspired to visit other Earthcaches elsewhere in the country);
- during the week, as many visit initiatives around the country as possible will run, in the hope of growing the approach across the UK over the years ahead.

We are planning to circulate a SurveyMonkey™ questionnaire soon to:
• choose the best nine-day ‘week’ in 2018 to run the initiative for the first time;
• choose the best name for the initiative from those suggested so far.

We think the initiative will be most successful if some of the sites to be visited are Earthcache sites. Earthcaching is based on the Geocaching initiative, where enthusiasts across the world seek Geocache sites using GPS. They know when they have found a site, because a small plastic box is usually hidden there containing trinkets; they take one trinket, replace it with another that they have brought with them, and then log the site as successfully found. Earthcache sites are different in that, although they are also found using GPS coordinates, when visitors they reach the site, they answer a series of educational questions and email the answers to the person who set the Earthcache. They log the site as successfully found, when they receive an email reply saying that they have answered the questions correctly (Box 1).

The number of Earthcache sites across the UK is steadily growing, but hopefully will be given a further boost by the ‘mobilising’ initiative.

So, what can your group do now to carry the initiative forward? During a future group meeting, please consider:
• the geoscience sites local to your group which could be linked together into a fieldtrip to introduce local people to the geoscience of the area
• choosing a day during the designated ‘week’ to run the fieldtrip
• deciding who will lead the trip and support the leader
• making some of the sites into Earthcache sites, if possible
• how to advertise the initiative and coordinate local interest
• sending a note of your progress to Chris King at: chrisjhking36@gmail.com

If we can ‘build a head of steam’ between us, we can lead the UK public to a much greater appreciation of geoscience and our dynamic planet.

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**Box 1. An example of an Earthcache**

At the ‘From sorting the sizes to revealing the story’ wall near the Wells and Mendip Museum in Somerset, visitors are given background information and asked:

Of the sizes given, what is the size of the largest sand/grain or fragment of rock or fossil you can find in the:

1. rusty red Triassic rock?
2. yellow ochre-coloured Jurassic limestone?
3. grey Carboniferous limestone?
4. reddish-brown Devonian rock (circled in the image)?
5. How is it possible that, while the climate in Britain today is temperate, the evidence of these local rocks shows that:
   • around 165 million years ago, the Jurassic climate here was sub-tropical
   • about 240 million years ago, in Triassic times, the area had a desert climate
   • around 340 million years ago, in the Carboniferous, the climate was equatorial
   • about 420 million years ago, during Devonian times, this area had a desert climate

Questions 1-4 have been posed to show that the Earthcacher has actually visited the site and to encourage close observation of the rocks. Question 5 is given for them to use the evidence of the rocks in the wall for the Earth’s past plate tectonic movement. The responses so far, sometimes from people who have clearly never heard of plate tectonics, have been very encouraging in the observations and thinking they provoked.
News item: Raising Horizons exhibition: two centuries of women in geology, archaeology and palaeontology

By: Rebecca Wragg Sykes

Since the earliest days of geological enquiry, countless astonishing discoveries have been made by thousands of individuals, yet female pioneers remain generally little known. Digging around in the history of the discipline, we discover that alongside all the men with dusty trousers, women have been there right from the start, as amateur collectors and enthusiasts, through to the beginnings of the professional discipline and beyond. The Raising Horizons project, supported through the award of a Curry Fund grant from the Geologists’ Association, explores this history, and its impact today.

In February 2017, the Library of the Geological Society at Burlington House was packed with a throng of people, there to see the launch of the Raising Horizons exhibition. A collaboration between photographer Leonora Saunders and TrowelBlazers— an organisation highlighting women’s roles in the earth sciences—, fourteen striking portraits were being viewed in public for the first time (Figure 1).

The project began with Leonora’s idea to use contemporary women from geology, archaeology and palaeontology, posed as their historic counterparts, to reframe how we think about the make-up of the ‘trowel-blazing’ disciplines past and present. She approached TrowelBlazers in 2015 for help, and through their knowledge and connections, fourteen pairs of matched women were selected, covering a wide range of periods and disciplines. Then came the considerable task of funding: generous support and sponsorship came from many quarters, including the GA’s Curry Fund, and in autumn 2016 a crowd-funding campaign raised over £11,000.

Sneak peeks of the costumes and photoshoots were shared with project supporters, but it was not until February 2017 that the portraits were finally revealed at the exhibition launch. Each image tells a story, pairing pioneers of the past with inspiring women today—and each one is absolutely beautiful. Many people at the launch noted the resemblance of the portraits, hung along the mezzanine railings in the Library, to the classic oil paintings of celebrated geologists of the past (but with fewer beards). One individual also noted that the event had filled the room with more women than she had seen in thirty years at the Society.

Leonora Saunders' work is about challenging stereotypes and promoting equality and diversity, so working with TrowelBlazers on Raising Horizons was an opportunity to change preconceptions about who geologists, palaeontologists and archaeologists are.

TrowelBlazers is run by a collective of four researchers (the author, plus palaeobiologist Victoria Herridge, zooarchaeologist Suzanne Pilaar Birch, and dental anthropologist Brenna Hassett) whose mission is to re-set imaginations, by telling the stories of inspirational women, and showing there were, and are, many more of them than most people think (check out trowelblazers.com/articles). But they also aim to reveal the huge webs connecting them, that can be traced between early pioneers to the present; such networks are hugely important in supporting those working today.

The Geologists Association was a leading pioneer in equality in the Earth Sciences. Established in 1858, right from the start it welcomed women, unlike the older professionals-only Geological Society, which took another 60 years to equalize membership. The open nature of the GA is clear not only from its present day membership and community, but all the way back in the fascinating Carreck Archive, currently being digitised in collaboration with the British Geological Survey.
This features photos from early fieldtrips including families, and showing women right up at the quarry face, enjoying the geology just as much as their male companions.

One very special object from the Carreck Archive links to the Raising Horizons exhibition: an album filled with signatures of women members of the GA (Figure 5). Amongst many names one can see "D. M. A. Bate" (Dorothea Bate), "M. C. Stopes" (Marie Camichael Stopes), and "Catherine Raisin". These women – two palaeontologists and a geologist - who are some of those represented in Raising Horizons, posed by their modern counterparts Professor Anjali Goswami of UCL, Professor Dame Jane Francis of the British Antarctic Survey, and Professor Cynthia Burek of University of Chester.

Marie Stopes is world famous today for her work pioneering women’s rights to reproductive health care and sexual equality. But she had a prior, extremely distinguished career in palaeobotany after earning a first class joint degree in geology and botany at UCL in only two years, becoming the youngest person in Britain to gain a DSc in 1903, then completed a second doctorate in palaeobotany (in one year) at the University of Munich. Stopes was a world authority in the formation of coal, and the Royal Society funded her solo fieldtrip to Japan, looking to find evidence for the earliest flowers. Her palaeontological publications continued for fifteen years after she resigned her lectureship at Manchester to set up the first ever contraceptive clinic. Our portrait (not figured) shows Jane Francis posed as Stopes, preparing for her DSc degree ceremony.

As director of the British Antarctic Survey, Jane Francis’ career is also based around palaeobotany, and she has even studied some of the same fossils that Stopes worked on, from Antarctic deposits (Stopes apparently requested to join Robert Scott’s final expedition, and although refused, he did collect the samples she was interested in). Francis has had the opportunity to visit the southern continent multiple times, and won many awards, including the US Navy Antarctic Medal, the Coke Medal from the Geological Society of London, and The Polar Medal (only the fourth woman out of over 4000 recipients). Last year she was made a Dame, recognising her contribution to British polar science.

Catherine Raisin is a true geological ‘trail-blazer’ featured in the exhibition. She was the first woman to gain a geology degree from UCL in 1884 (the highest scoring student that year). Fifteen years later she had won the Lyell Medal, been appointed Vice Chancellor at Bedford College (one of the first higher education bodies to admit women), and became only the second woman ever to receive a Doctor of Science degree. She was later Head of the Bedford College Geology, Botany and Geography departments during different periods, and In 1919, she was one of the first women Fellows of the Geological Society.

Raisin is shown in her portrait (Figure 2) examining a geological map, referring to her work on rock structure and metamorphism.
She is posed by Professor Cynthia Burek, who specializes in geology and ecology, forensic science, sustainability, and is the world’s first Chair in Geoconservation at University of Chester and the Open University in Wales. She also has a deep commitment to promoting equality in education, something shared with Catherine Raisin, her historic counterpart, and is Deputy Director of the Centre for Science Communication and Director of the British Federation of University Women and British Federation of Women Graduates. She gave the 2015 Sybil Campbell Annual Lecture for the University Women’s Club, and has published on the role of women in geological history, including writing about Catherine Raisin.

Another woman in the Raising Horizons portraits who is not in the Carreck album, but who lived at the time the GA was founded, was Charlotte Murchison. A geologist in the early 19th century ‘natural scientist’ model, she worked closely with her husband, Roderick Impey Murchison, a key player in establishing the ancient age of the Earth. By some accounts it was only through her persistent encouragement that he pursued his geological career, and apparently Charles Lyell’s geological lectures were opened up to women in 1831 because Charlotte wished to attend. She collected, prepared and illustrated fossils, and was well-known within the natural history circles of the day, hosting evening soirees at her London mansion. She also went on many field trips, including to Lyme Regis, where she first met – and was then trained by – Mary Anning. Charlotte’s modern counterpart is Dr Natasha Stephen of Plymouth University (Figure 4), who today is expanding the reach of geology not in time, but in space, though her research into volcanic regions in our own solar system using meteorites that fall to Earth. Natasha poses as Charlotte in the exhibition, off to bed after hosting one of her famous evenings filled with early scientists she would have discussed geology with. The portrait also plays with the theme of a contemporary caricature of Charlotte by Henry de la Beche, where she is shown holding a lantern, titled “THE LIGHT OF SCIENCE dispelling the DARKNESS that covered the WORLD”

You can find out more about the Raising Horizons women at raisinghorizons.co.uk, as well as at the upcoming UK tour dates, including 5th September Women In Science evening reception at the British Science Festival, Brighton, and Lapworth Museum of Geology, University of Birmingham 24th September – 10th December.

Explore the archives of over 150 other trowelblazing women at trowelblazers.com, and you can support our work through buying our geological-themed merchandise at redbubble.com/people/trowelblazers

Figure 5: Album of signatures of early members of the GA, including “Catherine A. Raisin”, “Marie C. Stopes”, and “D.M.A Bate” (Dorothea Bate), all women in the exhibition. Image credit: Digitised from the Geologists’ Association Carreck Archive, reproduced with permission of the British Geological Survey.
The Curry Fund Committee considered seven new applications for funding support earlier this year in June – I am happy to report that four of the projects were successful.

The GeoMon UNESCO Global Geopark (Anglesey) will receive support, as part of a larger research project, to produce a geological map of part of Anglesey which will eventually be available on-line.

A detailed survey of Local Geological Sites in Leicestershire was supported together with work to conserve and document associated archival material.

Two educational initiatives were successful: an initiative to deliver geological workshops to primary schools in and around Newcastle (here acquisition of hand specimens was funded), and ‘Colour Chemistry’, a KS2 project being run by the Bristol Science Centre exploring the world of chemistry, production of a number of thin sections of different rock-types was supported by the Curry Fund.

Grant support for an earlier application where a decision was pending was also agreed: the production of interpretation panels and leaflets for the ‘Coigach Geotrail’ in the North West Highlands UNESCO Global Geopark.

Reflecting 30 years since the establishment of the Curry Fund (1986) the Committee has agreed to establish a ‘recognition’ certificate for the best Curry Fund projects delivered in any given year. We’re currently working on this with a planned launch in the coming year.

curryfund@geologistsassociation.org.uk

Summer with Rockwatch has been very busy with some splendid field trips and more to come. Sadly, my recent illness means I’ve been unable to enjoy them myself, but I wish to record my grateful thanks to the many colleagues who have been unstinting in their help and support to ensure that everything went forward as planned. You are too numerous to name, but Rockwatch and I know who you are and we will remember your generosity.

We’ve had two great visits to Selsey and Bracklesham with David and Anne Bone, exploring the largest coastal realignment scheme in Britain at Selsey and collecting some superb Eocene fossils at Bracklesham. Exploring Triassic age quarries in N.E. Lincolnshire with Paul Hildreth and Mick Oates proved a great success with our Rockwatch members. They were encouraged to become geo-detectors for the day and work out the depositional environments of the sites they visited using the field evidence. They saw some superb ripple marks in fallen rock slabs, rain prints and salt pseudomorphs, all of which helped them with working out mysteries of the depositional environment.

Our annual weekend field trip to South Wales was very popular and the weather was so hot and sunny that the trip ended early on the second day: it was just too hot! The first day was spent exploring the Bendricks coastline and searching for dinosaur footprints on these Triassic rocks with considerable success! The second day the group explored the beach and superb cliffs at Lavernock Point where the rocks are of Upper Triassic to Lower Jurassic age. The beach is littered with many fossils including Liassic bivalves and ammonites along with a range of trace fossils, so lots to find and collect. Thanks to Steve Howe for another superb Rockwatch field trip. The annual residential week on the Jurassic World Heritage Coast of East Devon & Dorset was once again voted a great success by the participants. The first evening activity was to map the grounds of Leeson House, where the group stayed. Clearly, this was going to be a working week! The theme for the course was Depositional Environments, so the first full day at Bincombe cutting near Weymouth, examining the rocks of the Purbeck Group, they tried to work out how the environment changed during the deposition of these sediments. They found ‘beef’ and freshwater bivalves here and Philip also collected a sample of shales known to very occasionally contain mammal fossils, so he will let us know if he’s lucky! During lunch overlooking Chesil beach the group talked about the beach’s formation
North London
Mineral, Gem & Fossil Show

Saturday
25th November 2017
10.00am – 4.00pm

+ Jewellery, Raffle & Lucky Dip

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Near ‘Tally Ho’ Pub & Artsdepot, Ballards Lane, North Finchley

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ADULTS £2  Accompanied children under 12 - Free
Large Hall with stalls + refreshment area

Amateur Geological Society
For contact details and all about us: amgeosoc.wordpress.com
and then moved on to explore some blocks of Purbeck limestone containing dinosaur footprints stored in a nearby old engine house. There were iguanodon-type and theropod footprints, but no sauropods. At Portland Bill they saw two raised beaches in close proximity, but of significantly different ages. There were lots of small gastropods in the younger deposits and a range of beautifully sorted flint pebbles in the older one. They visited Keates quarry on their evening walk and identified dinosaur footprints on the rocks of the quarry floor after removing the weeds(!) and then walked on to the ‘Square and Compass’ to look at the owner’s splendid fossil collection and stopped in for a drink!

The following day was a great success. First off a visit to Kimmeridge Bay where ammonites, bivalves, a few small fish scales and vertebra and a bony plate from the skull of Lepidotes were collected. The latter, somewhat more specialist fossils, collected by Philip who is about to head off to university to read geology! They then had a look at the structural geology of the area, trying to assess why it was so good for oil production. Kimmeridge, part of the Wytch Farm oilfield, is still producing some 65 barrels of oil a day from its single ‘nodding donkey’. The group then split into two smaller groups to visit Landers Quarry and Swanworth Quarry. Landers quarry is small, cut into Purbeck limestone with many beds of varying colours - blue, grey and green; all weather to a red-brown. There were also lots of desiccation cracks in the sediments, a clue to the depositional environment. They also saw the owner’s collection of fossils from the quarry, including coprolites, fishes and turtles. Stone from Landers Quarry is used for building, internal and external paving, cladding, hearths, mantels and worktops amongst other things.

Swanworth quarry was very different, as it was cut into jointed Portland Limestone, so they considered the depositional environment and how it might have differed from that at Landers Quarry. The limestone blocks at Swanworth were extracted by drilling and blasting and used primarily as aggregate. Apart from a few bivalves and some fragments of Titanites, few fossils were found. The group was shown the various stages of the quarry’s rock processing which they found very interesting.

A special treat after supper was a return to Kimmeridge to visit ‘The Etches Collection – Museum of Jurassic Marine Life’, with Steve Etches as the group’s guide; and what a special event this was. Steve explained how his collection had been useful at developing understanding of the Kimmeridge Clay and shared his knowledge and enthusiasm with the youngsters and their parents about his wonderful collection. They were shown several holotypes, including a pyritised goose barnacle. The visit occurred just a few days after Steve was awarded an Honorary Doctor of Science degree from the University of Southampton, a most richly deserved acknowledgement of Steve’s commitment and dedication to palaeontology.

After the museum tour, Richard Edmonds gave a superb talk on the outstanding geology of the Dorset coast and how that had led to its World Heritage status. He showed some excellent photographs of fossil finds from the Dorset coast and also explained to the group how the present day can be used as a key to the past when modelling ancient environments.

The final full day was very wet, but good young geologists that they were, they braved it for much for the day. They visited Osmington Mills, looking at various trace fossils in the Corallian limestones, found occasional body fossils of Myophorella, crossections of Pseudomelania heddingtonensis, and a few examples of Nucleolites scutatus. Eventually the rain won out and they returned to Leeson house at midday for classroom activities. Using photographs of a variety of different trace fossils, they used these to determine what the environment at Osmington was like over time. Fossils included Arenicolites, Planolites, Skolithos, Diplocraterion, Thalassinoides and Ophiomorpha. Simon’s talk then showed the group the palaeography of the world in the Kimmeridgian, which helped them to understand environmental conditions on a global scale. These models used palaeomagnetic information as well as other clues to determine the orientation and location of the continents - computer modelling was then used to see how the climate would change seasonally across the globe. One thing of note was how few landmasses were relatively close to the Kimmeridge area; Steve’s sauropod bones must’ve drifted a very long way! (comment from Philip). Once again, the day was voted an overwhelming success.

The final morning was spent at the nearby Outdoor Centre working on a range of challenging team building exercises including low ropes, swinging across chasms and learning to trust your team mates in ‘dangerous’ situations! After a picnic lunch, the group dispersed and agreed that it had been a very good week.

In early summer Rockwatch joined the British Geological Survey at its Open Day in Keyworth and ran some very popular activities at this public event, including fossil plaster casting which was managed by Geraldine and some of our Rockwatch parents. They had an extremely busy day, used many kilograms of plaster, saw hundreds of fossil replicas made and were astonished at the huge number of visitors at the event and how many of them made their own fossils to treasure afterwards! Thanks to all of you for ensuring that Rockwatch had a presence at this very popular event.

We have many more trips planned for the late summer and early autumn, including the Dinosaurs of China exhibition at Wollaton Hall Museum Nottingham. This is a ‘once in a lifetime’ chance to see this amazing collection of fossils from China, but especially exciting for Rockwatch is that the geological curator at the museum and one of the two organisers of the exhibition is Dr Adam Stuart Smith a former Rockwatch member, winner a number of times of our annual competition and a current mentor and supporter of Rockwatch. The exhibition continues until 29th October; do try to visit, it’s amazing.
Exhibitors from the World of Geology
Fossil and mineral displays, stonecraft, books, maps, geological equipment, jewellery, Building Stones walk around UCL, Tours of the UCL Earth Science Laboratories and more...

Discovery Room
Fossil identification, fossil plaster casting, geo-puzzles, make your own Eurypterid and much more...

Geological Talks
Lidunka Vocadlo: Core! What a scorcher! Hot and squashed in the centre of the Earth.
Chris Jackson: Hot Rocks Under Our Feet; What Can We Learn About Volcanism From X-Raying The Earth?
Iain Stewart: Hot Rocks: the Fall and Rise of UK Geothermal Energy
Susannah Maidment: How to weigh a dinosaur

Festival Trips - Sunday 5 November
Matthew Loader leads: Building Stones Walk: Central London
Liam Gallagher leads: Riddlesdown Quarry, Croydon: London’s best chalk exposure
Haydon Bailey leads: The Route of HS2 in the Misbourne Valley

Amateur Photographic Competition
Any geological topic: 1st Prize £100, 2nd Prize £50, 3rd Prize £25

Further Festival details:
www.geologistsassociation.org.uk | www.rockwatch.org.uk
Tel: 020 7434 9298
Email: festival@geologistsassociation.org.uk