Hastings & District Geological Society Journal

Founded 1992

Hastings and District Geological Society
affiliated to the Geologists' Association

President
Professor David Price, UCL

HDGS members and guests walking towards cliffs at Fairlight Cove, east of Hastings - September 2007

Volume 13 December 2007

CONTENTS - Vol. 13, December 2007

2007 Officials and Committee

Professor David Price - President

Ken Brooks - Chairman.....Tel: 01424 426459.....E-mail: Iggyken@aol.com

Norman Farmer - Treasurer.....Tel: 01342 410102

Diana Williams - Secretary.....Tel: 01424 426459.....E-mail: Iggyken@aol.com

Peter Austen - Journal Editor.....Tel: 01323 899237.....E-mail: PJAusten@ukgateway.net

Joyce Austen - Assistant Editor

Trevor Devon - Website Manager.....Tel: 01424 870402.....E-mail: trevordevon@madasafish.com

Gordon & Siân Elder - Librarians

Gordon Elder - Education Officer.....Tel: 01424 812216

Other Members of Committee

Colin Parsons

John Boryer

Hastings & District Geological Society Website - http://www.hastingsgeolsoc.org.uk

Geologists' Association Website - http://www.geologist.demon.co.uk

Cover picture: Cliffs at Fairlight Cove, east of Hastings - photo: Peter Austen

If you have any news or reports that may be of interest to members of our society, please let me know, and I will try to include them in the next issue of the Journal. Deadline for copy for the 2008 Journal is the October meeting, **19th October 2008**.
Please contact Peter Austen on: tel: 01323 899237 or e-mail: PJAusten@ukgateway.net

Taxonomic/Nomenclatural Disclaimer - This publication is not deemed to be valid for taxonomic/nomenclatural purposes.

HASTINGS & DISTRICT GEOLOGICAL SOCIETY

Minutes of the A.G.M. - 10th December 2006

The Meeting was declared open at 2.40 p.m. by the Chairman, Ken Brooks. There were twenty-nine members present.

1) **Apologies:** None

2) **Minutes of the last A.G.M.:** Ken quickly read through these. Their acceptance was proposed by Pat Littleboy and seconded by John Boryer, and a show of hands indicated that they were unanimously accepted. Copies of the Minutes were available to be read.

3) **Matters arising from the Minutes:** Ken said that the idea of setting up a stall in Alexandra Park or booking another venue during Hastings Week had failed. He said that after having written to the Tourism & Leisure Department, the Department said that they would pass his letter on to the correct person, who would be in touch. He said that when he had heard no more, he phoned to find out what was happening, only to be told that the letter hadn't got through to the right department and that all the venues were fully booked.
After last year's appeal for someone to take on the role of Publicity Officer, no-one had volunteered.

4) **Chairman's report:**

a) Committee: Ken introduced the Committee members

b) New members: Ken said that the Society had gained seven new members during the year.

c) 2006 Programme: Ken summarised the year's activities:

Lectures by visiting speakers:
'Dinosaurs of Southern England' by Darren Naish
'American Creationism & Intelligent Design' by Geoff Bennett
'A Hastings Crocodile' by Scott Moore-Fay
'Finding Minerals of the World' by Dr. Trevor Devon
'Building Stones of the Ancient World' by Ken Brooks
'The Mysteries of Quartz and Related Minerals' by Prof. David Price

Ken explained that the talk on ***'Volcanic Disasters: Past, Present & Future'*** had not taken place because Prof. Bill McGuire had let us down for a second year running, so we would not be inviting him to speak again.

Field Trips:
New Year's Day Walk
Sheppey Field Trip
UCL Trip
Barbecue Party
Folkestone Field Trip

Ken said a little bit about each trip, particularly thanking Trevor & Fiona Devon for hosting another superb barbecue. He explained that the trip to the Booth Museum had had to be cancelled through lack of support, and that this had been particularly sad as the curator, John Cooper, had specially arranged to come in on the Sunday and give us a talk.

d) The *H.D.G.S. Journal*: Ken thanked Peter & Joyce Austen for all the time and hard work they had put into producing the new *Journal*, and members gave them a round of applause. Gordon Elder (in his capacity as an ex-editor) very generously said that the *Journal* was now even better than it had been

under his editorship.

e) Magazines: Ken said that there were copies of old editions of the *New Scientist* available for sale for a nominal amount. They had been given by Peter and Joyce Austen and all proceeds would go into Society funds.

5) **Treasurer's report:**

Diana had typed up Norman Farmer's *Statement of Income & Expenditure for the Year Ending 31st December 2006* which was handed out to members. Ken briefly ran through the items.
Norman Farmer said that although the balance was down on the previous year, it would not be necessary to increase the membership fees.
The acceptance of the Minutes was proposed by Roger Blaker and seconded by Trevor Devon, and they were unanimously accepted.

6) **Election of the Committee:**

Colin Parsons suggested that rather than go through each individual member, the entire Committee be voted in again *en bloc* unless anyone objected. This was then proposed by David Spicer and seconded by Tony Standen and members voted in favour.
Ken suggested that Gordon Elder (who had been a Committee member since 1992) should be elected as Education Officer as well as taking over the post of Librarian which had been vacated by Roger Blaker.
This motion was proposed by Dale Smith and seconded by John Fowler.

Therefore the Committee as elected was as follows:

2006	**2007**
Chairman	
Ken Brooks	Ken Brooks
Treasurer	
Norman Farmer	Norman Farmer
Secretary	
Diana Williams	Diana Williams
Journal editor	
Peter & Joyce Austen	Peter & Joyce Austen
Librarian	
-	Gordon Elder
Education Officer	
-	Gordon Elder
Website Manager	
Trevor Devon	Trevor Devon
Other Officers	
1. Gordon Elder	
2. Colin Parsons	Colin Parsons
3. John Boryer	John Boryer
4. David Dewhirst	

Colin asked whether Gordon would be making all talks available for members of the Society to borrow. Gordon replied that he had taken copies of all the PowerPoint presentations that had been given, and Ken said that he was transferring all the videos he had made of lectures on to DVDs.
Gordon also suggested that there might be a nominal charge for borrowing CDs with the PowerPoint presentations and that this would make a few more pence for the Society.

7) **2007 Programme:** Copies were handed out to all members present. Those unable to attend would be receiving their copies with the next letter to members. Ken said again how it was becoming more and more difficult to find new speakers. He then gave a brief résumé of next year's lectures:

'Fairlight Sea Defences' - by Terry Oakes
'A Geological Scandal: Hastings Water Supply' - by Bob Allen
'Geology & Minerals of Iceland' - by Peter Hay
'Fossils of the Chalk' - by Prof. Rory Mortimore
Presidential Lecture - by Prof. David Price

He said that there would be one Members' Day talk this year:
Members' Day: ***'Volcanoes of Tenerife'*** **-** by Dave Spicer

Ken said the 'outings' for 2007 would be:
New Year's Day walk at Fairlight
UCL visit with Prof. David Price
Visit to the Booth Museum, Brighton
Barbecue Party with Gordon Elder
Field trip to Fairlight

Ken also said that in response to members' queries about field trips to France he had arranged for anyone interested to join Steve Perkins' group at Wimereux for the weekend of 24th - 26th March 2006. However, he said that no members had taken up the offer. He said that if Steve Perkins offered any more dates, he would pass these on to members.

8) **Any Other Business:**

Ken thanked Gordon Elder for bringing along his PowerPoint presentation on up-to-date information on planetary geology, and John Fowler who had brought along some rock samples.

Ken reminded everyone of the New Year's Day Walk which would begin with optional lunch at the Smuggler Pub, Pett, at 12 o'clock. The walk would then start at 2 o'clock from the Visitor Centre at Fairlight.

Joyce Austen gave a vote of thanks to the Committee for their work during the year.

Ken declared the Meeting closed at 3.15 p.m.

HASTINGS & DISTRICT GEOLOGICAL SOCIETY

Statement of Income & Expenditure for the Year Ending 31st December 2006

INCOME	£	EXPENDITURE	£
Subscriptions		G.A. Affiliation fees	32.00
Single 31 @ £12.50	387.50	Hire of rooms	70.00
Family 11 @ £15.00	165.00	Books & Films for Library	31.98
		Insurance premium	136.00
		Stationery, Copying, Postage	172.29
Donations	12.00	Field trips (inc. UCL visit)	210.00
Magazine sales	26.50	Lecture fees	95.00
UCL visit	224.00	Gratuities to Lecturers	46.03
Barbecue receipts	115.00	Refreshments & Lunches	38.00
Nat.Hist.Museum visit (2005)	28.00	Summer barbecue expenses	126.00
		Tributes & Donations	50.00
		Christmas Party Expenses (2005)	4.97
		Bank charges	9.86
		Nat.Hist.Museum visit (2005 refund)	14.00
	958.00		1,036.13
Deficit being excess of expenditure above income	78.13		
	1,036.13		1,036.13

HASTINGS & DISTRICT GEOLOGICAL SOCIETY

Bank Account and Monies in Hand

Balances as at 31st December 2005	£	Balances as at 31st December 2006	£
Nat. West Bank	379.02	Nat. West Bank	325.43
Monies in hand	38.62	Monies in hand	14.08
	417.64		339.51
		Decrease in Balances	78.13
	417.64		417.64

December 2006

OBITUARY

JOYCE HARRISON

1928 - 2007

Joyce was born in Maidstone on 14th January 1928. Her parents were Dorothy and Laurence Chrisford. Two years later Joyce's mother gave birth to another child, but tragically both mother and baby died shortly afterwards. Joyce was brought up an only child, although she did have a big family on her mother's side. After a few years she went to live with her aunts in Headcorn.
At the age of seven Joyce was sent to Uplands Boarding School, St. Leonards. Later, when her father remarried and had three more children, Joyce often went to stay with them during the summer holidays in their house in Sutton Valance.
During the Second World War the pupils of Uplands School were evacuated to Monmouth in Wales, but this was not a happy time for Joyce as she missed her family very much. Then in 1945 she and her aunts moved back to Hastings.

In 1946 Joyce enrolled as an art student at Hastings College and it was here that she met her future husband, Don. It was love at first sight and they were married a year later, on 7th April 1947. By this time Don was an art teacher and they moved into 66, High Street, in the Old Town.
Later, they left Hastings to live in Fairwarp, a little village near Uckfield, for a short time. Their next move was to Whitehouse Farm in the same area. As well as his teaching job in Uckfield, Don kept a herd of twenty Jersey cattle. When their first children were born it was a great place for them to grow up, surrounded by fields and forest.
Although it was wonderful for the children, it was a hard life for Joyce. There was always much work to do and the farm was rather isolated. Perhaps she missed the more artistic scene that she had been involved with in Hastings. Tragedy was added to this when one of her children was killed in an accident.

Unfortunately, Don died in 1970 and it was with her new partner, Steve, that Joyce moved to Goitre, near Lampeter in Wales. Some of the family went with them and some stayed behind, as they were already settled in Sussex.
In 1976 Joyce and Steve moved to St Mary's Bay, but returned to Hastings five years later. They had an Antiques shop in Queens Road, and as Joyce had always had dealings with antiques, she really enjoyed this work. Ten years later they sold the shop and moved to Linton Crescent, but Joyce continued restoring pottery at home.
More recently she had a job working for a few days a week in Robert Mucci's antique shop in the Old Town. Her big treat on Fridays when she was paid was to go down to the Fish Market and treat herself to a piece of fresh fish. She continued working at the shop until October 2006, when she went into hospital.

Joyce attended adult education classes in ancient history, local history and geology, which she always enjoyed, and she was an enthusiastic member of the Hastings and District Geological Society. She gained much pleasure from her garden and the woods at the back of the house, and had recently joined the Friends of Summerfield Woods.
With her many interests, Joyce was a great collector - her house was full of furniture, ceramics and books on many different subjects. Her activities even included writing novels - one of them was about time-travelling Marsh Cats!

During her life Joyce had sixteen children and many grand- and great-grand-children. She was very proud of all of them and really enjoyed the big family reunions. She made sure she attended all the family weddings, travelling to Australia for one and to America for another.
Recently, Joyce talked of selling her house and moving away to a warmer climate, perhaps to the South of France. She wanted to live somewhere on a hill overlooking the sea where she could walk down to the beach and paint every day. Joyce had a great love of life, but sadly she died on 27th January, 2007.

She was very popular and had many friends (as was obvious from the great number of people at her funeral). Those who knew her will remember the warmth, enthusiasm and love that she shared with everyone.

Collecting minerals around the world

by Trevor Devon

I suppose we have all collected rocks or minerals at some time when we were travelling to new places, mostly as mementos, but nothing quite beats the buzz of collecting specific minerals from classic locations with like-minded colleagues. This type of collecting implies you know something of the geology and mineralogy of the location, what sort of rock to explore (often with a sledgehammer to start with!) and what colour and shape the minerals are likely to be found in. Of course it helps to travel with colleagues who have been there before and can show you what to look for. That is one of the reasons why I joined the Sussex Mineralogy and Lapidary Society (SMLS) a few years ago.

Since 1980 SMLS has conducted trips to many parts of the world, including the USA and Canada, India, Namibia in Africa, and several countries in Europe. Such trips usually attract around a dozen or so participants and are often organised with a bit of tourism so that non-mineralogical spouses can join in. I have been personally fortunate enough to join recent SMLS trips to Cornwall, Isle of Skye, India, South of France, USA, Canada, Caldbeck Fells in Cumbria and Bulgaria.

Fig. 1. Behind the scenes at the mineralogy department of the Royal Ontario Museum, Toronto.

Perhaps I should start with the basic question of why I collect minerals. First of all I think some of us are born "collectors" – I collect stamps, books and minerals for example. Then there is the aesthetic aspect – in my opinion many postage stamp designs are miniature works of art, and likewise I feel that many mineral crystals can be enjoyed as works of art too, nature's sculptures. As a scientist (chemist by training) I also enjoy an activity that uses (and extends through research) my chemistry background. Finally, collecting minerals is a great group activity where the other people are intellectually stimulating and fun to be with on trips.

Turning now to the minerals: what sorts of minerals are collected on these trips? Well of course that very much depends on the locality. In places like Cornwall, Derbyshire and Cumbria, where there has been a tradition of mining (metal ores, fluorite and barite mostly), collecting tends to be from old mine dumps and quarries. Access to quarries is of course now very limited because of the owners' concerns about Health & Safety issues and litigation in the event of any accident. Looking over mine dumps (that are generally in the region of 100 years old!) is usually productive, but the minerals are generally microscopic (eg. lots of blue-green copper secondaries, brown-black iron minerals) needing a hand lens to spot them. Old quarries vary in yield from microscopic to small hand specimens (eg. fluorite, calcite, barite, quartz, siderite). Going to more remote areas where there has been volcanic activity in the distant past tends to be more productive for the larger specimens (eg. silicate zeolites) and "interesting" minerals.

Fig. 2. Basalt quarry in India showing the zeolite cavities.

Both the Isle of Skye and India provide the latter environment – large areas of basalt in which a wide variety of alumino-silicate minerals, mostly zeolites, have been created from superheated steam reacting with and dissolving the silicate-based basalt. These minerals crystallize out of solution in cavities (vugs) created by the hot steam within the basalt and form often quite spectacular crystal clusters. In Skye small hand specimens of thomsonite, stilbite, analcime, apophyllite and chabazite can be found combing the beach on the southwest coast: breaking open some of the boulders, especially in some of the remoter beaches (accessible only by scaling 800ft cliffs!) can yield very fine crystal specimens indeed. The western Maharashtra state of India also boasts vast basalt deposits known as the Deccan Plateau. Here there are many quarries (Fig. 2) for extracting building stone and roadstone. The zeolite crystals found there are

considered a "nuisance" by the quarry owners, but such is the size and quality of these crystals that Indian mineral dealers make arrangements to collect the best specimens as they are uncovered.

In our trip to India friendly dealers arranged for us to visit a number of the most famous quarries around Mumbai (Bombay), Pune (Poona) and Nasik. In Nasik we were also invited to the Gargati Museum where we could see the fantastic range and size of minerals that have been collected in that region. Although limited to a few dozen more common mineral varieties, the quality of the collecting was quite outstanding: particularly the size of the crystals. In one quarry we were present when a new section of the quarry face was blasted out with dynamite: when the dust had cleared we were able to go and search for new pockets of minerals that had now been freshly uncovered. It was just amazing to look at crystals that had not been seen since their creation millions of years ago!

From India, among many other minerals, we were able to bring back impressive hand specimens of apophyllite (especially from the famous Jalgaon quarry), stilbite and heulandite crystals, as well as beautiful small clusters of the blue bladed crystals of the vanadium bearing silicate cavansite from the Wagholi quarry. In one location we found two rare (for India) zeolites, levyne and cowlesite in small vesicles (<10mm) in the matrix rock and I had the even rarer good fortune to find a specimen with both these minerals in the same piece of basalt!

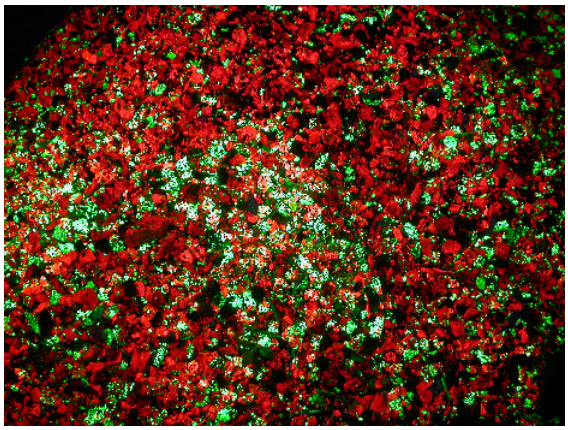


Fig. 3. UV illumination shows the fluorescent zinc mineral willemite(green) in the calcite matrix(red).

The SMLS trip in 2006 to North America took us away from the basaltic minerals of Skye and India to the world's most prolific zinc mine (Franklin and Sterling Hill, New Jersey), the mineral capital of Canada (Bancroft, Ontario) and the famous Mont St. Hilaire quarries in Montreal. All of these locations are stars in the mineral world and are associated with large numbers of different minerals, several of which are "first finds". For example, at Sterling Hill/Franklin over 340 minerals have been found (10% of all known minerals!). Of especial note at Sterling Hill was the night-time collecting with UV lamps, where the ground lit up in spectacular red (calcite) and green (zinc silicate, willemite) (Fig. 3). We also collected wollastonite (SWUV yellow) and norbergite (SWUV golden yellow).

Entering Bancroft in Ontario the road sign proclaims the area "Mineral Capital of Canada" and certainly in the surrounding countryside there are many mineral bearing pegmatites to explore. One of the easiest is found at the side of the road, the Essonville Roadcut, where shiny black blades of fluororichterite can be extracted from the feldspar matrix without much difficulty: I found several attractive little (1-2cm) doubly terminated crystals there. Up at Bear Lake we dug for the world-renowned apatite crystals (Fig. 4), but only found lots of small pieces (Fig. 5): it was clearly a place where you need to dig in for several days looking for the mineral-bearing granite pegmatites. Bancroft was famous for its sodalite mines and this blue silicate and the related pinkish hackmanite were easily found on mine dumps (and both show up clearly at night with UV lamps). While in Bancroft we visited an active rose quartz quarry and a beryl pit and for a small fee did some easy collecting of hand specimens.

Fig. 4. Digging at Bear Lake for apatite.

Our last stop in North America was the Mont St. Hilaire quarries in Quebec 25 miles north east of Montreal, a mecca for microminerals collectors from around the world. Over 350 minerals have been found here, of which 50 have been new minerals. The quarries are now actively worked for road stone, but the enlightened quarry management allows access to mineral collectors 5-6 times a year on specified Sundays under the supervision of the local mineralogical society. Such is the popularity of these days that when we arrived half an hour before the quarry opened there was already a long queue of cars waiting to enter. Inside the quarry the sight of the towering side walls added to the majesty of the place. The geology

of the 100 million year old rocks is very complex (especially to me!) as the environment varies across the quarry to include pegmatites, syenites, xenoliths, breccias, hornfels and limestone. Collecting seriously requires some knowledge of the various rock environments in the quarry as the interesting minerals are microscopic and really requires some reference specimens to help with identification. Fortunately two or three local experts were on hand to tell us about the history of the mineralogical finds there. I did find a number of specimens with small crystals present, but these await serious examination with a microscope and reference materials! On this note it was interesting to observe the Canadians at work: they just collected bucketfuls of small rock specimens from the quarry floor and took them back to their estate cars, returning with fresh buckets. Enquiring of this practice we were told that the winters were long and cold and so these specimens would be investigated under the microscopes then!

Last year (2006) our society decided to visit Bulgaria, based upon the recommendations of the Warrington Mineral Society, who had visited there twice recently. Bulgaria is an active mining country with famous lead mines in the Rhodope mountains (notably Madan) in the South. In the North near Sofia we visited a copper mining pit (Elatzite), a goldmine (Chelopech) and an open iron ore pit (Kremikovtsi). Many small mineral specimens were easily found including shiny chalcopyrite, sharp clear rhombohedral calcite crystals, black stalactitic spires of goethite, black pyrolusite, grey romanechite and small crystals of green fluorite. No gold was found! Down in the South we went down a lead mine (that is a whole story in itself!) in Madan but didn't find any of the unique spinel law twinned galena crystals that Madan is so famous for (we did buy some locally from the miners though). We did collect wonderful large manganocalcite epimorphs of both the scalenohedral and rhombohedral forms of calcite. During our visit we also collected some igneous minerals (andalusite and garnet in attractively crystalline orthoclase feldspar) from a pegmatite half way up a mountain side. And of course we did find some zeolites in a basalt deposit (good crystals of analcime, chabazite twins, clinoptilolite and harmatome).

Fig. 5. Apatite from Bear Lake - before cleaning!

I hope the above accounts give some idea of what mineral collecting can be like when properly organised, especially having some local expertise on hand.

An Irish Odyssey

by Colin Parsons

Like most of you, I suspect, Joan and I were fed up with the "summer" we were having so we decided to go to Ireland. Not just Ireland, but the west coast. As you are probably aware, Ireland is not noted for its sunshine record and the west coast particularly so. Suffice to say that it rained on some part of every day we were there but it was, as the locals called it, "a gentle rain" and knowing that made us feel much better.

I have family in Ireland and know the South East and South West of the country quite well but had never explored the west coast north of the Dingle Peninsula. We considered flying to Limerick and hiring a car but changed our minds and decided to take our own car for the simple reason that we could load it up with wet weather gear, just in case we needed it. Good decision that. We travelled up to Holyhead and over to Dublin by fast Seacat ferry, stayed for two nights, and then drove to Sligo where we settled for a few days. The poet W. B. Yeats is associated with Sligo, much of his writing dealing with the area around Sligo town and in particular

Fig. 1. Bloody Cranesbill.

the adjacent loughs. Sligo town is the second largest urban area in Connacht, after Galway, with fewer than 18,000 inhabitants.

The town is encircled by two mountain ranges, the Dartry Mountains to the north and the Ox mountains to the south. The Dartry range is dominated by Arroo mountain (523 metres) which, together with Ben Bulben, has been described as the botanically richest mountain in Ireland (Fig. 1). The mountains are part of the Upper Carboniferous Dartry limestone plateau and were once completely capped in sandstone and shale which survives only on Arroo. On one of the very few sunny mornings we went to Mullaghmore (Fig. 2) where Lord Mountbatten had a holiday home on the far north coast of Sligo county. It really was a beautiful, sunny day but looking inland we could see Ben Bulben with its top shrouded in cloud about 6 miles away. The map showed a circular road around an amphitheatre formed by Ben Bulben and the adjacent Truskmore mountain which we decided to explore. As we got closer the weather deteriorated until we reached the amphitheatre when it started to rain through a heavy mist, getting progressively darker with heavier rain. The circular road is about five miles long with some very steep gradients and lots of hairpin bends. Throughout its length we did not see a single vehicle or person and the whole experience was rather eerie and felt slightly sinister. As soon as we emerged from the amphitheatre the rain stopped and when we got back to the coast the sun was shining again. It was a marvellous experience of how mountains cause precipitation, but one which we wouldn't be keen to repeat in a hurry.

Fig. 2. Mullaghmore Head, County Sligo.

Our next port of call was Galway about 80 miles from Sligo as the crow flies or 120 miles via a rather circuitous route which took us through County Mayo, the Maumturk mountains and beautiful, rugged Connemara. Once again it rained in the mountains but stopped as soon as we reached the relatively flatlands of Connemara.

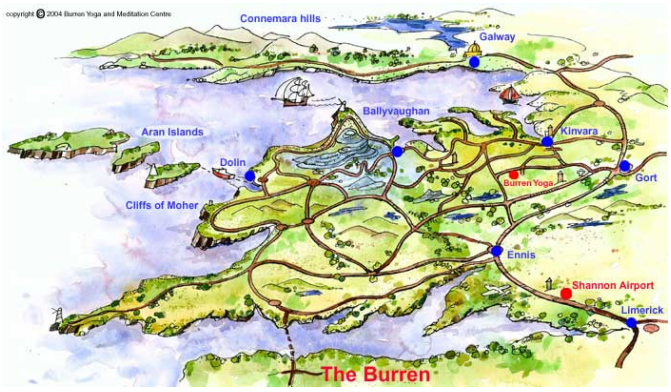


Fig. 3. Map of the Burren.

I had read about the Burren (Figs 3 & 4), which is tucked away in the north-west corner of County Clare, and of its fascinating geology and archaeology, so it was a must for a visit. The name Burren comes from the Gaelic "boireann" meaning a stony place and the area is an upland region of some 300 square miles of exposed Carboniferous limestone known as karst. The scenery, although rather bleak, is also quite beautiful, the flat sedimentary rock having a blue-white colour forming huge areas of limestone pavements (Fig. 5) made up of two separate parts known as clints and grykes. Clints are the blocks of limestone that constitute the paving and grykes are the fissures that isolate the individual clints. The most dominant gryke system runs north to south and there is a secondary, less developed system, at right angles to it. The ones we saw were invariably straight but it appears that they are occasionally curvilinear.

Fig. 4. Limestone pavement at Black Head, the Burren.

Water created the Burren and, strangely, it is slowly destroying it. This can be clearly seen in some of the clints where the water draining from the horizontal tops is cutting ever deeper channels into the shoulders of the clint where it is slowly widening the gryke and under-mining the clint itself. On many clint tops one can see small saucer shaped depressions like shallow pans. These pans can hold water which contains organic material including an algae called Nostoc. This algae exudes a mild acid which further breaks down the limestone forming an even larger depression which

eventually holds soil capable of sustaining plants and grasses. A large collection of Alpine and Mediterranean species grow together in the Burren with some of them, strangely, being lime hating plants.

Fig. 5. Limestone pavement.

There is a long tradition of mining in north-west Clare and detailed maps show many sites of defunct lead and silver mines. Fluorspar is found throughout the Burren and was worked from open-cast sites until the 1960s when the shallow seams were exhausted. Calcite is found in many areas of the Burren and grows in from both sides of the grykes, sometimes completely filling the fissure. But of all the worked deposits of the Burren the mining of phosphate was the largest enterprise using both open-cast and underground techniques. The heyday was during the Second World War which prevented the importation of this fertiliser. Two seams were worked producing approximately 115,000 tons.

The Burren is also Ireland's most important cave area although very few are open to the public, the best known of these being Aillwee cave. Unique to Aillwee are the so-called Bear Pits, hollows scraped out by brown bears which have been extinct in Ireland for over one thousand years. Bear bones have been found in the caves and it is believed that they may have been used as hibernation pits. Most of the limestone formations are very recent in the history of the cave itself, the stalagmites in the Mud Hall being a mere 8,000 years old.

There are more than 70 megalithic wedge tombs and almost 500 forts in the Burren making it Ireland's richest area for these structures. Despite this profusion we were only able to visit one tomb at Creevagh and then managed to leave the camera in the car and so haven't even got a picture of it. We wondered why there are no structures in the Burren similar to the Beehive Huts one sees in the Dingle Peninsula only a hundred miles or so south. These strange igloo-like buildings were in use from around 1,000 BC to as late as 1200 AD and are generally believed to have been habitation sites, sometimes within fort complexes.

Fig. 6. Glengowla mine, ore veins in marble cavern.

The Glengowla Mines are situated about 15 miles north west of Galway City in the rugged Connemara country-side close to Lough Corrib. Glengowla is a 19th century lead and silver mine which had a relatively short commercial life between 1851 and 1865 when it closed. The mining followed ore veins in marble (Fig. 6) which contain calcite and quartz and, of course, some ores, galena being the most abundant. The total production of the mine during its 14 years was 390 tonnes of lead and some 28 kg of silver. The mine is well known amongst mineral collectors for it's beautiful and sometimes rare minerals including quartz, calcite, sphalerite, chalcopyrite and the rare blue-green octahedral fluorite crystals. The mine is owned by the Geoghegan family who have done an enormous amount of work stabilising the surface, pumping out the mine and general repairs to give access to the upper workings.

The mineral vein was discovered when loose lumps of galena were found just below the surface of farmland. The underground tour is fascinating not least for the considerable number of artefacts including ladders, pumps, ore tubs, pulleys, windlasses and timbers. The pitch pine timbers are believed to have been brought back to the west of Ireland by the emigrant "coffin ships" and are still intact today. Coffin ships were so called because they were usually old and often unseaworthy. They tended to be overinsured and therefore worth more to the owners sunk than afloat.

We enjoyed our visit to the west coast of Ireland and are determined to return, having only scratched the surface. All that remained was the 200 mile drive via Limerick, Tipperary and Waterford to the ferry at Rosslare, stopping for a couple of days in Wexford to see the family. We drove just over 1,700 miles in all, the worst being the 320 miles back from Fishguard to Hastings.

Ireland is a lovely country and they couldn't have chosen a better greeting than the traditional "caid mille failte".

Our new Solar System

A review of current ideas on planetary geology with particular reference to Mars

by Gordon Elder

THE PLANETS

Fig. 1. The planets as they are now classified.

The word "**planet**" originates with the Greek term "πλανήτης" (planetes), meaning "wanderer". It has been used for thousands of years to refer to astronomical bodies orbiting the Sun, and more recently around other stars!

However, prior to the 2006 adoption of an official definition by the International Astronomical Union (IAU), there was no formal definition of what constituted a "planet". The resolution adopted by the IAU states that, within the Solar System, a planet is a celestial body that:

(a) is in orbit around the Sun;
(b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape;
(c) has cleared the neighbourhood around its orbit.

As a result of this definition, the Solar System is now considered to have **eight** planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. Those objects which fulfill criteria (a) and (b) but not (c) – Ceres, Pluto and Eris – are categorized as dwarf planets. So, 76 years after its discovery, Pluto has been downgraded from a fully fledged planet to a dwarf planet.

Beyond the Solar System, there have been more than two hundred objects discovered orbiting other stars. The IAU defines these objects as "extrasolar planets" if they:

(i) orbit a star or stellar remnants;
(ii) each has a mass below that required for the thermonuclear fusion of deuterium;
(iii) each fulfills the minimum mass/size requirement for planetary status in the Solar System.

This is a provisional definition which has not been formally adopted. The IAU also has not decided on whether the term "planet" should be extended to free-floating objects of planetary mass outside star systems, except to exclude those in young star clusters.

MARS

I've chosen to go into detail on Mars as it is a planet of great interest to planetary scientists and governments - after all, President Bush has stated that by 2018 Man will be back on the Moon with a further mission to move on to Mars.

Mars is the fourth planet from the Sun and is historically named after Mars, the Roman god of war. Mars is also known as the "Red Planet" due to its reddish appearance when seen from Earth. The prefix areo-, pertaining to the Greek god of war, Ares, refers to Mars in the same way geo- refers to Earth.

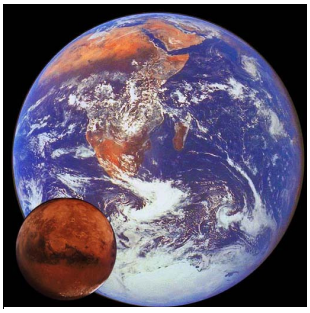


Fig. 2. Earth and Mars in comparative size.

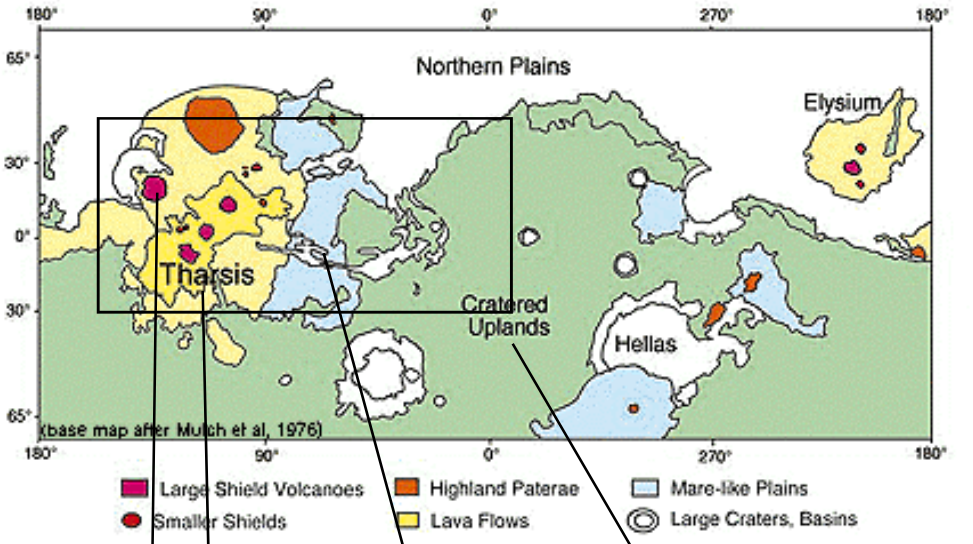
Mars is currently host to four orbiting spacecraft: Mars Global Surveyor, Mars Odyssey, Mars Express, and Mars Reconnaissance Orbiter. This is more than any planet other than Earth. It is also home to the two Mars Exploration Rovers (Spirit and Opportunity).

Geological history of Mars

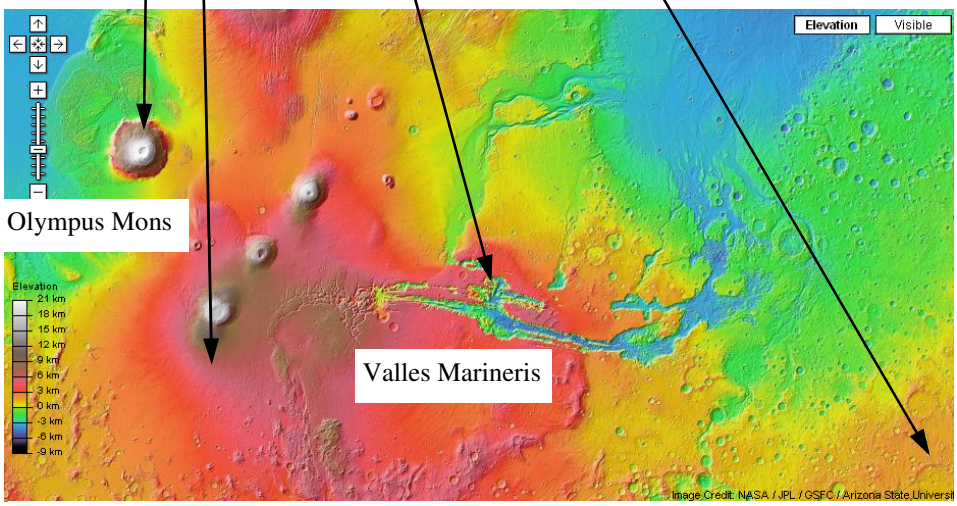
Geologically, Mars is split into three broad epochs:

- **Noachian epoch** (named after Noachis Terra): from the formation of Mars 4,500 million years ago to 3,500 million years ago. Noachian age surfaces are scarred by many large impact craters. The Tharsis bulge (Map 1) is thought to have formed during this period, with extensive flooding by liquid water late in the epoch.
- **Hesperian epoch** (named after Hesperia Planum): 3,500 million years ago to 1,800 million years ago. The Hesperian epoch is marked by the formation of extensive lava plains.
- **Amazonian epoch** (named after Amazonis Planitia): 1,800 million years ago to present. Amazonian regions have few meteorite impact craters but are otherwise quite varied. Olympus Mons (Map 2 & Fig. 3) formed during this period along with lava flows elsewhere on Mars.

Geography of Mars (Areography)



Map 1. Showing major areographical features.



Map 2. Showing major topographical features.

Notable features in the above maps include the Tharsis volcanoes in the west (including Olympus Mons), Valles Marineris to the east of Tharsis, and the Hellas Basin in the southern hemisphere.

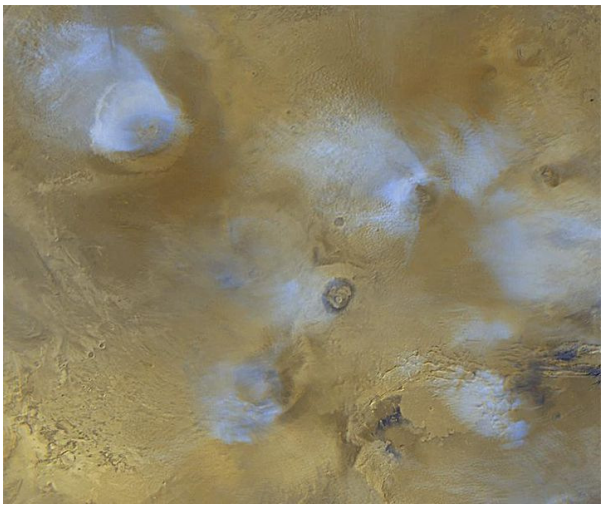


Fig. 3. Tharsis volcanoes in the west (including Olympus Mons).

Olympus Mons, the cloud swept shield volcano situated in the top left corner of this image, stands 27km (about 88,600 feet) high above the mean surface level of Mars (about three times the height of Mount Everest above sea level).

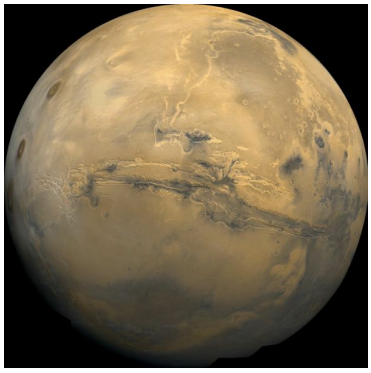


Fig 4. Valles Marineris to the east of Tharsis is the huge scar seen cutting across Mars' equatorial region (see Map 2).

Today, features on Mars are named from a number of sources. The large brighter features retain many of the older names, but are often updated to reflect new knowledge of the nature of the features. For example, Nix Olympica (the snows of Olympus) has become Olympus Mons (Mount Olympus).

Mars' equator is defined by its rotation, but the location of its Prime Meridian was specified, as was Earth's, by choice of an arbitrary point. Mädler and Beer selected a line in 1830 for their first maps of Mars. After the spacecraft Mariner 9 provided extensive imagery of Mars in 1972, a small crater (later called Airy-0), located in the Sinus Meridiani ("Middle Bay" or "Meridian Bay"), was chosen for the definition of 0.0° longitude to coincide with the originally selected line.

Since Mars has no oceans and hence no 'sea level', a zero-elevation surface or mean gravity surface had to be selected. The zero altitude is defined by the height at which there is 610.5 Pa (6.105 mbar) of atmospheric pressure (approximately 0.6% of Earth's).

The differences in Martian topography are striking: northern plains flattened by lava flows contrast with the southern highlands, pitted and cratered by ancient impacts. The surface of Mars as seen from Earth is thus divided into two kinds of areas, with differing brightness. The paler plains covered with dust and sand rich in reddish iron oxides were once thought of as Martian 'continents' and given names like Arabia Terra (land of Arabia) or Amazonis Planitia (Amazonian plain). The dark features were thought to be seas, hence their names Mare Erythraeum, Mare Sirenum and Aurorae Sinus. The largest dark feature seen from Earth is Syrtis Major.

Mars is also scarred by a number of impact craters. The largest of these is the Hellas impact basin, covered with light red sand. Despite being closer to the asteroid belt, there are far fewer craters on Mars compared with the Moon because Mars' atmosphere provides protection against small meteors. Some craters have a morphology that suggests that the ground was wet when the meteor impacted.

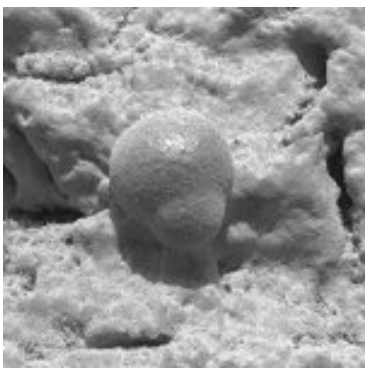


Fig. 5. Photo of microscopic rock forms indicating past signs of water, taken by Opportunity.

The large canyon, Valles Marineris (Map 2) (Latin for Mariner Valleys, also known as Agathadaemon in the old canal maps), has a length of 4,000km and a depth of up to 7km. The length of Valles Marineris is equivalent to the length of Europe and extends for a fifth of the circumference of Mars. Valles Marineris is thought to have formed due to swelling of the Tharsis region which caused the crust in the area of Valles Marineris to collapse. For comparison the Grand Canyon on Earth is only 446km long and nearly 2km deep.

There is evidence that liquid water existed at one time on the surface of Mars. Key discoveries leading to this evidence include the detection of various minerals such as hematite (Fig. 5) and goethite which usually only form in the presence of water.

The red/orange appearance of Mars' surface is thought to be caused by iron(III) oxide (rust). Mars has half the radius and only one-tenth the

Fig. 6. Viking Lander 1 site

mass of the Earth. Its surface area is only slightly less than the total area of Earth's dry land.

The surface of Mars is thought to be primarily composed of basalt, based upon Martian meteorite collections and orbital observations. There is some evidence that a portion of the Martian surface might be more silica-rich than typical basalt, perhaps similar to andesitic rocks on Earth, though these observations may also be explained by silica glass.

Dozens of spacecraft, including orbiters, landers, and rovers, have been sent to Mars by the Soviet Union, the United States, Europe, and Japan to study the planet's surface, climate, and geology.

Internal Geology

Current models of the planet's interior infer a core region approximately 1,480km in radius, consisting primarily of iron with about 15-17% sulphur. This iron sulphide core is partially fluid, with twice the concentration of light elements that exists at the Earth's core. The core is surrounded by a silicate mantle that formed many of the tectonic and volcanic features on the planet, but now appears to be inactive. The average thickness of the planet's crust is about 50km, with no area thicker than 125km.

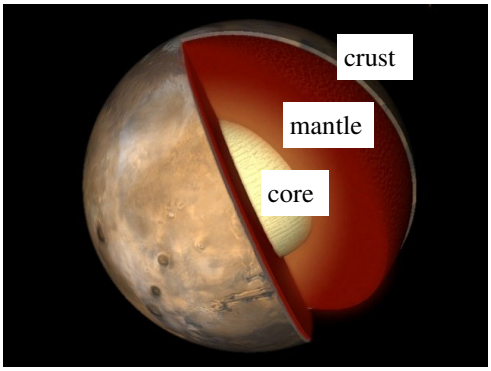


Fig. 7. Mars' internal structure.

Current Missions

Fig. 8. Artist's concept of the 2001 Mars Odyssey.

Following the 1992 failure of the Mars Observer orbiter, NASA launched the Mars Global Surveyor in 1996. This mission was a complete success, having finished its primary mapping mission in early 2001. Only a month after the launch of the Surveyor, NASA launched the Mars Pathfinder, carrying a robotic exploration vehicle, which landed in the Ares Vallis on Mars. This mission was another big success, and received much publicity, partially due to the many spectacular images that were sent back to Earth.

In 2001 NASA launched the successful Mars Odyssey orbiter (Fig. 8). Odyssey's Gamma Ray Spectrometer detected significant amounts of elemental hydrogen in the upper metre or so of Mars' surface. This hydrogen is thought to be contained in large deposits of water ice.

In 2003, the ESA launched the Mars Express craft consisting of the Mars Express Orbiter and the lander Beagle 2. Beagle 2 apparently failed during descent and was declared lost in early February 2004. In early 2004 the Planetary Fourier Spectrometer team announced it had detected methane in the Martian atmosphere. ESA announced in June 2006 the discovery of aurorae on Mars.

Also in 2003, NASA launched the twin Mars Exploration Rovers named Spirit (MER-A) and Opportunity (MER-B). Both missions landed successfully in January 2004 and have met or exceeded all their targets. Among the most significant science returns has been the conclusive evidence that liquid water existed at some time in the past at both landing sites. Martian dust devils (Fig. 9) and windstorms have occasionally cleaned both rovers' solar panels, and thus increased their lifespan.

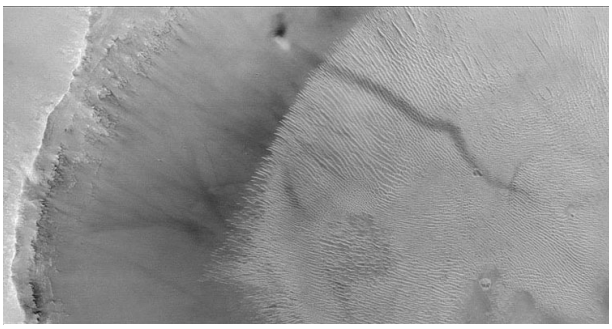


Fig. 9. A dust devil on Mars, photographed by Mars Global Surveyor. The long dark streak is formed by a moving swirling column of Martian atmosphere. The dust devil itself (the black spot) is climbing the crater wall. The streaks on the right are sand dunes on the crater floor.

On August 12, 2005 the NASA Mars Reconnaissance Orbiter probe was launched towards the planet, to conduct a two-year science survey. The purpose of the mission is to map the Martian terrain and find suitable landing sites for the upcoming lander missions. It arrived in orbit on March 10, 2006.

In August 2007 NASA's Phoenix Mars Lander was launched - its purpose to study the history of water on Mars, and the habitability potential of the Martian arctic's ice-rich soil.

Future plans

Future plans for unmanned Mars Exploration include the sending of the Mars Science Laboratory in 2009, followed by the Phobos-Grunt sample-return mission, to return samples of Phobos, a Martian moon. Other missions have been proposed, although not yet confirmed.

Manned Mars exploration by the United States has been explicitly identified as a long-term goal in the Vision for Space Exploration announced in 2004 by US President George W. Bush.

The European Space Agency hopes to land the first humans on Mars between 2030 and 2035. This will be preceded by successively larger probes, starting with the launch of the ExoMars probe in 2011 or more likely 2013, followed by the 'Mars Sample Return Mission'. Likewise, astronauts will be sent to the Moon between 2020 and 2025 in preparation for this mission.

Astronomical observations from Mars

It is now possible, with the existence of various orbiters, landers, and rovers to study astronomy from the Martian skies. In particular, the Earth and the Moon would easily be visible to the naked eye. Also, one could observe the two moons of Mars. The moon Phobos appears about one third the angular diameter that the full Moon appears from Earth, and when it is full it is bright enough to cast shadows. On the other hand Deimos appears more or less star-like, and appears only slightly brighter than Venus does from Earth.

There are also various phenomena well-known on Earth that have now been observed on Mars, such as meteors and aurorae. The first meteor photographed on Mars was on March 7, 2004 by the Spirit rover. Aurorae occur on Mars, but they do not occur at the poles as on Earth, because Mars has no planet wide magnetic field. Rather, they occur near magnetic anomalies in Mars's crust, which are remnants from earlier days when Mars did have a magnetic field. They would probably be invisible to the naked eye, being largely ultraviolet phenomena.

A transit of the Earth as seen from Mars will occur on November 10, 2084. At that time, the Sun, Earth and Mars line up. There are also transits of Mercury and transits of Venus, and the moon Deimos is of sufficiently small angular diameter that its partial "eclipses" of the Sun are best considered transits.

Viewing Mars from Earth

To a naked-eye observer, Mars usually shows a distinct yellow, orange or reddish colour, and varies in brightness more than any other planet. Approximately every 26 months opposition occurs, which is when Mars is nearest to Earth. At its most favourable, Mars shows a wealth of surface detail through a telescope. Especially noticeable, even at low magnification, are the polar ice caps (Fig. 10).

Fig. 10. Mars, 2001, with polar ice caps visible.

The next Mars opposition will occur on December 24, 2007, and in August 2003, Mars made its closest approach to Earth in nearly 60,000 years. The last time it came so close is estimated to have been on September 12, 57,617 BC in the Middle Palaeolithic. Due to metrological and astronomical data being slightly inaccurate at that time I cannot give any details of it being observed!

I look forward to my next viewing of Mars, be it through a telescope, in a book, on CD/DVD or on the internet – I hope this article will inspire you to do the same.

General references:

www.nasa.com

www.space.com

www.esa.com

www.wikipedia.org

A new sauropod dinosaur from Hastings

by Peter Austen

As many of you may be aware from reports in both the regional and national media in mid-November, Hastings now has a brand new dinosaur. The dinosaur, known only from a single dorsal vertebra (Figs 1, 2 & 3), has been described in *Palaeontology* (Taylor & Naish, 2007), the journal of the Palaeontological Association. It has been named *Xenoposeidon proneneukus*, and it is thought that the vertebra belonged to an elephant-sized herbivorous dinosaur with a long neck and tail and a small head (Fig. 4), looking a bit like *Apatosaurus*, *Diplodocus* or *Brachiosaurus*, and is around 130 million years old.

Fig. 1. Partial dorsal vertebra from which Xenoposeidon proneneukus *was named. Height of preserved portion of vertebra is 30 cm (1 foot).*

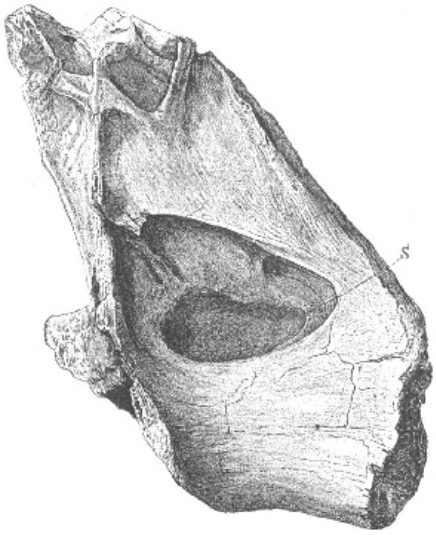


Fig. 2. Original drawing of vertebra in Lydekker's 1893 paper (Lydekker, 1893).

The vertebra was found by Philip James Rufford in the late 1800s, and eventually found its way to the Natural History Museum, where it was first illustrated by Richard Lydekker in 1893 (Fig. 2) (Lydekker, 1893), who suggested that it may be referable to the Wealden sauropod *Morosaurus brevis*.

Philip Rufford was the local Hastings collector who amassed a large collection of fossil plants from the Hastings area which formed the basis of Albert Seward's two volumes on Wealden fossil plants (Seward, 1894 & 1895). It is thought that the vertebra was found in the area around Ecclesbourne Glen, but as with the fossil plants, detailed records were not kept of the localities, and most are only recorded as Ecclesbourne.

The vertebra was rediscovered by Mike Taylor, a specialist in sauropod vertebrae, in the Natural History Museum collections in January 2006, 113 years after it was last figured by Lydekker. He contacted Darren Naish (who gave a lecture to our Society in January 2006), and after much work and research they produced a paper describing the new species (Taylor & Naish, 2007).

What is so unusual about the vertebra is that it is clearly a sauropod (strictly speaking a neosauropod), but it is totally different from any other sauropod vertebra so far found, and cannot be placed within any existing family. The genus name *Xenoposeidon* means 'alien sauropod' because it is so different from any known sauropod, and the species name '*proneneukus*' means 'forward sloping' after one of the bone's most distinctive and unusual features - the upper part of the bone (the neural arch) slopes forward.

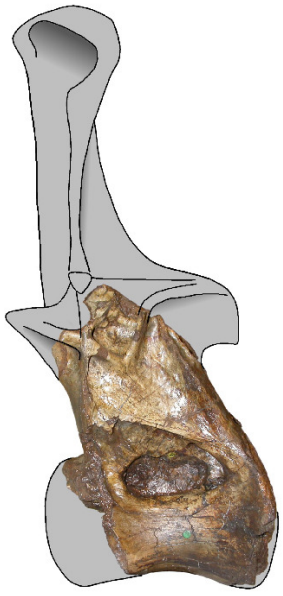


Fig. 3. Reconstruction of complete dorsal vertebra.

The Hastings area appears to be enjoying rather a glut of sauropod dinosaurs recently (well, two is a glut when you're talking about sauropods). In the last issue (*H&DGS Journal*, Dec 2006, Vol. 12, p.24) we reported on the recent

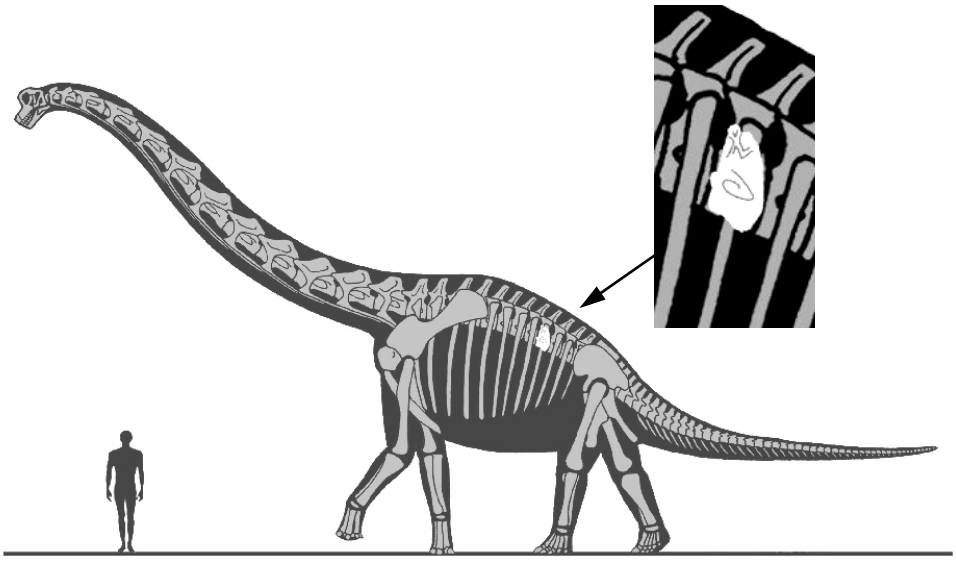


Fig. 4. A guess at the size and shape of the whole dinosaur (not to be taken too seriously), showing where the bone would have been positioned.

discovery of a diplodocid metacarpal (toe-bone) from Bexhill, the identification of which has since been confirmed by Matt Bonnan (Darren Naish's blog - Feb 25, 2006). In his blog on *Xenoposeidon* (Darren Naish's blog - Nov 15, 2007) Darren also reiterates the view he put forward in his lecture to us that the dinosaurs from Hastings and the surrounding region might now equal or exceed the Isle of Wight in terms of different species. There's almost certainly more out there along the Hastings coastline to be found, so keep on looking!

The original article can be downloaded from the 'Palaeontology Publications' section of Mike Taylor's website (http://www.miketaylor.org.uk/dino/pubs/), where you will also find a copy of the press release from which the pictures used in this article have been taken. There is also an excellent article on the find on Darren Naish's blog site (http://scienceblogs.com/tetrapodzoology/).

References

Lydekker, R. 1893. On a sauropodous dinosaurian vertebra from the Wealden of Hastings. *Quarterly Journal of the Geological Society, London*, **49**, 276-280.

Seward, A.C. 1894. *The Wealden flora I. Thallophyta–Pteridophyta.* Catalogue of the Mesozoic plants in the Department of Geology, British Museum (Natural History), xxxvii + 179 pp., 11 pls. (London).

Seward, A.C. 1895. *The Wealden flora II. Gymnospermae.* Catalogue of the Mesozoic plants in the Department of Geology, British Museum (Natural History), xii + 259 pp., 20 pls. (London).

Taylor, M. P. & Naish, D. 2007. An unusual new neosauropod dinosaur from the Lower Cretaceous Hastings Beds Group of East Sussex, England. *Palaeontology*, **50**, 1547-1564.

Extracts from '*Wealden News*'

by Peter Austen

Introduction

Wealden News is a newsletter produced by myself and Ed Jarzembowski, which covers items of interest relating to the Wealden deposits of southern England that may not necessarily be covered in the scientific or national press. These can be new fossil finds, reports on stratigraphy or new publications. Below are extracts from the September 2007 issue of *Wealden News* (No. 7) that have a local interest to the Hastings & District Geological Society. Any website references have been updated.

The full version can be accessed by going to www.kentrigs.org.uk/newflash.html, scrolling down the page to "Wealden News" and clicking on "Wealden News No7". The file is in pdf format, 18 pages long, and is 8.9MB, and without broadband could take between 45 minutes and an hour to download. Alternatively it

can be downloaded at your local library, all of which are now equipped with computers with internet access for use by the general public. Unfortunately this was the smallest the file could be made without compromising picture quality - the original was 23MB.

A smaller version of Wealden News No.6 (May 2005) is also still available at the same web address (reduced from 7.6MB to 3.8MB).

New Wealden plant from Hastings

A new Wealden plant from Hastings has recently come to light. The fossil frond is from the Hastings Beds and was found by Rod White in 1957 in the vicinity of Ecclesbourne Glen, east of Hastings. The 20-cm section of frond (Fig. 1) appears to be a bennettitalean and is similar in gross morphology to the Middle Jurassic bennettitalean *Otozamites parallelus* (Harris, 1969, p.34, fig. 14) from the Lower Deltaic Series of Yorkshire, and is unlike the only species of *Otozamites* recorded from the Lower Cretaceous Hastings Beds. This is *Otozamites titaniae* (Watson & Sincock, 1992, p.39, fig. 21) which is only known from a single specimen, collected from Ecclesbourne by the Victorian collector Mr Philip Rufford in the late 19th century. However, the main features used to separate different species of Bennettitales are the stomatal and cuticular structures, rather than gross morphology so the jury is still out. Of the 130 or so species of fossil plant recorded from the Wealden, around 90% occur as macrofossils only at Hastings, and a considerable number of these are only known from a few specimens. Most of these plants were collected in the late 19th and early 20th century, and although exact localities were not published, Ecclesbourne is one of the more common locations given (Seward, 1894, 1895).

Are there any more new Wealden fossil plants out there in people's collections waiting to be discovered? If you think you may have something unusual from the Wealden, please contact us.

Fig. 1. New Wealden plant, possibly Otozamites *sp. nov. (length of specimen 20 cm).* *Photo: Peter Austen*

References

HARRIS, T.M. 1969. *The Yorkshire Jurassic flora, III. Bennettitales*. British Museum (Natural History), London, vi + 186 pp., pls 1-7.

SEWARD, A.C. 1894. *The Wealden flora I. Thallophyta–Pteridophyta.* Catalogue of the Mesozoic plants in the Department of Geology, British Museum (Natural History), xxxvii + 179 pp., 11 pls. (London).

SEWARD, A.C. 1895. *The Wealden flora II. Gymnospermae.* Catalogue of the Mesozoic plants in the Department of Geology, British Museum (Natural History), xii + 259 pp., 20 pls. (London).

WATSON, J. & SINCOCK, C.A. 1992. Bennettitales of the English Wealden. *Monograph of the Palaeontographical Society*, **588**, part of volume 145 (for 1991), 228 pp., pls 1-23.

Peter Austen

Hastings braincase confirmed as ankylosaur

In issue no. 6 (May 2005; Anon., 2005), we reported on the discovery by Alan Prowse of a dinosaur braincase (endocranium) from Hastings. Since the publication of this article in 2005 Dr Paul Barrett of the Natural History Museum has confirmed that the braincase is that of an ankylosaur, and Alan has kindly agreed to donate the specimen to the Natural History Museum. This is an extremely important specimen as there are no known fossils of the skull or braincase of Wealden ankylosaurs. We look forward to hearing about what it tells us concerning dinosaur cerebral activity!

Reference

ANON. 2005. Dinosaur braincase from Hastings. *Wealden News*, 6, 2.
http://www.kentrigs.org.uk/newflash.html

'*Iguanodon*' *atherfieldensis* renamed

That old favourite of the English Wealden dinosaurs '*Iguanodon*' *atherfieldensis* has been renamed. Gregory Paul (2006) argues that the differences between the gracile '*Iguanodon*' *atherfieldensis* and the more robust *Iguanodon bernissartensis* are sufficient to warrant a new genus, and he has proposed that '*Iguanodon*' *atherfieldensis* be renamed ***Mantellisaurus atherfieldensis***.

Reference

PAUL, G.S. 2006. Turning the old into the new: A separate genus for the gracile iguanodont from the Wealden of England. In CARPENTER, K. (ed.). *Horns and Beaks - Ceratopsian and Ornithopod Dinosaurs*. Indiana University Press, 69-77.

Crocodile or *Baryonyx*?

When Bill Walker picked up and cracked open a nodule in a Surrey claypit in 1983, little did he know that his find would still be having repercussions nearly 25 years later (and very likely far beyond). The story of Bill Walker's find has been told many times – inside the nodule was a 31 cm claw from a large predatory dinosaur. When the claw was taken to the Natural History Museum, its importance was immediately recognised, and following a reconnaissance of the site, an excavation was planned and undertaken at the first available opportunity. The claw was from a new kind of flesh-eating dinosaur, and around 65% of the skeleton was recovered. It was named *Baryonyx walkeri* – *Baryonyx* from the Greek for 'heavy claw', and *walkeri* in honour of its discoverer, Bill Walker. It was the most complete specimen of a theropod dinosaur ever discovered in Britain, and was one of the most important European dinosaur finds of the 20th century. Together with fossils from Africa it proved to be the key to the understanding and re-interpretation of the group of dinosaurs known as the spinosaurs, and is often referred to as their 'Rosetta Stone'. Recently, an article in *The Times* (Smith, 2006) reported that the Natural History Museum has been looking at the Wealden crocodile teeth in their collections, and have found that an estimated 10% of them are actually from *Baryonyx*, including some that were collected in early Victorian times. This re-identification would not have been possible if Bill Walker hadn't made his spectacular discovery almost 25 years ago, and it should encourage people to look again at any Wealden crocodile teeth they may have in their collections to check if any are actually *Baryonyx* teeth.

Baryonyx teeth can only be distinguished from crocodile teeth under a microscope. There are very fine serrations (also referred to as denticles) along one edge of the tooth, at approximately 7 serrations per millimetre (see McGirr, 2000, p.185, figs., Charig & Milner, 1997, p.30, fig. 19, Austen, 2005, p.7, figs 21 & 22).

Acknowledgements

Thanks to Gordon Alchin for bringing to my attention *The Times* article of the 30th June, 2006.

References

AUSTEN, P.A. 2005. Smokejacks fieldwork 2001-2004. *Wealden News*, 6, 6-8.
http://www.kentrigs.org.uk/newflash.html

CHARIG, A. J. & MILNER, A. C. 1997. *Baryonyx walkeri*, a fish-eating dinosaur from the Wealden of Surrey. *Bulletin of the Natural History Museum (Geology)*, **53**(1), 11-70.

McGIRR, N. 2000. *Nature Connections – An exploration of natural history*. The Natural History Museum, London, 212 pp.

SMITH, L. 2006. Dinosaur has means to be mother of all meat-eaters. *The Times – 30th June, 2006*.

Peter Austen

More Wealden otoliths

In issue no. 6 (May 2005; Anon., 2005), we reported on the first record of an otolith (fish ear stone) from the Wealden, found at Warnham Brickworks in early 2005 by Geoff Toye. Since then many more have been recovered.

Fig. 2. Slab of shelly limestone from Clockhouse containing around 50 scattered otoliths. *Photo: Peter Austen*

Fig. 4. Otolith from slab in fig. 2. *Photo: Peter Austen*

Fig. 5. Otolith from slab in fig. 2 showing surface mineralisation. *Photo: Peter Austen*

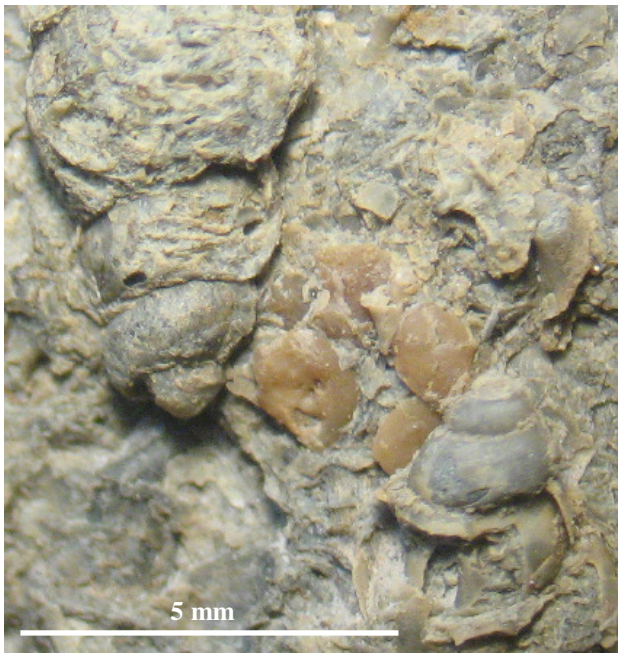


*Fig. 3. Cluster of otoliths between two gastropods (*Viviparus *sp.) from slab in fig. 2.* *Photo: Peter Austen*

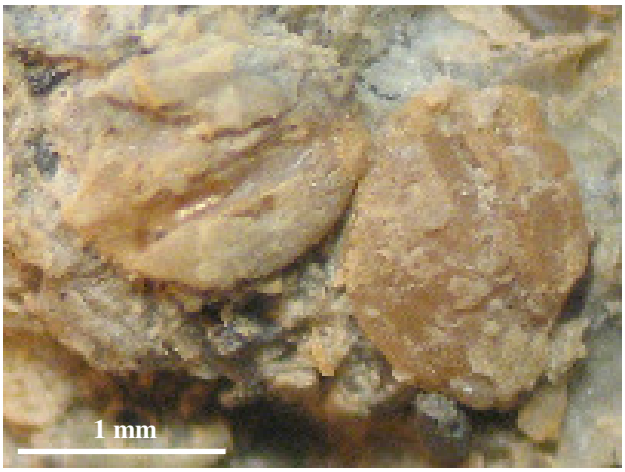


Fig. 6. Pair of otoliths from slab in fig. 2. *Photo: Peter Austen*

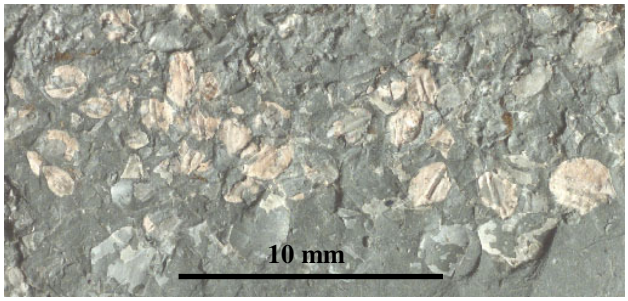


Fig. 7. Numerous partially decalcified fish otoliths from Worssam's Bed 21 at Clockhouse. *Photo: Terry Keenan*

On the Geologists' Association Wealden excursion to Warnham Brickworks in July 2005 one of our aims was to identify the bed from which these otoliths came. Additional specimens were found about half way up the Southeast face of the pit, and although they were not *in situ*, it confirmed that they occur above BGS Bed 2a (Toye *et al.,* 2005). The excursion also included a visit to Clockhouse Brickworks. The sections exposed at Clockhouse are stratigraphically above those at Warnham, but despite this, more otoliths were found, making this the second locality for otoliths in the Wealden (Toye *et al.,* 2005). They were recovered from the floor of the pit, not *in situ*, but close to Worssam's Bed 21. On a follow up visit to Clockhouse in October 2005, Richard Agar found a 14 cm x 7 cm slab of shelly limestone on the eastern flank of the pit, about 2 m above Worssam's Bed 21. The slab (Fig. 2) contained around 50 scattered otoliths (Figs 3 to 6 show a representative sample). Also, on the GA Wealden excursion to Clockhouse in July 2006, Biddy Jarzembowski found an *in situ* bed of abundant partially

decalcified otoliths in Worssam's Bed 21 (Fig. 7) (Jarzembowski *et al.,* 2006). These were unusual in that all previous otoliths have been found in shelly limestones and have been of a fairly substantial nature (Anon., 2005, fig. 9; Toye *et al.,* 2005, fig. 3 and figs 3 to 6 herein) whereas Biddy's finds (Fig. 7) were fragile and partially decalcified and were contained in a grey shaley mudstone with partings packed with ostracods, *Viviparus* and fish debris (Jarzembowski *et al.,* 2006).

Rory Mortimore (pers. comm.) has further reported that fish otoliths were recorded from an exposure of Weald Clay at Small Dole, West Sussex in the 1970s.

It now appears that providing conditions for preservation are right, otoliths are probably common throughout the Lower Weald Clay.

References

ANON. 2005. Warnham otolith. *Wealden News*, 6, 3.
http://www.kentrigs.org.uk/newflash.html

JARZEMBOWSKI, E.A., AUSTEN, P.A., AGAR, R., TOYE, G. & KEENAN, T.J. 2006. Wealden field meeting - Clockhouse, Historic Horsham Stone & Smokejacks - 22nd July, 2006. *GA (Magazine of the Geologists' Association)*, **5**(4), 8-10.

TOYE, G., AGAR, R., AUSTEN, P.A. & JARZEMBOWSKI, E.A. 2005. Wealden field meeting – Warnham & Clockhouse – 23rd July 2005. *GA (Magazine of the Geologists' Association)*, **4**(4), 14-15.

Peter Austen

Editor's note - Otoliths have so far only been found at Warnham and Clockhouse, both in the Lower Weald Clay, and although they are not local to Hastings, I have included this article because there is no reason why they shouldn't also be found in the deposits at Hastings. It's unlikely they will be present there in the same abundance as in the Weald Clay because the lithology of the two deposits is quite different, nevertheless it would be worth keeping an eye open for them. Let's not forget that until just over 2 years ago they had not been recorded from the Weald.

Palaeontology in the News

A review of recent research and discoveries

Edited by Peter Austen

Introduction

The following is a summary of recent research and discoveries in or associated with palaeontology. Where possible I have included enough detail (i.e. species name, author, etc.) to allow for a search of the internet for further information. In most cases more information is available, including an abstract of the paper, press releases, and quite often if you go to the author's own website you may be able to obtain a copy of the original paper. If you do not have a computer at home, all libraries in the UK are now equipped with computers with internet access for use by the general public.

Seawater temperature in the Precambrian

Cherts, dense silicaceous rocks containing microcrystalline quartz, are among the best preserved ocean sediments in the geological record, and they cover the period from 3.5 billion years ago to the present. Past research using the oxygen isotope ratios of cherts has implied a gradual cooling of the ocean temperature over the Precambrian period from 3.5 billion years ago to 800 million years ago, but this has been questioned because the oxygen isotope signature could have been reset by hydrothermal fluids after deposition. Two French scientists have now used the silicon isotopic composition of these cherts to estimate ocean temperatures over this period and their findings are in remarkable agreement with the earlier estimates based on oxygen isotope ratios (*Nature*, 2006, Vol. 443, p.969-972). Their work implies that seawater temperatures changed from around 70^0C 3.5 billion years ago to around 20^0C 800 million years ago. However, because of the possible effect this would have in impeding the development of early multicellular animal life, sceptics of the 'hot-tub' Precambrian sea still remain unconvinced.

Devonian lampreys

In the last issue (*H&DGS Journal*, Dec 2006, Vol. 12, p.23) we reported on the discovery of a Cretaceous

fossil lamprey from China, which showed that by the Cretaceous the lamprey had assumed its modern form. Prior to this only two fossil lampreys were known, both from the Carboniferous of North America and dated at between 300 and 330 million years old. It was thought that the lampreys were descended from the now extinct armoured jawless fish (ostracoderms), but a recent discovery of a 360 million year old well preserved fossil lamprey in the Devonian of South Africa has cast doubt on this (*Nature*, 2006, Vol. 443, p.981-984). The fish, named *Priscomyzon riniensis*, shows a number of features of the modern forms and is in fact closer to the modern lampreys than the North American Carboniferous specimens. It shows that the lampreys' morphology has remained remarkably stable for 360 million years, and also implies that rather than being descended from the ostracoderms, they actually shared the Devonian seas with them, and any relationship goes much further back.

Plesiosaurs were bottom feeders

The plesiosaur, a marine reptile that lived in the Jurassic seas 160 million years ago had a two metre neck (the length of its body and tail combined), and the reason for such a long neck has always puzzled palaeontologists. Leslie Noè of the Sedgwick Museum, Cambridge has come up with an answer (*New Scientist*, 2006, Vol. 192, No. 2576, p.17). He studied fossils of the plesiosaur *Muraenosaurus*, particularly the articulation of the neck bones and concluded that they used their necks to reach down and feed on soft-bodied animals living on the sea floor – the small skulls of plesiosaurs could not cope with hard-shelled prey. He also concluded that the plesiosaur could not lift its head up out of the water, disappointing supporters of the plesiosaur as a candidate for the Loch Ness Monster! He reported his findings to a meeting of the Society of Vertebrate Palaeontology in Ottawa, Canada.

Oxygenation of Earth's atmosphere

Oxygenation of the Earth's surface is thought to have occurred in two main steps. The first was around 2.3 billion years ago, and saw a significant increase in oxygen levels, and the second, less studied, occurred between 800 and 540 million years ago. A team of American scientists has now studied the carbon and sulphur isotope records from sediments in the Sultanate of Oman covering the period 635-542 million years ago (*Nature*, 2006, Vol. 444, p.744-747). Their research suggested that there were three distinct stages of oxidation within this period, and the second stage, around 575 million years ago, involved the oxidation of a large reservoir of organic carbon suspended in the deep ocean and appears to have corresponded with the evolution of complex life in the Ediacaran.

Jurassic/Cretaceous gliding mammals from China

A recent discovery in China has put back the record of gliding flight in mammals by around 70 million years to 130 million years ago (*Nature*, 2006, Vol. 444, p.889-893). The discovery from the Jurassic/Cretaceous Daohugou beds in Inner Mongolia, China, is of a squirrel-sized mammal named *Volaticotherium antiquus* and is different from any other known Mesozoic mammal. It had a set of sharp teeth suitable for eating insects and a fold of body skin membrane used for gliding flight. The skin membrane was covered in hair and supported by elongated limb bones and tail. The discovery shows that gliding mammals were around when the first birds were evolving, and that even at this early stage in their evolution the mammals were living extremely diverse lives.

Triassic amber

The largest known deposit of 220 million year old Triassic amber has been discovered in the Italian Dolomites (southern Alps) (*Nature*, 2006, Vol. 444, p.835). The amber contains microbes, many of which can be assigned to present day genera – finds of amber older than 135 million years are rare and none have previously been found with microbial inclusions. They contain bacteria, fungi, algae and protozoans. Until now the fossil record of these organisms has been poor and this new find shows that whereas higher animals have been shaped by environmental changes (i.e. major extinctions, etc.) the microbes have changed very little over this period.

Cambrian invertebrate eggs

500 million year old invertebrate eggs have been recovered from deposits of silty shales from the Kaili Formation in the Guizhou province of China (*Geology*, 2006, Vol. 34, p.1037-1040). A team led by Jih-Pai Lin of Ohio State University in Columbus, USA, used X-ray imaging to study the eggs. The eggs,

from the Middle Cambrian, were preserved three-dimensionally in silica and even reveal cells in the act of dividing. It is hoped that the discovery will shed new light on the life histories of the early marine invertebrates that produced the eggs, and it also raises the possibility of finding other fossil embryos in similar deposits.

Extracting DNA from fossils

Recent work by a team of French and Spanish scientists has shown that to stand the best chance of extracting DNA from fossil bones they need to be put into cold storage as soon as they are discovered (*Proceedings of the National Academy of Sciences*, 2007, Vol. 104, No. 3, p.739-744). They found that freshly recovered samples yielded six times more DNA than those stored in museums – this is attributed to washing, chemicals and warm storage.

Early flight control

Researchers in America have taken a step towards understanding how flying birds evolved from non-flying ancestors (*Nature*, 2007, Vol. 445, p.307-310). They have identified a shoulder ligament (acrocoraco-humeral ligament) that stabilizes the wing against downward dislocation, and as it is non-muscular, it does so without effort. This ligament is either missing or poorly developed in early birds (i.e. *Archaeopteryx*), so they would have needed to use muscular effort to sustain flight. Intermediate stages have also been found in early birds.

Gliding dinosaurs

According to a new interpretation of the feathered dinosaur *Microraptor gui* put forward by the palaeontologist Sankar Chatterjee (Texas Tech University, Lubbock, USA) the animal flew much like a WW1 biplane (*Proceedings of the National Academy of Sciences*, 2007, Vol. 104, No. 5, p.1576-1580). It had previously been suggested that *Microraptor* spread its arms and legs to form two pairs of gliding wings on the same level, but Chatterjee argues that *Microraptor's* legs could not be splayed sideways and that it would have been more aerodynamically efficient to hold its legs under its body like modern day avian raptors, so that the long leg feathers stuck out to the side giving a similar configuration to a biplane.

Raptor's opposable fingers

Dinosaurs are often portrayed as grabbing their prey with their mouths, but work by Phil Senter of Lamar State College in Orange, Texas, USA, claims that the small predatory dinosaur *Bambiraptor* actually had opposable fingers (*Journal of Vertebrate Palaeontology*, 2006, Vol. 26, Issue 4, p.897-906). He compared the arm movements of *Bambiraptor* with another well-preserved dromeosaur, *Deinonychus*, and although both could hold prey in their arms and use them to bring the prey to their mouth, *Bambiraptor* could also put the tips of the outer two of its three fingers together, similar to the way a human can touch the tip of the thumb to the tip of the third finger, enabling it to impale prey from both sides.

Snakes from lizards

In the last issue (*H&DGS Journal*, Dec 2006, Vol. 12, p.23) we reported on the discovery of a fossil snake from the Cretaceous of Argentina that led researchers to believe that snakes had a terrestrial origin. Scientists from Italy and Canada have recently described a fossil lizard in the process of limb reduction (*Journal of Vertebrate Palaeontology*, 2007, Vol. 27, p.1-7). The marine lizard, named *Adriosaurus microbrachis*, lived about 95 million years ago and had greatly reduced forelimbs and supporting skeletal girdle and also an elongated neck, as seen in today's snakes. More fossils are now needed to fill in the evolutionary gaps between lizards and snakes.

Burrowing dinosaurs

Researchers in the US have discovered the jumbled remains of an adult dinosaur and two juveniles in what appears to be a custom-built burrow in southern Montana, USA, providing the first evidence that dinosaurs burrowed, and also lending support to the idea that some dinosaur parents cared for their young (*Proceedings of the Royal Society, Series B, Biological Sciences*, 2007, Vol. 274, No. 1616, p.1361-1368). The two metre long burrow appears to have been filled with mud during a flood event. The animal had a broad snout and powerful shoulders well adapted for digging and has been named *Oryctodromeus cubicularis*.

Darwin's delay in publishing '*On the Origin of Species*'

It has long been held that the 20 year gap between Charles Darwin formulating his theory in 1837 and publication of '*On the Origin of Species*' in 1859 was because he feared an outcry from the establishment, and that he was loath to publish a theory that so obviously contradicted religious beliefs at the time about the Creation. Now John van Wyhe, a science historian at the University of Cambridge, UK, has trawled through the letters, notes and books written by, to or about Darwin and has concluded that this was not the case (*Notes and Records of the Royal Society,* 2007, Vol. 61, p.177-205). Van Wyhe found that throughout this period he continually communicated his belief that species could change to friends, family and colleagues – not the action of someone scared to reveal their beliefs. In fact the first time this reluctance to publish appeared in print was in a popular book published in 1948. Van Wyhe believes that Darwin used the 20 year gap to publish outstanding works, build up a mass of data to support his theory and also to solve major stumbling blocks. This together with a busy personal life and poor health easily filled the years. Basically, rather than rush into publication, he just didn't publish until he was ready.

No Snowball Earth

The current Snowball Earth theory holds that the planet was locked in a complete glaciation for tens of millions of years. Work by Philip Allen from Imperial College London and colleagues studying chemical weathering in sedimentary rocks from Oman between 630 and 640 million years old, showed both glacial and warm periods, but the changes from hot to cold happened too quickly for the oceans to freeze over as predicted by the Snowball Earth theory (*Geology*, 2007, Vol. 35, p.299-302).

Early plate tectonics

The hunt for signs of the earliest life on Earth in 3.8 billion year old rocks in south-western Greenland has instead found evidence of plate tectonics (*Science*, 2007, Vol. 315, No. 5819, p.1704-1707). Prior to this work by Harald Furnes of the University of Bergen in Norway and colleagues, the earliest evidence for plate tectonics was from 2.5 billion year old "ophiolites", a distinctive sequence of rocks from the ocean floor that end up on land as a consequence of plate tectonics. The new discovery suggests that plate tectonics had already begun at least 3.8 billion years ago.

The rise of the mammals – Part 1

It has long been thought that the demise of the dinosaurs 65 million years ago allowed for the evolutionary explosion of modern mammals, but recent work by Olaf Bininda-Edmonds of the Technical University of Munich, Germany, and colleagues shows that there was an evolutionary explosion of mammals about 95 million years ago, while dinosaurs were still very much in their prime (*Nature*, 2007, Vol. 446, p.507-512). Rather than relying just on the fossil record Bininda-Edmonds and his colleagues used fossils, present day mammalian DNA and statistical estimations. He also found that the demise of the dinosaurs in fact had very little impact on the mammals, and that there was a second burst of diversification about 50 million years ago which gave rise to the more advanced modern-day mammals.

Crown found for earliest tree

The earliest evidence for forest communities comes from 385 million year old fossil tree stumps named *Eospermatopteris* from the Gilboa fossil forest in Upstate New York, USA. However, until now their affinities were unknown because no aerial portions of the tree had been found. This has changed with the discovery of a spectacular fossil tree from Schoharie County, New York, USA (*Nature*, 2007, Vol. 446, p.904-907). The discovery was of a trunk of *Eospermatopteris* more than 8 metres in length, crowned by a previously known plant *Wattieza*, which although unrelated looked very similar to a modern day tree fern. This complete fossil of a tree-like fern will now allow palaeobotanists to reconstruct the world's first forests.

Ancient lava fossils dated

Microscopic fossils have been found in 3 billion year old pillow lavas from the Pilbara Craton of western Australia (*Geology*, 2007, Vol. 35, p.487-490). The fossils are microscopic tubular structures, which contain traces of organic carbon, and appear identical to those left in basaltic rocks by modern microbes.

Lumbering *T.rex*

Tyrannosaurus rex could run at up to 40 km per hour, but biomechanical calculations reveal that because of its long tail the 8 tonne beast would have taken a ponderous 2 seconds to change direction, more than enough time for more agile potential prey to swerve and escape (*Journal of Theoretical Biology*, 2007, Vol. 246, p.660-680).

Gigantic bird-like dinosaur from China

The small bird-like carnivorous dinosaurs known as the oviraptors rarely exceeded 40 kg in weight. However, a giant dinosaur belonging to this group has been discovered in Late Cretaceous deposits in Inner Mongolia, China (*Nature*, 2007, Vol. 447, p.844-847). The dinosaur, named as *Gigantoraptor erlianensis*, weighed in at 1,400 kg.

The rise of the mammals – Part 2

Another team of researchers describe a newly discovered fossil mammal from the Late Cretaceous of Mongolia (*Nature*, 2007, Vol. 447, p.1003-1006). The team, led by John Wible of the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, USA, have named the 75 million year old mammal *Maelestes gobiensis*, and at the same time have taken the opportunity to re-analyse the morphology of Cretaceous mammals. Contrary to the results in the previous article (see "*The rise of the mammals – Part 1*", page **19**), which was partly based on molecular analysis, they place the 'explosive' evolutionary origin of the placental mammals at the K/T boundary, just after the dinosaurs had become extinct. The debate rumbles on!

Mammoth find

A 10,000 year old mammoth has been found in the permafrost of north-west Siberia (*Nature*, 2007, Vol. 448, p.237; *New Scientist*, 2007, Vol. 195, No. 2612, p.5). The mammoth is a 6 month old calf and is one of the best-preserved mammoths to be found. It has been sent to Japan, where scientists are hoping to use its DNA to clone a mammoth.

Cretaceous roadrunner

A fossil trackway found in the Shandong province of China is thought to be that of a fleet-footed bird (*Naturwissenschaften*, 2007, Vol. 94, p.657-665). The discovery, dated at 110 million years old, predates previously described avian runners by 50 million years. The trackway, originally described two years ago as those of a shore bird and named *Shandongornipes* has been re-analysed by Martin Lockley of the University of Colorado, USA, and his colleagues, and they found that the bird had feet like a roadrunner, with two toes pointing forward and two pointing backward. Based on the distance between the tracks and the estimated height of the bird its speed was estimated to be around 8 km per hour.

Dinosaurs lived alongside archosaurs

It has long been thought that the dinosaurs came to prominence after a mass extinction, which wiped out the more primitive archosaurs. However, recently discovered fossils at Ghost Ranch in New Mexico, USA, show that they actually lived alongside each other for about 10 million years (*Science*, 2007, Vol. 317, No. 5836, p.358-361). The deposits from New Mexico cover a period from 220 to 210 million years ago, a period that was thought to be the sole preserve of the archosaurs, but the deposits yield a mix of both archosaurs and true dinosaurs, some of them new species. This implies that rather than the archosaurs being wiped out in a single mass extinction, it's possible they were gradually ousted by the dinosaurs.

The rise of atmospheric oxygen

The rise of atmospheric oxygen so important to life on Earth occurred around 2.5 billion years ago, but evidence for oxygen-producing cyanobacteria, which were thought to be responsible for this event, has been found in rocks dated at around 2.7 billion years. Two scientists from the USA and Australia think they know what caused the 200 million year gap (*Nature*, 2007, Vol. 448, p.1033-1036). They believe that from 2.7 billion to 2.5 billion years ago submarine volcanoes acted as a sink for the oxygen, thus stopping it from entering the atmosphere, but a major tectonic episode around 2.5 billion years ago led to a

change in patterns of volcanism. The tectonic episode led to a reduction in submarine volcanoes, and subaerial volcanism, which does not take up as much oxygen, became much more common. This set the stage for a rise in atmospheric oxygen.

The origin of the orchids

The discovery of a bee carrying orchid pollen in 15-20 million year old Dominican amber is the first record of orchids in the fossil record (*Nature*, 2007, Vol. 448, p.1042-1045). The orchids had been thought to have evolved in the Tertiary about 45 million years ago, but based on the new find (named *Meliorchis caribea*) and related fossil plants, a team of researchers led by Santiago Ramirez of Harvard University, USA, now place the origin of the orchids in the Late Cretaceous around 84 million years ago. Today's orchids comprise around 28,000 species.

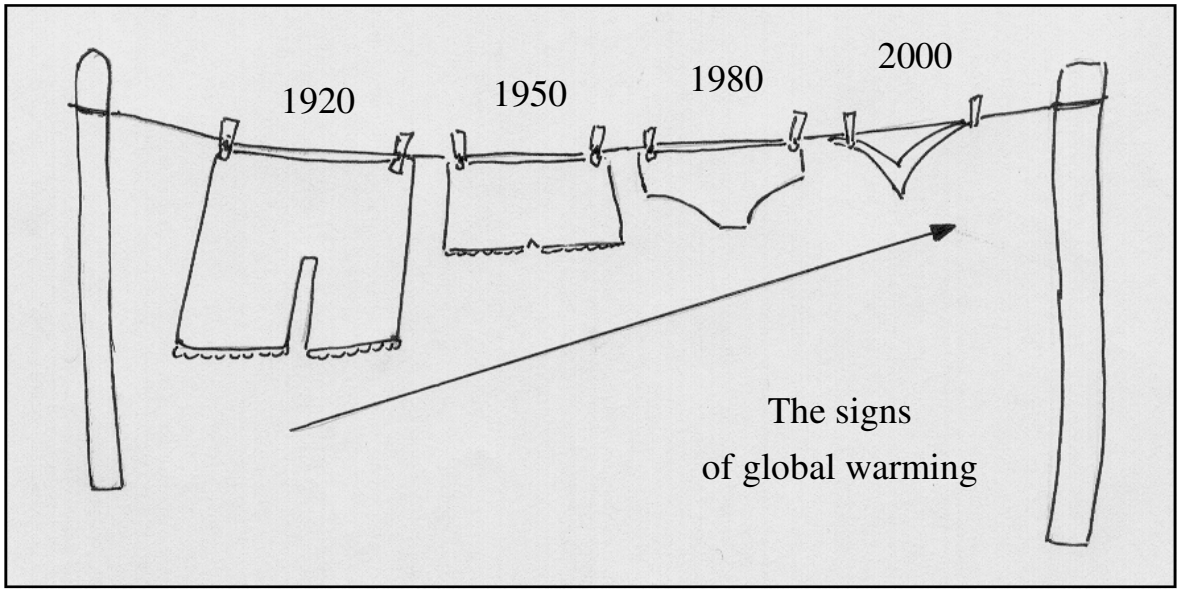
Dinosaur killer

A team of scientists led by David Nesvorny from the Southwest Research Institute in Boulder, Colorado, USA, has identified a group of asteroids, named the Baptistina family, to which they believe the asteroid that played a part in the demise of the dinosaurs belonged (*Nature*, 2007, Vol. 449, p.48-53). Astronomers have already found more than 40 families of asteroids that are fragments of larger bodies, but Nesvorny and colleagues have calculated that this newly discovered family was formed by a collision in the inner asteroid belt around 160 million years ago. They calculate that a 10 km asteroid from this group collided with the earth 65 million years ago, with other fragments colliding with Venus and Mars.

Radiation cleared of killing dinosaurs

Some scientists have argued that a lethal dose of ionising radiation from cosmic rays or gamma ray bursts may have contributed to the demise of the dinosaurs. Adrian Mellot, an astrobiologist from the University of Kansas in Lawrence, USA, has examined the fossilised bones of 708 dinosaurs from around the time of the mass extinction for signs of elevated rates of cancer which could have been caused by radiation (www.arxiv.org/abs/0704.1912). He compared them with cancer rates in present day birds and reptiles and found no evidence of elevated cancer rates in dinosaurs.

Thanks to Jim and Mildred Priestley for sending in the following cartoon.
Thanks also to "Knitting Machine Journal" for allowing the cartoon to be reproduced.



Geological Websites

Useful websites with a geological interest

Edited by Peter Austen

The internet is home to tens of thousands of websites with a geological interest, and it is often difficult to sort the wheat from the chaff. For every quality website there are many which leave a lot to be desired. As a general rule university and museum websites are fairly good, but I've tried to list below (in no particular order) sites which are worth a visit, together with a brief description of their content. If you do not have a computer at home, all libraries in the UK are now equipped with computers with internet access for use by the general public.

All sites were valid as at 21st November 2007.

If you know of any particularly good websites then please let me know and I will include them in the next issue of our Society Journal. This item is followed by an article on mineralogical websites by Trevor Devon.

The Dinosaur Society

http://www.dinosaursociety.com

The Dinosaur Society is a non-profit making charitable organisation dedicated to the promotion of dinosaur related science and education. The site is updated weekly and the section "Dinosaur News", which goes back to 2004, gives up-to-date news on dinosaur finds from around the world.

ScienceDirect

http://www.sciencedirect.com

ScienceDirect allows access to more than a quarter of the world's scientific, medical and technical information online. It has access to over 2,000 peer-reviewed journals (including the earth sciences), and hundreds of book series and other reference works. Although in most cases you will not be able to access the article unless you choose to buy it, you will have access to the abstract, which should normally give the article's key arguments and conclusions. The archive can be digitally searched, so unless you know the exact paper you want, it may be advisable to use key words in the site's search engine.

John Sibbick's website

http://www.johnsibbick.com

John Sibbick is one of the world's best dinosaur illustrators, and this website contains most of his work over the last 25 years. Although it is a commercial site, it is certainly worth looking through his galleries – you may well recognise a lot of the paintings from books.

A Collection of Eocene and Oligocene Fossils

http://www.dmap.co.uk/fossils

This is an excellent site if you wish to identify Tertiary fossils. The site illustrates the Tertiary fossils of the Eocene and Oligocene rocks of southern England, and has been produced by Alan Morton. It contains pictures of around 1,000 fossils and is regularly updated. In 2006 it won the Palaeontological Association's Golden Trilobite Award for the best palaeontological website.

The Echinoid Directory

http://www.nhm.ac.uk/research-curation/projects/echinoid-directory

This site has been designed and created by Andrew B. Smith of the Natural History Museum's Palaeontology Department and is the last word in echinoids. The primary purpose of the site is as a taxonomic resource for the scientific community, but it can also be used to good effect by the informed amateur for the identification of echinoids, and as a pointer towards the relevant literature. If you know nothing about echinoids, there is also an introductory section where you will find some basic facts about how echinoids live, feed and reproduce, presented in non-technical terms. There are currently over 1,500 pages of detailed information, and the site is regularly updated. In 2004 it won the Palaeontological Association's Golden Trilobite Award for the best palaeontological institutional website. An excellent site.

Fossil Trees in the Basal Purbeck Formation on Portland – *The Great Dirt Bed Forest*
http://iq.learningstone.net/p2/nf/bob_ford/briefing_pack/fossil_forests.php
An excellent article on the fossil forests of the basal Purbeck Formation of Portland in Dorset. It uses the fossil forest vegetation in these deposits to illustrate the forests that grew on the borders of the shallow, hypersaline Purbeck lagoon which covered southern England during the late Jurassic. The article has been abridged by Bob Ford from:
Francis, J. E., 1984. The seasonal environment of the Purbeck (Upper Jurassic) fossil forests. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 48, 285-307.

As Old as the Hills
http://www.asoldasthehills.org/oath_homepage.html
This site is dedicated to the Middle Ordovician rocks and fossils (465-455 million years ago) of the Builth Inlier of central Wales. The Builth Inlier is internationally famous for its trilobites, but it was also home to a bewildering variety of other creatures, many of them quite obscure. Rather than just looking at the fossils, the site uses them to reconstruct the habitats and ecosystems of the Middle Ordovician. The site serves as a resource for anybody studying the fauna and ecosystems of this area and includes an introduction to the various fossil groups, a geological history of the inlier, and detailed information on identification of Builth Inlier species. For the specialist, there is a comprehensive reference list for the fossils of the inlier, and the 'Research' page includes an ongoing 'complete' faunal list of both described and undescribed fossils. Most of the fossils are illustrated in the image gallery.

Darwin Correspondence Project
http://www.darwinproject.ac.uk
In the last issue (*H&DGS Journal*, Dec 2006, Vol. 12, p.29) we reported on the University of Cambridge website hosting the complete works of Charles Darwin (http://darwin-online.org.uk). The University of Cambridge has now created a new website dedicated to the correspondence of Charles Darwin. It includes the complete, searchable texts of around 5,000 letters written by and to Charles Darwin up to the year 1865. This includes all the surviving letters from the *Beagle* voyage, and all the letters from the years around the time of the publication of '*On the Origin of Species*' in 1859.

Emma Darwin's Diaries 1824-1896
http://darwin-online.org.uk/EmmaDiaries.html
Another addition to the Darwin online archives is a site dedicated to the diaries of his wife Emma Wedgwood Darwin (1808-1896). There are a total of 60 diaries covering the periods 1824, 1833-4, 1839-45 and 1848-96, and the site contains over 3,200 images. Although her husband's research is rarely mentioned it gives an insight into the family lives of the Darwins, and also the ongoing ill health that plagued Darwin throughout his life after he returned from his voyage on the *Beagle*.

Admiralty EasyTide
http://easytide.ukho.gov.uk/EasyTide/EasyTide/index.aspx
If you are planning coastal field trips this is an extremely useful site for tidal predictions. The site gives tide times and heights free of charge 6 days in advance, and for a fee of £1 you can get tidal predictions to cover a 7 day period up to 50 years into the future!

Websites for mineral collectors

by Trevor Devon

The websites listed below are a selection of those that I have personally accessed for information, browsed the minerals for sale, or actually purchased minerals from. Some contain excellent collectors' information about mineral sites or regions, including history of mining etc.

- **alpine-minerals.de** - a German website (English version too) of worldwide minerals including alpine minerals specialization.

- **brminerals.com** – minerals for sale from Brazil. P&P can be expensive!

- **broadstoneminerals.com** – Dorset based online mineral sales: owner is former geology teacher Mike Brooke who can be seen at his stand at many of the mineral shows around the country: wide range of minerals in stock.

- **crystalvine.com** – Norfolk based online mineral sales: owner is Sara Giller who can also be found at many of the UK mineral shows: good range of minerals – loves opal!

- **demineralia.com** – Italian online mineral dealer: worldwide minerals.

- **ebay.co.uk** – while you can buy almost anything on ebay, I do not find this such a good source of quality minerals as there is so much ephemeral crystal stuff you have to wade through. However, this browsing can be interesting and even occasionally rewarding. Also there are some specialist "ebay shops" such as the German online shop "Pyrominer" where good minerals are both sold and auctioned.

- **e-rocks.com** – provides regular mineral auctions (2-3 a week) from multiple dealers; run by Thames Valley Minerals (UK). There is a further selection of auctions and dealers' mineral sales on the parent web site **thamesvalleyminerals.com.** Probably one of the best sites in the UK to look for a particular mineral.

- **fabreminerals.com** – Spanish purveyor of fine (usually means expensive) minerals.

- **greensideminerals.com** – small Kent based online mineral sales; specializes in British minerals.

- **italianminerals.com -** Italian online sales of worldwide minerals.

- **lapis.de** – German website for the publisher of the mineralogical magazine Lapis. Also has an extensive online catalogue of mineralogical books.

- **madmineralz.com** – US online sales of worldwide minerals.

- **mindat.org** – the definitive worldwide database of up-to-date mineralogical information compiled by local Brit, Jolyon Ralph. Great source of identification data for both minerals and locations, including an extensive gallery of mineral photographs.

- **mineralsoftware.co.uk** – source of MineralDB, a superb full-function database for your personal mineral collection on your own PC: this is what I use and cannot praise it too highly! Not very expensive and includes a reference collection too.

- **minerant.org** – interesting Belgian website for mineral collectors: portal to several European mineralogical websites.

- **minernet.it** – Italian online sale of worldwide minerals: good source of rarer minerals.

- **minershop.com** - for information about minerals of Greenland, especially fluorescent minerals; has a mineral sales section too.

- **minservice.com** – Italian multi-dealer world-wide mineral sales site: one of my personal favourites for good quality, reasonably-priced minerals.

- **rockshop.cz** - a worldwide minerals website in Czech republic.

- **rock-site.co.uk** – great source of information on some of the key collecting localities in Britain: minerals sales too. Provides link to UK Journal of Minerals & Mines.

- **russellsoc.org** – website with information about the British national society for amateur and professional mineralogists, including the regional societies and their activities (meetings and field trips).

- **simonhildredfineminerals.com** - small British website: worldwide mineral sales; loves wulfenites!

- **smls.org.uk** – website of the Sussex Mineral & Lapidary Society: probably the best mineralogical club in the UK with a wide range of activities for members.

- **the-vug.com** – US based portal to mineralogical websites.

- **thomsonminerals.com** – small British website: worldwide mineral sales.

- **trinityminerals.com** – US based website for information on minerals, salesroom and access to the first online mineral auction site.

- **ukge.co.uk** – useful British website for all sorts of equipment and supplies for geological, mineralogical and fossil collecting use.

- **ukjmm.co.uk** – site for the UK Journal of Minerals & Mines.

- **webmineral.com** – US database of mineralogical information.

- **wildaboutrocks.com** – small UK-based online mineral sales: has worldwide selection, but stronger on British minerals.

Please note that the comments above are solely my personal views, written from the perspective of a mineral collector.

GEOLOGISTS' ASSOCIATION LOCAL FIELD MEETINGS – 2008

The Hastings and District Geological Society is affiliated to the Geologists' Association, and as such members are entitled to go on any of the GA field trips. Bookings must be made through the GA (details below), and the appropriate fee paid. I have only included field trips in the south of England. Details of more distant trips are available at HDGS meetings.

ENQUIRIES & BOOKINGS Geoff Swann organises day and weekend meetings in the UK. Michael Ridd is responsible for overseas and longer excursions. **Sarah Stafford at the GA office is responsible for bookings, payments and general administration (tel: 020 7434 9298, fax: 020 7287 0280, e-mail: geol.assoc@btinternet.com).**

You must book through the GA office to confirm attendance. Please do not contact the field meeting leader directly. Meeting times and locations will be confirmed on booking. These are not normally advertised in advance, as there have been problems with members turning up without booking or paying and maximum numbers being exceeded. ***Field meetings are open to non-members although attendance by non-members is subject to a £5 surcharge on top of the normal administration fee.*** Some meetings may have restrictions on age (especially for under 16s) or be physically demanding. If you are uncertain, please ask.

PAYMENTS for day and weekend meetings **must be made before** attending any field meeting. Cheques should be made out to Geologists' Association Field Meetings. If making multiple bookings, please enclose a separate cheque for each meeting unless you have first confirmed that there are places available. A stamped addressed envelope is appreciated. Please give a contact telephone number and, if possible, an email address and provide the names of any other persons that you are including in your booking. ***PLEASE ALSO PROVIDE AN EMERGENCY CONTACT NAME AND TELEPHONE NUMBER AT THE TIME OF BOOKING.***

There are separate arrangements for overseas meetings.

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.

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.

SAFETY is taken very seriously. Should you be unsure about either the risks involved or your ability to participate, you must seek advice from the GA office before booking. Please make sure that you study the risk assessment prepared for all GA field meetings 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 (07724 133290). *PLEASE NOTE THIS NEW NUMBER*. 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.

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 (see GA Circular No. 942, October 2000 for further details). Field meetings of 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.

FIELD MEETINGS IN 2008

We are hoping to arrange additional fossil collecting opportunities during the year. There may not be time to advertise these in the Circular so if you would like details when they become available contact Sarah Stafford at the GA office.

WEALDEN EXCURSION
Leaders: Pete Austen, Richard Agar, Dr Ed Jarzembowski and Geoff Toye
Saturday 26th July 2008

This trip continues the popular annual excursion to working pits in the Weald Clay of south-east England, where the GA has already participated in some superb fossil finds. The venue(s) will be confirmed later so as to take advantage of conditions at the time. Numbers may be limited.

Equipment: You must have suitable footwear, a high visibility jacket and hard hat.

Cost & booking: Further details will be available from Sarah Stafford at the GA office. Register with Sarah sending an administration fee of £5 per person to confirm your place.

THE CHALK AT EASTBOURNE REVISITED
Leader: Geoff Toye
Saturday 25th October 2008

Following the success of our visit in 2006 Geoff has kindly agreed to lead another visit to the coastal sections at Eastbourne. We will mainly be examining the Chalk succession and again there will be ample opportunities for fossil collecting.

Equipment: Hard hats are essential.

Cost & booking: Numbers will be limited to 25. Further details will be available from Sarah Stafford at the GA office. Please note it may be possible for the GA to arrange accommodation. Register with Sarah sending an administration fee of £5 per person to confirm your place.

SUSSEX MINERAL SHOW

Saturday 15th November 2008

10.00 am - 4.30 pm

Clair Hall, Perrymount Road, Haywards Heath

(Close to Haywards Heath Station)

Minerals, gems, fossils, meteorites, flints, books and accessories on display and for sale

Illustrated Talks

Organised by the **Sussex Mineral & Lapidary Society**

Details and map available at HDGS meetings closer to the date of the Show

Smokejacks Fieldtrips 2008

Two further visits are planned to Smokejacks in Surrey. The trips are being run as part of the **Kent Geologists' Group** field programme for 2008. This Weald Clay brickpit has yielded a number of important finds over the past two decades. In 1983 Bill Walker, a local collector, found a new theropod dinosaur, *Baryonyx walkeri*, a find which proved to be the key to the understanding and reinterpretation of the spinosaurs, and on the Geologists' Association fieldtrip to the site in July 2001 a well-preserved partial skeleton of a juvenile *Iguanodon* was discovered. The *Iguanodon* skeleton was from the same bed as *Baryonyx*, and two *Baryonyx* teeth were also recovered from the excavation, suggesting that it may have been scavenged by *Baryonyx*. The skeleton was excavated by the Natural History Museum and will eventually go on display in the newly refurbished Geology Gallery at Maidstone Museum. The site is also known for the early flowering plant *Bevhalstia pebja*, which was first published in 1995. Since then more remains of the plant have been found, some showing cellular structure and others showing seed-like structures in association with the plant. The concretions of sideritic ironstone and fine grained calcareous sandstone have also yielded numerous insect remains (at least 13 orders) including some species new to science. Remains of dinosaur, fish, crocodile, molluscs and non-angiospermous plants can also be found. Recent finds have included an arthropod trackway, the first to be found in the Wealden, new species of scorpionfly and leafhopper, pterosaur bones and a small cone similar to the present day *Sequoia*. Also in 2005 a spectacular death-bed assemblage of teleost fish was found, which included the first articulated pycnodont fish to be found in the Wealden.

N.B. Parts of the pit are still flooded – please take care.

Dates: Sunday 27th April 2008
Sunday 14th September 2008

Meet: Meet at 10.30 a.m. in the car park at Smokejacks Brickworks (**Wienerberger Limited – Ewhurst Works**).
Smokejacks is just south of Walliswood (4 km southwest of Ockley), Surrey.
O.S. map 187 – 1:50,000 series
Grid reference TQ 116 372

Equipment: **Hard hats and reflective jackets are compulsory**. Eye protection, hammer, chisels, wrapping material for specimens, handlens and boots suitable for claypit. Packed lunch. Sun protection is advisable if it is a hot day, plus sufficient drink.

Risk Assessment: All attendees must familiarise themselves with the **Risk Assessment** for the site. If you have not seen a copy please contact Peter Austen (details below). Copies will be available on site.

Cost: There will be a small charge of £2 per person to cover administration for non-Kent Geologists' Group members.

Contact: Please contact Peter Austen at least 10 days before the event with details of numbers attending.
Peter Austen on 01323 899237
e-mail: PJAusten@ukgateway.net

Future Visits: If you wish to be kept informed of future visits to Smokejacks, please send your e-mail address to me at PJAusten@ukgateway.net

HDGS Field Trip from Fairlight to Pett Level

Sunday, 23rd September 2007

HDGS members and guests assemble at the top of Fairlight Glen before descending to Covehurst Bay.

Photo: Peter Austen

Ken Brooks explaining the geology in Covehurst Bay.

Photo: Peter Austen

An outcrop of the Lee Ness Sandstone marking the crest of the Fairlight Anticline in the cliffs east of Lee Ness Ledge.

Photo: Peter Austen