Farnham Geological Society

[www.farnhamgeosoc.org.uk]

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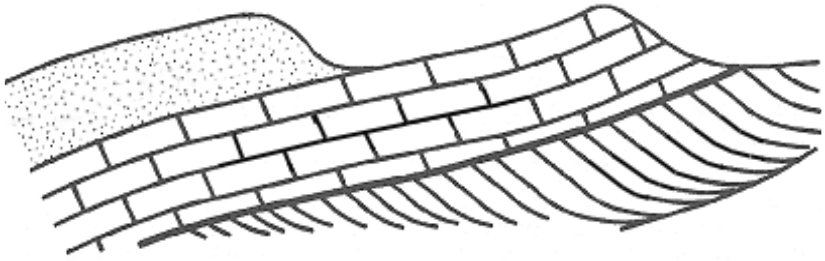

A local group within the GA

Vol. 6 No.2

Newsletter

June 2003

INSIDE THIS ISSUE

Margaret Bourgoing resigned as Chairman and as a Committee Member at the AGM. It is fitting that we should pay tribute to the hard work she performed both as a Committee Member and Chairman. Thank you Margaret for your dedication.

In a Newsletter some time ago, a summary of the history of the FGS since its inception in 1970 was included. (March 1988 by David Caddy). Shirley Stephens, who is the custodian of our Newsletter library, has looked through the early issues and a summary of some of the Newsletters from the 1970s appear in this issue.

It is a great pleasure to have received an article on the *Isle of Arran's Hutton's Unconformity* from Julian Bentick, who was the Chairman of the society some years ago and is now an Honorary member.

Once more in this issue the Editorial Committee has managed to assemble a mixed set of articles, lecture summaries etc. which it is hoped provide interesting reading. Our thanks to those members who have sent in contributions. In this issue there are no field trips being reported, but in future issues this will be remedied, assuming volunteers come forward to record their adventures in the Aegean, Welsh Marches and Brittany. We also need to have as many articles as possible from members on whatever subject of geological interest they choose.

Peter Cotton

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Position Vacant

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Peter Cotton
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Shirley Stephens
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Society dinner - Friday 17 October 2003

This year's annual dinner will be held at the *Farnham House Hotel* on **Friday 17 October**. The price of the 3 course meal, including coffee/tea, will be ~£17.30, a lower than inflation increase on last years excellent fare. Detailed arrangements will be announced at future monthly meetings, but the format will be the same as in previous years, that is, pre-selection from a choice of 4 dishes per course. A list will be posted for members wishing to attend to add their names to at the July and September monthly meetings; anyone who wishes to attend the dinner but cannot get to either of these meetings should let me have their name **no later than 13th September.**

Michael Weaver - Tel: 01252 - 614453

Proposed field trips - 2003/04

2003:

May 30 - June 1	Welsh Marches	Leader: Paul Olver
Jun 7	Lulworth Cove	Leader: John Gahan
Jul 6	The Weald	Leader: John Gahan
Sep 18 - 28	Brittany & Channel Islands	Leader: Paul Olver

2004:

September	USA - Cascades & Rockies	Leader: John Williams

For further details or expression of interest please contact the Field Secretary - Dorcas Cresswell
Tel: 01497 - 847262 or e-mail: *dorcas.cresswell@dial.pipex.com*

GA Field Trip to New Zealand led by Prof. Richard Moody - 12 Feb to 2 Mar 2004 - Cost: ~£2600

Spaces available - Contact: Richard Moody - Tel: 020-8942-3694

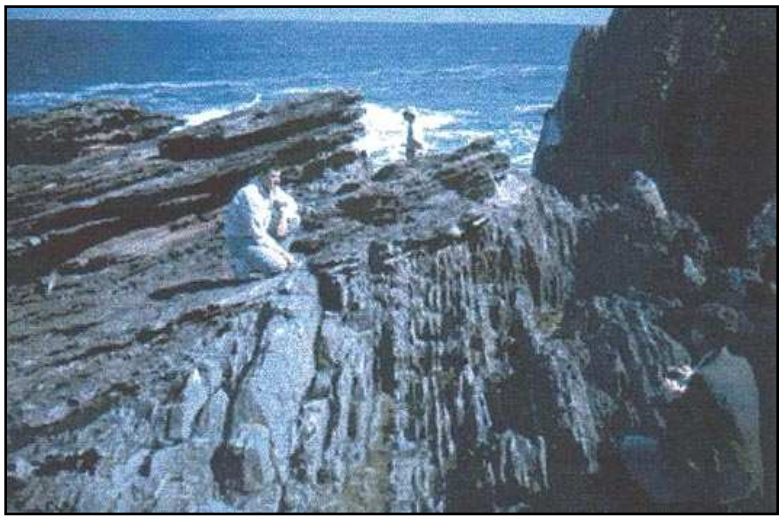
FGS monthly meetings - 2003

Jan 10	AGM followed by Dr John Linse, Astronomical Association: *The sun - our nearest star*
Feb 14	Dr Richard Fox, Richard Fox & Associates: *Landfill & waste disposal*
Mar 7	Prof. Richard Moody, Kingston University: *Petroleum geology of North Africa*
Apr 11	Dr Chris Edlers, Royal Holloway College: *Using 3-D seismic data to understand the North Sea*
May 9	Dr Adrian Rundle, Geological Society: *Introduction to microfossils*
June 13	Kevin Attree, University of Surrey: *Meteorites - their origin & significance*
July 11	*Members evening & presentations*
Aug 8	*Summer break - no meeting*
Sept 12	Prof Roy White, Birkbeck College: *Geophysics without equations*
Oct 10	Dr Derek Rust, Brunel University: *Palaeoseismology of the 'big-bend' of the San Andreas*
Oct 17	**Society dinner - see above article**
Nov 14	Dr Alan Jobbings: *A gemological journey from the Alps to Vesuvius*
Dec 12	Dr Tony Hall: *The granites of Cornwall*
Jan 9	AGM 2004

Hutton's unconformity – The Isle of Arran

The article by Shirley Stephens in *February 2003's Newsletter* reminded me that this was not the first time that FGS members went in search of Hutton's Unconformity. Before starting this piece I did a search on the World Wide Web – putting in '*hutton's unconformity*' and made 171 hits including pictures.

One of the Society's earliest field trips was a week or so in the Isle of Arran under the leadership of Ted Finch (Life Member) in April 1974. What an adventure. Some 12 of us hired a minibus from a firm in Wrecclesham and drove to Ardrosson, then ferry to the Isle of Arran and to the Kildonnon hotel at the southern tip of Arran. While driving north we had a total loss of brakes near Kilmarnock due to a hose failure – it was rubbing on the wheel!



One day of our field trip included the task of finding, using our geological skills, the famous discontinuity in the succession of rocks called Hutton's Unconformity. The weather was not kind but undaunted we searched a particular area strewn with very large boulders, field notes in hand (Ted Finch was good at that) until we found, on a flat piece of one huge rock, a large white painted arrow with the message ***'Hutton's Unconformity >>>'*** – so much for Geological Science! Nevertheless the exposure was very impressive. [*Photograph by permission of Professor Emeritus Duncan Heron, Duke University, Durham, North Carolina, USA*].

There were those among us who were determined to make the top of Goat Fell, the highest peak on Arran, these included the late Basil Crosby (of Crosby Doors and husband to Pamela, a past/present member) who, when he sank up to his waist in boggy ground, caused me to abandon any thought of making the peak. A small group did make the summit.

A nearby Amateur Dramatic Society was putting on a play written by a local literary genius. Since entertainment was pretty limited we all attended the play called 'John Thomas' which proved to be a very apt title that exploited to the full much of the content of a highly psychological drama. On the way back to our hotel it fell to me to explain to one of the more senior, and well read, lady members of our Society – name and address withheld - the phallic nature of the title 'John Thomas.

The weather was so bad on the day of our return to the mainland the ferry got diverted to one of the many Tarberts in Scotland which had the effect of adding another 100 miles to our road journey home. When just short of Glasgow, on the road around Loch Lomond, our minibus became very sick and blew a head gasket. We limped into the outskirts of Glasgow into a place called Balloch, found a man in a pub, who said he would fix it. We made an unscheduled Saturday night stopover in Balloch, not to be recommended, and much to our astonishment our friendly mechanic, who had got one of his children to sleep all night in the minibus to protect our kit, presented us with a working minibus.

I do have photographs taken during our stay but I'm not sure which of many boxes of transparencies they are hiding in. Who might have been on the trip? I struggle with memory: Ted Finch (our leader), Pamela and Basil Crosby, Audrey Hewins, Maurice Hewins (unrelated), Wendy and Roger Ashcroft maybe, Melene Barnes maybe, et al.

Finally it has always been a matter of much regret that another of my interests, pottery, has always been on a Friday evening. Consequently I am largely unknown to the vast majority of the current membership. Congratulations on the wonderful newsletters that you produce with such erudition – which this piece certainly cannot boast! I wish the Society every success.

Julian Bentick - Past Chairman and Life Member

Our nearest star - the Sun

Summary of the Society's January 2003 lecture given by John Price, Member FGS

Because of John Linse's indisposition, a fellow member of the Farnham Astronomical Society, John Price, gave the lecture based mainly on the material provided by John Linse. The fact that several members of our society are also astronomers is not all that surprising because the processes by which the Sun was formed some 5 billion years ago also created the proto-planets, and hence the Earth, which is where geology starts!

Five billion years ago a vast dust cloud of interstellar material was the breeding ground for the formation of new stars as gravitation caused the particles to compress into proto-stars which were initially red coloured with temperatures of 5 million °C. When due to continuing compression the core temperature reached 10 million °C, this set in motion nuclear reactions converting hydrogen into helium. At this point our Sun lit up and became the beneficial provider of heat and light to our planet. Before scientific explanations were available, the Sun was personified by many mythologies since it was recognised as the sustainer of life on earth.

The Sun is by far the largest object in our solar system containing some 99.8% of its mass; Jupiter accounts for most of the rest. Hydrogen represents some 75% of the Sun's mass and the rest is mostly helium and small amounts of other atoms such as iron. Over time the remaining hydrogen atoms will be converted to helium and fusion energy will then cease. At this point, in ~5 billion years time, the Sun's gentle warmth will be gone. It will then begin to compress until further nuclear reactions involving the conversion of helium into carbon take over and create a massive expansion into a "red giant" which will be so huge that it will overlap the orbit of Mars. Earth dwellers will have a temporary respite but after another 700 million years when the helium runs out the exterior parts of the sun will flow into surrounding space to form a planetary nebula and the interior parts will contract to a "white dwarf" before totally disappearing.

The structure of the sun is as follows:

Core : This is where the nuclear fusion generates energy.
Radiative Zone: Where the core energy diffuses outwards by radiation comprising mostly gamma and x-rays. Elusive particles known as "neutrinos" are also produced and escape from the sun and reach as far as Earth but most seem to vanish.
The Interface Layer: This is the layer between the Radiative Zone and the Convection Zone and it is believed that fluid flows across this layer to produce the sun's magnetic field.
Convective Zone: This is the outermost layer extending from a depth of 200,000 km right up to the visible surface of the sun known as the Photosphere. The temperature at the base of this zone is about 2 million degrees C and this is low enough for heavy ions such as carbon and iron to remain and trap the radiation. The heat causes the fluid to boil and convection motions carry the heat rapidly to the surface.
Photosphere: This layer is about 100 km thick and can be studied with a telescope having a suitable filter. Features which can be seen are dark sunspots and granules. John Linse's slides showed these dramatic effects particularly the super granules as well as large scale flows and patterns of waves and oscillations. The temperature at the surface of the sun is about 5700 degrees C and the density of the gas is very low.

Much praise is due to John Price for presenting John Linse's lecture and to John Linse for his research and dramatic photographs.

Peter Cotton

Newspaper snippet: The night middle England trembled

On 23rd September 2002 an earthquake reaching 4.8 on the Richter Scale struck the Midlands, its epicentre being 6 miles below Dudley. The effect was felt over a wide area as far away as Merseyside and North Yorkshire. On a global scale this was a minor earthquake but only 7 of such magnitude have occurred in Britain in the past 100 years. A Spokesman for the British Geological Survey explained that, although Britain is not in a major earthquake zone it is affected by the pressure created by movement of the African Plate on the one hand and the opening of the Atlantic at the Mid-Ocean Ridge on the other. This pressure can cause tremors along fault lines that already exist.

The Times, 24 September 2002

Rocks of the Western Algarve

The *Centro de Observacao Astronomica no Algarve* (COAA) is an excellent base to use when studying the geology of the western Algarve. Many varieties of contrasting rocks can be seen within a radius of 20 km.

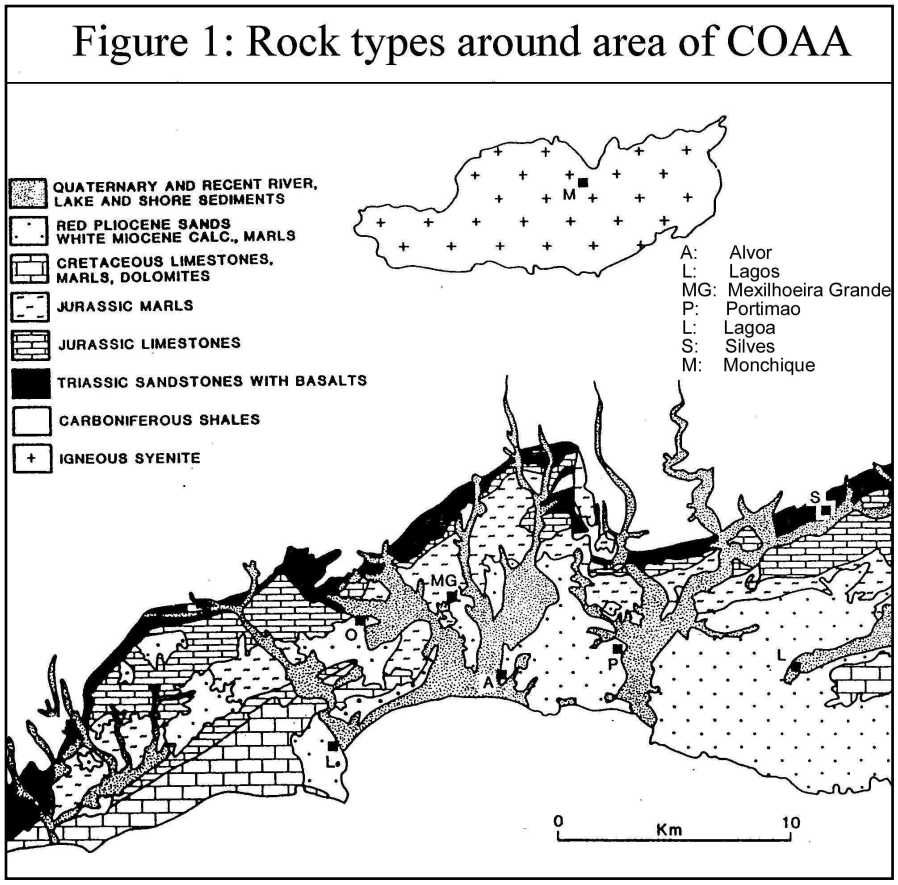


Figure 1 shows the general geology of the region which is dominated by the Monchique Mountains north of Portimao. which rise to 902m at Foia, the summit. The rock which forms this range can be seen in roadside cuttings on the way from Monchique to Foia. These rocks can easily be mistaken for granite with large crystals of grey quartz and white feldspar. Closer examination reveals that the grey mineral is nepheline, not quartz, making a very rare rock called syenite. There are two varieties from this area with unusual chemical compositions known internationally as *foyaite* and *monchiquite.* They are igneous rocks which were intruded as liquid magma at a very high temperature into the country rock some 70 million years ago. This event was probably related to the opening of the Atlantic Ocean as Europe and North America drifted apart.

Near the top of the road to Foia the rock is often white and crumbly. This has been produced by the weathering of the minerals into clays influenced by the warm climate and high rainfall. It is the percolation of rainwater through this weathered rock which gives the many springs in these mountains a distinctive chemical composition. They are rich in chlorides and sulphates. The medicinal value of these waters was known to the Romans who occupied the region and came to Caldas de Monchique to bathe in hot springs and drink the "waters". Caldas has been a health Spa ever since and now supplies bottled spring water to towns on the coast.

The igneous rocks of the Monchique Mountains are intruded into thinly bedded Carboniferous shales and sandstones which are widespread in southern Portugal underlying the deeply dissected hills around the mountain. These rocks were intensely folded during the Hercynian orogeny some 300 Ma. Fine examples of fold structures can be seen along the road form Porto de Lagos to Silves. One of the important properties of these rocks is that they are largely impervious to downward percolation of surface water. Hence the deep valleys draining southwards provide ideal sites for building dams. Two very large dams, one near Silves and the other near Odiaxere, provide water for domestic and industrial purposes on the coast and irrigation water for many citrus orchards in the valleys. There are many smaller dams built on farms to provide water for cattle or to irrigate crops.

Rocks of the coastal plain are much younger and very different in character. Underlying the higher land they include limestone, calcareous marl and sandstone of Jurassic and Cretaceous age. Often they are faulted but only slightly disturbed by folding. The hard thick limestones often outcrop at the surface of the landscape known as the *barrocal.* Here solutional weathering has created a karstic surface which is often associated with deep red soils which are present in solutional pipes and hollows in the rock. These rocks are quarried in several areas for limestone aggregate. There is an excellent exposure just north of Mexilhoeira Grande (near COAA) in the karst area showing pipes filled with bright red clay soils in the white limestone.

Sandstones can be seen in the cliffs behind the beaches between Lagos and Luz. Their general character indicates that they were deposited in a shallow sea which lapped against land formed by Carboniferous shales to the North. There are also volcanic materials in these sandstones. At the eastern end of the beach at Luz two volcanic features are prominent. The first is a volcanic neck full of explosion breccia whilst the second is a thin vertical dyke of dolerite.

Much younger sedimentary rocks are exposed at various points along the coast are exposed at various points along the coast eastwards from Ponte da Piedade south of Lagos. The thick hard limestones which often form high vertical cliffs are of Miocene Age and richly fossiliferous. Though hard, the limestone is readily soluble. The coast-line is characterised by high stacks, natural arches, cave systems, blow holes and chambers. These features can be especially enjoyed when seen from a boat. At Praia da Rocha near Portimao, the limestones form sea-stacks which have been revealed after the erosion of softer marl and sand of a more recent age. Their association with the long sand beaches and high cliffs have produced a wonderfully scenic coast.

The peninsula around the bird sanctuary at Cruzinha is covered by deep coarse reddish sands of Pliocene-Pleistocene age which overlie Miocene limestone. Their striking colour can often be seen in cliff exposures and they may also form flattish land surface away from the coast into which steep-sided narrow valleys have been incised exposing the hard limestones.

Lyn Linse

The role of the gravel industry in landfill and waste disposal

Summary of February 2003 lecture given by Eur. Geol. Richard Fox, Richard Fox & Associates

After some 36 years in the Quarrying Industry, Richard Fox decided to continue his involvement with the Industry through his Consultancy, Richard Fox & Associates Ltd, and to provide a service on aggregate site development.

The aggregate industry is now the major extraction activity in the UK with some 220 million tonnes being produced annually to satisfy the demand from the construction materials industry. This compares with the higher rates of output in Germany of some 700 million tonnes per year. The extraction of aggregates does bring with it the inevitable conflicts arising from the possible damage to the environment.


Gravel quarry in fluvo-glacial deposits with overburden being removed by "Dozer-Scraper"

The quarrying industry, and particularly the sand and gravel extraction operations, have been required to restore the quarries to landscaped lakes where appropriate or to agricultural land by the importation of waste as landfill where the geological conditions are acceptable. In some cases the extraction takes place above the water table and the restoration can be achieved below the original ground surface level by the careful placing of the topsoil and over burden at the base of the workings. This is commonly seen on the high plateau areas south of Reading where the gravels above the Tertiary and chalk deposits have been worked in a dry state. There are some 1300+ quarries in the UK producing aggregate materials ranging from sand, gravel, limestone, granite, basalt etc., and in many cases the material is used in the 300+ asphalt plants and 1150+ concrete plants producing the essential materials for the construction of roads, houses, hospitals, schools etc.

The types of materials available to be used as aggregates is very dependant on the geology, but another important factor is that the 'ex-quarry price' of the processed material is small (e.g. from £5 to £8 per tonne) and in many cases the transport costs are so high that transporting the material 10 miles can double the selling price to the customer. The sands and gravels that are commonly excavated throughout the UK are derived from the young unconsolidated superficial deposits called 'drift' which have accumulated in the recent geological past, usually, in the northern hemisphere, since the onset of the Pleistocene Ice Age. The older (pre-Quaternary) geological

deposits which form the 'bedrock'; formations etc. on which the weaker drift materials rest are referred to as the 'solid' formations. These occur at many levels in the geological column and in the Surrey and Hampshire areas include the Folkestone Sands, which have provided an important source of fine grained sands for use in concrete and mortar. The drift deposits include beach and lacustrine deposits, alluvials as well as the widely distributed glacio-fluvial deposits from the Pleistocene ice-sheets. Other drift deposits occurring round the coasts of the UK below sea-level also supply sands and gravels from up to 40 metres of water and are extracted by floating suction-dredgers.

The quarrying industry has played a very important role for many years in that it provides the voids into which the waste generated by the public and industry can be disposed of. The extraction of the aggregates and the disposal of waste can be carefully controlled through the planning system by selecting the most appropriate locations for quarries together with planning conditions, which are reviewed and upheld through the Local Authorities. The need to strike a balance between the need for aggregates, as well as sites for the landfill of waste ensures that 'sustainability' is maintained. This concept of sustainable development is fundamental to environmental policy and it was the concern of the 1987 Brundtland Commission that: "*Development should meet the needs of the present without compromising the ability of future generations to meet their own needs*"

Properly controlled landfill is an economic and environmentally sound operation, with the beneficial effects on the restoration of exhausted mineral workings. Where not adequately controlled landfill can have adverse impacts through the release of waste decomposition products including landfill gas (principally methane and carbon dioxide) and leachate – a potentially highly polluting liquid.

The OECD Member Countries in 1976 adopted the concept of a 'hierarchy' of preferred options for waste management in which waste avoidance and minimisation came at the top, and permanent storage and disposal in or on land came at the bottom. Thus the options were: Prevention; Recovery; Disposal.

There are some 400+ million tonnes of waste (i.e. 245m tonnes of controlled and 190m tonnes of other wastes) being produced each year in the UK, and this includes some 70m tonnes of 'construction & demolition' waste, and 20 million tonnes of 'household' wastes forming part of the controlled types. The major part of the controlled waste (70%) is disposed of to Landfill and it is now the EU and the UK policy to try to encourage 'recycling', and to persuade the public and industry to follow the recycling route, the UK government have introduced two taxes to enhance the activity:

- **Firstly**: the 'aggregate tax' of £1.60 per tonne on any materials that are derived from natural deposits (e.g. sand and gravel) so that there will be an inducement to use the re-cycled aggregates produced (e.g. from construction waste).

- **Secondly**: a 'landfill tax' of £2 per tonne on inactive waste (e.g. clays) and £7 per tonne on other wastes (e.g. domestic waste) with the intention that there should be an increase on the 'other waste' figures to reach a tax level of £35 per tonne in the medium term.

Those landfill sites, which are able to take putrescible wastes have in recent years been prepared to increasingly higher standards. Site Operators do not want leachate and landfill gas to escape into surrounding land areas causing environmental pollution. If allowed to seep away from landfill sites the methane can cause explosions in nearby, unprotected properties.

In July 2001 the EU Landfill Directive came into force, and has since become law in England and Wales through the 'Landfill Regulations' 2002. The Directive is intended to reduce the amount of waste going to landfill sites, and the improved standards in landfill sites are intended to reduce the levels of 'ozone – depleting' methane entering the atmosphere as well as minimising the impact of landfill sites on the general environment. With some 90% of the UK's municipal waste currently going to Landfill this is a challenge!!

The aggregate tax has encouraged the use of 'recycled' aggregates and already some 50 million tonnes of demolition waste out of a total of 70 million tonnes produced annually are currently being recycled. They find a market in low grade use because of their poor acceptability. In the last decade the emphasis on recycling has increased particularly for household waste, and the move towards high-technology incineration as well as increased 'producer' responsibility is a step in the right direction for the developed world in moving towards a genuinely sustainable society.

The Quarrying Industry, and in particular the Gravel Industry, have made it an important issue to ensure restoration of sites, and where landfill of waste can be achieved then the country benefits by the ongoing process of good land use.

Waste will always be with us and although today's society is becoming more complex, with the collection and reuse of material also more complex, there is now a better understanding of market considerations, economics, as well as the impacts of waste disposal on the environment for both industry, the public and the authorities to be better advised on the way forward for the future.

Richard Fox

Fuller's Earth

Fuller's Earth is a special sort of clay which has been used for centuries – even, it is thought, back to Roman times - for removing oil and impurities from woollen fleeces. It is found in various parts of England in shallow seams within the Lower Greensand Sandgate beds, particularly in Surrey. It is also found in the Jurassic limestones of the Southern Cotswolds, notably round Bath.

In earlier centuries small-scale extraction took place in many parts of the Weald from Headley in Hampshire to Maidstone in Kent and was probably traded by local farmers who would have extracted the material from bell pits. Towards the end of the eighteenth century there was a move towards concentrating production in areas where there were extensive seams; chief among these were the deposits at Nutfield between Reigate and Godstone where the beds extend for some 9 km along the strike of the Sandgate formation. In 1840 an entrepreneur by the name of James Cawley opened two pits for opencast extraction at Nutfield. This was large-scale production and much of the output was taken from the railhead at the Surrey Iron Railway at Merstham to the wharves at Wandsworth in London where significant amounts were exported.

Later in the nineteenth century Cawley brought about a merger with the Fuller's Earth business in Somerset, creating a combined enterprise called the Fuller's Earth Union, which quickly introduced a price fixing cartel. This business continued until 1954 when it was acquired by Laporte Industries who operated the Nutfield plant until 1981 when the seams were so exhausted that economic production was not sustainable.

How the properties of the natural clay substance were discovered is lost in the mists of time. Scientific analysis has now shown that the molecular structure of this substance gave it the adsorption properties, which enabled it to be used in the fulling or cleaning process. These self-same properties are used today for refining liquids, especially oils and syrups; for water purification plants; for pharmaceutical preparations and as a carrier for insecticides and herbicides. The chemical composition of pure Fuller's Earth consists almost entirely of montmorillonite, a clay mineral with a layer structure, which gives it its adsorption properties. It is generally believed that montmorillonite is formed by the decomposition of volcanic tuffs and basic igneous rocks. This belief is reinforced by the presence of other minerals of volcanic origin such as biotite in associated beds of the Lower Greensand. Although there is now general agreement about the volcanic origin there are several theories about whether the volcanic material fell in situ at the Fuller's Earth locations or whether the ash fall was elsewhere and was subsequently washed into marine lagoons. The main difficulty is knowing where the volcanoes were sited and what the paleo wind direction was. It is thought that around this time there was widespread volcanicity, associated with sea floor spreading as the Atlantic opened, and also in the southern North Sea and in northern Europe.

Returning to the production sites at Nutfield in the early twentieth century, the Fuller's Earth Union business found itself wrong-footed by a discovery made in Germany, that the addition of hydrochloric acid to Fuller's Earth improved its effectiveness in decolouring mineral oil. The English scientists produced their own activated material by constructing a separate plant at Nutfield using sulphuric acid. When Laporte Industries closed the whole Nutfield operation, they built a modern activation plant at Widnes in Lancashire.

Yet another use was found for the Fuller's Earth deposits at Nutfield when it was discovered that, by adding sodium chlorate to the Fuller's Earth, a synthetic form of bentonite could be produced. Bentonite is not found naturally in Britain and early oil exploration companies had to import this substance for use in sealing its boreholes. The essential property of bentonite is its ability to swell when wetted and this property was used not only by the oil companies but also in any situation where temporary support was needed to shore up the sides of holes or trenches. Because of this property it was called "swelling clay" and the synthetic bentonite was equally effective because the addition of sodium chlorate converted the naturally occurring calcium montmorillonite into sodium montmorillonite or bentonite.

I was prompted to write this article having been sent a copy of some proceedings of the Geologists' Association by John Gahan who knew of my interest in Fuller's Earth. The GA paper goes into elaborate technical detail about a recent find of Fuller's Earth near Shanklin on the Isle of Wight. This discovery extends the known distribution of this volcanogenic deposit southwards to the Channel Basin and confirms the widespread nature of the ash falls. My source for the history of the Fuller's Earth industry in Surrey was a publication of the Surrey Industrial History Group in 1999 entitled "Surrey's Industrial Past." This book covers the history of the former industries of Surrey and is a recommended read.

Peter Cotton

Petroleum geology of North Africa

Summary of the Society's March 2003 lecture given by Professor Richard Moody, Kingston University

Professor Moody has spent over 30 years working on oil and gas exploration in the three main countries of Libya, Tunisia and Algeria but with a particular emphasis on Tunisia. In 1996 these countries were ranked sixth in the world in terms of volume of output and pipelines now carry large volumes of gas under the Mediterranean to Europe.

He showed maps of Africa coloured to show the old shield areas from Pre-Cambrian times and the later basinal areas which, over time, have been filled with deposits from the upland areas inter-layered with marine deposits as the Tethys Sea advanced and retreated. To complete the sequence of deposits required to form oil and gas reservoirs the later deposits of Palaeolithic
and Mesozoic epochs provided the capping for these reservoirs. Interestingly enough Richard Moody showed that productive deposits are found in chalk which if the necessary organic material is entrapped in the pores before compression of the rock at depth, then a reservoir is created. All the oil bearing rocks must have adequate porosity for retaining the marine material which under the anaerobic conditions at depth in what Richard described as the "kitchen", is cooked into oil and gas. It is important to note that the underlying water levels in the Sahara play an important role in the mechanics of gas and oil exploration and produce the pressure to drive the hydrocarbons to the surface. This must, of course, be prevented by the capping sediments and where there is faulting or inadequacy of the capping sediments then seepage occurs.

The process of exploration was described by Professor Moody who underlined the massive amount of man and machine power required and the considerable cost to the exploration companies. He revealed how a 2600 Km length of seismic detection cable had been laid and how six huge machines proceeded slowly along it's length creating seismic shock waves down to 600 metres. Detection devices attached to the cable then produced images of the underlying strata. Where a likely pattern was revealed then cores were drilled to search for oil and gas.

Peter Cotton

FGS Newsletters of thirty years ago

Whilst looking through the old FGS Newsletters a few months ago, in order to number them, I found some fascinating reading which some of you might be interested in. They were all photo copied type written A4 sheets apart from two hand written ones.

In the **2nd Newsletter dated 1971** there was a list of future lectures and field trips including a Special Event – a Wine and Cheese and Rock Party in February when members were urged to bring plenty of rocks and fossil specimens as well as food. A film of the 1959 Kilauea eruption was to be shown.

In the **3rd Newsletter – no date**, from Audrey Hewins, an article by her 8 year old son Ralph was included, of a field trip to Somerset led by her husband Maurice. Roger Ashcroft described the field trip in more detail. They seem to have packed in an awful lot, if it was all in one day. Starting at the village green in Priddy they visited the Eastwater Swallet, then Blackwater Swallet and strolled over cornfields to the woods of Longwood Nature Reserve to Rhino Rift a recently discovered cave, then on to Burrington Combe and up a not too wet stream section, and found the junction of the ORS and the Carboniferous shales and limestones. Then on to the cave system of Wookey Hole and into the 3 accessible chambers of the 20 known. They then visited Wells and explored the cathedral and grounds. Roger still writes very detailed accounts for our Newsletters, of our field trips run by David Cronshaw.

The **4th Newsletter – no date**, described a visit to Lyme Regis and a visit to the Haslemere Museum which included seeing some of Sir Archibald Geekie's field note books. Of course it was due to him raising money by public subscription that the museum exists today. And there was to be another Wine and Fossil Evening!

In the **5th Newsletter dated Sept 1971** a field trip to the Dorset Coast was described, first to the Portland Museum (unfortunately closed!) then the sea shore at Church Ope Cove where a huge ammonite weighing over half a hundred weight was removed in three pieces for later reconstruction! After lunch they visited Ringstead Bay where the mineral fanatics removed some magnificent nodules from the Kimmeridge Clay containing large calcite crystals.

In the **6th Newsletter dated Oct 1971**, which was Audrey Hewin's last as secretary, a new constitution was to be circulated, all drawn up on the advice of a solicitor. As the treasurer too, she bemoaned the fact that there was still £7-50 of subs. to be paid. Twenty members attended a meeting that month given by a Mr J L Allan on the Lost Wax Method of Casting of small pieces such as rings, as well as mighty things such as huge statues.

Their **7th Newsletter dated Dec 1971** written by S H Smith the chairman, described a year of rather erratic performance as far as lectures were concerned, but hoped that members will discuss free and frankly at the AGM both past and future problems and objectives of the society.

The **8th Newsletter did not appear until Oct 1972** when Roger Ashcroft described two field trips; a day to Bracklesham Bay and a weekend to the Avon Gorge led by Ted Finch. In Dec 1972 they arranged a Wine and Cheese Party at the Cricketers, Lower Bourne costing 35p each! A suggestion then was to start a library of slides on any geological subject. In the summer a Mr Colley had led a geology trip round Alton. For the first time, two members were planning to put on a display at the annual GA Reunion then held at Lightfoot Hall, Chelsea College.

In their **9th Newsletter dated June 1973** there is a very detailed report on a day trip in March to the Isle of Wight, first to Alum Bay, then Freshwater Bay, and on to Compton Bay. The tide was wrong for the Atherfield coastal section but they still had time to see the recent landslip at Blackgang. In April 1973 they had another trip to Bracklesham Bay and saw Mr Fowler's collection of fossils and of course collected sharks teeth at East Wittering.

The AGM on 9-2-73 was well attended. The following month a lecture for newcomers to geology was held followed by a field trip on the Sunday to local sand and chalk pits, and an account of the day written by Julian Bentick. Members were invited to join a WEA Evening Class field trip to Swanage organized by Ted Finch at the end of March. A weekend trip in May was to Cheddar Gorge and the Mendips led by Maurice Hewins and Dr Stanton. They had a talk on the Denudation of the Weald by sea and river erosion and a Members' Evening in June brought in many new members. An afternoon trip to the Institute of Oceanography was organized too. The curator of Farnham's Museum offered the society facilities for displaying material of geological interest and they created their initial display on the Creation of a Fossil.

In their **10th Newsletter dated Nov 1973** Alastair Rawsay wrote a report on a field trip to Lyme Regis in July which went ahead despite a downpour on the Sunday morning and in September they'd had a lively lecture entitled "The Vagaries of Petroleum Geology" by Dr G V Woods from BP. In October a weekend trip to the Malvern Hills went well but was not enlarged upon. Mr Roberts gave a lecture on "Britain and the Plates" bringing together aspects of geology which were quite revolutionary in those days. A field trip to Clevedon and Portishead was organised by Ted Finch in November but unfortunately few people attended (We showed a photo taken by Roger Ashcroft on Portishead beach in our "30 Years of the FGS" at the GA Earth Alert Reunion in Brighton in 1999). Mr Jobbins , keeper of Gems at the Geological Museum lectured on Jade that same month. Another Wine and Cheese Party at the Cricketers was to be held in December and in January Ted Finch invited society members to his lecture on "A Geologist's Photography" at the RAE Camera Club.

Their **11th Newsletter dated Sept 1974** describes Dr Hawkes lecture about the Island of Rockall which is thought to be continental crust as it is an unusual granite containing two pyroxenes and one amphibole which is assumed to have been intruded thro' Tertiary Basalts. In February one of the members described a visit to Unst and Shetland and included the spectacular bird life he saw too. The AGM was held on Feb 25th on a bitterly cold evening and few attended and at 10pm sharp the caretaker turned them out! In March another trip to the Isle of Wight was held. The WEA Class invited society members to their Isle of Arran field trip on 21st–27th April led by Ted Finch and three joined them. Julian Bentick has kindly written an account of the week in **this** Newsletter. I remember when I was studying for my O-Level with Marjory Outlaw as tutor, (she was doing her A-Level Geology with Paul Olver at the time) she had been on the trip to Arran and was so excited about all the sills and dykes!

Shirley Stephens

A monster Ichthyosaur from British Colombia

In the 1990s the fossil remains of a huge Ichthyosaur were found in the remote Northeast of British Colombia, near the border with Alberta. It has taken several years to excavate this gigantic fossil, over twice the size of an Tyrannosaurus Rex and possibly the largest predator ever to have inhabited the earth. It has a length of 75 feet and a skull of over 17 feet. The excavation process therefore, is very complicated, and involves the cutting of the fossil into 30 major pieces that are winched by helicopter to Alberta's *Royal Tyrrel* museum for removal of the surrounding rock. The lifting of the 4½ ton skull required a Sikorsky heavy-lift aircrane normally used for heli-logging, a manoeuvre requiring very careful planning and execution.

In this area of British Colombia, around Williston Lake, the shale and siltstone cliffs are full of Triassic fish fossils, the remains of the teeming marine life of the Continental shelf of the super-continent of Pangea, whose coastline would have been where Alberta now lies and before British Colombia had been created.

Summary by Charles Ganter of an article in the British Colombia Magazine, Winter 2002

Across the Sahara in a Landrover

Summary of the lecture given to FGS by Ann Fereday on 13 April 2001

Ann Fereday is a palaeontologist who undertook a five week tour of the Sahara Desert with a small party of intrepid fee paying travellers, two of whom were a married couple in their 70s.

Ann began her talk by giving a brief history of how deserts are formed. These unique arid regions are indicative of a delicate climatic balance between the so-called Hadley Cells (types of weather patterns) that operate north and south of the equator in and around the tropics of Cancer and Capricorn. Deserts were said to be related to cyclical changes that occur every 90,000 years or so when hot dry regions are formed due to localised climate change. The same hot desert regions become cool barren environments for approximately another 10,000 years before reverting back to deserts once again. Ms Fereday made the point that due to current deforestation programs within the tropical rainforest belts these areas can be identified as a possible cause for increasing desertification outside of the natural climatic succession. As the desert cycle is today, she went on to say that the Sahara is the largest desert region on earth made-up of roughly of one-fifth of shifting sands with the remainder consisting of barren rock-strewn wasteland underlain by Palaeozoic and Archaean (Cratonic) rocks.

The tour commenced in the northern hemisphere summer of 1985 along the eastern Sahara at the Roman city of Tunis (Carthage) in Tunisia. The plan was to travel south through Algeria and on into Niger and then down into the Sahal (Burkina) - a distance of some 1,500 miles. Arriving at the city of Constantine in Algeria barely adequate food supplies could be obtained. An irritating distraction soon forgotten by a visit to the expansive Roman ruins and museum at Tungad dated at about 100 AD. This stunning ruin was said to be a Trojan city of alabaster and onyx pillars supporting the civic buildings with its sophisticated infrastructure and efficient hypocausts (plumbing, water systems and hot baths). Once into the desert proper and now travelling due south, Ms Fereday recounted the dramatic scenery of aeolean (wind-swept) star and crescent-shaped dunes and how easily one might get lost in such surroundings where the horizon and scenery appeared not to change in every direction. Unlike previous years it seems, the desert summer of 1985 was said to be exceptionally hot giving rise to the unusual appearances of horned vipers and plagues of flies. It was not until the party ascended 2000ft onto the Fadnoon Plateau that relief from the stifling heat could be quenched. Here Ann described with dramatic slides the impressive sandstone quartzite towers or mesas honed by water erosion over millions of years. The Fadnoon Plateau also provided an oasis of cypress trees to form a shelter away from the by now undiluted fierce sunlight. At some nearby sandstone caves a variety of ancient wall drawings of antelopes were shown cavorting in different reproductions and drawn over thousands of years. The party travelled still further south by returning to the desert floor before rising once again onto the much higher Algerian Ahaggar Mountain range. Here slides were shown of exfoliating granite rocks (onion peeling) together with towering basaltic necks indicative of former volcanism.

Once again the resolute band continued their journey south covering in excess a 1,300 miles into the town of Agadez in the country of Niger. The desert here is described as littered with abandoned cars and trucks. Apparently once a vehicle dies it stays dead while its intimate parts are cannibalised for the survival of other valiant motorists in these harsh desert conditions. Slides were shown of quicksand known locally as ‘fesu’ but more importantly the local market with its exotic food supplies which were said to make most travellers fill with utter despair. Much was

made of an entrenched 'spy culture' which seemed to exist everywhere as foreigners come under suspicion as perceived, and perhaps in some cases, genuine secret agents or lawbreakers. Camels and donkeys in the Agadez region apparently develop peculiar 'wind eyes' to protect them from the suffocating sand or 'fever storms' in which it was said a fever can be contracted. On one occasion a plague of butterflies was so intense it actually choked the Landrover's engine to a full stop. The journey finally ended in the Sahel region of NW Niger. Ms Fereday went on to compare other desert regions of the world such as Morocco, Egypt and Namibia all considered to offer similar climates to the Sahara but evidently less large. The high deserts of Chile (Atacama) and Bolivia (Alti Plano) were felt to be challenging but much less interesting, as was the Gobi Desert (Mongolia) and small regional semi-arid deserts around Asia Minor such as those in Israel, United Arab Emirates and The Yemen.

After a good hour of speaking Ms Fereday answered a host of questions before being thanked by Janet Catchpole on behalf of the Society for the fascinating talk. She then presented her with the customary beverage. Our Chairman Margaret Bourgoing also expressed the Society's thanks and very best wishes for her long journey home.

John Gahan

New insights into the geology of the North Sea from 3D & 4D seismic data

Summary of the Society's April 2003 lecture given by Dr Chris Edlers, Royal Holloway College

Dr Chris Edlers presented a very technical but clear indication as to how advances in seismology are contributing to the ever increasing understanding of the geological structure beneath the North Sea. Detailed knowledge of this kind is essential if all gas and oil reserves are to be located and their extraction maximised.

Simply, seismology involves the sending of sound waves down into the earth's crust and, using an array of microphones, picking up the echoes that are reflected from the various geological layers. These returning signals are then captured by computers and analysed to give an indication of the underlying geological structure. The resolution of the geological maps thus produced is a function of a variety of factors such as: spacing of the microphones, a knowledge of sound propagation within the types of rock being encountered and most important of all, computing power available.

In the early 1980s, computing power was such that microphones could only be placed some 200 metres apart in order to avoid swamping the computers with data; this limitation meant that mapping, even though it was down to many kilometres in depth, was limited to 2-Dimensional slices. By the late 1990s, computing power had increased enormously, and microphone arrays having typically 25 metre spacing were being utilised to produce 3-D maps of the geological structure beneath large areas of the North Sea.

These detailed maps have enabled geologists to determine the local geological conditions pertaining in the North Sea over a wide spectrum of geological time, from present day back to Jurassic times. The maps have been crucial in providing evidence for both the presence and formation of salt-domes, features so very important in the entrapment of gas and oil, and have revealed that, during glacial times, the ice sheet did in fact extend from UK across to Scandinavia. Many more examples of the information that these 3-D maps reveal were presented.

As to the future, computers are now so powerful that the seismological data can now be processed to produce "Virtual reality" images that allow one to be "within" a life-size 3-D image of the geological structures encountered; although something of a novelty, such images are of use in explaining to the actual well-drillers exactly where any drilling should take place.

Michael Weaver

Newspaper snippet: Graphite

Delegates from a pencil factory met the Queen in February when they went to pick up an Award for Enterprise. Graphite was first discovered near Keswick around 1500, making it the home of the pencil and the technicians at the Derwent factory had pioneered a revolutionary advance in the way pencils are lacquered, which is 22000 times faster than the old way. Well spotted by the Queen!

From the Guardian, Feb 2003