Stonechat

The Magazine of
Horsham Geological Field Club

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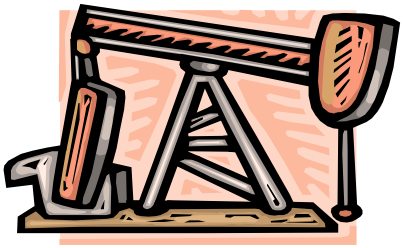

Petroleum in the Wessex Basin

HORSHAM GEOLOGICAL FIELD CLUB

OFFICERS AND COMMITTEE 2011/12

President **Dr Ellis Owen**

64 Collingwood Road, Horsham, RH12 2QW
(01403 252265) ellis.owen@talk21.com

Vice President **Frank Diggon**

26 Ashleigh Road, Horsham, RH12 2LF
(01403 254100) frank@diggon.fsnet.co.uk

Lecture Programme Co-ordinator **Mrs. Beryl Jarvis**

Orchard Cottage, Warnham Lodge, Northlands Road, Warnham, Horsham RH12 3SQ (01403 254549) b.jarvis549@btinternet.com

Hon. Secretary **Mrs. Gill Woodhatch**

42 Redford Avenue, Horsham, RH12 2HJ
(01403 250371) r.woodhatch@uwclub.net

Hon Treasurer **Mrs. Janet Owen**

19 Rowan Way, Horsham, RH12 4NS
(01403 263224) janthegan@hotmail.co.uk

Field Trip Secretary **Geoffrey Toye**

Collyers Cottage, The Street, Slinfold, Horsham, RH13 7RR
(01403 790469) gandgtoye1@btinternet.com

Librarian **Mrs. Valerie Bell**

24 Byerley Way, Worth, Crawley, RH10 7YU
(01293 882969) bells@campanile210.fsnet.co.uk

Magazine Editor **John Morton**

7 Windmill Close, Horsham, RH13 6BY
(01403 261304) john@pontius.freeserve.co.uk

Corps de chiens et de chiennes

Bill Luck, 2 Newlands Road, Crawley, RH11 8AL (01293 517130)

Mrs Susan Reese, Jackdaws Field, Park Lane, Maplehurst, Horsham RH13 6LL (01403 891624) – mob. 07976 280683) sue@jackdawsfield.co.uk

John Stace, 32a North Road, Three Bridges, Crawley, RH10 1JX
(01293 533945) christine.johnstace@gmail.com

Mrs. Gillian Toye, Collyers Cottage, The Street, Slinfold, Horsham, RH13 7RR (01403 790469) gandgtoye1@btinternet.com

WEB SITE : http://hgfc.club.officelive.com/default.aspx
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STONECHAT
Volume 22, Part 3 - December 2011

CONTENTS

Editorial

This is the first of our six-monthly productions of *Stonechat*. It's a pity we cannot produce the magazine more often, as some of the reports on our meetings come rather a long time after the talks. However, they do give us all an excellent reminder of the lectures we enjoyed. Thanks are due to our two stalwart reporters. If anybody else would like to have a go at what might look straightforward but is often not as easy at it might at first seem, please let me know. We probably only remember about ten per cent of what is heard, so what we need is a sort of flight simulator to give us all an interactive role! I guess that is something for future generations to invent!

For those of you who opt to receive the magazine by e-mail, there will be the advantage of the odd splash of colour in some illustrations – something that is too expensive to provide by photocopying.

Here's hoping that David Bone's efforts to protect the fossils washed ashore at Bracklesham Bay are successful – I know that a number of you have signed his petition to West Sussex County Council regarding the sectioning of the beach for kite surfers.

Our public lecture presenting Chris Stringer's *The Origin of our Species* was a great success and provided a significant boost of £106 to the Club's funds, whilst offering excellent value to our guests and recruiting at least two new members. We will certainly repeat the exercise, though it will be difficult to find such an excellent expert speaker.

Your Editor and the Committee wish you all a Happy Christmas and quantative easing of your burdens in the New Year.

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How many of you believe in psycho-kinesis? Raise my hand.

The Anthropocene: A New Epoch of Geological Time

(adapted from the Geological Society's Newsletter, a podcast by *The Guardian* and the BBC broadcast *The Material World*).

On 11 May 2011, the Geological Society hosted a conference co-sponsored by the British Geological Survey, to discuss evidence for the dawn of a new geological epoch: the Anthropocene. The conference was an opportunity for discussion and debate over the question of formalising the already well-established term. "Anthropocene" was coined by Professor Paul Crutzen of the Max Planck Institute in 2002, to suggest human activity has had such an irreversible affect on our planet, that we have entered into a new geological period, influenced by humans.

Over the last 11,700 years - an epoch that geologists call the Holocene - climate has remained remarkably stable. This allowed humans to plan ahead, inventing agriculture, cities, communication networks and new forms of energy. Some geologists now believe that human activity has so irrevocably altered our planet that we have entered a new geological age. Professor Jan Zalasiewicz of the University of Leicester is quoted as saying "Simply put, our planet no longer functions in the way that it once did. Atmosphere, climate, oceans, ecosystems… they're all now operating outside Holocene norms. This strongly suggests we've crossed an epoch boundary."

Dr Zalasiewicz added: "There are three ideas about when the Anthropocene began. Some people think it kicked off thousands of years ago with the rise of agriculture, but really those first farmers didn't change the planet much.

"Others put the boundary around 1800. That was the year that human population hit one billion and carbon dioxide started to rise significantly due to the burning of fossil fuels in the Industrial Revolution," he explained. "However, the really big changes didn't get going until the end of the Second World War - and that's another candidate for the boundary."

To define formally a new epoch, geologists must show how it can be recognised in the layers of mud that will eventually form rocks. As it turns out, there is enormous practical advantage in fixing 1945 as the beginning of the Anthropocene. "1945 was the dawn of the nuclear age," explained Dr Zalasiewicz. "Sediments deposited worldwide that year contain a tell-tale radioactive signature from the first atom bomb tests in

the States." So, thousands of years from now, geologists (if any still exist) will be able to place their finger on that very layer of mud. Nonetheless, the choice of 1945 for start of the Anthropocene is much more than just convenient. It coincides with an event that Professor Will Steffen of the Australian National University describes as the "Great Acceleration". Professor Steffen told the BBC: "A few years ago, I plotted graphs to track the growth of human society from 1800 to the present day. What I saw was quite unexpected - a remarkable speeding up after the Second World War." In that time, the human population has more than doubled to an astounding 6·9 billion. However, much more significantly, Professor Steffen believes, the global economy has increased ten-fold over the same period.

"Population growth is not the big issue here. The real problem is that we're becoming wealthier and consuming exponentially more resources," he explained. Humans have made a dramatic impact on many of the planet's ecosystems. This insatiable consumption has placed enormous stresses on our planet. Writing in the prestigious journal *Nature*, Professor Steffen and colleagues recently identified nine "life support systems" essential for human life on Earth. They warned that two of these - climate and the nitrogen cycle - are in danger of failing, while a third - biodiversity - is already in meltdown. "One of the most worrying features of the Great Acceleration is biodiversity loss," Professor Steffen said. "Species extinction is currently running 100 to 1000 times faster than background levels, and will increase further this century."

In New Orleans, large areas of the city are already below sea level. The disastrous combination of rising sea level and subsidence of the Mississippi Delta on which it is built suggest that it will succumb at some point in the future. Although the Intergovernmental Panel on Climate Change (IPCC) predicts less than a metre of sea level rise over the next 90 years, more than five metres of sea level rise is possible over the coming centuries, as the Greenland and West Antarctic ice caps melt. Sea level rise of this magnitude will mean that the lower storeys of buildings will be preserved intact. Such "urban strata will be a unique, widespread and easily recognisable feature of the sedimentary deposits of the human age," Dr Mike Ellis of the British Geological Survey commented.

Dr Ellis told BBC News: "As a result of rising sea level, scientists of the future will be able to explore the relics of whole cities buried in mud. When humans look back… the Anthropocene will probably represent one of the six biggest extinctions in our planet's history." This would put it on a par with the event that wiped out the dinosaurs. But perhaps more

alarming is the possibility that the pronounced global warming seen at the start of the proposed Anthropocene epoch could be irreversible. "Will climate change prove to be a short-term spike that quickly returns to normal, or are we seeing a long term move to a new stable state?" asked Professor Steffen. "That's the million dollar question."

If the Anthropocene does develop into a long-lived period of much warmer climate, then there may be one very small consolation: the fossil record of modern human society is likely to be preserved in amazing detail. Humans are likely to leave behind many markers of their presence. Geologists of the future may also hunt for other, more unusual, "markers" of the Anthropocene epoch, such as the traces of plastic packaging in sediments.

But geologists like Dr Mark Williams from the University of Leicester hold much more serious concerns: "One of the main reasons we developed the Anthropocene concept was to quantify present-day change and compare it with the geological record," he explained. "Only when we do so, can we critically assess the pace and degree of change that we're currently experiencing." Dr Williams added that while the Anthropocene has yet to run its course, "all the signs are that the human age will be a stand-out event in the 4·5 billion-year history of the Earth."

One application for exploring the changing coastlines of the Anthropocene world is Google Flood. It allows users to raise sea level by up to 14 metres and zoom into street level to see the effects.

Hubble Ultra Deep Field in 3D

Taken from Deep Astronomy.com's www.flixxy.com/hubble-ultra-deep-field-3d.htm

Astronomers, in 1996, attempted to do something extraordinary. They pointed the Hubble Space Telescope into a part of the sky that seemed utterly empty – a patch devoid of any planets, stars and galaxies. This area was close to the Big Dipper, a very familiar constellation. The patch of sky was no bigger than a grain of sand, held out at arm's length.

This was a somewhat risky move by the scientists, after all observing time on this telescope is in very high demand and some questioned whether it would be wasted trying to look at nothing. There was a real risk that images returned would be as black as the space at which it was being pointed. Nevertheless they opened the telescope, and slowly, over the course of ten full days, photons that had been travelling for over

13 billion years finally ended their journey on the detector of humanity's most powerful telescope, their feeble signals collected almost one by one. When the telescope was finally closed and the images were processed, the light from over 3000 galaxies had covered the detector, producing one of the most profound and humbling images in all of human history. Every single spot, smear and dot was an entire galaxy and each one containing hundreds of billions of stars.

Later, in 2004, they did it again, this time pointing the telescope towards an area near the constellation Orion. They opened the shutter for over eleven days and 400 complete orbits around the Earth. Using detectors with increased sensitivity and filters that allowed more light through than ever before, over ten thousand galaxies appeared in what became known as the Ultra Deep Field, an image that represented the farthest we've ever seen into the Universe. The photons from these galaxies left when the Universe was only 500 million years old, and 13 billion years later, they end their long journey as a small blip on a telescope CCV!

These galaxies, while standing absolutely still, are racing away from us, in some cases faster than the speed of light. The space/time between us and everything else grows larger by the minute, pushing the galaxies in this image to a distance of over 47 billion light years. Because of Universal expansion the farther something is away from us, the more its light is shifted towards the red and the faster it appears to be moving. Edwin Hubble himself discovered this by measuring the red shift of many galaxies, and it's a measure of not only speed but distance as well.

Recently Hubble scientists put the icing on the cake. Using the measured red shifts of all the galaxies beside the image, they made a 3D model of the Ultra Deep Field. This is probably the most important image ever taken.

There are over 100 billion galaxies in the Universe. Simply saying that number doesn't really mean much to us because it doesn't provide any context, our brains have no way accurately to put that in any meaningful perspective. When we look at this image, however, and think about the context of how it was made and really understand what it means, we instantly gain the perspective. We cannot help but be forever changed by it.

We pointed the most powerful telescope ever built by human beings at absolutely nothing for no other reason than because we were curious and discovered that we occupy a very tiny place in the heavens.

A Transect across the Himalayas

The evening lecture in June was given by Dr. Chris Duffin.

He opened his talk by telling us that he had been to the Himalayas, and that he was intending to show us his holiday snaps! Indeed, to keep up the aura of triviality associated with 'snaps', he did open by showing images taken in his hotel in New Delhi. Then of course, that extraordinary and marvellous building, the Taj Mahal, appeared on the screen. Although he had clearly been impressed by the aesthetics of that magnificent mausoleum, honouring a *second* wife, to a geologist's eye there was more to be seen. The translucent white marble is decorated with inlaid lapidary patterns, the coloured slivers being derived from an extensive variety of minerals and rock. So for instance, he identified carnelian, turquoise, coral, jasper, malachite and various other materials skilfully set into the marble to produce that characteristic intricate Mogul artwork. Which takes us back to his hotel, where 400 years later, the same decorative work is on display. He also had a couple of examples of modern pieces, which were much admired at the end of the talk.
Thus concluded that the "holiday snaps". The burden of his talk now followed: this was to follow his journey northwards from New Delhi to the high plateau of the Himalayas, in the company of a party of geologists.
He first described the tectonic history of India, how it had become detached from Gondwanaland: how that colossal triangular island had migrated across the globe, hurtling into Asia at 16cm per annum, with that truly-catastrophic outcome at the interface, the Himalayas. There was, of course, a sub-plot: all was rather more complex than that simple story. There were other more-complex events and issues which have subsequently given rise to the variations in geology to be observed travelling along the northern transept into the Himalayas.
Along this journey, these geological tourists had encountered many interesting features, both micro and macro in scale. As an illustration of the former, Chris had brought along a hand sample showing soft sediment folding. He noted that it had been impossible to bring home as many samples as he would have liked! On the macro scale he had photographs of sections illustrating the geomorphology, and of a rugged mountain landscape carved by rushing water and grinding ice.

Finally they ascended to the Tibetan Plateau, that granite batholyth,bleak and inhospitable. Clearly they had enjoyed a typical 'tourist' evening in Leh, including dancing displays, but even so the geologist in him noted that the splendidly-ornate head-dresses of the ladies were indeed covered in intricate swathes of turquoise, a blue mantle stretching from crown to waist.

As an aside, Chris noted with some enthusiasm that he had visited a tall, rather austere granite obelisk high in the mountains. This is the memorial to Ferdinand Stoliczka, a polymath from the middle of the 19th century who had done much work towards the scientific investigation of the area. Thus concluded an interesting lecture, covering as it had a journey through a remarkable landscape, with a wide variety of rock, and numerous features familiar to us all from long-forgotten geography books. Many thanks to Chris Duffin for sharing his experiences with us.

Peter Webster

Jaws, a prehistoric prequel – *The Times*, 9 July 2011

The 155 million-year-old skull of a sea monster described as the most fearsome creature that ever lived has been seen by the public for the first time. The pliosaur, whose reconstructed skull is 2·4m (8 ft) long, had the biggest bite of any animal and its jaws could have broken a car in half.

At 95 per cent complete, it is the best pliosaur skull specimen in the world and was unveiled on 8 July by Sir David Attenborough at Dorset County Museum, Dorchester. Remains of the body have never been found.

Bones from the skull of the creature, which could grow to 16m long, were found at Weymouth Bay by an amateur collector, Kevan Sheehan, between 2003 and 2008. He said: "It was sheer luck – I was sitting on the beach and saw three pieces. I'd go back every year and find a new piece."

Archaeologists took 18 months to remove the bones from cliffs and nine months to piece them together.

The creature powered through water, using four paddle-like limbs. Richard Forrest, a palaeontologist who helped the reconstruction, said: "This is an iconic specimen. It was probably the most fearsome predator that ever lived."

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Support bacteria – they're the only culture some people have.

The Geology and Fossils of Bracklesham Bay

For our meeting on July 13th we were fortunate enough to be addressed by David Bone, well known to many of us from field trips to this area. He will now be known to a wider public as a consequence of being filmed, searching for fossils on a beach, by a European T V channel in June. During his talk David made several references to others who have studied this area during the last 150 years, notably, Frederick Dixon and Edward Heron-Allen.

David commenced his talk by outlining the geology of the Selsey Bill area. The oldest Tertiary beds to the north-west gently dip to the Quaternary beds in the south-east. The Bracklesham Group date from about 49 – 41 mya. In Eocene times this region was sub-tropical and was located where mid Spain is now, i.e. 40º N. The area was then a mangrove swamp some 10 – 30m deep, and it was rich in vegetation and fauna. Fossils include crocodile teeth/bones, turtle shell, bivalves, gastropods, shark and ray teeth (Myliobatis), corals etc. The tide needs to be very low, as the sand covers everything higher up the beach. This uniquely rich region was declared an SSSI in 1986.

The formations are: Wittering (W1 – W17), Earnley (E1 – E8), Marsh Farm (E9 –E12) and Selsey (S1 –S11). At places channels filled with Quaternary material cut through this sequence. From the Bracklesham car park approximately 1 km in the direction of Selsey Bill is the Earnley Formation which is the richest in fossils. At very low tides fossils can be found *in-situ*, in rock and not just in the sand. The most common examples found here are Venericor, often double-valved and Turritella. The Turritella bed – E4, has been dated as 46.4 +/- 1.5 million years. We were shown interesting examples of Turritella, which can be identified from one another by the angles of the whorls which increase in number as the shell grows.

Other plentiful examples are the Nummulites(E7). These ‘coin fossils’ are in fact large Foraminifera. When, sometimes with great difficulty, they are split open, they reveal a beautiful, intricate spiral pattern. Also in this bed can be found the coral *Goniopora websteri*. In the Cakeham Beds (W10), can be found the fruits of the Nipa palm. These are coconut-like fruits which contain several seeds within the husk. There is a nodule band near the caravan park, which is part of the Selsey formation. Some fossils may be found at the bottom of runnels or eroded channels at Selsey, e.g. pyritised molluscs such as Tibia and Corbula, but these are not common. Mixon Rocks, or ‘CLIBS’ at Selsey (S11) contain the abundant Nummulites and Alveolina.

David then turned our attention to the Quaternary (last 2 million years). This was the time of periglacial Britain. Climate and sea levels often changed. At Selsey there is a raised beach, which was formed in the Ipswichian interglacial (130 thousand years ago), when the sea level was higher than it is today. To find fossils among the gravels is rare. Erratic boulders of granite/gneiss can be found on the raised beach. Glaciation did not reach this far south, so speculation suggests they could have been carried across the Channel in ice and deposited in the Solent area. There are interglacial channels in the Solent river systems formed at different times. In the Selsey channel the remains of mammoths, rhino and elephant have been found. Even more recent fossils have been recovered in peaty deposits, these include deer antlers which may date from the Neolithic period only 6000 years ago or be even more recent. David then mentioned that in the opinion of some geologists, these more recent strata are merely topsoil.

Government interest is now focussed on this part of the coast due to the problems caused by the rising sea level. We were shown a diagram of the present flood risk. Between ½ - 1 mile of coastline has been lost since Roman times. In fact the sea level at Portsmouth has risen by 171mm since 1962. The Selsey lifeboat station is now approached by a walkway 200m long. David then showed us a map of the flood and erosion risks relating to the period 2008-2108.

How western Selsey might look

The Medmerry Managed Realignment Scheme, estimated to cost £16m, was approved in December 2010. David explained that this will entail a substantial area of the peninsular being returned to marshland. It will create wildlife habitats lost elsewhere in the Solent region. The project affects land east of Sussex Beach Holiday Village, Earnley, west of Bunn Leisure Park and land south of Sidlesham. Another defence scheme is being investigated by the Bunn Leisure Park (Caravan site). Construction

of the Medmerry scheme has now begun and is due to be completed in 2013. It is hoped that this scheme will be effective for at least 100 years. Finally we were shown a map predicting results were the Greenland icecap to melt – the land south of a line from Chichester to Findon would be under 6m of water. Not in our lifetime we hope!

After his talk, David was asked a question relating to the best weather conditions for finding fossils. He replied that there was no hard and fast rule but it is known that long waves will deposit sand while short waves will wash sand away. Then Terry thanked David for a most interesting talk.

Valerie Bell

The Club's Summer Social Event

Eighteen Members braved a cold, wet and windy trip on the deck of a catamaran without side panels. Surprisingly, the ride was a particularly smooth one, in spite of the wind, along the Chichester Channel leaving from the quay at West Itchenor. As the boat was electrically driven, it was virtually silent and it was rather disappointing that we were able to see only a very limited amount of wild life. Several cormorants were spotted and a number of egrets could be seen on the shore. We were, however, given a comprehensive briefing on the navigation of the catamaran, as the Captain steered it safely up the channel using buoys and colour-coded cones. It was certainly a gentle and relaxing ride and our Members enjoyed it in spite of the inclement weather,

After lunch, as the weather started to clear, members made separate decisions on what to do for the afternoon. Some went home, others went into Chichester to the Pallant Art Gallery or shopping, or to garden centres. Fishbourne Roman Villa was visited and Boxgrove was another destination. Well worth a trip for the interesting stones - full of fossils, including sea urchins with lots of detail, and belemnites - Caen stone, Quarr stone, etc outside, and inside are columns of Sussex Marble (Viviparus) and several slabs with sandstone formations - ripples, trough bedding, Unio beds, etc. If you don't mind crawling about on your hands and knees in a very splendid church, it's all there.

Six members went on to Bracklesham Bay to take advantage of the falling tide in the hope that they would find some of the fossil beds mentioned in David Bone's lecture of the previous week. It turned out to be an absolutely glorious evening. A long walk towards Selsey along the shingle gleaned some well-worn specimens of *Venericor planicosta* and

Echinocorus. At low tide on the walk back to Bracklesham at the water's edge the Holocene beds were found with fossil wood well displayed but no animal remains. Then the Turritella and Nummulite beds were discovered and fossils collected. The evening ended with a long fruitless search, adjacent to Bracklesham town, for sharks' teeth and then a bag of chips each to round off the day.

John Morton and Gill Woodhatch

Bracklesham Bay

On the West Sussex coast, Bracklesham Bay is one of the most productive fossil-hunting locations around these parts. Throughout the year the sea erodes undersea exposures of fossil-bearing clay formed some 46 million years ago. Given the right conditions, a variety of fossils can be simply picked up from the sand or beach, including: bivalve and gastropod shells, shark and ray teeth, corals and many other marine fossils. One man has been leading fossil-collecting hunts here since 1983, and has his own website at www.westsussexgeology.co.uk.

On the sea-floor of Bracklesham Bay,
Tidal erosion each day
Jiggles and jostles
Its Eocene fossils
And washes them out of the clay.

From there, as the tides come and go,
They're carried with each ebb and flow
Till they land on the sand
Of the Bracklesham strand,
Where they make a spectacular show.

If it rains, just put up umbrellas
And hunt for your first *Turritellas*,
Nummulites, Carditas –
Oh, there's nothing as sweet as
When you chance upon these little fellas!

You need a good day at low tide
And must scour the beach, eagle-eyed,
If you want to go back
With a fossil-filled sack
To show to your friends with great pride.

If you're lucky, and in the right zone,
You may find that you're not quite alone;
For who might appear
But the expert round here –
Yes, the Bracklesham King, David Bone!

Gordon

Cosmic puzzle solved – Nick Collins, *The Daily Telegraph*, 4 August 2011

Scientists believe they have discovered the secret of the dark side of the Moon, after finding that it may have been created by a collision with a smaller companion moon. (It isn't dark – it's just that we don't see it – Ed.) Experts believe that the Earth originally had two moons in orbit around it, but that one was absorbed into the other when they smashed together about 4·4 billion years ago. The theory would explain why the far side of the Moon has a thick, mountainous crust, while the nearside is flat – a conundrum physicists have never been able to agree on.

It could also solve the riddle of why the side of the Moon facing Earth is rich in minerals, such as potassium and phosphorus and the other side is not, researchers said.

Dr. Martin Jutzi from the University of Bern in Switzerland, who led the research, said it is likely that both moons were created at the same time, when an object the size of Mars crashed into Earth and broke up.

A computer model suggested that after about 50 million years the smaller moon would have hit our Moon, then three times larger. Because of the slow collision speed, the smaller moon would have broken up and "splatted" itself against our Moon's crust in mountainous piles rather than leaving a crater.

The clouds of rock would have settled on to the far hemisphere regardless of where the impact happened because the Moon is not perfectly round, according to the study published in *Nature*.

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Research has established that the people of Dubai don't like
The Flintstones – but those of Abu Dhabi do!

The Habitat of Petroleum in the Wessex Basin

The first lecture of the Winter Season for 2011-12 was given by Richard Selley.

Enter the name "Richard Selley" into a search engine, and the numerous returns which appear fall into the two parts of a neat dichotomy. On the one hand, Richard's enthusiasm for viticulture manifests itself by the copious number of returns relating to the topic of wine. He did, of course, come and speak to us some while ago on the factors which influence the choice of an ideal site for a vineyard, and the significance of appropriate geological factors in the choice of any location, using Denbies' in nearby Dorking as an example. On the other side of the dichotomy are an equally numerous set of returns which reflect our speaker's other role, that of the petroleum geologist. Or, as he put it, "a corrupted sediment-ologist". It was the latter role, that of Petroleum Geologist, that he took for this talk.

Richard's talk was subtitled "The Bob Stoneley Memorial Lecture", in honour of his colleague who had made a significant impact on the understanding of the sedimentology and the subsequent oil formation of the Wessex Basin.

So what of the Wessex Basin? This area proves to be an excellent area for the study and the teaching of petroleum geology. It stands competition from the world's major oil fields in that respect.

To understand the presence of oil in the Wessex Basin, it was necessary to understand the complex sequence of sediments and the subsequent faulting therein, and with a series of diagrams Richard explained the geological history of the area. Of particular importance are the "yo-yo tectonics", where faults are compressed and then relaxed.

The conditions which must obtain for a successful reservoir of oil can be tabulated as follows:

Source rock, containing hydrocarbons: Reservoir rock: porous, to hold the oil; Seal; A trap: for example, an anticline; Heat: the hydrocarbons must be "cooked in the devil's kitchen", to a temperature of between 60 and 160 degrees C for the formation of oil.

Richard then went on to describe in detail various features of the Wessex Basin which are relevant to petroleum geology. He showed images of the oil seeps in areas such as Lulworth, Osmington Mills and Mupe Bay. Of particular interest in the latter location was a conglomerate which was cemented by now-hardened oil, evidence for a paleo-seep. He then moved on to Kimmeridge Bay, "beloved by petroleum geologists, and simple enough for an engineer to understand". It was, however, necessary to understand the significance of the "roll-over anticlines" in the area. (I noted with great interest that, Richard, a leader in his field, uses images from Google Earth to illustrate his talks!)

He gave much credit to Bob Stonely for having made a considerable contribution to the understanding of the petroleum geology of the oilfield.

As for the Wytch Farm Oilfield, this should of course be called the “Bournemouth Oilfield", but that would offend the sensibilities of the good burghers of that town! He pointed out that the drilling of exploratory boreholes at Leith Hill had caused considerable controversy, and yet the extraction of oil on a small scale has little effect on the countryside.

This was a challenging, but thoroughly-interesting, commentary on many aspects of the petroleum geology of the Wessex Basin. Richard set a high standard for the start of the winter season of lectures, and we much appreciate his coming to speak to us.

Peter Webster

Hell’s Kitchen

You can get oil from organic-rich shales, such as those in Dorset’s Kimmeridge Clay Formation, but only if they have previously subsided deep enough (several kilometres) below overlying sediments to reach temperatures in the region of 100°C – what Professor Richard Selley of Imperial College calls “Hells Kitchen”. (There were, of course, no men around in the Jurassic, except those with poetic licence).

Pack-a-clay, pack-a-clay, Jurassic man,
With organic remains as full as you can.
Compress it and cook it at one hundred C
Deep down in Hell’s Kitchen – and then tell BP!

Gordon

The Origin of our Species

The title of October's lecture was that of a new book by Professor Chris. Stringer of the Natural History Museum, who had agreed to speak to us on this subject. He had suggested that he would prefer the lecture to be open to the public. We therefore arranged to use the Business and Enterprise Centre at the rear of the school and did indeed attract a good attendance.

Prof. Stringer took two years to write his new book after extensive travels and study. It is based on two main phases of human evolution and to illustrate this we were shown images of two distinctive skull shapes. In one, shared species features could be seen, in the other this did not occur. We were then shown photos of various modern racial types for comparison purposes.

The evidence his book examines includes signs of complex behaviour and tools used by ancient hominoids. These include wood, bone and metal (e.g. a bone needle was 30,000 years old). Many examples of art, such as cave painting in France and symbolism such as a statuette of "Venus", all over 30,000 years old, were cited as important. Different burial methods and remains of houses all indicate a level of organised societies.

Professor Stringer emphasised the value of the many new techniques for study, including CT scans for reconstruction. By this means it has been revealed that the inner ear bones of Neanderthals are different from those of modern man. More reliable carbon dating covering 40,000 years, and also isotope studies are used. For the first time, the diet of some early humans can be revealed.

Phases of human evolution

For the first five million years evolution was wholly in Africa. Modern human shape evolved during the last two million years when man moved out of Africa. It should be of interest to note that *Homo erectus* brains were half the size of modern humans.

Neanderthals

They are known to have buried their dead. They had large brains and noses, the latter may be connected with their evolution in the prevailing cold climate. They are found in Europe, Syria and farther east. They were once thought to have been the ancestors of modern humans but new analysis based on skull shape shows Neanderthals not to be early human.

There are two views how *Homo sapiens* evolved from the assumed ancestor *Homo erectus*. One belief is that *Homo erectus* gave rise to *Homo sapiens* across the whole range 1mya including Africa, China and Indonesia. *Homo erectus* spread around and gradually developed modern features and racial differences. In Europe one line of evolution gave rise to the Neanderthals. This was the view of the German paleo-anthropologist Franz Weidenreich.

The other view is " Out of Africa" - basically that origins were restricted in time and area. Some recognise an intermediate species between *H. erectus* and *H. sapiens* called *H. heidelbergensis* – named after a 500,000 year old jawbone found near Heidelberg, Germany in 1907.

The African Record

There is plenty of tool evidence but few fossil remains. Skulls found display great variation in shape, showing how modern humans developed. The transformation had been gradual. It would seem that modern anatomy and behaviour was rooted in Africa. Shell jewellery and red pigment for decoration appeared 70 - 100,000 years ago. In the Sahara, stone tools were found, which were some 120,000 years old. For much of this time, the Sahara featured lakes and plenty of vegetation, whilst other parts of Africa were much drier.

Different tools used at different times show that the knowledge of crafts and probably experience was passed on. This process was probably developed very slowly at first due to early mortality and that small isolated groups might have died out before knowledge could be transferred to other groups. As people began to live longer, knowledge was exchanged, contributing to the well-being and success of local people.

Development was piecemeal and eventually led to racial differences. About 100,000 years ago, the African stock of humans started to spread to other regions. Basic features of these people were shared with other races elsewhere. Study of similarities and differences is made by using Mitochondrial DNA. This is the smallest chromosome and the first significant part of the human genome to be sequenced in humans. MtDNA is inherited solely from the mother. The Y chromosome is inherited from the father. Comparison of the DNA sequences allows scientists to study evolutionary relationships between populations. It is therefore now known that interbreeding between *H. sapiens* and Neanderthals did take place before Neanderthals disappeared between 40 and 30,000 years ago.

One of the latest discoveries is that of remains found at Denisova in Siberia. However, whether this individual was related to the Neanderthals is not clear.

Professor Stringer then answered several questions before being thanked by Peter Webster for a most interesting talk.

Valerie and Brian Bell

It was good to hear from Chris Stringer how valuable granddads are. So I invented a new species:

Homo granddadus

This little-recognised species, now known to be important in passing on experience, ideas and inventions to succeeding generations, did not exist during the Palaeolithic, when early humans lived and hunted in small groups and repeated climate changes forced them to move and adapt. Lives were short and blue-sky thinking was not the first priority for most people. But here, a young, brighter-than-average Homo heidelbergensis *describes how he once gave it a go:*

"Life in the Stone Age is brutish and short.
Our hunting techniques haven't changed:
Our elders die young, so we youngsters aren't taught
New techniques, and ideas aren't exchanged.

"This week, we men slaughtered a mammoth or two.
Our adrenaline makes us feel brave,
But we're knackered to bits by the time that we're through
And we've lugged back its parts to our cave.

"So I started to think, with this big brain of mine:
If I rig bits of wood, hinged on pegs
To a platform and work them, back-and-forth, with some twine,
I could drive it around – they'd be 'legs'…

"Then mammoth retrieval would just be a doddle.
My platform on legs would work hard,
And, thanks to the grey matter inside my noddle,
I'd have *time* – I could be the tribe's bard!

"But Granny had noticed me thinking. She said:
'I have a solution, I feel.
Your Granddad invented…… .' And then she dropped dead."
Thus, the world was deprived of the wheel!

Eventually, Homo granddadus *evolved.*
Living longer in better conditions,
He could pass on his wisdom, so problems got solved…
And that's how the wheel got invented!

Gordon

Book Review: The Earth After Us;
What legacy will humans leave in the rocks? Jan Zalasiewicz ISBN 978-0-19-921498-3 Oxford University Press. Price: £8.99

The spiel on the back cover of this most thought-provoking book says: "What would alien visitors of the far future, piecing together the history of Earth, find of our brief reign? What clues will we leave? What fossils? Just as we have gained knowledge of the past, of ancient climates and the activities of creatures long dead, so too might they decode the rocks." Jan Zalasiewicz uses this imaginary scenario to show how geologists reconstruct past worlds. If aliens were to uncover the 'human stratum' a hundred million years in the future, what would they make of us? And how might we be judged?

In his prologue the author, a lecturer in Geology at the University of Leicester, tells of what alien visitors might find: "Here, an exposed rock surface with a regular, rectangular pattern, unlike any produced by normal geological processes; there, layers of angular pebbles with hard organic coatings. The remains of a long tubular structure, now oxidized, that had once been metallic. Parallel-sided shards of a white glassy substance. Another oxidised metal fragment, this time hinting at a complex internal structure: not a biological skeleton, but obviously manufactured.

"There could now be no doubt. There had lived here, many millions of years ago, an ancient civilization, and one that could colonize on a grand scale."

The author considers that a century from now a quarter to a half of the World's species will be extinct, due to climate change, carbon dioxide in the atmosphere and sea level rise. The dinosaurs lasted for 100 million

years. *Homo sapiens* has existed for about 160,000 years. Our impact has only been significant for the last 200! For the first half of our history we inhabited Africa and only began our diaspora about 80,000 years ago. The Grand Canyon is a mile deep and represents about one and a half million years of sedimentation. Using that as a scale, our 'human stratum' would be about three inches thick, the industrial part of this about one hundredth of an inch! In Roman times the population of the World was about 200 million people – now it is seven billion and likely to be nine and a half billion by the end of the twenty-first century. Famine and/or war make our extinction likely.

Most traces of us would be destroyed, but open concrete structures – underground car parks, nuclear shelters – might still be found, almost certainly filled with sediment. Our species being terrestrial, its remnants would not, like marine creatures, be protected by the sea. They would be subject to upheaval and burial by sediment, continental drift and mountain building. Perhaps stone statues would be the only indication of human shape and size.

This fascinating book, consisting of 266 pages of rather small print, reviews present geological methods of discovery and suggests how future visitors might work along similar lines to deduce the fact of and the impact of our short stay here. It develops an original idea and is well worth a read.

John Morton

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During a visit to my doctor, I asked him, "How do you determine whether or not an older person should be put in an old age home?"
"Well," he said, "we fill up a bathtub, then we offer a teaspoon, a teacup and a bucket to the person to empty the bathtub."
"Oh, I understand," I said. "A normal person would use the bucket because it is bigger than the spoon or the teacup."

"No" he said. "A normal person would pull the plug. Do you want a bed near the window?"

****

I have kleptomania but when it gets bad, I take something for it.

How Britain became an Island

Professor Sanjeev Gupta, of Imperial College, visited us in November, to talk about recent research that he and his team have been undertaking on the formation of the English Channel.

He gave a short overview of the historical explanations that had been put forward for the formation of the Channel. Various leading scientists, including the renowned Dudley Stamp, had proposed suggestions. They were, of course, handicapped by the lack of detailed data relating to the sea floor.

The advent of detailed mapping, consequent upon the introduction of sonar technology, has enabled the proposition of well-constructed theories. Sanjeev outlined the techniques and physics of the process of detailed sonar mapping, and some of the difficulties of doing this from a small, bobbing boat.

Uniquely, it was at this stage that he departed from the normal *modus operandi* of the lecturer! It became apparent as to why he was keen to use his own laptop rather than the available PC. Most visitors are happy to put their lecture notes temporarily into our machine, and work through a set of prepared slides. However, Sanjeev's laptop had a rather useful item of software, "Fledermaus". Into this software had been entered detailed surveying data.

Fledermaus, with Sanjeev manipulating the mouse, then displayed a bathymetric map of part of the English Channel derived from this high-resolution sonar data, showing the morphology of the Channel in unprecedented detail. The effect was rather like looking at a Google Earth presentation. The display was remarkably realistic, so much so that it was difficult to remember at times that this was a sub-aqueous landscape, some 20 to 60 metres below sea level, below the turbid and opaque waters of the Channel.

Using the software, Sanjeev then outlined many of the features which had been revealed. There are channels, islands, cliff edges, waterfalls, all the features that would be expected in a sub-aerial watercourse. All of this he did " live", flitting about the digital seabed, displaying all the relevant features.

Having discovered these structures, the next challenge is to propose a suitable explanation. The magnitude of the channels and other features suggest that a huge body of water must have flowed through them at some time. But where could such a body of water have originated?

An analogy with the Scablands is proposed. This area, in the north west USA, bears all the hallmarks of having been subjected to huge flows of water, where now there is but a miserable trickle. That paradoxical puzzle was solved by postulating the presence of the transient Lake Missoula, formed behind a temporary glacial dam. When this was breached, huge volumes of water were released, carving the channels and cutting the waterfalls which we see today.

Sanjeev is proposing a similar megaflood model, in which breaching of a rock dam at the Dover Strait instigated catastrophic drainage of a large pro-glacial lake in the southern North Sea basin. Indeed, the images on Fledermaus were remarkably similar to those of aerial views of the Scablands. He was able to display, using Fledermaus, and then explain, the many features which were consistent with the mega-flood hypothesis.

He then briefly looked at the progress of human colonisation of Britain, and its relevance to the isolation of our country by the Channel.

To sum up then, the megaflooding hypothesis offers an explanation for the permanent isolation of Britain from mainland Europe during interglacial high-sea-level conditions.

This talk was most compelling. The active displays using Fledermaus were remarkable, made all the more interesting in that Sanjeev was able to choose features which fitted the flow of his talk. In all a fascinating lecture, and one which generated a good number of comments and questions.

Peter Webster

Famous newspaper headline: ”Fog in the Channel – Continent isolated”.

How St. George lost his land

St. George's Land refers to the western end of what is now known as the Wales-London-Brabant Massif, a band of ancient rocks, whose crystalline arrangements were altered by heat and pressure in earlier stages of the Earth's tectonic history. In the UK, the massif is now buried deeply beneath later sediments; but such seismic activity as there is in the region seems to cluster around its edges…

St. George's land once stood up proud
In old Dinantian times[1],
An island in a shallow sea
With equatorial climes[2].

The island's ancient basement rocks
Resisted being drowned,
While Carboniferous Limestones
Were laid down all around.

St. George grew overconfident
Of his Dinantian mapping;
And pride, they say, precedes a fall –
Our Saint was soon caught napping.

Gondwana[3], that land-grabbing thug,
Was moving north apace;
It squeezed the Rheic Ocean[4] dry
And captured George's place.

Poor George – disheartened and depressed –
Subsided and was gone,
Part of Pangaea's basement now.
And yet, *St. George lives on*…

For round the margins of his Land,
His seismic spirit grumbles:
He last was felt in Lincolnshire[5]
As subterranean rumbles.

1. They were part of the early Carboniferous Period, around 340 million years ago (give or take 20 million years or so).
2. That's because the area of crust on which St. George's Land stood, while being dragged northwards by the Earth's churning mantle, was then close to the Equator.

3. This was a huge single ancient continent which incorporated most of today's southern hemisphere land masses.
4. This ancient ocean, between Gondwana and the Rest of the World, first appeared during the Cambrian Period (some 500-odd million years ago) but disappeared as Gondwana's progress northwards created a new, single continent, Pangaea.
5. For ten seconds, just after midnight on 27 February 2008, registering 5·4 on Charles Richter and Beno Gutenberg's 'Richter' scale, with nine aftershocks over the following weeks (Wikipedia).

Gordon

Bores that aren't crashing - from Wikipedia

The Kola Superdeep Borehole is the result of a scientific drilling project of the Soviet Union in the Kola Peninsula (north-west Russia, south of Murmansk). The project attempted to drill as deep as possible into the Earth's crust. Drilling began on 24 May 1970 using the *Uralmash-4E*, and later the *Uralmash-15000* series drilling rig. A number of boreholes were drilled by branching from a central hole. The deepest, SG-3, reached 12,262 metres (40,230 ft) in 1989, and is the deepest hole ever drilled, and the deepest artificial point on earth. For two decades it was also the world's longest borehole, in terms of measured depth along the well bore, until surpassed in 2008 by 12,289 m (40,318 ft) long Al Shaheen oil well in Qatar, with a record horizontal reach of 10,902 m (35,768 ft), in only 36 days and in 2011 by 12,345 metres (40,502 ft) long Sakhalin-I Odoptu OP-11 Well (offshore the Russian island Sakhalin). However, by actual depth, the Kola Superdeep Borehole still retains the world record as of 2011.

The drill resides under the site's 200-foot tower

Drilling

The initial target depth was set at 15,000 m (49,000 ft). On 6 June 1979, the world depth record held by the Bertha Rogers hole in Washita County, Oklahoma, at 9,583 m (31,440 ft) was broken. In 1983, the drill passed 12,000 m (39,000 ft), and drilling was stopped for about a year to celebrate the event. This idle period may have contributed to a break-down on 27 September 1984: after drilling to 12,066 m (39,587 ft), a 5,000 m (16,000 ft) section of the drill string twisted off and was left in the hole. Drilling was later restarted from 7,000 m (23,000 ft). The hole reached 12,262 m (40,230 ft) in 1989. In that year the hole depth was expected to reach 13,500 m (44,300 ft) by the end of 1990 and 15,000 m (49,000 ft) by 1993. However, due to higher than expected temperatures at this depth and location, 180° C (356° F) instead of expected 100° C (212° F), drilling deeper was deemed unfeasible and the drilling was stopped in 1992. With the expected further increase in temperature with increasing depth, drilling to 15,000 m (49,000 ft) would have meant working at a projected 300° C (570° F), at which the drill bit would no longer work.

Research

The Kola Borehole penetrated about a third of the way through the Baltic continental crust, estimated to be around 35 kilometres (22 mi) deep, reaching rocks of Archaean age (greater than 2·5 billion years old) at the bottom. The project has been a site of extensive geophysical studies. The stated areas of study were the deep structure of the Baltic Shield; seismic discontinuities and the thermal regime in the Earth's crust; the physical and chemical composition of the deep crust and the transition from upper to lower crust; lithospheric geophysics; and to create and develop technologies for deep geophysical study.

To scientists, one of the more fascinating findings to emerge from this well is that the change in seismic velocities was not found at a boundary marking Harold Jeffreys' hypothetical transition from granite to basalt; it was at the bottom of a layer of metamorphic rock that extended from about 5 to 10 kilometres beneath the surface. The rock there had been thoroughly fractured and was saturated with water, which was surprising. This water, unlike surface water, must have come from deep-crust minerals and had been unable to reach the surface because of a layer of impermeable rock.

Another unexpected discovery was the large quantity of hydrogen gas, with the mud flowing out of the hole described as "boiling" with hydrogen.

Status

The site is controlled by the State Scientific Enterprise on Superdeep Drilling and Complex Investigations in the Earth's Interior (GNPP Nedra) as the Deep Geolaboratory. As of 2003, the deepest active bore, SG-5, is 8,578 m (28,143 ft) and with a 214 mm (8.4 in) diameter. The project was closed down in late 2005 due to lack of funding. All the drilling and research equipment was scrapped and the site has been abandoned since 2008.

Kola Superdeep Borehole commemorated on a 1987 USSR stamp

Similar projects

The United States had embarked on a similar project in 1957, dubbed Project Mohole, which was intended to penetrate the shallow crust under the Pacific Ocean off Mexico. However, after some initial drilling, the project was abandoned in 1966 due to lack of funding. This failure inspired great successes of the Deep Sea Drilling Project, Ocean Drilling Program, and the present Integrated Ocean Drilling Program. The KTB superdeep borehole (German Continental Deep Drilling Program, 1990–1994) was drilled down to a depth of 9101 m (29,859 ft) reaching temperatures of more than 260° Celsius. The ambitious measuring program had to develop high temperature tools like a magnetometer.

Longest borehole record

The deep core-drilled Kola Borehole cannot be directly compared with any other borehole in the world. In a deep core borehole, a section of the rock drilled through is recovered from within the hole. It is this recovered drill core, and the information it represents about the rock that it was retrieved from, that is the most important feature of the borehole.

Paludina

So-called Sussex 'Marble' is also known as winklestone, Paludina *limestone, Bethersden Marble, Charlwood Stone, Laughton Marble, and Petworth Marble. But whatever it's called, its defining characteristic is the particular type of fossil snail whose sectioned shell gives the stone its unique character: the freshwater gastropod* Paludina *(now known as* Viviparus*). In the past, other shelly limestones, especailly those containing the bivalve* Cyrena*, were probably passed off as Sussex Marble.*

To claim that 'Sussex Marble' is a marble isn't right –
It's a *limestone* in the beds of old Weald Clay.
But it takes a lovely polish, so it shines up nice and bright
Once you've dug it up and carted it away.

And polishing reveals its ancient snail-encrusted core,
A challenge for the Latin-name-assigner.
They came from boggy places, these old fossil shells of yore,
So from *palus* (meaning marsh) came *Paludina**.

(Beware of 'Sussex Marble' though, with *bivalves* peeping through –
Not a single sectioned snail-shell to be seen.
It *isn't* Sussex Marble with its *Paludina* crew,
These bivalves are *Cyrena* – 'sovereign queen'.)

* *[The pronunciation of this word was a puzzle (I had a Latin-free education). Sources at two learned institutions admitted they didn't know, but an on-line pronunciation aid for biological terms seemed to suggest a long, stressed penultimate vowel: Pal-u-DYE-na.]*

Gordon

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Paddy said "Christmas Day this year falls on a Friday."
"Let's hope it's not on the13th then," said Seamus.

****

Came home today to find all my doors and windows smashed in and everything gone.
What sort of sick person does that to someone's Advent calendar?

The Club's Programme 2012

Wed. Jan. 11	**Planetary Penetrators - and search for other life in the Solar System** - Dr Rob Gowan, Mullard Space Science Laboratory
Wed. Feb. 8	**3D Seismic Data: a subsurface Google Earth** – Prof. Chris Elders, Dept of Earth Sciences U.C.L., Royal Holloway College
Wed. Mar.14	**Unusual Microfossils -** Dr Adrian Rundle, Learning Curator, The Natural History Museum
Wed. Apr. 11	**The Chalk Revolution** – Prof. Rory Mortimore, Emeritus Professor of Geology, University of Brighton
Wed. May 9	**A.G.M.**
Wed. Jun. 13	**William Buckland** – Dr.Chris Duffin, Streatham & Clapham High School
Wed. Jul. 11	**High resolution biochronology of the Inferior Oolite of Dorset** - Bob Chandler
Wed. Sep. 12	**T.B.A**
Wed. Oct. 10	**Impact cratering & ejecta deposits** – Dr Kieran Howard, Dept of Mineralogy, The Natural History Museum
Wed. Nov. 14	**T.B.A.**
Sat. Dec. 8	**Christmas Party** – Millennium Hall, Roffey, 7.30-11pm

Club meetings

Unless otherwise stated, all evening meetings are held at Forest Community School, Comptons Lane, Horsham at 7 for 7.30pm. To ease the Treasurer's mind, we ask for a nominal contribution of 20p for coffee and biscuits.

Field trips

Field trips require appropriate clothing: waterproofs, stout boots or Wellingtons. All geological sites are potentially dangerous and Members are reminded that they attend field trips at their own risk. Any children attending are the sole responsibility of parents or guardians. It is always advisable to telephone a Committee Member, if you are coming on a field trip, in case there are any last minute changes.

Equipment for Field Trips

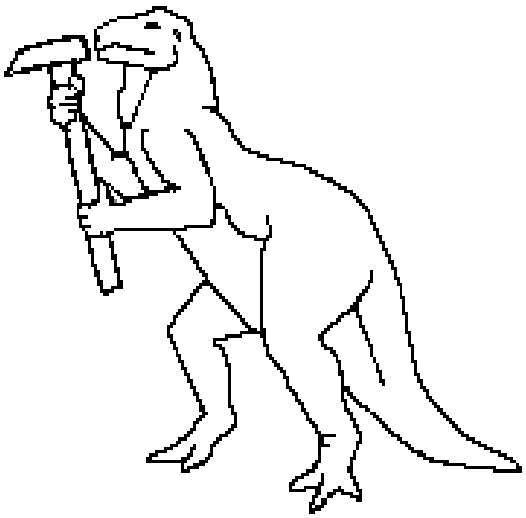
Some UK sources of tools, clothing and other equipment for field trippers are:
GA Enterprises Ltd. (Geological Association) Order online at www.geologist. demon. co.uklmerchandise.html.
UKGE (UK Geological Equipment) (Freephone 0800 0336 062) Order online at www.ukge.co.uk
Geo Supplies Ltd., 16 Station Road, Chapeltown, Sheffield S30 4XH (0114 245 5746). Order on line at www.geosupplies.co.uk)

Geological Maps and Area Guides:

British Geological Survey, Keyworth, Nottingham NG12 5GG (0115 936 3241). Order online at www.bgs.ac.uklcataloguelhome.html
Maps available from **Geological Museum Bookstall,** Exhibition Road, London SW7 2DE and **Geologists' Association**, Burlington House, Piccadilly, London W1 V 9AG (020 7434 9298)
www.geologists.org.uk/publicationsales.html

Tide Predictions:

UK Hydrographic Office, Admiralty House, Taunton, Somerset TAI 2DN (01823 723366). Free tide predictions for six days ahead are available online at
http:Ileasytide.ukho.gov.uk/easytide/EasyTidelindex.aspx.



Edited by:
John Morton FGS
Brocken Spectre
7 Windmill Close
Horsham
West Sussex
RH13 6BY
(01403 261304)
john@pontius.freeserve.co.uk