



Manchester Geological Association



Newsletter ~ December 2008

www.mangeolassoc.org.uk

President: Christine Arkwright PhD

!! GOOD NEWS !!

Our lectures are back in the Williamson Building next year.
So come along at 1 pm on January 17th to the Earth Sciences Department
and enjoy a fabulous afternoon of talks on the Cretaceous World.
Coffee, tea and biscuits in the interval !

Dear Member,

With this mailing you should receive your **free** copy of the super new edition of the **Manchester Building Stones Field Guide** prepared by Fred Broadhurst and Morven Simpson. More copies can be purchased for your friends and relatives at the reduced price of £3 + £1 pp from Dr Fred Broadhurst, 77 Clumber Road, Poynton, Cheshire, SK12 1 NW

It's that time of year folks! **Subscriptions are due on the 1st of January.** It will greatly help our Membership Secretary Fred Owen if your subs can reach him before the end of January . Please send the enclosed membership form with your subs, noting any changes in your details (address, phone or email) .

The MGA has been ranging far and wide this year.. across the seas no less... more field reports follow. There's nothing more to say except to wish you all a Merry Christmas and a very happy New Year!

Mary Howie newsletter editor

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Quick Diary 2008 -9

Lectures and Seminars

- 17 Jan Seminar 1.00 pm The Cretaceous World
- 18 Feb AGM 7.00 pm & Presidential Lecture
- 18 Mar 6.30 pm joint lecture Environmental Magnetism



Greater Manchester RIGS Group

I attended a meeting of the North West Region Geodiversity Partnership in September, 2008, at Natural England, Wigan. Amongst the items discussed were how to spend the funding received from Natural England, Site Selection Criteria, a logo for the Partnership, a constitution, and the Partnership's name. A decision was taken that the Partnership would now be known as the North West Geodiversity Partnership.



The Greater Manchester Local Geology Action Plan (GMLGAP) has now been finalised and will be distributed by Greater Manchester Geological Unit (GMGU) for consultation.

The Warden of Healey Dell Country Park, Rochdale, has asked GMRIGS to undertake a geological survey of the Country Park. This is to go alongside the Ecology and Archaeology Reports on the Park's website and education programme. If you would like to be involved in the survey or have any maps or information which might help then please contact me.

Marjorie E. Mosley, GMRIGS Group, November, 2008.

gmrigs@hotmail.com

Derek Brumhead has been reading old books!.....



The Island all Night vomited Fire and Smoak very amazingly; and at every belch we heard a dreadful Noise like Thunder and saw a Flame of Fire after it, the most terrifying that ever I saw. The Intervals between the belches, were about half a Minute, some more, others less: neither were these Pulses or Eruptions alike; for some were but faint Convulsions, in Comparison of the more vigorous, yet even the weakest vented a great deal of Fire; but the largest made a roaring Noise, and sent up a large Flame 20 or 30 Yards high; and then might be seen a great Stream of Fire running down to the Foot of the Island, even to the Shore. From the Furrows made by this descending Fire, we could in the Day Time see great Smoaks arise, which probably were made by the sulphurous matter thrown out of the Funnel at the Top, which tumbling down to the Bottom, and there lying in a Heap, burn'd till either consumed or extinguished; and as long as it burn'd and kept its Heat, so long the Smoak ascended from it; which we perceived to increase or decrease, according to the Quantity of Matter discharged from the Funnel.

William Dampier, *A Voyage to New Holland*, 1699.

Other Societies

MGA members are welcome guests at other Geological Societies events.
Ring the contact given below for further details or look on their websites via links from ours.

Leeds Geological Society

Contact anthea.brigstocke@zen.co.uk

Liverpool Geological Society

Contact **Joe Crossley**
20 Jan - Dr Phil Manning's *Distinguished Visitor's Address* - 'Stardust and Dinosaurs'.
10 Feb - Vaughan Williams on 'Gold Exploration in Ireland'.
24 Feb - Mark Jenkins on 'Drilling for Oil'.
27 Feb - LGS Dinner at the Casa Bella
6-15 Mar - National Science Week Events.
24 Mar - *Distinguished Member's Address* by Professor Silvia Gonzales.

North Staffs GA

Contact **Gerald Ford**,
8th Jan 7.30 pm Dr Ian Stimpson, Keele University
"The 2004 Boxing Day Earthquake and Tsunami"
5th Feb 7 30 pm Professor David Siveter, University of Leicester.
"Silurian soft-bodied sensations: a unique window on the evolution of life".
5th Mar 7:30 pm AGM and Chairman's Address by Elizabeth Hallam *"Shark Bay to Wave Rock"*.

Oldham GS

Contact **Jo Holt**

Open University Geological Society, North West

Contact **Ian Barrow**

22 Feb Afternoon of Geological Talks at Lancaster University

Urban Geology of Liverpool - Real Rocks in a City Centre? 19th October 2008

Who would have expected to find proper rock outcrops in a City Centre? Ten members joined Leader Alan Diggles in Liverpool on a grey October day to see if it was true.

We met outside Lime Street Station in front of St George's Hall and after a quick briefing, set off for our first location: Everton Park about 10 minutes walk away. Liverpool is set on Triassic sandstone which can also be seen at Alderley Edge and Frodsham. At the time of deposition Britain was part of a landmass at a latitude approximately that of the Sahara today. The climate would have been fairly similar.

In Everton Park we clambered over two outcrops of red sandstone showing multidirectional dune bedding and containing pebbles. Although the environment was desert-like, examination of the rocks proved them to be water-lain. There were rip up clasts within the bedding and at the third location in the park, some of the best cross cutting bedding I have ever seen. There were thin mud layers too. This represented a braided river system with the changes in paleocurrent noticeable. It had been cut by later faulting.

We then walked down to the Metropolitan Cathedral, starting near the Crypt. Since Alan had first visited the area, work had been done which had removed quite a large amount of rock. However, it had exposed more of the fine grained, well sorted and horizontally laminated bedding. Alan told us this suggested a lower energy environment than Everton Park.



Alan Diggles explains this normal fault in Channel fill deposits

The Cathedral itself was built initially (from 1933 - 1940) of granite and quartz, feldspar, biotite and muscovite were easily seen without the aid of a hand lens. Magma flow currents could be made out occasionally due to aligned phenocrysts of white feldspar. There also were some very fine aplite veins in evidence. After the war, the building was completed using Portland Limestone in which shelly debris (brachiopods and bivalves) could be seen. The oolitic nature of the rock could be seen with the aid of a hand lens. It was interesting to note some differential weathering of the limestone on some of the building corners. Evidence of volcanic ashfalls could also be seen.



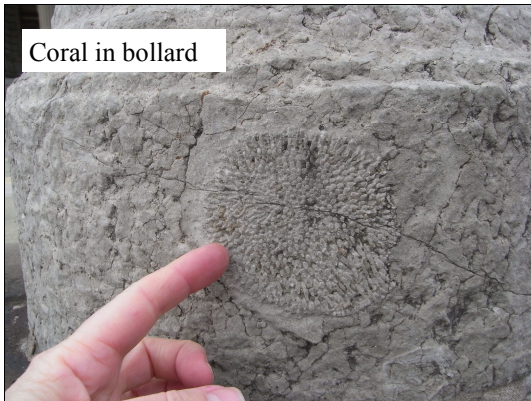
After a tasty lunch in the Cathedral cafe, and with the weather becoming windier and chillier, we moved to the Anglican Cathedral. This huge building, completed only in 1978, dominates St James Mount. There was rock exposure to one side and we were able to look more closely at the well-sorted fine-grained and laminate bedding. There were inclusions and again this all added up to a water-lain environment. This was thought to be a sandy plain with shifting rivers and during very dry periods, windblown sand dunes formed.

Inside the cathedral, which is the largest Anglican Cathedral in the world (it is massive - an awe-inspiring sight), some of the flooring is made of limestone slabs: black and white with calcitic brachiopod fossils and some corals. The brown French Marble font sits on a limestone dais containing stromatolites and tabulate corals (rather difficult to photograph). It is probably Ashburton Marble (Devonian from Torquay area). The redness is due to leaching from the Permo-Triassic beds above. It was also deformed during the Variscan Orogeny.

The Cathedral is built next to an old quarry (350m long, 50m wide and 30m deep - a very large hole!) which was turned into a cemetery after all the useful stone had been exhausted in 1825. By the time of closure in 1936 57774 burials had taken place. It has since been 'tidied' up so that you can actually walk around and reading some of the gravestones was very interesting. It is now a conservation site. On the east wall, there is an outcrop of red and grey/green mudstones and siltstones which are flat bedded and indicative of a low energy environment. Near the base is Liverpool's only running natural spring - permeable sandstone and impermeable mudstones come together. The water still flows, tastes ok (according to a couple of people who risked drinking it!) and was recommended a cure for rickets, weak eyes and lowness of spirits.

We saw evidence of the three tunnels out of the quarry. One of them, the Quarrymen's Tunnel runs under the

cathedral and did cause problems when the foundations were laid.



We then walked back to St George's Plateau where we looked at the paving slabs which showed some evidence of trace fossils. Alan told us that Lime Street is so named because of lime kilns which used to be found there. Walking to the Wellington Column, we passed Cornish Granite plinths although the column itself is of Darley Dale Sandstone with an Aberdeen Granite plinth. Most impressive however were the bollards around it which were nodular limestone with lots of corals, brachiopods and crinoids.

It was a wonderful trip, opening our eyes to a side of Liverpool which I don't think any of us really appreciated. Alan Diggles was an inspirational leader and provided us with an excellent handout which could be used again on private visits to see other aspects which we did not have time to see.
Jane Michael

Of Babies, Boats and Basalt - or Who Needs Chaos Theory??

Diary of an MGA Weekend

2 October: Jane sends final details of the trip to the 10 other people attending.

Evening of 7 October: hears from Angela, the Hotel owner that chef has broken her wrist so evening meals will be taken at sister hotel.

9 October: text from Steam Packet Company to say Liverpool - Douglas ferry for 10.15am Friday 10 October has been cancelled due to expected adverse weather conditions (Force 9 gales). Rearranges crossing to go from Heysham at 2.15pm on 10th.

10 October:

- a. everyone arrives at Heysham to find ferry delayed by 45 minutes due to weather
- b. 2pm Jane contacts leader, John and Angela to warn them we will be delayed.
- c. 6pm Jane phones Angela to let her know we won't be there until 7.30pm. Angela answers from her bed at the local maternity hospital having gone into labour a week early!!!
- d. 7.30pm arrive at hotel, get booked in and finally get evening meal.

No one was sick on the boat in the force 7 gale (a miracle in itself).

11 October: hear that Angela had a little girl at 12.30am.

After hearty breakfast, John arrives and field trip gets underway.

12 October:

- a. 4.45am everyone woken by drunken labourers also using hotel banging on doors and shouting.
- b. They break into Room 5 next to Brian and Frances in Room 6 and finally (presumably) fall into drunken slumber. No one really gets any more sleep.
- c. Jane arrives back at hotel at 4.30pm to find no heating and no hot water. Eventually a plumber is summoned but by then cold showers or 'kettle full' hot washes had been taken by most of the party.
- d. Dinner: well don't talk about the food!!

13 October:

- a. No milk at breakfast and waitress has to go out to buy some.
- b. Bacon runs out so Frances doesn't get any
- c. A very calm crossing ensues for the two cars leaving at 10am to Liverpool.

And then there was Bruce's rucksack.....!!!!

So onto the geology which is what we went for.....



Saturday October 12th

Douglas, Niarbyl and Peel

Saturday morning dawned bright and clear and we were eager to get out onto the rocks. John Barker our leader, met us at the hotel for a short briefing before we drove to our first location.

We started with the up-ended Ordovician greywackes on Marine Drive, a high *corniche*, which used to go round the headland, immediately south of Douglas harbour. The road has fallen away here these days, so now it is only a foot path and bike track. Here we were able to get very close to the rocks and examine them in great detail.

The Ordovician greywackes are turbidites, laid down off-shore 410 million years ago and subsequently subjected to several episodes of pressure during continental collision, leaving them sub-vertical, faulted and beautifully jointed. Much discussion of f_1 , f_2 and f_3 stresses, (not to speak of d_1 s etc.) ensued. The result of these stresses left the rock beautifully split into triangular “chunks” on both a micro and macro scale. Fossils (acritarchs, graptolites and trace fossils) have been found in these rocks. We found none. We did however see some superb flute casts and sole marks. Big faults and the presence of dykes were also evident.



Sole marks and triangles in Ordovician Greywackes. Marine Drive, Douglas, I o M.

Then off to “Snuff the Wind” an abandoned lead mine in the interior near Foxdale, so called because it was worked in the 1880s by a Horse Gin or Whin. Here we found various minerals on the dump; a little galena, a lot of barytes and some sphalerite. Lunch was taken at Niarbyl, some picnicked, others ate in the café.

After lunch we descended to the delightful rocky cove at Niarbyl, with its whitewashed thatched Fishermen’s cottages. The bulk of the peninsula is composed of multiply folded schists of the Ordovician Manx Group with a complex network of quartz veining. A thrust fault runs down this side of the island, cropping out at the landward end of the cove. The thrust was formerly thought to be within the Manx Group, but recently, however, the marine sediments of the over-thrust section have yielded Silurian (Wenlock) graptolites, and have been re-named the Dalby Group. The thrust possibly represents the Iapetus suture in the Isle of Man. A half-metre thick plane of



“Hands across the Iapetus Suture”

quartz, separating the highly discordant bedding of the two units, marks the thrust itself. Immediately beneath the thrust, the Manx Group is isoclinally folded. There is a small adit in the cliff – the entrance to an old antimony mine.

The next stop involved a scenic walk from Peel Castle along Peel Hill, high above the sea, to visit two quarries in which the main feature displayed was a large-scale fold, occupying most of the hillside. The axis of the fold runs right through the second quarry – the slates on the east side are vertical; those on the west about thirty degrees to the horizontal and exhibiting diffraction cleavage in section, and orthocones up to thirty centimetres on the bedding planes.

A short drive to the other end of Peel Promenade brought us to our final stop of the day, where the large cliffs display a section through sandstones of the Peel Harbour Group.

Here a section through a faulted block, about three kilometres long by 350 metres wide, reveals the only Devonian rocks on the island. These reddish-brown fluvial sandstones show rippled surfaces, channel lags and cross-bedded units. A little further north a coastal section revealed calcreted horizons within the Peel Harbour Group.

Sunday October 12th Langness, Scarlett and Poyllvaish

Sunday was fine and bright as we travelled south on to the Langness peninsular. Driving with care through the golf course we parked within sight of the lighthouse. A short walk and scramble down to the beach led to an adit; this being one of many unsuccessful mineral trials carried out on Langness. (G.W.Lamplugh 1903). A search of the spoil tip nearby revealed a few small pieces of malachite and amongst the pebbles on the beach we found two microgranites, allegedly from Ailsa Craig. One was pale grey and the other a red reibeckite; the latter used for making curling stones.

Climbing back on to the path we made our way to an exposure of the Langness Conglomerate. This is the lowest unit in the Carboniferous succession in the Castletown area, the age of which is hard to establish because of its lack of fossils, but thought to be 354 to 351Ma. The Langness Conglomerate is approximately thirty metres thick and is composed of successive deposits of red coloured conglomerates, sandstones and siltstones resting unconformably, at a low angle, on the eroded surface of the steeply dipping Manx Group rocks. Due to weathering of the land surface in a hot climate the Manx Group rock could be seen to be reddened for a few metres below the unconformity. John informed us that the surface separating the Langness Conglomerate and the Manx Group represents a time gap of approximately 60 million years.

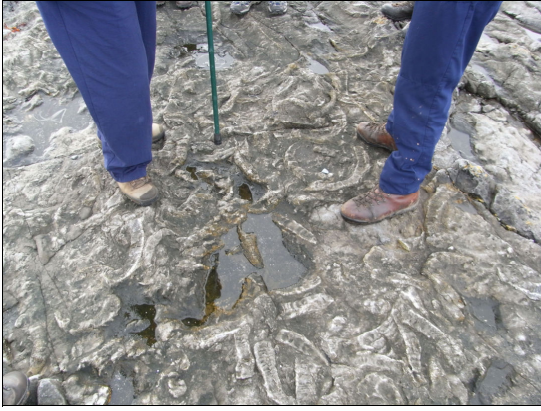


Unconformity on the Langness Peninsula, I o M.

The lower part of the conglomerate contained angular and poorly sorted pebbles from the Manx Group. A quick random selection of five quartz pebbles yielded lengths of 25cm, 23cm, 15cm, 7cm and 2cm, indicating they had been transported only a short distance from where they were eroded, probably in a flash flood or ephemeral river running off higher ground in a seasonally arid environment. Faulting, caused by the tectonic upheaval and high heat flow during the Carboniferous period and active during the deposition of the conglomerate, was visible and small veinlets of mineralization were present.

Moving on to the next site we saw the sandstones that had been deposited higher up in the succession. These had been reworked by wave action when sea water had flooded over the area prior to the deposition of the limestone. Unfortunately, time was running out, so reluctantly we left this interesting site and headed back to the car park for our journey to Scarlett and lunch.

Our final location for the weekend was to walk along the coast from Scarlett round to Poyllvaish to look at the Carboniferous reefs and lagoons and to see the Scarlett Volcanics. We started at the beach in the Seamount Member (now known as the Hodderense Limestone Formation) (c332Ma). This was highly fossiliferous limestone with crinoids, perfect solitary corals such as *Caninia siphonofilia*, (see photo overleaf) large



Corals on the foreshore at Scarlett Point , I o M

Bryozoans and the occasional colonial coral mound. We could see evidence of faulting and there were calcite filled tension gashes, some of which were 'en echelon'. Examples of Goniatites (particularly *americanites*) were also seen. At Scarlett Point the rocks were dark in colour possibly representing anoxia. This was a very cobbly rock. There was evidence of layering: limestone and muds possibly representing a lagoonal setting. The beds also showed a coarse/fine/coarse/fine sequence which could be seen as the lagoon being breached. There was a layer of crinoids in death position and pyritised bits of bryozoan probably represented decay of organic material.

The volcanics were very interesting. They have been dated as Lower Carboniferous (320Ma) and are from a shallow water fissure volcano. There was volcanic conglomerate with large clasts 30/40cm in size. The basalt was vesicular in nature and there was some evidence of pahoehoe rippling. Some had really sharp contacts and others did not show chilled margins. They were all NE/SW oriented. The folding was spectacular with zig zag tension gashes. Some of the interleaved limestone had been dolomitised. We also came across an area with layers of volcanic sand, breccia and ash with slumped blocks. John referred to the area as Crinoid Pompeii! We walked round a corner to find a small section of pillow lavas with glassy margins and showing spheroidal weathering. We also came across several dolerite dykes of various widths which were Tertiary in age.

By Poyllvaish we had returned back into limestone, a black limestone which takes a good polish and is packed with brachiopods. We did find the contact between the volcanics and the limestone and this demonstrated that the limestone was not completely lithified when the ashfall occurred. We found Productids, lithostrotion and a mud-draped coral mound.

John Barker took us on a really interesting trip. Everyone was most appreciative of his having given up his weekend. Geologically, the Isle of Man is like the north of England including the Lake District in miniature. Practically everything we see here can be found on the island and we only touched the surface. For instance, the north part has Quaternary glacial deposits. Perhaps that could be the subject for another trip (but staying at a different hotel !!).

Jane Michael, Marjorie Mosley , Jim Spencer and Mary Howie,

NB. On Saturday our leader went to the ferry terminal and acquired a dozen simplified geological maps of the Isle of Man. At 50p each these were fantastic value ~ if you are going there get one at the terminal or look on the Manx Geology site, www.manxgeology.com

It's a folded, annotated, illustrated paper map –“Manx Geology – A Guide to the rocks on the Isle of Man” . D J Burnett and D G Quirk, 2001



Here are two recently published books about the geology in our region.

"The Ice Age in the Lake District"

If you are into the Quaternary, at £3.99 post free from Rigg Side Publications, 10 Grange Side, Keswick, Cumbria, CA12 4AY looks good! It's a new full colour 60 page booklet A5 size.

Fully illustrated with 63 specially drawn maps, diagrams and colour photographs.

ISBN - 0-9544679-2-2

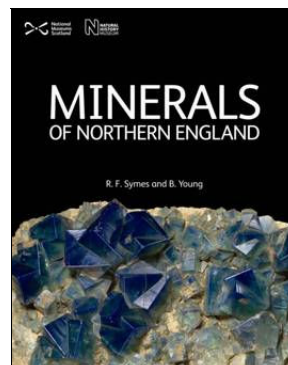
Check it out on www.riggside.co.uk

Minerals of Northern England

R. F. Symes and B. Young

- The geology of northern England
 - The mines and minerals
 - Mining
 - Collecting and collectors
 - The minerals
- co-published by NMS Enterprises – Publishing and The Natural History Museum
Look on www.nms.ac.uk/books for details

On offer at £25 from the National Museum of Scotland website



It's nearly time for the AGM.....

Is it time for YOU to join the happy band of MGA council members??

Make your New Year resolution NOW.

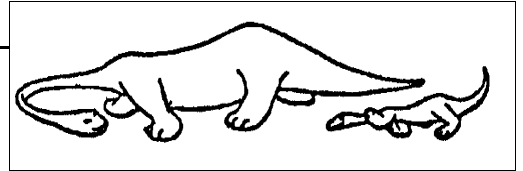
Your MGA needs YOU!

Who's Who in the MGA Council 2008-2009

President	Dr Christine Arkwright
General Secretary	Nick Snowden
Membership Secretary	Fred Owen
Treasurer	Niall Clarke
Indoor Meetings Organiser	Jim Spencer
Field Excursions Organiser	Jane Michael
News Letter Editor	Mary Howie
Web Site	Sue Plumb
RIGS Group	Marjorie Mosley
Minutes Secretary	Kathleen Mais
Archivist	Derek Brumhead
Other Council Members	President Manchester University Geol. Society (ex officio)

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MGA email addresses :- To contact our President or either of our Secretaries email info@mangeolassoc.org.uk
for Jane Michael and field visits - outdoors@mangeolassoc.org.uk
for Jim Spencer and indoor meetings lectures@mangeolassoc.org.uk
for Mary Howie and the newsletter - newsletter@mangeolassoc.org.uk



Manchester Geological Association

Programme of Indoor Meetings - Winter 2009

Saturday 17th January 2009 - 1.00 pm

"The Cretaceous World"

Dr. Peter Skelton, Professor Bob Spicer,
Professor Simon Kelley, Dr. Iain Gilmour, Open University

Wednesday 18th February 2009 - 7.00 pm

Annual General Meeting followed by Presidential Address

"Mam Tor: A landslide still on the move"

Dr. Christine Arkwright, University of Manchester

Wednesday 18th March 2009 - 6.30 pm

"Magnetic Lakes and Trees: What Environmental Magnetism can tell us"

Professor Barbara Maher, University of Lancaster

A joint meeting with the Manchester Geographical Association, 6.30 pm

Further information about the MGA from the Hon. Gen. Sec. Nick Snowden, 41, Merston Drive, East Didsbury, M20 5NT
email info@mangeolassoc.org.uk or go to our website www.mangeolassoc.org.uk

VISITORS ARE ALWAYS WELCOME

All meetings are again to be held in the Williamson Building, Oxford Road,
opposite the Manchester Museum.

Tea, coffee and biscuits will be served during the interval or before the evening meetings.

The next newsletter will be in **March 2009**. Copy to me by the **end of February** please. Mary Howie -
newsletter@mangeolassoc.org.uk or Snail Mail to Kinder View, 118 Glossop Road, Marple Bridge, Stockport SK6 5EL.
Tel: 0161 427 2965

Views expressed in the Newsletter are not necessarily those of the Association or its Council.

Lecture Notes for MGA Indoor Meetings – Winter 2009

Saturday 17th January 2009 – “The Cretaceous World”

**Dr. Peter Skelton, Professor Bob Spicer, Professor Simon Kelley, Dr. Iain Gilmour,
Open University**

The rock record shows that changes to the climate and oceans have occurred throughout geological time, and that conditions in the past have sometimes varied considerably from those of today. The Cretaceous Period provides in many ways an extreme example of a different sort of world – a ‘greenhouse’ world. Because Cretaceous rocks have been preserved, both on the continents and also on the sea floor, it is possible to decipher some of these differences and gain an insight into the processes that have operated. The speakers, co-authors of the book “The Cretaceous World,” will apply a total Earth Systems approach to unravelling this, whereby recent discoveries concerning present-day climate change, based upon the latest techniques of satellite imagery, modelling using powerful computers, isotope geochemistry, etc, are applied to the Cretaceous period. Copies of “The Cretaceous World” will be available for purchase on the day.

Wednesday 18th February 2009 - A.G.M. followed by Presidential Address

“Mam Tor: A landslide still on the move”,

Dr. Christine Arkwright, University of Manchester

In 1802 a section of the Manchester-Sheffield turnpike road was built across landslipped material below Mam Tor to the west of Castleton, in Derbyshire. But after constant repair and maintenance, necessitated by land movement, the road was abandoned in 1979.

Records of slippage on this landslide have been kept for many years but mainly concern the road surface. In order to establish a more comprehensive pattern of movement, researchers at Manchester University have been monitoring movement since 1996, by means of an annual EDM survey of a measuring network installed across the whole of the landslip (Arkwright, 1996; Arkwright & Rutter, 2003 and Rutter, *et al.*, 2003).

Skempton, *et al.*, (1988) proposed that the initial rock slump had occurred about 3600 yrs BP and that continuing movement was triggered periodically by a combination of a high water table and winter storms. Local rainfall records substantiate this hypothesis but to gain a better correlation, climate data has been collected remotely from an on-site weather station since 2003. The recent installation of boreholes containing strain gauges, piezometers and seismometers adds to the remote data now being collected to give a more complete picture of current slippage.

Results of the recent monitoring of the Mam Tor landslip, together with details of the underlying geology, will be used in an attempt to explain why so many episodes of mass movement are found in the Pennine area.

References:

Arkwright, J C, 1996. Monitoring the Landslide at Mam Tor near Castleton, Derbyshire. MSc thesis.

Arkwright, J C. & Rutter E H. 2003. The Mam Tor landslip: still moving after all these years, *Geology Today*, 19, No 2.

Rutter, E.H., Arkwright, J.C., Holloway, R.F. and Waghorn, D., 2003. Strains and displacements in the Mam Tor landslip, Derbyshire, England, *J of the Geol Soc, London*, Vol 160, pp735-744.

Skempton, A.W., Leadbeater, L.D. and Chandler, R.J., 1989. The Mam Tor Landslide, North Derbyshire. *Phil Trans of the Royal Soc of Lond*, A329, pp503-547.

Wednesday 18th March 2009 – “Magnetic Lakes and Trees:

What Environmental Magnetism can tell us”

Professor Barbara Maher, University of Lancaster

Joint Meeting with the Geographical Association, 6.30 pm

Please note earlier time for the last lecture!