ROTUNDA GEOLOGY GROUP

Newsletter 2009

From the Editors . . .

Launched in July 2006, and formally established at its first AGM on 5th February 2009, the Rotunda Geology Group has been active in organizing indoor and outdoor field meetings since September 2006. At the end of this first official year we thought it timely to publish a record of activities to inform members, and to publicise the existence of the RGG to potential members. This Newsletter is the result, and it covers the history of the RGG's events from 2006 to date. It is our intention to produce further editions annually.

Any project of this type relies almost entirely on written and graphic contributions from members. This first effort has been produced rather hurriedly and is probably dominated by material from the editors and other committee members. In future, its contents could be considerably enhanced by contributions from the general membership tendered at any time during the year. Such contributions do not have to be learned; they could be anecdotal, amusing, or a request for information or comment on an unusual observation or specimen.

We hope you will enjoy reading this first Newsletter.

Derek Gobbett
Janet White

Rotunda Geology Group Committee 2009

Chairman
John Hudson

Vice-Chairman
Derek Gobbett

Treasurer
Daniel Henley-Welch

Programme Secretary
Sue Rawson

Minutes Secretary
Lynda Henley-Welch

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Janet White

Members
Gerald Butterfield
Christopher Hall
Dorothy Needham
Peter Robinson
Alan Staniforth
Stuart Swann

SMT Trustee representative
Michael Pitts

SMT Staff representative
Will Watts

Chairman's Message

I can hardly believe it's been a year since I agreed to take on the role of our first official chairman. It is appropriate to mention the initial work Michael Pitts, Pete Rawson and Will Watts, and other members of our 'unofficial committee' put in prior to me taking on the chair. Without their input there would not be a Rotunda Geology Group today, and I feel we owe Michael et al a sincere vote of thanks.

I am sure all our members would be pleased with our present committee. You are all very fortunate to have such a hard working group of individuals striving on your behalf. I also feel privileged to be part of this talented team.

I'm sure the original aim set out by Michael & Co is still there; that of a members club with an interest in geology and the continued success of the Rotunda Museum.

Over the last two years we have combined some of our outdoor, and one indoor, meeting(s) with the Scarborough Archaeological and Historical Society. These have been well received and go to show the quite wide interest of our membership, and it is hoped to continue these joint meeting into the future.

I thank all our membership for the continued support you give to the meetings. I hope that the winter and summer programme give a variety of subjects that meet with most peoples interests. If you have any suggestions for any subject to be included, then please see our programme secretary, who will do her level best to accommodate you.

I look forward to the 2010 season with anticipation.

John Hudson

News from the Rotunda

It has been a busy few months at the Rotunda. In September a group from the Belfast Geological Society visited the Rotunda and enjoyed a couple of days on the coast led by members of the RGG. The trip was a great success and rumours of a reciprocal visit to Northern Ireland abound! In October a party from the Natural History Museum visited the coast and the Rotunda on a collecting trip to fill some gaps in the collections held in London (yes, there are gaps!).

Again the trip was a great success with a number of specimens collected for both the London collections and those held by Scarborough Museums Trust. The NHM are now working with the Trust to run a fossil festival in Scarborough in June this year. Finally, a number of geologically themed events are planned for the next few months and details can be found via the Rotunda website, www.rotundamuseum.org.uk.

Will Watts

RGG Meetings *(Field meetings are shown in blue)*

2006

7 Sep.	Coastal Erosion in North Yorkshire	Brian Sweeney
5 Oct.	Dinosaur Footprints, Yorks. Coast	Dr. Martin White
2 Nov.	Volcanoes of Montserrat	Dr. Sue Loughlin
7 Dec.	Evolution of plant life, Antarctica, Cret.	Prof. Jane Francis

2007

1 Feb.	Open Evening	
1 Mar.	William Smith in Yorkshire	Prof. Hugh Torrens
7 Apr.	Mining on the Heritage Coast	David Pybus
3 May	Scarborough: the last 250 million years	Prof. Pete Rawson
2.Jun	Tracking Scarborough Dinosaurs	John Hudson
30 Jun.	Walking in the footsteps of William Smith	Peter Robinson
4 Aug.	The Speeton Clay	Peter Rawson
6 Sep.	New insights into Hydrocarbon prospects, North Yorks.	Dr. Neil Oates
4 Oct.	The search for the World's remotest lake – Lake Vostok, Antarctica	Prof. David Drewry
1 Nov.	Investigating dinosaur footprints	John Hudson
6 Dec.	Rotunda Museum, 175 years in the making	Will Watts Karen Snowden Ann Ainsworth David Buchanan

2008

7 Feb.	Open evening	
6 Mar.	Petra to Pella: the geology and geoarchaeology of Jordan	Dr. John Powell
3 Apr.	The Speeton clay; regional and global significance	Prof. Peter Rawson
1 May	Plesiosaurs	Mark Evans
5 Jul.	Gristhorpe Bay (prematurely ended by heavy rain)	Peter Robinson
20 Jul.	Gristhorpe Bay	Peter Robinson
2 Aug.	Saltwick Bay	Peter Rawson Chris Hall
6 Sep.	Fairy Stones and Vessey Ponds: aspects of the Wolds	Derek Gobbett
2 Oct.	Applied palaeontology since William Smith	Prof. Alan Lord
6 Nov.	Plate Tectonics	Derek Gobbett
4 Dec.	Geological Time: an introduction	Peter Rawson Marilyn Robertson Sue Rawson Will Watts

2009

5 Feb	Open evening and AGM	
5 Mar	The Ravenscar Group as a model for North Sea Oilfields	Dr. Steve Livera
9 Apr.	If only rocks could talk: preserving our geological heritage	Kate Ravilious
7 May	Plate tectonics – the UK jigsaw	Prof. Peter Rawson
13 Jun.	Forge Valley and Yedmandale: Coral Seas and Glacial Floods	Peter Robinson
11 Jul.	Whitby Museum and East Clif	Roger Osborne Derek Gobbett Stuart Swann
8 Aug.	Structures in the Northern Wolds: a monoclinal story	Derek Gobbett
12 Sep.	Star Carr	John Hudson Patrick Hadley
8 Oct.	Tectonics, rivers and landscape evolution	Prof. Lynne Frostick
5 Nov.	Glacial evolution of the Vale of York	Dr. Tony Cooper
3 Dec.	Glaciation in geological time	John Hudson Derek Gobbett Pete Rawson

Volcanoes of Montserrat

2 November 2006

Dr. Sue Loughlin worked at Montserrat Volcano Observatory as Deputy Chief Scientist between 1997 and 1999.

Summary: The andesitic Soufriere Hills Volcano has been active now for more than 11 years making this the fifth longest eruption in the World. Viscous lava in the summit crater of the volcano forms a lava dome that is capable of growing to great heights and volumes, at times completely filling and towering above the 1km wide crater.

Lava domes eventually become unstable and may collapse catastrophically producing voluminous pyroclastic flows, pyroclastic surges and explosions that can send ash and gas high up into the stratosphere. This last occurred on 20 May 2006, when gas clouds reached altitudes of 20km (60,000ft) and were tracked around the planet as far as India, and probably went further. Secondary effects of these major dome collapses include tsunamis and hydrovolcanic blasts from the sea back onto the land. Away from the evacuated exclusion zone around the volcano, 4,500 people live in the lush north of the island.

Scarborough: the last 250 million years

3 May 2007

Peter Rawson – University College London, University of Hull, and Scarborough Museums Trust

Over the last 250 million years, the area on which Scarborough now stands has moved progressively northwards from a tropical latitude only some 15-20º north of the equator to its present day position of 54º N. Over that long interval of time changes in sea level meant that the area was sometimes land while at others it lay beneath the sea. From approximately 300-200 million years ago the area formed part of a huge landmass, Pangaea, and experienced desert conditions. Four times during the Permian (c. 300-250 million years ago) a hypersaline sea invaded the North Sea Basin from the north, only to evaporate and deposit salts, including the potash mined at Boulby.

Desert conditions continued through the Triassic (c. 250-200 million years ago) until almost at the end of that time global sea levels began to rise and our region became flooded.

For most of the Jurassic (c. 200-145 million years ago) time we lay beneath the sea, but regional uplift in the northern North Sea linked to an interval of volcanicity saw the spread of fluvio-deltaic sediments in mid Jurassic times. There dinosaurs flourished, while the varied plant life is one of the best documented in the World. The region was also experiencing earthquakes linked to rifting, and Scarborough lies in one such ancient rift valley. After the seas returned, coral reefs flourished for a time, suggesting that the climate was at least still subtropical.

Globally, sea levels fell across the Jurassic-Cretaceous boundary interval, but in our area the sea retained a tenuous presence. During the Cretaceous (145-65 million years ago) sea levels rose again to reach probably the highest level for the last 500 million years during Late Cretaceous times. That is when the Chalk was deposited. But as sea levels fell again, the Scarborough area became dry land by the beginning of the Cenozoic (65-0 million years), though much of the North Sea Basin remained flooded. Early in the Cenozoic the Alps began to form, and the effects of those mountain-building movements were felt even here – creating some of the remarkable disturbed areas in the Chalk, as in Selwicks Bay, Flamborough and the chalk quarry at Foxholes, and forcing the underlying Speeton Clay into small, tight folds.

As global climate deteriorated during the last 30 millions years, ice caps formed in polar areas until in the last million years or so ice sheets spread over much of our region, only disappearing about ten thousand years ago. There were several phases of glaciation, each separated by an interglacial interval – in the last one of which straight-tusked elephants, hippopotamus, rhinoceros and hyenas roamed here! Each Glacial/Interglacial couplet lasted about 100,000 years and we are in an interglacial today.

The geological history of the Scarborough area has played a fundamental role in influencing our landscape, soils, industrial history, choice of building materials and even the founding of Scarborough.

Gristhorpe Bay

20 July 2008

At Yons Nab we walked seawards to see the intertidal outcrops of the marine Lebberston Member of the Cloughton Fm., a thick-bedded impure limestone of comminuted shell. Evidence for a marine origin was found in crinoid debris and a few belemnites but the characteristic bryozoan *Haploecia straminea* was not found.

The beds dip gently towards the cliff and returning thence we traversed the sequence through the Gristhorpe Member noting silty mud horizons with fragmentary plant remains – part of the Gristhorpe Plant Bed. Above high water mark a massive sandstone near the top of the Gristhorpe Member displayed the dinosaur tracks. This was a convenient lunch stop.

We then walked south along the shore of Gristhorpe Bay following the succession up through the Scarborough Fm into the Scalby Fm. The leader pointed out the sequence in the cliffs – the sandy Osgodby Fm. locally obscured by surface slips of the overlying Oxford Clay. Fallen blocks of Upper Cornbrash provided abundant fossils including the brachiopod *Microthyridina lagenalis*, belemnites, and bivalves. There were also larger blocks of Hackness Rock with the large belemnite *Cylindroteuthis puzosiana.*

Finally we continued towards Cunstone Nab hopping over large blocks mainly of Lower Calcareous Grit with impressive *Thalassinoides* burrows, to find the Upper Cornbrash in situ at the base of the cliff.

Saltwick Bay

2 August 2008

From the cliff top some of the man made structures associated with the alum workings were briefly pointed out.

We descended to the beach and walked across the shallowly inundated North Batts to the low tide mark where the upper part of the Jet Rock is marked by a reef of large circular concretions "Millstones."
Chris Hall explained that below the millstones the Jet Rock had been worked for its 0.1% of jet over a long period during the 17th to 19th centuries but of course only at low tide. The removal of the shale has left pillars and benches of Jet Rock but how this was worked is unknown as there are no written records.

Pete Rawson introduced the Bituminous Shale section most of which forms the cliff. The uniform lithology of the shale is divisible by marker horizons of which the most prominent was a thin red-weathering horizon seen in the cliff. The shales contained large numbers of belemnites, some with the crushed, pyritised phragmocone and pro-ostracum. The ammonites *Harpoceras, Dactylioceras* and *Phylloceras* were found and the two bivalves *Steinmannia bronni* and *Pseudomytiloides dubius* were very common. The black shales are oil rich (we later saw oil seepages at the base of the cliff) and locally provide a source rock for North Sea oil. They were clearly formed in an anoxic environment.
We walked south into the middle of the

bay .The alum Shale outcrops in the higher cliffs here. We noted the remains of the alum workings: large excavations in the cliff, the breakwaters enclosing a small harbour, the massive stone trod with wheel ruts, the remains of the alum house in the cliff and on the shore, an excavated dock near Black Nab, and a large block of stone, now upside-down, with the date 1766 carved on it.
The tide was now coming in apace and had flooded most of the foreshore.

Fairy Stones and Vessey Ponds: aspects of the Wolds

6 September 2008

We started at Burdale, noticing the spring-fed pond very near the base of the Chalk which is underlain by Kimmeridge Clay. We walked into Burdale Quarry which was opened in 1925 to replace quarries at North Grimston and Wharram which supplied chalk to use as a flux in the iron and steel industry in Teeside. Burdale Quarry continued to be important through the 1950's but thereafter the trade stopped and the railway declined and was closed in 1961.

The chalk in the quarry is somewhat disturbed showing dips of c.10º generally southwestwards towards the valley and some minor faulting. The leader expressed his opinion that this deformation was due to camber accentuated by clay movement into the valley as valley bulges. We walked up Fairy Dale to the southeastern entrance of the Burdale Tunnel now bricked up. It is 1622 m long and runs mainly in the Kimmeridge clay. Construction began in 1847 and it was opened in 1853.

From the tunnel we climbed along the west side of Fairy Dale to the Fairy Stones. The leader suggested an origin for these as infill of a depression or series of depressions akin to dolines by loosely packed angular flint and chalk, which was later cemented by sparry calcite crystallising as fringes around the fragments.

After lunch at Thixendale we walked a traverse to look at the geomorphology. The flat floors of dry valleys abut abruptly the valley sides. The sides are steep (22º on average) but some are terraced. The valleys are very varied in plan from straight to sinuous and have a relatively steep long profile. They appear to be young elements of the landscape being incised deeply into the gently sloping Wolds plateau. The form of these dry valleys suggests they were formed by intermittent flashy braided stream systems. It seems likely that their present appearance was fashioned by meltwater streams flowing over the permafrost in the Devensian summer although the valleys would have been initiated at some earlier period.

We noted apparently slipped masses forming small hillocks partly blocking Back Dale, and later on in the walk climbed onto Vessey Hill which we interpreted as a rotational slip.

The Ravenscar Group as a model for North Sea Oilfields

5 March 2009

Dr. Steve Livera
Chief Petroleum Engineer for Shell, Europe.

Ever since the discovery of the North Sea Middle Jurassic oilfields in 1971, geologists have looked for analogues to help in understanding the nature of their reservoirs. The Ravenscar Group is of the same age and has broadly similar rock types as these reservoirs, both having been deposited in coastal plain settings. Data collection so deep below the seabed (over 8000ft sub sea) is limited and expensive, but an experienced geologist can use analogues to describe the reservoirs and place oil producing wells in the optimal position.

River channel fill and shallow marine sandstones are mixed in with coals and mud rocks in a regular organised way in both systems. An understanding of the dynamics behind this organisation allows us to develop detailed models of our oilfields. The extensive coals and shallow marine sandstones, such as those of the Eller Beck Formation, contrast with the localised development of thicker channel fill sandstones, and examples were shown of these differences in the Brent oil field and in our Yorkshire coast outcrops.

The Yorkshire coast shows a number of erosive cliff failure features, such as the Holbeck Hall Hotel landslip, that, combined with our knowledge of the continuity of the Lower Jurassic mud rocks, have allowed us to understand some of the complex structural geology features at the crest of the Brent Field.

If only rocks could talk: preserving our geological heritage

9 April 2009

Kate Ravilious gave a thought provoking talk about geological conservation. Kate spoke about the natural and human threats to rock exposures, citing examples from the UK and abroad. She considered various types of important sites, exceptional fossil preservation (Messen), rock structures (Glarus thrust), special sedimentary sequences (gravel bar in Utah) and significant sedimentary boundaries (K/T). Kate then spoke about protection measures, UNESCO World Heritage Sites, Geoparks, SSSI's and RIGS and discussed the conflicts of interest over sites, eg. the opening of new quarries for Portland Stone to repair major public buildings v. Dorset Coast WHS. Quarrying can be regarded as somewhat double edged in this regard. Finally she considered the extent of increasing geological education and geo-tourism and the pros and cons of collecting. Peter Robinson raised an important point about the hierarchy present in the public awareness and attractiveness of the natural world in which birds are probably dominant (and get the most financial support) and rocks are near the bottom of the list.

Whitby Museum and the East Cliff

11 July 2009

This meeting was in two parts.
In the morning Roger Osborne introduced about 15 members to the geology display in Whitby Museum. He first gave us an historical review of the development of amateur collecting in the Whitby area which started in the 18th Century but blossomed in the 19th especially the collecting of large marine reptiles mainly discovered in the extensive alum workings.

The display itself is very compact and very rich in fossil material. Magnificent ichthyosaurs and plesiosaurs, not to mention the famous crocodile *Teleosaurus chapmani*, are built into the walls.

The second part of the meeting started at East Pier and from here about 12 members traversed the foreshore to Long Bight and returned closer to the cliff. We walked eastwards up the succession from the top of the Hard Shale, which was marked by a sideritised bed which formed a prominent platform, through the Main Alum Shale with some siderite nodule horizons and some levels rich in irregular calcareous and pyrite nodules. The fossil fauna was dominated by belemnites, dactylioceratid ammonites and in the higher part of the sequence by numerous *in situ* examples of the small deposit –feeding bivalve *Dacryomya ovum* which was clearly adapted to living in a low oxygen environment, there being a total absence of other benthonic organisms.

Stuart Swann then introduced us to the Dogger which is well exposed and very accessible on the back shore of Long Bight. Here it comprises about 50 cm of coarse sandstone with phosphatised pebbles. Immediately below it Stuart pointed out some fine *Diplocraterion* burrows in the top of the Cement Shale: we also found some well preserved *Thallasinoides* burrows. Fallen blocks of sandstone displayed abundant plant remains mainly leaf fragments and rootlets but a fine *Zamites gigas* frond was collected. The top surfaces of upside-down sandstone blocks showed impressive dinosaur footprint moulds. We had to beat a hasty retreat to avoid paddling through the incoming tide.

RGG Field Meeting 8 August 2009

Structures in the northern Wolds: a monoclinal story
Leader Derek Gobbett

Six members attended this meeting and enjoyed excellent weather. We met at Staxton Hill car park at 0940 hrs and took two cars.

Knapton Quarry. This large quarry is now mainly a landfill site but there is a face along the south and west sides about 60m long and 10-15m high which exposes the Ferriby and Welton Fms of the Chalk. This we traversed in a clockwise direction. A good marker horizon is provided by the Black Band which is here about 0.5m thick
The leader explained that this was the equivalent of the Plenus Marl of southern England and the horizon through which most of the Channel Tunnel was bored. The Chalk here dips generally SSW at amounts varying from 25º to 65º . The Black Band shows up a number of small faults with about 0.2 -0.4m throw and a larger,
E-W-striking fault is well exposed towards the northern end of the main face downthrowing to the north about 20m as seen by the displacement of the Black Band. A second E-W fault to the north was poorly exposed but indicated by very disturbed chalk and fragments of vertical Black Band.

Formerly the NW part of the quarry exposed Burnham Fm Chalk dipping S at 75º which provided evidence of the steep limb of a monoclinal fold. The leader showed a photograph of this exposure because nothing is now visible in the quarry.
Thanks are due to FD Todd and Sons and, in particular to Martin Barlow the Operations Manager, for allowing us free access.

Langtoft Pit. Here the folding of flintless Flamborough Fm Chalk was seen to be facilitated by bedding plane slip lubricated by thin marl bands. Slickensides on the bedding showed the sense of movement which could be simulated by folding a pack of playing cards when the core of the fold is seen and felt to pull away from the fold envelope. The beautiful curve of this fold is completely free of faulting.

Weaverthorpe. We stopped here for lunch on the green outside the Star Inn beside the dry Gypsey Race. Weaverthorpe pit is owned by Andrew Mason from whom we obtained the key for the gate. Unfortunately the lock was rusted and the key would not turn so we had to climb over the 2m high gate. The pit exposes well-bedded chalk of the Burnham Fm which dips vertically to slightly overturned. It is part of the middle limb of a monocline and by studying slickensides in the bedding plane we established the fold faced north. On the south side of the quarry a small exposure showed chalk dipping about 15º south. We inferred that an E-W trending fault separated the two exposures.

Finally we stopped at Foxholes Quarry where the top of a north facing monocline is well exposed. The thin-bedded chalk displays disharmonic folding. A E-W striking fault occupies a wide gulley suggesting some lateral movement. The fault wall is well seen on the south side of the quarry. There was interest in splashes of red lichen on the fault wall and elsewhere in the quarry.

We returned to Staxton Hill at about 3 pm.

Star Carr

12 September 2009

Nineteen members enjoyed a walk below a cloudless sky to visit the famed Mesolithic site of Star Carr. At Burton Riggs sand and gravel workings, now landscaped and flooded, we gained some idea of how the Vale of Pickering may have looked in the early Holocene. At Seamer Junction John Hudson mentioned the excavation of a less than high status Romanised farmhouse, now a housing estate.

Along Metes Lane towards Star Carr John pointed out the relationships between the drift covered eastern end of the Vale of Pickering, the edge of the Jurassic Tabular Hills to the north and the margin of the Chalk Wolds to the south. We noticed on the way minor topographic features indicating the margins of Lake Flixton now drained by the canalised River Hertford. The drainage had caused the peat of Lake Flixton to dry and compact, thus lowering the surface.

At the Star Carr site Patrick Hadley explained that the original archaeological interpretation by Graham Clarke in the 1950's had been superceded by work done in the 1980's and 90's. The strange distribution of barbed points made of Red Deer antler, 194 found at Star Carr and only 4 in the rest of Britain, and the unique occurrence of 21 examples of antler head gear strongly suggested that the site was probably in the lake and one of great ritual significance comparable with the Bronze Age site at Flag Fen. The discovery of a number of Mesolithic sites around Lake Flixton generated the idea of a Mesolithic landscape, of which the original Star Carr was one, albeit important, aspect. This Mesolithic community lasted from some 700 years, from 9500 to 8800 BC.

Glacial evolution of the Vale of York

5 Nov 2009

Dr Tony Cooper informed us that a lobe of the Devensian ice sheet flowed south over soft bedrock, which lies about 20m below modern OD, down the vale of York, hemmed in by the uplands of the Pennines and the North York Moors – Howardian Hills - Wolds area. Coastal ice had plugged the Humber Gap so that the drainage was impounded to form an extensive proglacial lake, Lake Humber. In this lake fluvioglacial sand and gravel were overlain by laminated clays. The ice moved south over these deposits depositing boulder clay over them as far as Escrick where ice advance stopped and the Estrick Moraine was formed, seen now as an arcuate ridge crossing the Vale. Beneath the ice, streams deposited sinuous strings of sand and gravel now exposed as eskers.

The ice subsequently moved back to another standstill at York and formed the York Moraine. Water pounded between these two Moraines formed a higher level lake. The rivers Nidd and Wharfe were diverted by the ice and cut gorges along the west side of the ice to drain into Lake Humber.

Tony explained the techniques used in gathering data from the surface and sub-surface, the former by Digital Terrain Mapping, the latter by means of numerous borehole records. This information was processed by powerful computer programmes to produce Digital Terrain Models in 3D which could be manipulated in wondrous ways.

Glaciation in Geological Time

3 December 2009

Three members gave short talks. John Hudson began by summarising the evidence for Pleistocene glaciation. He illustrated this with superb photographs of modern glaciers, moraines, roches moutonées, striated pavements, U-shaped valleys, and also of local sections in boulder clay and fluvioglacial sands and gravels.

Derek Gobbett gave an overview of the Permo-Carboniferous glaciation of Gondwanaland (S. Africa, India, Australia and S. America) evidenced by many of the features described by John. He touched upon the wider aspects of Permian climatic zonation and the provinciality of Permian floras and faunas.

Pete Rawson concluded the evening by giving a broad view of glaciations through the whole of Earth's history and discussing the theories of Snowball Earth, Slushball Earth and Exaggerated Orbital Tilt to account for Precambrian glaciations that appear to have crossed all latitudes from pole to pole.

Open Evening Activity

Field activity - Spiker's Hill Quarry