Farnham Geological Society

[**www.farnhamgeosoc.org.uk**]

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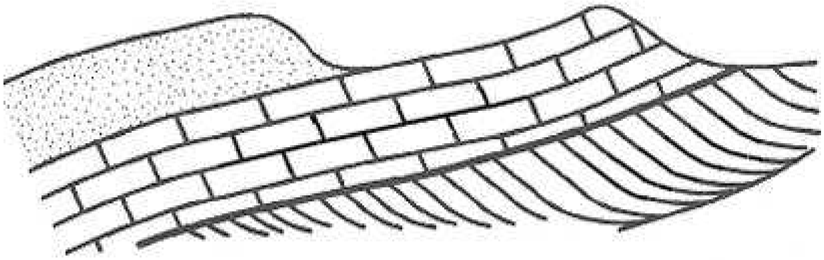

A local group within the GA

Vol. 13 No.1 **Newsletter** February 2010

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Editorial

As your new editor I shall give you a quick introduction as to who I am for those who do not know me. I started at BP Research Centre working across the corridor from Graham Williams and was then ‘sacked’ at exactly 6 months pregnancy. I then continued working for BP as a free lance consultant during the early years of North Sea exploration. Since then I have spent a further 30+ years in the oil industry working on oil and gas fields around the world and for many different oil companies. I am a ‘hard rock’ geologist at heart but will endeavour to not let this affect the Newsletter content.

Peter Cotton’s editorship will be a difficult act to follow but I look forward to the challenge and will attempt to follow his example by including articles from various sources from members to academics and covering the monthly talks, FGS field trips and members’ own views, field trips or other geological experiences.

I will however need your help - particularly those members who have attended field trips - I should be very grateful if one or several of you could provide me with summaries of field trips attended, complete with any suitable photographs or diagrams. In particular, I am hoping that we can include an article about the Aberdeen Area field trip in the next issue.

You will be impressed by the ‘theme’ of ‘*ice age, periglacial, soil and chalk’* articles running through much of this Newsletter; however I have to declare that this is purely by complete chance as the talk summaries and other articles have been randomly provided to me. I doubt that future newsletters will manage a ‘theme’.

Liz Aston

Lecture Programme - 2010

Date	Lecture	Speaker
Jan 8th	AGM followed by a lecture on Antarctica	Janet Catchpole – Member FGS
Feb 12th	How Britain became an Island; catastrophic megafloods in the English Channel	Dr Sanjeev Gupta – Imperial College
Mar 19th	The Palaeontological Association Baldwin Lecture: Carboniferous coal forests	Dr Howard Falcon-Lang, Royal Holloway College
April 9th	Santorini Supervolcano: the cause and devastating effect in the Aegean	Dr Fred Witham, Bristol University
May14th	Geology and Disease	Dr Gerry Slavin, Consultant
June 11th	Dolerite Emplacement and Continental Breakup: the Theron Mountains, Antarctica	Dr Donny Hutton - Consultant
July 9th	Members evening and presentations	Dr Alan Witts – Member of FGS
Sept 10th	SE Asia - Thailand	Dr Michael Ridd - Consultant
Oct 8th	30 years of mineral collecting	John Pearce – Sussex Mineral & Lapidary Society
Nov 12th	Can we clone a mammoth?	Dr Danielle Schreve – Royall Holloway College
Dec 10th	Diversity in stone: regional geology and links to building style	Dr Lesley Dunlop – University of Northumbria

FGS Field trips - 2010

April 10th -12th **EAST MIDLANDS** led by **Drs Steve Booth, Keith Ambrose,** and **John Carney** of the British Geological Survey

The Charnwood Forest Area has numerous outcrops of Pre-Cambrian volcanics and sediments; It was here that Roger Mason found the first unequivocal multi-celled Pre-Cambrian life form – *Charnia masoni* – now referred to the Ediacaran fauna and found in many areas of the world. Also, we plan to go to see the Mountsorrel Granite, and a number of classic Palaeozoic localites. Finally, building works permitting, Steve Booth will conduct us on a tour of the British Geological Survey at Keyworth.

April 25th – 2nd May **MADEIRA** led by **Drs Alan Bromley and Graham Williams**

Madeira is a volcanic isle, the product of a Mantle Plume (above a hot spot), formed in the Miocene and continuing into the Holocene; initial volcanic shield formation was succeeded by vast fissure eruptions; finally, a few local volcanic cones were formed, and the volcanic activity is believed to be extinct …..? This sequence of basic igneous rocks demonstrates a variety of lava formations, plus a classic differentiation series; as the basaltic magma cooled, high temperature (predominantly iron rich) minerals crystallized and sank away into the magma leaving a progressively silica rich melt, with local formation of Gabbro and Rhyolite.

June 6th, Sunday **PORTLAND** led by **Alan Holiday** (chairman of Dorset GA)

Portland Bill needs no introduction. The classic Portland and Purbeck sequences are wonderfully exposed throughout the "Isle", together with some intriguing Quaternary sediments and raised beaches at the Bill. We will see fossil trees of substantial size, marine to brackish to freshwater limestones and their fossils as the sea shallowed until eventually it became a freshwater lake.

June 26th, Saturday (pm) **PART OF THE SOCIETY'S 40th ANNIVERSARY CELEBRATION**

Led by Dr Graham Williams, this circular walk covers the Cretaceous rocks at the western end of the Hog's Back.

July 4th, Sunday **POXWELL PERICLINE & RINGSTEAD BAY** led by **Graham Williams**
The Poxwell Pericline is a famous Dorset feature mapped by many generations of university students. Why is it asymmetric? Why have mischievous university staff for generations teased their students with the Poxwell Pericline geoproblem? Ringstead Bay is another classic locality with the "Burning Cliff", Chalk of White Nothe, and the Holworth House section where Greensand and Chalk resting with angular unconformity directly on Portland and Purbeck rocks.

September 2nd - 6th **PAS de CALAIS** led by **Drs Graham Williams and Martin Bates**
The Weald extends across the Channel into the Pas de Calais (NE France). Only Cretaceous (~65-145 Ma) rocks are exposed in the English Weald, but in France the Pas de Calais Weald exposes Devonian and Carboniferous rocks including Coral Limestones, shallow marine clastic sequences and Coal Measures in a large fault block. This block is overlain unconformably by Middle Jurassic sediments, followed by a thick late Jurassic and Cretaceous sequence. The Late Jurassic rocks are spectacular, perhaps even better than in Dorset, and are world famous for their ichnofossil assemblages. We will see the entire Kimmeridgian, Portlandian, "Wealden", mid and late Cretaceous succession. There are exceptional Quaternary sequences including those at Abbeville where where Prestwich and John Evans accepted the antiquity of humans and extinct animals.)

October 9th - 11th **PINHAY, BEER and SEATON** led by **Dr Graham Williams**
Wonderful cliff exposures, beautiful sea and landscapes. At Pinhay is the classic Triassic through Rhaetic to Jurassic transition, the great marine transgression across a desert landscape. At Seaton, the contrast between bright red Triassic desert rocks and white Chalk cliffs has to be seen to be believed. At Beer is one the great Cretaceous puzzles; here Upper Greensand passes up into the Chalk via a severely condensed sequence; some 10 million years is represented by only a few feet of rock; the differentiation of Albian, Cenomanian and Turonian aged sediments is a nightmare, compounded by younger animals burrowing down into older rocks, mixing both sediments and fossils together !! I hope to have a very distinguished local geologist to tell us his lifetime's interpretation!!

I hope this programme will provide something of interest for everybody - interesting places, beautiful countryside and seascapes, wild life and plants, ancient and modern rocks, building stones and archaeology. Please contact me if you wish to join any of the trips.

Graham Williams

40th Anniversary celebration – Saturday 26 June

The Farnham Geological Society was founded in 1970 by a small group of local enthusiasts who had been regularly attending geology courses in Farnham arranged by the Council for Extra-Mural Studies (University of London) and administered by the Workers Educational Association (WEA). To mark the Society's 40th birthday, the Committee has decided to hold a special Anniversary event on Saturday June 26th. This will be in three parts:

- A morning at the Maltings with talks by 3 very distinguished speakers, plus members' poster and rock presentations illustrating FGS' glorious past.
- An afternoon field trip across the Hog's Back which terminates with
- An evening with food, drinks and Jazz combo in Joan Prosser's garden on the Hog's Back.

The three speakers at the morning session, who will talk about inferences from their research that help to understand the climates of the times, are:

- Susan Marriott, Professor of Earth & Environmental Sciences, University of Bedfordshire
  - *"Terrestrial sediments of the Siluro-Devonian"*
- Malcolm Hart, Professor of Micropalaeontology, University of Plymouth
  - "*Microfaunas and climate of the Cretac*eous"
- Dr Danielle Schreve (President of the GA), Reader in Physical geography, Royal Holloway College
  - *"Mammalian evolution in the Quaternary"*

Neighbouring Geological Societies and local eminent geologists will be invited to the event to help us celebrate. Please make a note in your diaries of the date.

Graham Williams

Geology of the Falkland Islands

The Falkland Islands lie on the western end of the Falkland Plateau, an area of shallow water, overlying continental crust, which extends out from South America towards South Georgia in the South Atlantic Ocean. Rocks from Precambrian to Permian age outcrop onshore, crosscut by numerous Jurassic and Cretaceous dolerite dyke swarms (Figures 1 and 2). The islands are surrounded by four sedimentary basins, ranging from Mesozoic to Cenozoic in age, with potential oil reserves, which have been the focus of recent oil prospecting. The basins to east, west and south are interconnected although their tectono-stratigraphic histories vary; whilst the basin to the north, where several wells have been drilled, is structurally isolated.

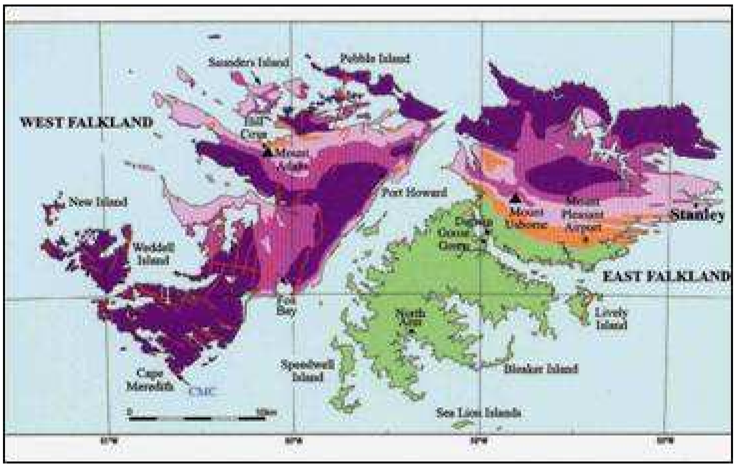

Fig 1: Onshore Geology of Falkland Islands.

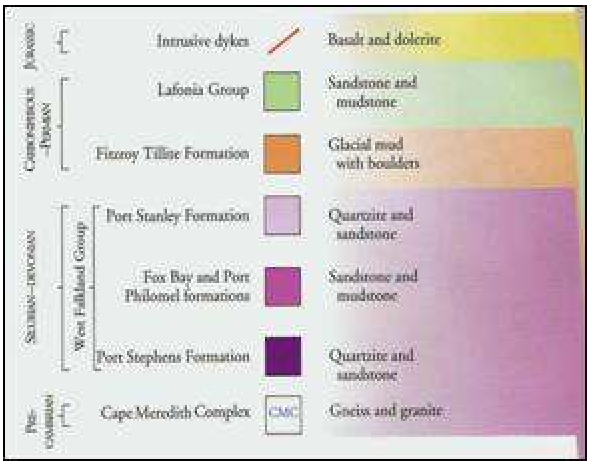

Fig 2: Precambrian to Jurassic Stratigraphy of the onshore Falkland Islands.

Geological History

The Falkland Islands have an interesting geological history having started life within the large landmass of Gondwana. About 400Ma (million years ago), the southern continents had drifted together to form the Gondwana supercontinent with the future Falkland Islands situated between the south eastern corner of South Africa and Antarctica, Figure 3.

Fig 3: Falkland Islands nestled between south east Africa and Antarctica, 400Ma (million years ago).

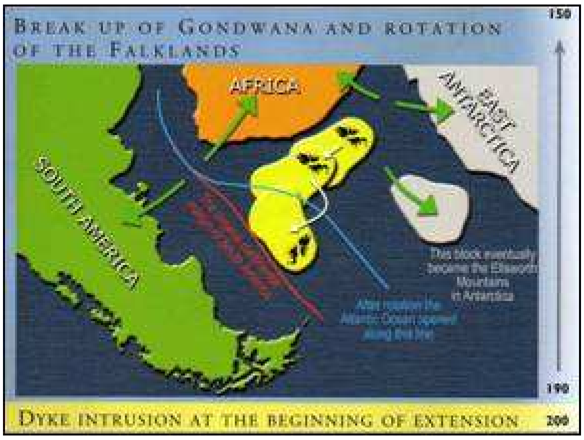

Fig 4: Movement of Falkland Islands Microplate during the Jurassic

Precambrian - The interior of Gondwana was underlain by crystalline rock, now visible in the cliffs of the Cape Meredith complex in south west Falkland, Figure 1. Schists, gneisses and granitic rocks have been dated radiometrically at about 1100Ma and resemble basement rocks in South Africa near the Natal coast and in Dronning Maud Land in Antarctica.

Silurian/Devonian - The margins of the Gondwana supercontinent were lapped by shallow seas during Silurian/Devonian times. Rocks in the West Falkland Group, Figure 2, contain fossils of shallow water marine organisms, brachiopods, crinoids and trilobites; the same assemblage is found in equivalent rocks in Southern Brazil, South Africa and Ellsworth mountains in Antarctica. The cross-bedded and ripple-marked sands with interbedded muds of this Group are interpreted as a deltaic sequence. Similar deposits are found in South Africa, West Antarctica and Brazil. In the Falkland Islands, these deltaic sediments show transportation in a northerly direction, however the same sequence of sandstones and mudstones found in South Africa suggest a southerly flow direction. These changes in flow direction suggest rotation has occurred after separation.

Permo-Carboniferous - About 290Ma, during the Permo-Carboniferous ice age, Gondwana was located in fairly high southern latitudes. Advancing glaciers eroded the land and this rock debris was deposited as large moraines on land or dumped into the sea from floating ice sheets - these deposits comprise the Fitzroy Tillite (a distinctive dark coloured fine-grained matrix enclosing a varied assortment of pebbles and boulders including limestones found nowhere else on the islands) on East Falkland, similar to the Dwyka deposits of South Africa.

As the Ice Age waned, tectonic forces, starting about 280Ma, caused buckling of the rocks, squeezing and thrusting the layers over each other to form a mountain range, a fragment of which forms the Wickham Heights in East Falkland. The increased weight of the mountain range depressed the crust to form a large, low lying, basin. Sands and muds accumulated in the basin, which continued to subside as more material accumulated. These deposits comprise the Lafonia Group in East Falkland and are similar to deposits in the Karoo basin, South Africa. The Black Rock member of the Lafonia Group contains up to 40% carbon and may be a viable hydrocarbon source rock in offshore areas.

Jurassic/Cretaceous - About 200Ma, at the beginning of Jurassic times, tectonic forces in the earth's mantle started the breakup of Gondwana. This led to extension and rifting of the supercontinent, intrusion of igneous dyke swarm through much of Gondwana crustal and overlying sedimentary rocks and, ultimately, at a complex triple point, the Falkland Islands microplate broke away from South East Africa and East Antarctica.

A volcanic ridge developed to the east of the Falkland Island microplate, which moved away from its South African location towards South America, rotating clockwise by almost 180^{o} as it went, so that by about 150Ma, it lay adjacent to the margin of the new South American continent, Figure 4. Rotation of the Falkland Islands microplate has been controversial but considerable evidence now exists to support the rotation theory, namely:

- The fold belt in the Falklands shows a 'push' from north to south, whereas in the Cape Fold Belt of South Africa the 'push' direction is from south to north.
- Equally, the Lafonia Group sediments lie to south of the fold belt in the Falklands, while equivalent rocks of the Karoo basin lie to the north of the Cape Fold Belt; and, as noted above, the sediment transport direction in the Falklands is to the north whilst that in the South African sediments is to the south.
- The magnetic field direction in the Jurassic dyke swarms on West Falkland run in opposite direction to dykes of the same age in South Africa, suggesting they rotation linked to the breakup of Gondwana.

As this new Atlantic Ocean widened, the margins of the bordering continental fragments were stretched and fractured allowing more dykes to be intruded. These later Cretaceous Dyke swarms show evidence of post-rotational emplacement and are probably linked to the opening of the North Falklands Basin during the early development of the South Atlantic Ocean.

Sediments accumulated in newly formed subsiding basins and these form the focus for offshore drilling exploration. Over 4000 m of sediments, varying from Mesozoic to Cenozoic in age, have been proved in one of the basins to north of the islands.

Fig 5: Current Location of Falkland Islands Microplate in Southern Atlantic Ocean

Fig 6: Aerial view of stone runs in East Falkland (width of view 1km)

Recent - The Atlantic Ocean is still opening and today the Falkland Islands lie 6,500 km from their original home, Figure 5. **Pleistocene Stone Runs -** Charles Darwin visited the Falklands from HMS Beagle and noticed the hillsides covered with angular 'streams of stones', a spectacular and unusual landscape feature, Figure 6. These are periglacial deposits. No permanent ice sheet covered the Falklands during the Pleistocene (25,000 - 15,000 years BP), but these relict accumulations formed as repeated cycles of freezing and thawing broke the surface rock into boulders. During seasonal thawing, the slow downward creep of these boulders and soils over deeper permafrost layers (a solifluction process) carried the boulders across the landscape, forming stone terraces and parallel alternations of boulders and vegetated ground.

I should like to acknowledge the use of the BGS (*British Geological Survey*) website from which I have downloaded the photographs used in the figures above.

References:

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Falkland Islands; stone runs - rock in the landscape. Stone,P. and Aldiss,D 2001 BGS.
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Stone runs in the Falkland Islands. Rosenbaum,M. Geology Today 1996 **12** (4) p151-154

Janet Catchpole

Field trip to St Austell – April 2009

The journey to St Austell via the M3, A303 and A30 was good; especially the last part where the roundabouts on the A30 had been removed since I last travelled this way. We arrived at the Porth Avallen Hotel just after 2pm to find most of our party already there. Graham's choice of hotel was excellent, on a cliff overlooking the sea at Carlyon Bay.

We met in the conservatory at 4pm, where our leader Alan Bromley and his wife Lesley joined us. I understand that Alan has lead trips for Farnham before and was known to many of the group. Alan gave us a short introductory talk explaining that the top of St Austell granite was only now becoming uncovered and was therefore less eroded that the other Cornish granite plutons.

We then drove to the end of the road where there was beach access down 82 steps. (Fig 1) Here we looked at the sand, which, since it had only travelled a short distance from it's granite origins, still showed course grains of quartz, together with mica, tourmaline and some feldspar. There were also some very large outcrops of Lower Devonian Mudstone showing interesting fold patterns.

It was very cold and windy on the beach and we were glad to climb back up to the car park and head back to the hotel for dinner.

Fig 1: Lower Devonian mudstone on the beach.

Fig 2: Arriving in the quarry

Saturday morning we were up early and met up with John Howe from Imerys who was to take us into the Wheal Remfry China Clay Quarry. We were shuttled into the site by Land Rover over 1½ miles of white clay roads, some of which were rock hard but in other places were soft with large puddles (Fig 2). We stopped at an area of the workings where we could still see evidence of the final stages of the granite intrusion and the hydrothermal breccia at the edge of the quarry workings (Fig 3). We spent a couple of hours looking for minerals and collecting specimens of the different rocks (Fig 4).

Fig 3: This is a sample of the Hydrothermal Breccia.

Fig 4: Altered feldspar crystals where a tourmaline / quartz vein had been in contact with the granite

Whilst sections of the granite to the east and west contain biotite mica the main body in Wheal Remfry contains lithium mica and a small section has some topaz. It is the absence of iron in the mica that gives the resulting clay its white colour, making it very suitable to use as china clay.

Fig 5: China clay quarry

Fig 6: High pressure hose

The china clay is formed by kaolinisation whereby the feldspar and mica break down as water based fluids circulate through the granite leaving a mix of quartz sand and clay minerals. High-pressure hoses called monitors (Fig 6), are used to create a clay slurry which is used in the following process to extract the clay.

Fig 7: Large slurry tanks

Fig 8: Sheets of refined clay

After lunch at a local hostelry John took us to follow the progress of the slurry through the processing plant at the Melbur Refinery. The liquid was stirred in large tanks (Fig 7) before passing into the mass of machinery that removed any impurities, until it ended as sheets of refined clay (Fig 8) with the correct water content for the end products. The paper industry uses 70%, 21% is used for ceramics and the rest is used in paint, rubber, plastics and other small industrial processes.

Sunday started with a visit to the Wheal Martyn Museum (Fig 9). This is on the site of a former processing plant, where water wheels were used as power to move the clay slurry.

Fig 9: Wheel Martyn Museum

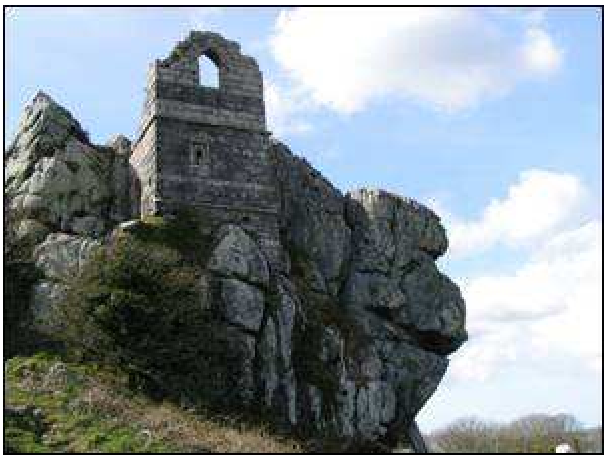

Fig 10: Roche Rock

It was interesting to compare the old methods used in the Victorian clay works that were very labour intensive with the works of today. We spent the whole morning at the museum looking at the outdoor exhibits followed by lunch. In the afternoon we drove to Roche Rock (Fig 10), a most impressive lump of quartz/tourmaline granite, topped by a ruined Chapel that can be seen rising from the surrounding moorlands.

From here Alan took us to a tiny quarry in the Tresayes Geological Nature Reserve where we saw giant feldspar crystals, over 300mm (10") long. Final stop was a very small, disused quarry on the Trevalour Downs where we found examples of zinnwaldite mica (a mica comprising potassium, lithium, iron and fluorine; individual sheets are flexible and elastic and it is used occasionally as electrical and heat insulators). Cornwall is one of the key localities of the mineral and we think it must have been found in larger sheets than the examples we found. Just to round off the weekend we spent Monday morning at the Eden Project before heading for home.

Pam Minett

Brick making & chalk mining in Reading

Summary of October 2009 lecture given by James Ford, Consultant

Whilst the instability problems of coal, metalliferous and stone mine workings are well known, those associated with abandoned chalk mines in urban areas, such as in the Reading area of Berkshire, are less familiar. There on 4th January 2000, residents of Field Road, in the district of Coley, Reading, were graphically introduced to the town's chalk mining problem when a large collapse structure occurred in the road; demolishing the frontages of two houses. During the next two years of investigation and remediation a number of mine workings were discovered which stretched the length of the road and, which it transpired, were associated with a Victorian brick kiln.

Reading was once a centre of nationwide renown for brick, tile and pottery production, the geological characteristics of the Lambeth Group (or 'Reading Bed' clays) necessitated chalk as part of this manufacturing process. From medieval times onwards, chalk or lime was added to clay for use as a binding agent during firing of such wares. Fresh, unweathered chalk was a crucial component; it was required in large quantities, and was commonly obtained from underground mines in a variety of styles and at many scales. However, in contrast to many past industrial locations, where considerable archaeology survives, few indications remain of chalk mines as the extensive surface infrastructure, associated with most mining activities (e.g. pumping and winding apparatus), was not necessary; the excavations being entirely above the water-table. Indeed the parent kiln sites are now largely built over and thus the mining legacy of such historical brick, tile, and pottery making can constitute a hazard to both property and individuals.

As a result of the historical research undertaken thus far, it has become apparent that Reading has had an extensive history of clay working. The findings show that mining occurred from the Medieval ages until as late as the Second World War and was a widely practiced activity, not just for clay ware manufacture. Kiln sites have been discovered across modern Reading, covering over one-third of the urban footprint. Two concerns were working till as recently as 1967. Indeed in quantitative terms over 30 individual mines are known to exist in Reading, although there are undoubtedly far more.

Through the historical analysis in combination with Geographical Information Systems (G.I.S.) it is proving possible for individual kiln locations to be identified, and their potential for associated chalk mine workings to be assessed. The problems experienced in Field Road are not just confined to Reading however, and extensive historical clay extraction and associated chalk mining is known to have occurred throughout other areas of south and east England, in which the same the same geological conditions apply.

Photo from BBC news website showing damage and repair work to the houses in Field Road.

Photo by Nick Catford from an article (site records) on Emmer Green (Hanover) South Chalk Mine at: http://www.subbrit.org.uk/sb-sites/sites/h/hanover_chalk_mine/index.shtml

James Ford

Chalky soils

Summary of July 2009 lecture given by David Fourt, Member FGS

Soils in General:

Over the bedrock of geological strata, lies the soil – this is typically a zone of mineral and organic material that forms by weathering of the bedrock supplemented by extraneous material, and animal and plant residues respectively. Soils are important to mankind as they hold and supply water and essential minerals for the growth of plants and trees, including plants as food crops and wood for shelter and fuel.

Fig. 1: Decalcified loess over brecciated chalk; uncultivated for 500 years

Fig. 2: Cultivated gravelly chalky soil over compacted chalk / rubble

Fig 3: Loamy loess and sand over variably compacted chalk / rubble

The inorganic mineral content of the soil deposits have formed either by the modification (comminution or dissolution) of the original minerals as a result of air, water, freeze-thaw, wet-dry, etc. processes; or by accretion from upslope areas through gravitational processes or from the air as blown sand and loess. The organic content comes from the addition of (usually rotted) organic materials.

Ever since agriculture started, farmers have learnt to identify “fertile” soils – those rich in nutrients and with good moisture retention. Typical examples in our area, are the malmstones of the the Upper Greensand; these form grade 1 soils, rich in potassium (K) derived from glauconite (a complex aluminosilicate comprising potassium, sodium, calcium) as well as other nutrients – ideal for cereal crops.

Chalks:

Chalk is calcium carbonate ($CaCO_3$) but unlike the older limestones, such as the Durness, Devonian, Carboniferous, and Jurassic limestones, it is a soft, fine-grained white foraminiferal limestone, which has 10-30% porosity with a fine pore matrix (10-20 microns), which is suitable for capillary water movement. The Road Research Laboratory studied the physical properties of chalks while investigating their potential use as a road foundation. *Engineering data are: chalk retains moisture, with common joints and fissures; it has high porosity and permeability and is susceptible to frost action and acid attack. Problems are likely to arise with chalk foundations, and during embankment construction, requiring stabilisation with cement to increase the compressive strength.*[1]

Whilst chalks are an asset for many farm crops, in excess, the alkalinity is so high, it can induce foliage disorders in sensitive crops.

Soils on Chalk Bedrocks:

These are derived from solution residues, plus inter- and late glacial loess (Fig 1). Thicker drifts commonly include Reading Beds material. Thin deposits are low in nutrients, especially potassium (K), and to a lesser degree phosphorous (P), which forced early farmers to resort to slash-and-burn techniques, so they had to continually migrate to new areas, or rotate crops to include rest periods for the ground, e.g. under woodland.

Free chalk is neutralised by acidified rainfall, which slowly decalcifies the surface layers. These also gain organic debris from trees, plants and roots, to form a distinctive layered profile sequence (Figs 1, 2). The acidity of the rain may reduce the pH from over 7.0 to 4.0 after lengthy exposure. With a rainfall of 750mm, evaporation of 450mm, 300mm acidic rain, as groundwater, remains available for the leaching process.

Studies of chalky drifts present on plateaux, slopes and in valleys show rounded fragments in a matrix of smaller particles (Fig 1). Fine particles may be hidden, but they effervesce aggressively in contact with dilute hydrochloric acid (HCl), whereas coarse material in a clay-rich matrix reacts more slowly, and in discrete locations.

During Pleistocene periglacial conditions, this drift soil became hardened and now forms a separate relic deposit, often with pipes (Fig 3), fissures, and frost polygons. Needle-ice is able to form from capillary ends in the chalk pores, while frost heave is able to lift flints to the surface. Fine chalk can also form muds or slurries, when thawing from frozen; with a density of 1.5-2.0g/cc such slurries are capable of carrying debris downslope.

The series of slides presented, showed the degrees of de-calcification and the effects of cultivation - where ploughing had brought up chalk fragments, which were then comminuted by frost action to produce a particulate chalk mixture with additional loess sand/silt grains.

Flints:

Fragments of flint (cryptocrystalline silica) are a common feature of chalk soils, occurring typically as relatively large angular fragments. Most flints occur in the Upper Chalk; the Middle, being flint-free, is favoured for quarries and cement works; whilst the Lower Chalk is marly, comprising weathered basic volcanic ash.

References: Summary of abstracts from Transportation Research Board Findings

David Fourt

Lakes on Mars

Mars featured large lakes of melted ice about 3 billion years ago, according to new research suggesting that the planet reached its present, dry state more recently than previously thought. Observations by a team from Imperial College and University College London, have indicated that a series of depressions near the Martian equator were formed by water in lakes up to 12.5 miles (20km) wide. The lake beds have been dated to 3 billion years ago, showing that the surface of Mars was still wet during a period called the Hesperian Epoch

Mark Henderson, The Times, Tuesday 5 January 2010

Ice age England

Summary of November 2009 lecture given by Dr Julian Murton, University of Sussex

During the last two million years, England's climate has repeatedly fluctuated between a) cold periods that favoured ice formation above or below ground and b) warm periods that favoured shrub or forest and soil/peat development and greater ecological diversity. Ice-core evidence from Greenland indicates that the rate of change in parts of the North Atlantic region has sometimes been astonishingly fast. Near the end of the last ice age, about 14,700 years ago, warming of several degrees C probably took place within just two or three years, and likewise at the very end of the last ice age, about 11,700 years ago, a similar amount of warming took place in just several decades (Ref 5). Such abrupt climate change may reflect, in part, abrupt changes in the circulation of the North Atlantic Ocean. But what is significant for the evolution of England's landscape isn't so much the warming or temperate conditions as at present, but the persistent cold conditions that have characterised the greater part of the last 2Ma - the ice ages.

Much of the English landscape is a product of ice age glacial and periglacial processes. Glaciation has eroded the uplands, deposited sediment as till sheets and moraines in the lowlands and often ponded up meltwater in lakes around the ice margins. The largest glacial lake, Lake Humber, developed in the Vale of York, south of a major terminal moraine (the Escrick moraine ridge (Ref 1)). Recent dating (by measuring light emitted from sand grains) of wave-rippled sand, deposited in the lake shallows, indicates that deposition occurred during the Last Glacial Maximum, ~21,000 years ago, when one margin of the British Ice Sheet lay just south of York (Ref 3).

South of the ice margin, periglacial processes shaped the landscape. The key processes involved:

(1) Growth of ice lenses in porous rocks and soils, which led to fracture and heave of the substrate (ice segregation; Ref 4).
(2) Downslope creep and flow of thawing soil, depositing spreads of stony debris on hill slopes and valley bottoms (solifluction).
(3) Thermal and mechanical erosion of frozen ground by water flowing in snow-fed streams, leading to undercutting and collapse of river banks, reworking of gravelly river deposits and flushing out of clays from the valleys (thermal erosion).
(4) Cracking of frozen ground due to rapid cooling and contraction under frigid winter air temperatures, leading to wedge-shaped bodies of ice and sediment forming in permafrost.
(5) Blowing of sand and silt across the sparsely vegetated landscape by winds sweeping off the ice sheet and those associated cyclones moving eastward across the North Atlantic region.

Modern analogues for periglacial England are found in the ice-rich fractured Mesozoic bedrock clays, shales, limestones and arkoses of Arctic Canada and Svalbard, where similar periglacial and permafrost processes occur.

The impact of periglacial processes on landscape development in southern England began during the early Pleistocene, on a relict Tertiary landscape that had been reduced by erosion to flattish, low-lying terrain - erosion surfaces, as characterise the South Hams (Devon; Fig. 1) and Salisbury Plain (Wiltshire) (Ref 2). It is suggested that uplift and periglacial processes during the Pleistocene resulted in valley cutting and scarp formation (Fig. 2), primarily as a result of (1) ice segregation in porous bedrock clays, (2) solifluction of stony debris on sloping ground and (3) thermal erosion of ice-rich brecciated clays during cold, arid periods of limited solifluction. This conceptual model now needs to be rigorously tested, for example by dating of clay deposits offshore in the North Sea and English Channel.

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Julian Murton

The Shell lecture series 2010 - www.geolsoc.org.uk/gsl/events/shelllondonlectures10

The Geological Society of London is delighted to again host the Shell London Lecture Series throughout 2010. These monthly public lectures are all held at the Geological Society's Piccadilly apartments in Burlington House. A full programme is listed below.

Entry to all lectures is free to all, but by ticket only. To obtain a ticket please contact Alys Hilbourne (see contact details below). Please note that due to the popularity of the lecture series, tickets will be allocated on a monthly ballot basis. We will not be taking indications of interest months in advance this year, so if you would like to attend any of the talks, please email us to let us know around 3 or 4 weeks in advance of the talk date. If at any point attendees, or their guests, are unable to attend, please notify the Society as soon as possible.

Most talks will be given twice on the same day, once at 3pm and once at 6pm – please note that if you would like to attend the talks, the 3pm matinees generally have more availability. The talks will be exactly the same in the afternoon and evening. Please see each lecture's page (links below) for further details:

Programme – 3pm talk	**Programme – 6pm talk**
14.30 Tea & Coffee 15.00 Lecture begins 16.00 Event ends	17.30 Tea & Coffee 18.00 Lecture begins 19.00 Short drinks reception 20.00 Event ends

Programme of Shell Series talks for 2010

Wednesday 13 January - *Living with the rising tides*, Lynne Frostick (Hull University and President, GSL)

Wednesday 10 February - *Hot prospects in the cold: the new geological map of the Arctic*, Marc St-Onge (Canadian Geological Survey)

Wednesday 10 March - *Carbon capture and storage: our only hope to avoid global warming?*, Martin Blunt (Imperial College)

Wednesday 14 April - *The search for source rocks on Mars* , John Grotzinger (Caltech)

Wednesday 12 May – *Geography and ecology- the evolution of a megaproject on Sakhalin Island*, Chris Finlayson (Shell)

Wednesday 9 June - *The chemistry of the Oceans: Past, present & future*, Derek Vance (Bristol University)

Wednesday 8 September - *A lot of hot air: Degassing and volcanic eruptions*, Marie Edmonds (Cambridge University)

Wednesday 13 October – *Impacts*, Jay Melosh (Purdue University)

Wednesday 10 November – *Title TBC*, Rob Kleibergen (Shell)

Wednesday 8 December - *Geological hazards: how safe is Britain?*, Martin Culshaw

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