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East Midlands Geological Society

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Cover photograph: East side of the Derwent Gorge just below Matlock, seen from the slopes of Masson Hill. The white limestone cliff bisects the High Tor reef (see landmark on page 235), while Riber Castle stands on the Ashover Grit, and Chatsworth Grit forms the skyline [photo: Tony Waltham].

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PROFILE

Ian Thomas

Ian, our new president, was born and brought up in Mansfield Woodhouse, Nottinghamshire, where two generations earlier his grandfather had worked the Parliament Quarry, on Vale Road (in the 1840's the quarry was one of a number which supplied stone to rebuild the Houses of Parliament after a major fire). In 1957, his family moved to Aberystwyth (where great grandfather had sailed ships laden with lead ore). So geology was in the family blood. Ian's interest in geology stemmed from a fascination for industrial history of the lead mines in Wales that he explored as a school boy.

He read geology, biology, physics and geography at University of Swansea, graduating in geology in 1968 (having also taken a course in cartography).

For four years he worked at the Institute of Geological Sciences (later to become BGS) in Exhibition Road, London – advising British and foreign governments and industry, on a portfolio of refractory, ceramic, carbonate and strontium minerals worldwide. Had BGS decided to move out to Keyworth at that stage, he would probably have still been working for them. Instead, in 1972 he joined Derbyshire County Council's Strategic Planning Division to work on minerals policies for Britain's largest mineral producing county.

The following year, he set up the first Regional Aggregates Working Party (RAWP) (i.e. for the East Midlands) and continues as its Technical Secretary. In 1979 he became the Convenor of the RAWP Secretaries for England and Wales, which again he continues under contract to the Office of the Deputy Prime Minister. He also became involved in adult education, teaching applied geology in various Derbyshire centres.

In the 1980s, he promoted the idea of the National Stone Centre (NSC) and gradually gained seconded time from the County Council to this end, becoming the Centre's full time Director in late 1988. The Centre opened to the public in 1990, and now attracts hundreds of school groups and thousands of family visitors. In 1989, he was also appointed to BGS's first Programme Board.

Two thirds of the work at the Stone Centre is unrelated to visitors. It includes the design of interpretative panels for leading quarry companies in Britain, collecting and publishing data on minerals planning, and advisory services relating to Earth Science education for English Nature and the Countryside Council for Wales.

Much of Ian's work is now involved with developing national policies for both the English and Welsh governments for balancing the need to provide for aggregates with the need to protect the environment. In the last few years, the NSC has been more involved in Wales, including assessing the scope for a Welsh Stone Centre.

At the Stone Centre, Ian is able to combine his passions for the history of quarrying, geology and design. Ten years ago, nineteen members of the Thomas family staged an art and design exhibition ranging from Jaguar car designs to apples made from applewood, and Ian still undertakes freelance design work.

Apart from involvement in various local and national committees, covering the arts, tourism, regeneration of Wirksworth, mining history and building stone, Ian has just completed a two-year term as chairman of ESTA (Earth Science Teachers' Association). In 2002 he chaired the Standing Joint Committee on Natural Stones, a group linking key professional and government organisations concerned with building stones.

During this period, he became concerned that ESTA was focused on catering for those teaching the few thousand school students studying geology per se. Not adequately addressed were the needs of the 8-10 million pupils being taught a more limited amount of Earth Science (often poorly), through mainstream National Curriculum science. As a result, a small group approached the main professional institutions concerned with chemistry, physics, biology and science teaching, successfully engaging them in the Joint Earth Science Education Initiative which Ian now Chairs – readers should visit www.jesei.org to see some of the results.

GEOBROWSER

Warm times

The recent succession of years with anomalous climatic conditions, either excessively warm and dry, or stormy, or both, has stimulated interest not only in predicting future trends, but also in reconstructing past climatic regimes. Two major global warming events are particularly well documented, but can we draw any lessons from these examples, that may help us to anticipate or even regulate future climate trends?

Cretaceous warming: Probably one of the most important discoveries of the past 20 years has been the recognition that the Polar landmasses of Gondwana were warm, forested regions throughout the Mesozoic and into early Tertiary times. A recent review (*Journal of the Geol. Soc. 2001, p.709*) notes that the global thermal maximum occurring in the Cretaceous Period, between 112-88 Ma (late Albian-Turonian), was characterised by broad-leafed and conifer forests of warm-temperate aspect in Kamchatka and Russia (up to at least 82°N) and Antarctica (up to at least 75°S). Fossil tree-ring structures indicate that the forests (with their specialised dinosaur fauna) were adapted to long, dark winters with average temperatures between 0°C and -4°C, and long, light summers with temperatures of 20-24°C.

These proposals are difficult to reconcile with suggestions that Cretaceous global sea-level fluctuations were caused by temporary continental ice sheets in Antarctica (*Geol Soc. America Bulletin, 2000, p.308*). Strontium and oxygen isotope data supported the glacio-eustatic models, but better information has recently been made available from the more continuous drill cores recovered from the Atlantic by the Ocean Drilling Project. Oxygen isotopic analysis of fossil foram carapaces in the cores indicates that bottom-waters were very warm in the Cretaceous oceans, ranging from 9ºC to 20ºC (*Geology, 2002, p.123*). Such conditions, coupled with warm high-latitude surface water temperatures, rules out the possibility that ice sheets could have existed then.

The general global warmth of the Cretaceous has usually been attributed to elevated levels of atmospheric CO_2 due to the vigorous volcanic and tectonic regime of ocean creation that then prevailed. Expansion of the oceanic ridge systems would, incidentally, also account for the Cretaceous sea level fluctuations. It appears, however, that CO2 outgassing reached its peak during the Aptian-early Albian (120-110 Ma) – before the Albian-Turonian thermal maximum. The latter must therefore have been caused by a mechanism of regional climate change additional to the flux of CO2 to the atmosphere. This mechanism, it is now suggested, was the particular phase of oceanic spreading that occurred during Albian times (*Geology, 2003, p.115*). It changed the configuration of the landmasses, opening up a deep-sea gateway between the (equatorial) north and south Atlantic basins, each of which was formerly characterised by very different water temperatures and salinity. The ensuing vigorous circulation and mixing of waters between the two former basins would have been sufficient to bring about rapid and substantial changes in temperature and salinity throughout the newly-enlarged proto-Atlantic ocean.

Tertiary warming: Global warming that occurred in Palaeocene times, about 55 Ma ago, was of a similar intensity to that in the Cretaceous, but its causes were radically different. It was characterised by a massive and rapid (within a few thousand years) addition of isotopically light carbon to the oceans and atmosphere. In this global 'greenhouse', sea-surfaces had warmed by 4-8°C, to around 16°C off Antarctica, and the deep oceans by 5°C. The thermal maximum then continued for a further 210,000 years (*Geology, 2000, p.927*), before recovery to more normal temperatures. Three possible explanations have been proposed to account for this change, and its rapidity: enhanced CO_2 outgassing during emplacement of the North Atlantic volcanic province (of which the Tertiary volcanics of north-western Scotland are part); dissociation of massive quantities of methane hydrates along continental slopes; and a carbonaceous bolide impact. The stable isotope records of Southern Ocean deep-sea cores had pointed to either seafloor methane outgassing or the bolide impactor explanations as being the most likely, but one line of evidence was missing.

Vital to discrimination between these two models is the answer to the question of which came first - global warming or carbon inputs to the sea or atmosphere. This problem has now been resolved, thanks again to the Ocean Drilling Program. The latest isotopic results (*Geology 2002, p.1067*) confirm that the outgassing event was geologically instantaneous and that, most importantly, it was preceded by a brief period of gradual surface-water warming. Possibly this warming was a consequence of the Tertiary volcanism mentioned earlier; it is unlikely to have been caused by a bolide impact. Whatever its causes, however, this initial surface warming provided the trigger for the whole event since it penetrated downwards, bringing about the rapid thermal dissociation of methane hydrates locked in oceanic sediments. The dissociated methane was then liberated into the atmosphere-surface water zone and the global 'greenhouse' proceeded apace.

If a lesson were to be learnt from these Cretaceous and Tertiary thermal events it is probably to be drawn from the latter, since in Tertiary times the oceanic areas closely resembled those of today. The Tertiary experience demonstrates the sensitive nature of the linkage between atmosphere and ocean, and it shows that the balance between these two systems can suddenly change without any particularly catastrophic trigger being applied. It seems that modern anthropogenic carbon emissions have caused a gradual atmospheric warming trend that is strikingly similar to the one that preceded the Tertiary thermal event (*Geology 2002, p.1067*). This has caused the modern atmospheric and surface-ocean carbon reservoirs to be altered. There is no cause for alarm just yet, but if the warming trend were allowed to continue downwards, to the deep ocean, liberating methane from the hydrate layers, there would be little to prevent a rapid, Tertiary-style thermal event from being re-enacted.

Proof of Life

In a previous 'Geobrowser' (*Mercian, 2001*), the possibility of life originating as simple cells hosted within Archaean mid-ocean ridge hydrothermal systems was reviewed. But is the mere presence of organic compounds indicative of life, and if not, what then constitutes proof of life? In this debate, philosophy and pedantry both enter the ring, as an article in the *New Scientist* (*22 Feb. 2003, p.28*) explains. Up till a couple of years ago, the received wisdom was that the existence of 'Life' had been demonstrated in rocks as old as the early Archaean. The burden of proof relied either on chemistry (carbon molecule structures and isotopic signatures in rocks) or on findings of cyanobacteria-like microfossils, the latter from the 3.5 billion years-old Apex Chert of Western Australia. Now, however, doubt has been cast on the organic nature of the Apex Chert structures, which Martin Brasier has concluded could equally well be of abiogenic origin. Even the famous Archaean stromatolites can be generated abiogenically, he maintains; for example by precipitation around hydrothermal springs or vents. The chemists have replied with the suggestion that Raman spectroscopy could distinguish biogenic carbon molecules in Archaean rocks, but it is now thought that this technique alone cannot provide evidence that the material was once alive. Brasier does suspect that life was under way 3.5 billion years ago, but concludes that the earliest *unequivocal* evidence of life, in the form of definite microfossils, comes from the Gunflint Chert of Ontario, Canada. At 1.9 billion years old, however, these microfossils are more than a billion years younger than the problematic structures found in the Apex Chert.

So what chance of detecting life on Mars?

Answers to this question will very soon be sought, when the European Space Agency's Beagle 2 probe lands at the end of this year, and again in 2004 when NASA's Mars Exploration Rover arrives. It was hoped that the sensors with which these probes are equipped will find proof of the former existence of life, perhaps in the form of organic residues or isotopic fractionation that will discriminate between organic and inorganic phases; possibly even cell-like shapes will be found. We have seen, however, that the case for early life on Earth, if based solely on the interpretation of such evidence, may be flawed; at the very least it has not found universal acceptance within the scientific community. In view of this, the *New Scientist* (*22 Feb. 2003*) suggests, there is a strong chance that only controversy will emerge from the results of the Martian investigations – unless we can resolve this debate here on Earth, and come up with criteria for the unequivocal confirmation of life that all can agree on.

REVIEW

Geology of the Loughborough district, by J N Carney, K Ambrose and A Brandon, 2002, Sheet Explanation of Loughborough, England & Wales Sheet 141, Solid & Drift Geology 1:50,000, British Geological Survey. 34 pages A5, ISBN 0 85272 411 X, £9. (Map is £11 alone, or £18 with its Sheet Explanation). Also - Geology of the country between Loughborough, Burton and Derby, by same authors, 2001, Sheet Description, BGS; 92 pages A4, ISBN 0 85272 388 1, £25.

If this is the new format for our Geological Survey publications then it is a great and very welcome leap forward. The explanation booklet is an excellent, concise, authoritative, well-illustrated and very readable account of the area north and west of Loughborough (as covered by map 141). It contains everything that the local resident or amateur geologist is going to need, and is a valuable summary for any professional land-user or researcher.

Almost half the booklet describes the solid geology, while the other half is split into equal thirds on the Quaternary, applied geology aspects and references. A series of whole-page tables that summarise the coal seams, Triassic lithostratigraphy, Quaternary events and deposits, mineral resources and geotechnical data are especially useful and make the data so accessible. Also welcome is the map of the buried palaeochannels that show early stages in the evolution of the Trent valley. The Quaternary correlation chart meets the inevitable problem of the Wolstonian's existence by downgrading stages 8 and 6 to periglacial. But the chart then defines the Upper Devensian as glacial, when it was only periglacial within the area covered by this publication (and glaciation did occur in outside areas during at least some of the Wolstonian stages marked here as periglacial). A reviewer usually feels obliged to pick on some detail (in order to prove that he has read the item completely and critically), and the Loughborough Explanation must be good if the Wolstonian provides its biggest bug.

The accompanying new addition of the map contains a staggering wealth of detail that makes it undeniable value. Slightly irking that a big slice of the Charnian appears as almost exactly the same colour as the Upper Triassic - one wonders if this is going to be a recurring problem as "seamless" mapping is constrained to a universal set of stratigraphic colours for the entire country.

If more detail is required, the Sheet Description is a much deeper database, covering the subjects in about the same proportions as does the Explanation. It approaches the detail of the old “sheet memoirs” with the benefit of a more readable writing style and less slavish devotion to stratigraphy. It is inexpensively produced by desk-top printing, so there are many more colour photos (of slightly reduced quality).

As Loughborough is local to many EMGS members, the package of the “Explanation plus Map” is going to be especially attractive, and will be welcomed too by many more members who live “off the sheet”. It now appears to be BGS policy to keep the prices of the 50,000 maps and their Explanations low (and accessible) for the wider market, while charging high for the 10,000 maps and the detailed reports that are valuable to the professionals - and this makes sense. We eagerly await an Explanation of the Nottingham Sheet.

Tony Waltham

THE RECORD

The Secretary reported that since the last AGM, 21 new members had joined and membership now stood at nearly 377. Last year, the Society heard of the death of two long-standing members, W W Campbell and founder member W A Sarjeant.

The Society has had another successful year, and this review is used to record and thank the various individuals that have made that possible.

Indoor meetings.

The Society is very grateful to all the speakers, in a programme organised by Beris Cox.

In March 2002, John Martin gave the Foundation Lecture on bringing dinosaurs to life, at a meeting that also held the AGM and the Foundation Buffet.

In April, Prof. Ian Smalley described Wagga Wagga as a model for Nottingham in the Permo-Trias, as part of the successful weekend visit by the Geologists’ Association to Nottingham

The new season opened in October, with Prof. Dixon Cunningham talking about his research on tectonic developments on the Southern Andes.

In October there was a successful and well-attended joint meeting with the Yorkshire Geological Society entitled Crinoids!, with lectures by Prof. Stephen Donovan, Dr Mike Simms and Dr Claire Milsom.

In November, Prof. David Keen revised some of the traditional views on Midlands glaciations.

In December, Dr Tony Waltham described geological treats in Central Asia on an overland journey from Aralsk to Huanglong, before Cheese and Wine arranged by Janet Slatter.

In January, Prof. David Siveter presented a very animated and informative lecture on soft-bodied sensations from the Silurian.

In February, Dr Paul Wignal enlarged on his BBC Horizon appearance to talk on new developments of the end-Permian extinction.

Field meetings

The Society is very grateful to all the leaders, and again the programme was organised by Ian Sutton.

In May 2002 Keith Ambrose repeated his trip to the Millstone Grit of South Derbyshire Melbourne.

In June, Colin Bagshaw took members to the mineralised limestone of Bonsal Moor.

In July, Peter Gutteridge led a trip to Monyash.

In September, Vice-President Richard Hamblin led a weekend to the East Devon and Dorset coast.

In October, Neil Aitkenhead led on Ilkley Moor.

Events

The Society was represented at the Geologists’ Association Earth Alert 2 in Scarborough, at the Creswell Crags Archaeology and Geology road show, and at the ESTA conference at BGS.

Publications

The EMGS Field Guide will be published in 2003 as Geology of the East Midlands, GA Guide 63, edited by Peter Gutteridge.

The booklet on Nottingham City Building Stones is in preparation, as well as a comparable guide on Leicester.

The Society’s book on the Sandstone Caves of Nottingham, by Tony Waltham, has now sold nearly 7000 copies, and has been reprinted again.

The Society’s website at www.emgs.org.uk now has a local geology section using material from Mercian Geologist and contributions from members, maintained by Rob Townsend.

This report ends on a personal note. After ten years on Council, with nine as Secretary, I am standing down. I would like to thank members for their consideration and courtesy in their dealings with me. It has been a pleasure to work with three presidents and I would like to particularly thank my predecessor secretary, Sue Miles, for her help notably on matters procedural and constitutional.

Alan Filmer, Secretary 2002

FROM THE ARCHIVES

An archive photograph of East Midlands geology from the British Geological Survey collection.

Langwith Bone Cave

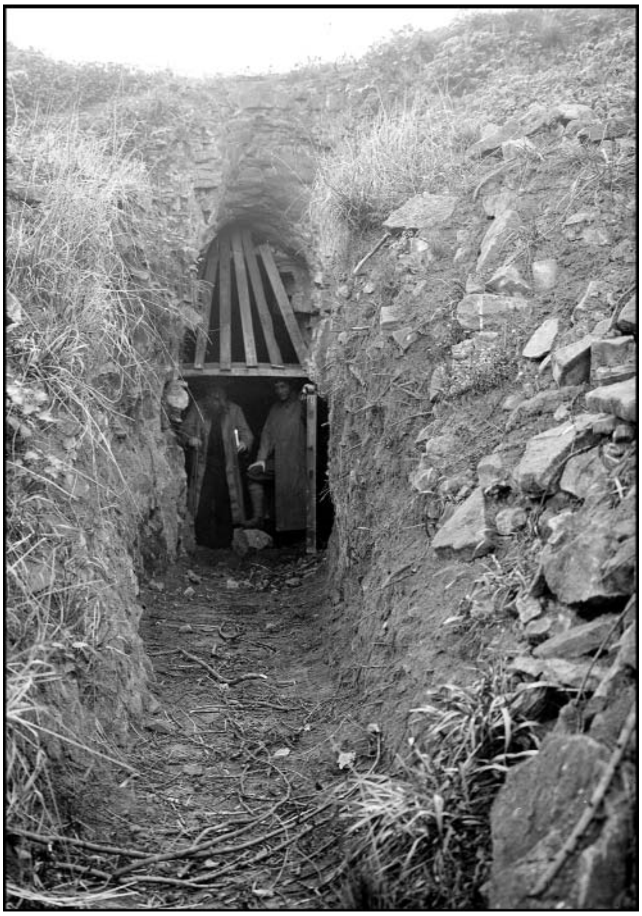
Like the more extensive and well-known cave systems at Creswell Crags, the Langwith Bone Cave is a natural cavern formed by groundwater solution within the Lower Magnesian Limestone. Formerly concealed by talus, its entrance was discovered by the local Rector of Upper Langwith, the Reverend Edwin Mullins. Between 1903 and 1912, Mullins led the excavation of the cave and carefully collected and identified the vertebrate remains and human artefacts he found inside. He published a list of his collection in 1913. Dorothy Garrod completed a later excavation and collection in 1927.

The photograph dates from 26 April 1911, during Mullins' excavation work, and was taken by the prolific Geological Survey photographer, Jack Rhodes. It was the last of a series of local geological photos he took on that day – the time was 6.40 pm and an exposure of 10 seconds was needed to counter the evening gloom, despite the feeble assistance of a candle held by one of the two shadowy figures in the cave entrance.

The cave lies near the small village of Upper Langwith, about 4 km east of Bolsover, on the northern valley side of the River Poulter, and its site is shown on 1:50,000 Ordnance Survey maps. The Lower Magnesian Limestone forms river bluffs about 13 m high. The cave entrance lies about 7 m above the flood plain of the Poulter, but parts of the cave are only 2-3 m above flood level. The Poulter valley was not incised to its present level until the end of the late Devensian ice age about 10,000 years ago, so any occupation of the cave by animals or humans is likely to post-date that period following fall of the local water table.

The vertebrate fauna collected by Mullins included bison, auroch, arctic fox, wolf, reindeer, horse, lynx, hyena, woolly rhinoceros, bear, water vole and numerous species of birds. Animals may have occupied the cave for shelter, but some may also have fallen in via fissures in the roof. The bones represent a mixture of cool and warm climate faunas, suggesting that vertebrate remains may have accumulated in the cave for an extended period following the end of the last ice age. Dorothy Garrod found that recent occupation by badgers had also mixed the fauna considerably.

Flint artefacts within the cave are thought to be Late Palaeolithic. By association, a human skull found in the cave was originally thought to be of the same age, and played its part in the Piltdown Man controversy as a 'control' specimen of Palaeolithic man. More recent radiocarbon dating has shown the Langwith skull to be only about 2300 years old, dating from the Iron Age.



The Langwith Bone Cave, during the excavations in April 1911 (BGS photograph # A1156, © NERC).

Though the entrance is overgrown, the cave remains accessible today, and is designated a Regionally Important Geological Site in Derbyshire. Much of Mullins' collection has unfortunately been lost, but the remaining material is distributed among the Cambridge Museum of Archaeology and Ethnography, Oxford University Museum, Derby Museum, Buxton Museum, and the Natural History Museum, London.

Literature

Garrod, D.A.E., 1927. Excavations at Langwith Cave, Derbyshire, April 11-27, 1927. *Reports of the British Association for the Advancement of Science, for 1927.*

Mullins, E.H. et al., 1913. The ossiferous cave at Langwith. *Derbyshire Archaeological Journal*, **35**, 137-158.

Andy Howard, British Geological Survey

Footnote - Hemlock Stone

The archive photograph on page 153 of the last *Mercian Geologist* showed a party of from the Leicester Literary and Philosophical Society on an excursion to Nottingham on June 15th 1882. Thank you to Andrew Swift of the Lit and Phil for solving the mystery on this one.