Farnham Geological Society

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

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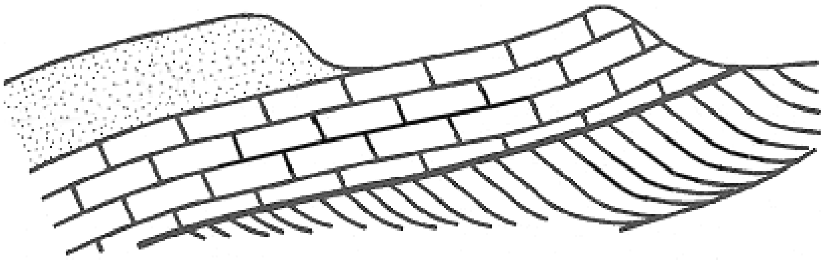


A local group within the GA

Vol. 8 No.1

Newsletter

February 2005

INSIDE THIS ISSUE

Happy New Year! This first issue of 2005 contains lecture summaries for the last four months, which has now brought us up to date. I trust that you find it helpful to have these summaries whether you were present or not at the lectures.

The recent devastation caused by the Indian Ocean earthquake and subsequent tsunami is a sharp reminder to geologists in particular that these earth shattering events, which have left their mark on our planet's landscape since the start of time, now have a human dimension of catastrophic proportions. Early warning systems can help, but as long as the human race continues a pattern of settlement based on economic and social factors, there will always be the risk of disaster from earthquakes, volcanoes, landslides and flooding. Even in the British Isles there was a massive tsunami on January 20th 1607 which swept up the Bristol Channel killing thousands of people and destroying settlements on the Welsh coast.

Shirley Stephens' summary of the G.A. Reunion in Cardiff, included in this newsletter, reminds me of all the literature available from other Geological Societies that can be summarised from time to time in our newsletter. For example, the North Staffordshire Society has produced a series of short articles on "The Industrial Utilisation of Natural Materials" including coal, rock salt, clay, ironstone, limestone, sand and gravel and water. The Kent RIGS Group have produced a glossy booklet on Kentish Ragstone. Look out for future articles.

Peter Cotton

COMMITTEE

FGS monthly meetings and field trips - 2005

Jan 14	Prof Eddie Bromhead, Kingston University ***Landslide and landslide dams in the Venetian Pre-Alps***
Feb 11	Mike Coates, Chief Warden RSPB, Surrey Heath ***The RSPB Farnham Heath Project***
Mar 11	Dr Roger Suthren, University of Derby ***Geology and wine in Southern France***
Apr 8	John L Morton, author of *'Strata'* ***William Smith, the father of English geology***
May 13	Dr Paddy Reagan, University of Surrey, Guildford ***Making gold –nuclear alchemy***
June 10	Dr Paul Craddock British Museum, London ***Early mining and extractive metallurgy***
July 8	***Members evening & presentations***
Aug 12	Summer break - no meeting
Sept 9	John Atkinson, Portsmouth Water Company ***Water supply with regard to Cretaceous strata'***
Oct 14	Dr Rex Taylor, School of Ocean & Earth Sciences, S'ton ***Volcanoes & volcanic processes along the Izu-Bonin arc***
Nov 4	**Society dinner at Farnham House Hotel**
Nov 11	Dr Christopher Green, Royal Holloway College ***Reconstructing Quaternary Rivers***
Dec 9	tba
Jan 13	Annual General Meeting 2006

Proposed Field Trips 2005

23-30 April: Isle of Arran   September?: Hallsannery Field Centre, Bideford   17-30 October: Tunisia

Boxgrove Man

Palaeolithic archaeological finds at Boxgrove near Chichester have "completely overturned" years of accepted thinking about the capabilities of pre-Neanderthal man, Dr. Mark Roberts, director of the excavation, told a meeting at the Guildford Institute.

Previously considered to be mere "tool-assisted apes," excavation of what was then a coastal area below a chalk cliff has revealed a very different picture of human life nearly half a million years ago.

Before the dig was back-filled, in 1996, fellow members of the Farnham Geological Society and I enjoyed the never to be forgotten experience of visiting the site.

We saw flint axes projecting from the vertically cut earth wall of the excavation – each looking as fresh and sharp as it was when dropped in the sand after a butchery session some 490,000 years ago. The hunters' quarry on that day could have been rhino, giant deer, or even elephant – as bones of all these animals and many other species have been found in the course of the dig.

Dr. Roberts began his lecture with a detailed description of the geology of this area of southwest Sussex. The geology, he emphasised, was key to an understanding of the archaeology. Since the days when the sea lapped a beach at the foot of a 75 to 100-metre high chalk cliff at this spot, the coast has gradually extended southwards, leaving behind a series of raised beaches. In the Boxgrove area only about three to four metres of the original cliff is left, the rest having eroded away. On the ancient beach lie blocks of chalk from the cliff. All this was later overlain by gravels. The buried chalk cliff and beach with their archaeological story were uncovered during operations for flint and gravel extraction.

Dr. Roberts said that Boxgrove contained “the best archaeology you are ever likely to see.” One could not tell the difference between the 500 million year old hand axes found and those made yesterday. Fifteen axes had been found in one small area, lying where they had been discarded after a butchery session, together with bits of four adults and one juvenile rhinoceros. Also found were bones of giant deer, which these people had somehow managed to cut through with hand axes. The bones were full of tiny pieces of flint. There was evidence of both encounter hinting and of planned hunting around a water hole. A scapula was found to have a spear wound.

This was towards the end of an interglacial period, showing evidence of very rapid climate change. A brown band of organic deposit was laid down in a fresh water marsh at a time when the sea regressed.

This was useful as a marker when, following completion of the excavation in 1996, Dr. Roberts embarked on a major geological project to map the line of the raised beach uncovered at Boxgrove. Conditions at this time explained the huge blocks of exotic rock found in the south Sussex area. The English Channel was closed at the time from present Brighton to France. Icebergs floated through the Irish Sea then ran aground in the shallow water, depositing these exotics – granite, millstone grit and igneous rocks.

“In 100 years the climate flips. Dormice, voles, bats and shrews, indicative of a warm climate, are gone, but people do not disappear. Hand axes continue to be found within the cold deposits. People are able to survive for a very long time in the cold conditions.”

Dr. Roberts said that the people at Boxgrove, of whom a tibia had been found, were of similar type to Homo Heidelbergensis, whose scull was found in southern Germany. They had come out of Africa before our own ancestors did and went on to evolve into Neanderthal man.

During the excavations 50 metric tons of sediment was sieved, yielding remains of numerous small mammals, birds and fish – the fauna for which Boxgrove is famous. Beaver mandibles were found and wolf skull. Most were in a natural death assembly. Some bone had been gnawed by a small wolf. There were masses of butchered bone, red deer vertebrae showing tool-cut marks, and a bear radius, which had been split for the extraction of marrow.

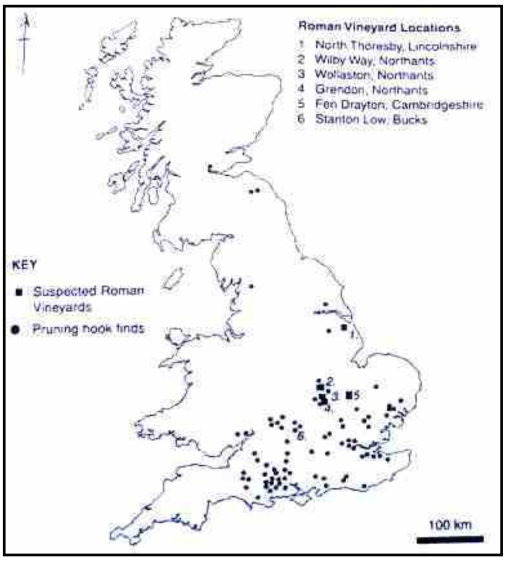
Mary E Clarke

The Geology of British Vineyards

Summary of the Society's September lecture given by Prof. Richard Selley, Imperial College

Introduction

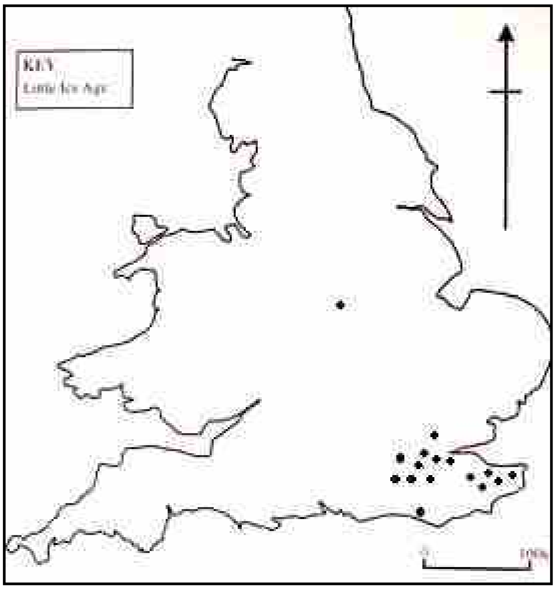
Grape vines have been grown in various parts of the British Isles for hundreds of years. But clearly in such a temperate region viticulture has been dependant not only on the geology but more particularly on climate. Vines first colonised Britain some 50 million years ago and it was only during extremely cold spells such as ice ages during the present Quaternary that grapes were not grown. The origins of wine growing and the merits of drinking plenty of it were briefly discussed by Professor Selley who outlined the growth of viticulture before during and after the Roman occupation of Britain.



Vine pips were discovered in sediments some 250,000 years ago in East Anglia during the so-called Mindel-Riss warm interglacial, and semi-domesticated grape seeds and pruning hooks found at Neolithic sites indicate a history of British wine growing. Viticulture was practised by the Celtic Allobroges who came from continental Europe prior to the conquest with the discovery of all types of amphorae in the south east of England.

These were used to hold olive oil and of course libations such as water, wine, cider and mead. Moreover recent archaeological discovery suggests vineyards flourished during the reign of Emperor Domitian in 90 AD who ordered the destruction of all vineyards in conquered Europe which included the most northerly province of Britannia. Mercifully such a draconian act was repealed by the Emperor Probus in 280AD.

Medieval Warm Period in Britain
When the Romans departed in the fifth century the favourite refreshment (by the now firmly ensconced Angles, Jutes and Saxons) was ale and mead from the hop and hive rather than the vine. The climate was most agreeable with long warm humid summers and wet winters ideal for the growing of orchard fruits and hops with a near perfect ripening season. It was only after the Norman Conquest that drinking habits began to change and reintroduced expertise for wide scale viticulture returned to southern Britain. Wine was again the required aperitif of the conquering classes.

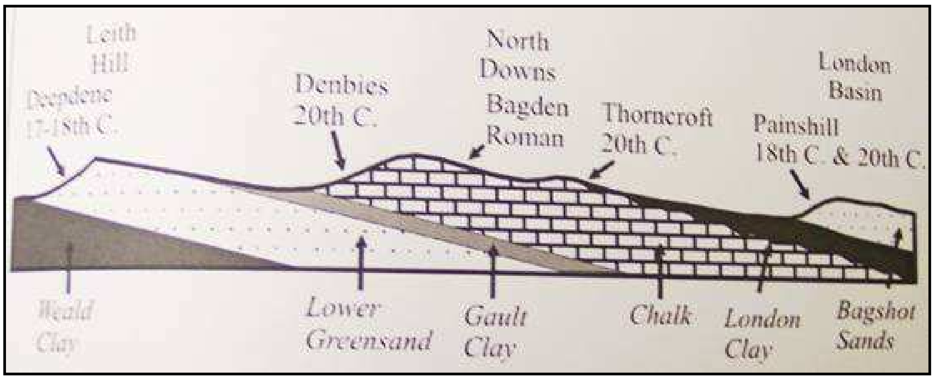


Some two hundred years later in the 12th century a slow decline in the cultivating of vineyards occurred. Access to the Bordeaux vineyards of France was said to be the cause when Henry II married Eleanor of Aquitaine and good quality wines were imported for the sole benefit of the royal court and landed gentry.

The gradual encroachment from the continent to Britain of the 'Black Death' in the mid-to-late 14th century eventually took a firm hold causing agriculture to collapse completely. At the same time the 'Little Ice Age' froze Britain to its core and temperatures plummeted to averages of O.5%C. During this period viticulture was just about hanging on in some parts of south east Britain and just one lone producer in Northamptonshire (See figure). Elsewhere in the country wine growing had ceased altogether.

Geological Controls on Vineyards
Professor Selley outlined that geology is one of the four variables that influence both the quality and characteristics of wine. The remaining three were said to be climate, grape variety and recipe, and that vines flourish on either Precambrian granites in Portugal or the young gravels of Australia. But controls, the good professor maintained, are more related to topography and top-soil type. He went on to outline rock classes (sedimentary, metamorphic & igneous) and how they may impinge on aspects of vine growth. For example igneous and metamorphic rocks are crystalline and more or less impervious so they lack pore spaces. On the other hand sandstones and limestones are permeable in some way and tend to drain very well. Nonetheless he was cautious about making geological assumptions and pointed to altitude, orientation, topography, geomorphology and climate as the principal controlling factors.

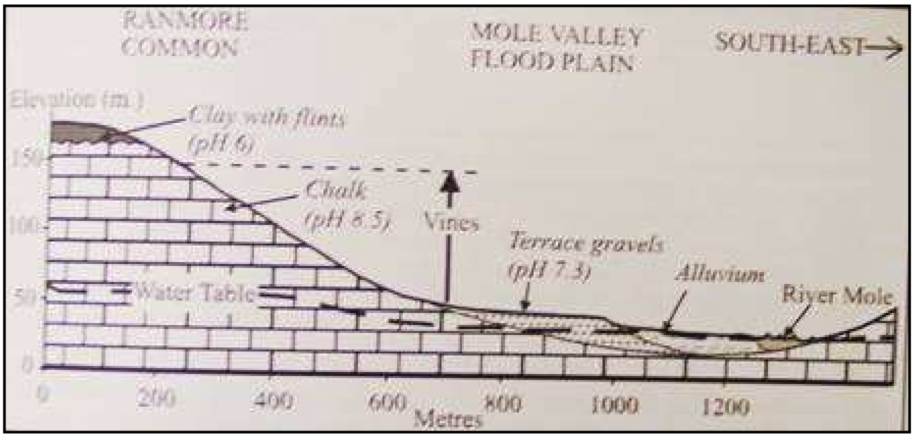
Winelands of Britain
Because climate influences erosional processes on landscapes and Britain lies in a temperate zone, the topography of southern England during ice ages experienced only permafrost conditions (tundra). And as temperature is said to decrease by 0.6^{o} per 100m, vines in hot climates flourish in mountainous regions. In Britain however the sun's angle decreases as does temperature and as a result the amount of solar radiation received at the surface. Hence conditions for vine growing in the British Isles can be somewhat limited. Southern England however does offer good topography particularly along 30^{o} slopes (North/South downs) where the angle of the sun is 62^{o} at midday in high summer and receives ~8% more radiation than a vineyard at ground level. While Richards maintained this is not altogether significant,



by October when the grape has ripened the difference may be as much as 30% of acquired solar radiation. A calculation was given to support the solar radiation received in certain conditions (available if required !).

A cross-section of the young and older rocks along the North Downs towards the London Basin indicate how vineyards were deployed utilising rock formations and slope gradients (See figure).

British Viticulture & Global Warming
Given that global warming appears to be a reality, for what ever reason, this phenomenon might well be a bonus for British viticulture. Warm phase vineyards could extend as far north as the south midlands as they did in pre-Roman and Roman times. Indeed it was even suggested that a northward advance for British viticulture could stretch as far north as the border country.



In conclusion Richard outlined a brief case history he had carried out in the 1990s of the Denbies Vineyard at Dorking in Surrey. It seems that many years ago a local geologist had noted similarities between the Champagne country in France and the North Downs. Both areas share the same Cretaceous chalk as their bedrock with southerly and south-easterly topography sheltered from the damaging westerly winds that can destroy young vines (See figure). As a result of this research Denbies Vineyard was set-up and now flourishes as a unique commercial venture today in central Surrey.

It was left that a field trip to Denbies Vineyard at Dorking the following day (Saturday) would enlighten our members as to the geomorphology and merits of growing English wine. This entailed a short walk along a part the North Downs where the vineyard is located in addition to showing an Imax film presentation of Denbies and wine growing in particular and not least some wine tasting or slurping of the Surrey vino. Ten members from the Society pitched-up at Denbies and by all accounts everyone had a rather ‘*shplendid*’ day out.

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John Gahan

Newspaper snippet - Dinosaur footprints in Oxfordshire

A set of dinosaur footprints that have helped scientists to estimate how fast the beasts could run were yesterday removed from the rock where they have been for more than 160 million years. The fossilised tracks were made by a massive meat-eater called megalosaurus, which once ran alongside an even bigger herbivorous dinosaur, called cetiosaurus. Quarry workers wielding circular saws helped scientists to cut the footprints from Ardley quarry in Oxfordshire, in order to house them in a new annex to the county's museum in Woodstock. Some of the footprints are up to three feet long, two feet wide and eight inches deep and are being cut out as part of 10 huge slabs of limestone.

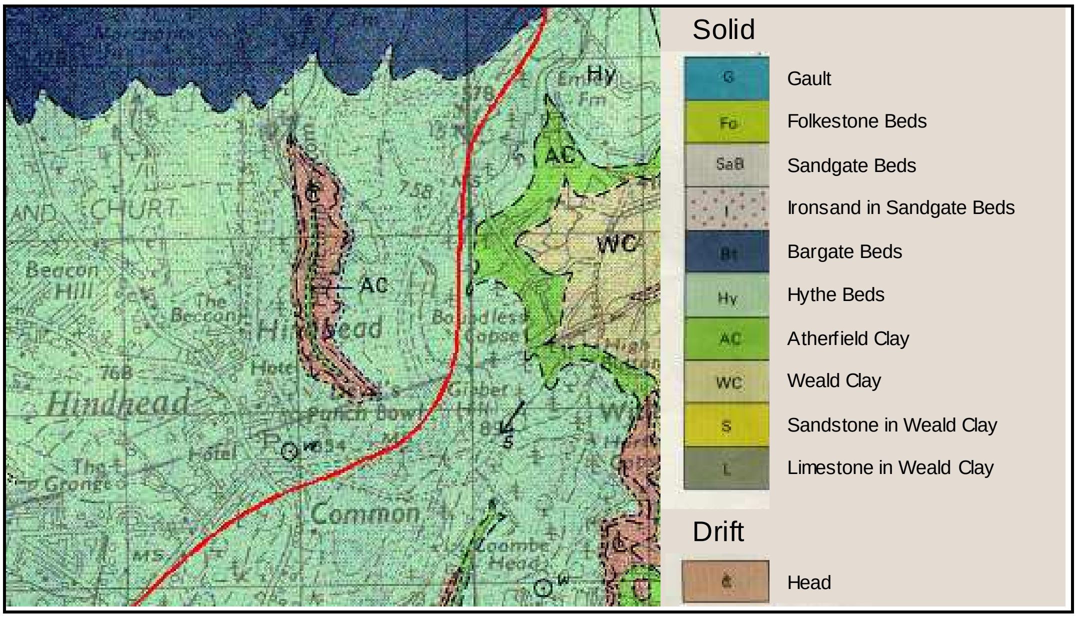
Hugh Coddington, Oxfordshire's deputy archaeologist, said the footprints were especially important because they are so well preserved and show two species living in the same prehistoric habitat. "*The footprints which have been found were over a large area and there are definite tracks of individuals which seem in very close proximity to each other*", Dr Coddington said. "*The inference is that the smaller carnivores were hunting the larger herbivores. It is unique in the fact that there are two different sorts of dinosaur in very close proximity at the same time, and also because of the conclusive evidence that the two-legged carnivore could run*."

When the two dinosaurs lived, in the Jurassic period, the site would have been a mud flat on the edge of a tropical sea. Their freshly made footprints probably dried out before being covered in a layer of silt. An analysis of megalosaurus's tracks shows that it walked on two legs with its toes pointing outwards in a swaggering gait, before stepping into a stride with its legs being brought directly under its body. Scientists calculate that it could have run at 13mph, which is almost as fast as an Olympic sprinter. That is fast for an animal that grew up to 23 feet long and had a three-foot skull. The lumbering cetiosaurus was nearly twice as big and probably ate vegetation growing in the shallow waters of the mudflat. It would have almost certainly been a source of food for megalosaurus.

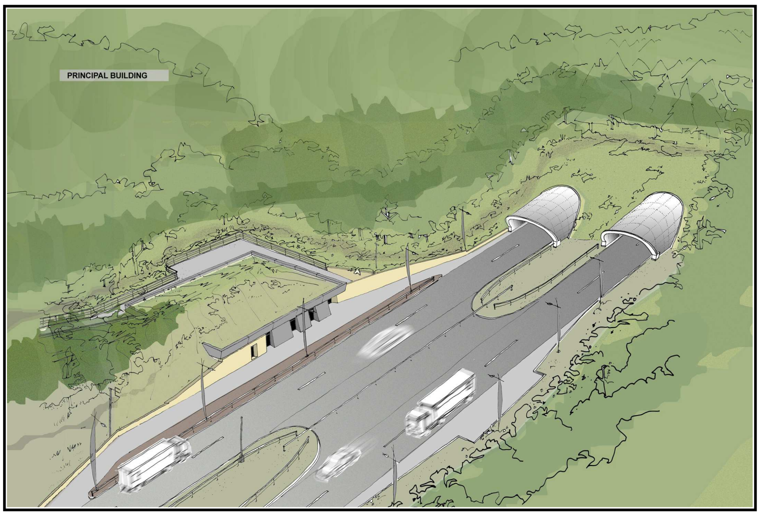
Steve Connor, Science Editor, The Independent, 20 May 2004

Geology of the proposed Hindhead tunnel on the A3

Summary of October 2004 lecture given by Andrew Davis of Mott McDonald



Andrew Davis explained that the proposed 1.9km tunnel will close the missing link on the A3. Together with open-cut works the scheme will be 2.6km in length and will form the last dual carriageway section between London and Portsmouth. It will remove the bottleneck of the crossroads with the A287 at Hindhead. He explained the geology of the tunnel route centre on the Hindhead Anticline that plunges to the west, and has the axis approximately coincident with Gibbet Hill. The Devils Punchbowl is an SSSI because of the geomorphology, which represents the largest example of a spring-sapped valley in Britain. This area was formed by a process of headward valley erosion at the interface of the permeable sands of the Hythe Beds and the impermeable Atherfield Clay. *An earlier article on this project featured in the FGS October 2003 Newsletter.*



They had drilled 54 boreholes of 100mm diameter up to120m depth. Cores were taken and instrumentation made from these boreholes, including piezometers installed in most of them in order to monitor groundwater levels continuously. The Hythe Beds have immense variability, and these were classified as engineering properties for designing the tunnels and their alignment. These beds are predominantly quartz with detrital glauconite, smectite and chert cement. The high primary porosity is due to dissolution of siliceous sponge spicules, the silica being re-distributed as chert beds and cement.

In his presentation, Andrew Davis then showed examples of some of the cores recovered. He concluded with details of how the tunnels would be driven. The construction commencement date is the winter of 2006, with the completion in the summer of 2009.

David Stephens

The Cascades, Mt. Rainier and Mt St. Helens

The Cascade Range

The Cascade Range is a mountainous region famous for its chain of tall volcanoes called the '*High Cascade'* that run north-south along the west coast of North America from British Columbia to the Shasta Cascade area of northern California. The Cascades (as they are called for short) are part of the Pacific Ring of Fire, the ring of volcanoes around the Pacific Ocean. All of the known historic eruptions in the contiguous United States have been from Cascade volcanoes. The two most recent were Lassen Peak in 1911 and Mount St. Helens in 1980.

At its southern end the range is about 30 to 50 miles wide and 4500 to 5000 feet high but is higher and 80 miles wide in northern Washington. The tallest volcanoes of the Cascades (called the High Cascades) dominate the rest of the range, often standing twice the height of the surrounding mountains and thus often have a visual height of a mile or more. The tallest peaks, such as the 14,410 foot high Mount Rainier, dominate their surroundings for 50 to 100 miles.

Because of the range's proximity to the Pacific Ocean, precipitation is substantial, especially on the western slopes, with annual accumulations of up to 150 inches in some areas and heavy snowfall as low as 2000 feet. Most of the High Cascades are therefore white with snow and ice year-round. The western slopes are densely covered with Douglas fir, Western hemlock and alder, while the drier eastern slopes are mostly pine, with Western larch at higher elevations. Annual rainfall drops to 8 inches on the eastern foothills due to a rain-shadow effect.

Two of the most well known mountains in the range are Mount Saint Helens and Mount Rainier, both on the itinerary of the FGS trip to USA and Canada in September 2004.

Mount Saint Helens

Mount St. Helens is most famous for a catastrophic eruption, on May 18, 1980. That eruption was the most deadly and economically destructive volcanic eruption in the history of the United States. 57 people were killed, and 200 homes, 47 bridges, 15 miles of railways and 185 miles of highway were destroyed. The eruption blew the top of the mountain off, reducing its summit from 9,677 feet to 8,364 feet in elevation and replacing it with a mile-wide horseshoe-shaped crater.

The two photographs below show the mountain before and after the 1980 explosion.

Like most of the other volcanoes in the Cascade Range, St. Helens is a great cone of rubble, consisting of lava rock interlayered with ash, pumice and other deposits. Volcanic cones of this internal structure are called composite cones or stratovolcanoes. St. Helens includes layers of basalt and andesite through which several domes of dacite lava have erupted. The largest of the dacite domes formed the previous summit; another formed Goat Rocks dome on the northern flank. These were destroyed in St. Helens' 1980 eruption.

According to geological evidence, St. Helens started growth in the Pleistocene ~37,600 years ago with dacite and andesite eruptions of pumice and ash. 36,000 years ago a large mudflow cascaded down the volcano - mudflows were very significant forces in all of St. Helens' eruptive cycles. Parts of this ancestral cone were fragmented and transported by glaciers 14,000 to 18,000 years ago during the last ice age. Repeated eruptions of pyroclastic flows, pumice, and ash followed until about 6500 BC when the volcano went dormant for 4000 years.

After this long period of quiet a series of eruptions began in 2,500 BC which, over 900 years, covered much of the surrounding area with up to 2.5 cubic miles of material. A quiet period of only 400 years followed and a pattern of eruptions, followed by 400 years of dormancy, continued through three eruptive cycles up to 800 AD There was then a long period of 700 years' inactivity before, in 1500 AD, the major Kalama eruptive cycle began. It was to last for 150 years during the course of which different phases of the cycle produced many varieties of ash and pumice deposits and led to massive pyroclastic, lava and mudflows which devastated a huge area and blocked the Kalama river drainage system.

The 57 year long Goat Rocks Eruptive Period started in 1800 and is the first cycle for which oral and written records exist. As with the Kalama cycle, the sequence of events started with an explosion of dacite tephra followed by an andesite lava flow and then culminated with the emplacement of a dacite dome. The ash drifted north-east over central and eastern Washington, northern Idaho and western Montana. There were at least a dozen small eruptions between 1831 to 1857 of ash reported as well.

Mount St. Helens woke up on March 20, 1980, with a Richter magnitude 4 earthquake. Steam venting started on March 27. By the end of April, the north side of the mountain started to bulge. With little warning, a Richter magnitude 5.1 earthquake triggered a massive collapse of the north face of the mountain on May 18. The magma inside of St. Helens burst forth into a large-scale pyroclastic flow which flattened vegetation and buildings in an area of over 230 mile².

For more than nine hours, a vigorous plume of ash erupted, eventually reaching 12 to 15 miles above sea level. The plume moved eastward at an average speed of 60 miles per hour, with ash reaching Idaho by noon..

The collapse of the northern flank of St. Helens mixed with ice, snow, and water to create lahars (volcanic mudslides). The lahars flowed many miles down the Toutle and Cowlitz Rivers, destroying bridges and lumber camps. A total of 3.0 million m³ of material was transported by the lahars.

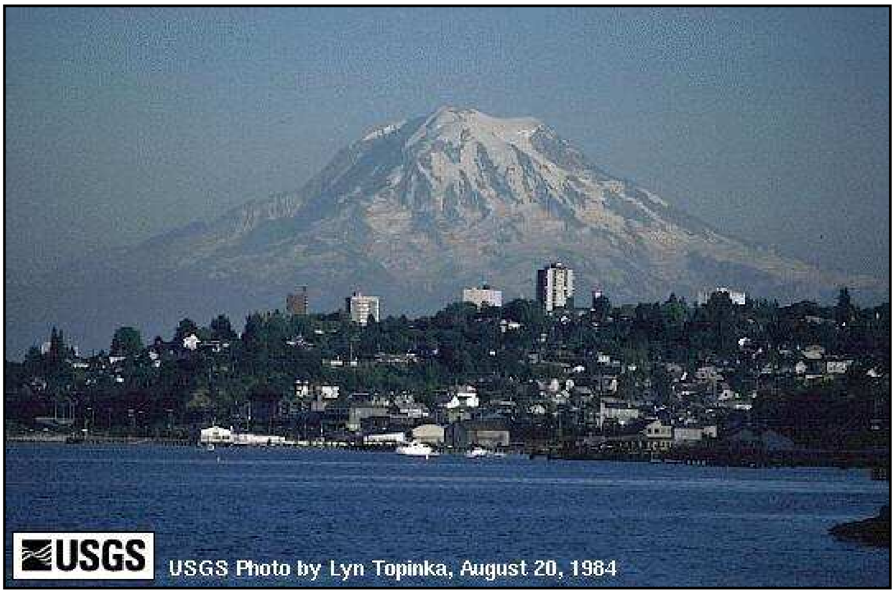
By around 5:30 PM on May 18 the vertical ash column declined in stature but less severe outbursts continued through the night and the following several days. In all, St. Helens released an amount of energy equivalent to 27,000 Hiroshima-sized atomic bombs and ejected more than a cubic kilometre of material. The removal of the north side of the mountain reduced St. Helens' height by about 1300 feet and left a 1 to 2 mile wide and 0.5 mile deep crater with its north end open in a huge breach. 57 people were killed along with 1500 elk, 5000 deer, and an estimated 11 million fish. In addition, 200 homes, 47 bridges, and 185 miles of highway were destroyed.

Between 1980 and 1986, activity continued on St. Helens, with a new lava dome forming in the crater. Numerous small explosions and dome-building eruptions occurred during this time. Between 1989 and 1991, a series of seismic events occurred, sometimes accompanied by small explosions from the dome. Later, in 1995, 1998, and 2001, earthquake swarms were recorded beneath the crater, though without explosive activity.

Mount St. Helens became active again in autumn 2004, just 2 weeks after the FGS visit, when swarms of hundreds and then thousands of localised earthquakes were followed by several significant emissions of steam and ash. On October 1, 2004, Mount St. Helens sent an enormous amount of steam and ash into the air for approximately 25 minutes, yielding evacuation orders from nearby areas. Mount St. Helens vented steam, ash and rock once more into the air. On October 6, 2004, the U.S. Geological Survey announced that the alert level was being lowered, saying: "*We no longer think that an eruption is imminent in the sense of minutes or hours*".

Mount Rainier

Mount Rainier, highest (14,410 feet) and third-most voluminous volcano in the Cascades after Mounts Shasta and Adams, dominates the Seattle-Tacoma area, where more than 1.5 million folk know it fondly as ***The Mountain***. The Mountain is, however, the most dangerous volcano in the range, owing to the large population and to the huge area and volume of ice and snow on its flanks that could theoretically melt to generate debris flows during cataclysmic eruptions.



Mount Rainier volcano dominates both Seattle (See photograph) and the landscape of a large part of western Washington. It stands nearly 3 miles higher than the lowlands to the west and 1.5 miles higher than the surrounding mountains. The base of the volcano spreads over an area of about 100 square miles, and lava flows that radiate from the base of the cone extend to distances of as much as 9 miles.

Mount Rainier is an active volcano that first erupted about half a million years ago. Because of Rainier's great height (14,410 feet above sea level) and northerly location, glaciers have cut deeply into its lavas, making it appear deceptively older than it actually is. Mount Rainier is known to have erupted as recently as in the 1840s, and large eruptions took place as recently as about 1,000 and 2,300 years ago. Mount Rainier and other similar volcanoes in the Cascade Range, such as Mount Adams and Mount Baker, erupt much less frequently than the more familiar Hawaiian volcanoes, but their eruptions are vastly more destructive. Hot lava and rock debris from Rainier's eruptions have melted snow and glacier ice and triggered debris flows (mudflows) - with a consistency of churning wet concrete - that have swept down all of the river valleys that head on the volcano. Debris flows have also formed by collapse of unstable parts of the volcano without accompanying eruptions. Some debris flows have travelled as far as the present margin of Puget Sound, and much of the lowland to the east of Tacoma and the south of Seattle is formed of pre-historic debris from Mount Rainier.

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Underground storage of carbon dioxide

Just East of Houston, Texas, lies an abandoned oilfield. It may be barren but it is by no means redundant. It has just become a testing ground for a technology that could prove crucial in the decades ahead. American scientists have started trucking in lorry-loads of liquefied carbon dioxide from a nearby BP oil refinery land pumping it into the rocks that lie above the emptied oil reservoir. Once underground, the theory goes, the gas will invade the mile-deep alternating layers of sand and shale, and push out the salty water that currently fills its pores. Barring any leakages, the gas will remain there for thou- sands of years, supposedly safely tucked away from the atmosphere and so unable to contribute to climate change.

Carbon dioxide is the villain in the drama of global warming. While efforts such as the Kyoto Protocol have focused on getting countries to reduce their greenhouse gas emissions in the future, scientists claim that the pollutants currently being produced must also be dealt with. The answer, some geologists argue, is to trap them underground.

This Texan experiment in so-called carbon sequestration - capturing carbon at its point of production and keeping it hidden from the atmosphere - is called the Frio Pilot Test after the Frio Formation, the saline aquifer (water-holding rock) atop the oilfield that will hold the gas. The idea of dumping carbon dioxide underground is not new. Since 1996 Esso and Statoil have been taking the carbon produced by the Sleipner West natural gas field off Norway and injecting it into the Utsira Sand, a saline aquifer underneath the North Sea, but until now the technique has not been tried on land. Environmental groups such as Greenpeace and Friends of the Earth condemned the Norwegian experiment as a "dangerous distraction", claiming that leakages could destroy marine life and cause a runaway greenhouse effect. They also dispute that stowing carbon underground can make anything but a small difference to long-term efforts to stem climate change.

Trapping carbon dioxide in underground rocks is far from untested, though. The technique is already used by oil companies to squeeze every last drop from dwindling reservoirs. The principle is the same - carbon dioxide is pumped in to flush out the oil. The carbon dioxide stays put, giving encouragement to geologists who believe that rock formations really can solve the problem.

"While we expect the carbon dioxide plume to spread out over a few hundred metres, it should stay buried for thousands of years," says Larry Myer, an engineer at the Lawrence Berkeley Laboratory, which, along with the Oak Ridge National Laboratory, will monitor the Texas site for leaks. "The risk of leakage is critical when storing carbon in brine formations but I'm optimistic that our test results will show that these formations are safe for carbon sequestration."

The Frio Formation is capped with a thick layer of shale, which should keep a lid on leaks. Sideways seepage is expected to be contained by faults at the formation's edges. Statoil says that the carbon dioxide stored in the Sleipner experiment has not leaked.

The figures certainly look encouraging - an estimated seven billion tonnes of carbon dioxide is created globally by human activity each year. According to Susan Hovorka, a geologist with the Texas Bureau of Economic Geology, which is leading the Frio Pilot Test, the Frio Formation alone can hold between 200 and 350 billion tonnes of carbon dioxide, or at least 28 years' worth. In the US alone there are an estimated 60,000 similar formations, providing a potential dumping ground for centuries. The Utsira Sand could hold all, the carbon dioxide produced by Europe's fossil fuel power stations for 800 years.

That, say green groups, is partly the problem - as long as there is a place to banish unwanted carbon, there is little incentive to stop producing it. However, energy companies reject the "out of sight, out of, mind" argument. They prefer to call carbon sequestration a "bridging technology" that will ease the transition to cleaner energy sources while meeting soaring demand, especially from the developing world.

The $C0_2$ Capture Project - a consortium of, among others, Shell, BP, Statoil, Chevron-Texaco, the US Department of Energy and the EU - is optimistic about underground carbon storage. It says that it "Intends to address the issue of reducing emissions in a manner that will contribute , to, an environmentally acceptable and competitively priced continuous energy supply for the world".

Offshore carbon storage might one day become an option for Britain - in which case, says Dr Simon Shackley, from the Tyndall Centre for Climate Change Research in Manchester, the public needs to be involved now. "Our research team interviewed 200 people about carbon capture and storage (CCS) and nobody had ever heard of it," he says. "They said it sounded dangerous and unnecessary. But when we explained the problem of emissions, they came round a bit. They don't like the idea of a quick fix or burying the problem. Most people would rather see a move to renewables and improved energy efficiency, but understand that CCS could solve a problem over the next few decades. People are more inclined to accept it as part of a package of measures, policies and ideas. Compared with America, the British Government hasn't put much money into it, and we do need a proper risk assessment because carbon dioxide leakages could be harmful to health and ecosystems. The only way to learn is to do trials. But we need to have a proper public dialogue now. Shell didn't think anyone would care about Brent Spar, but they were wrong."

Peter Cotton, from an article by Anjana Ahuja, The Times, 20 May 2004

The mines of the Pharaohs

This article is an edited version of one appearing in the Oxford University magazine "Oxford Today". It was written by Dr Andrew Shortland and described a joint Oxford University-Egyptian Geological Survey trip over 3,500 miles in the Western and Eastern deserts and the Sinai Peninsular. The main geological interest was in the identification of the source of the raw materials used in Egypt at the time of the Pharaohs. It must be remembered that much of the work undertaken by the ancient Egyptian craftsmen was in the production of luxury articles for the rich. It had become the custom of Rulers to exchange valuable objects such as precious metals, minerals and ceramics as part of their courtly rituals.

The trip started with a visit to the Wadi Natron which lies between Cairo and Alexandria. From this Wadi a sodium carbonate evaporite bearing the name of natron has been mined since ancient times for use in a variety of medicinal roles as well as in the process of mummification of the Pharaohs and other important people. In the Roman period it was used as a major component in the glass making process.

From Wadi Natron the party visited the Western and White Deserts to see the amazing geological scenery before turning east to visit the area round the oases of Dakhla and El Kharga. These oases have areas honeycombed with ancient mines exploited for alum, a mineral used in the bleaching and dyeing of cloth. There are also rarer varieties of alum some of which are pinkish in colour from the presence of cobalt; these were used in glass, glazes and ceramic vessels.

On then to the Eastern Desert between the Nile and the Red Sea. Here lie many sites of ancient mining, particularly for ornamental stone, and the Romans exploited a purple porphyry stone from Mons Porphyrites.

Across the Gulf of Suez there are even earlier mines in Sinai which are the major source of turquoise for Egypt and the Levant. A very rich Arab, Sheikh Selim, is the ruler of this area and an expert in the mining and fashioning of turquoise objects. The techniques described are unlikely to have changed since ancient times. The ancient craftsmen fashioned works of lasting beauty and technical perfection in all areas without the benefit of modern precision and controlled methods.

Peter Cotton

Turbidites of the Canary basin – Do deep sea muds hold the key to past disasters?
Summary of December 2004 Lecture given by Dr. Ian Jarvis of Kingston University

Turbidite flows are recognised as one of the important geological processes. This lecture sought to explain the complex nature of the movement of land masses over a continental shelf, down the continental slope and on to the abyssal plane. An extensive area around the Canary Islands and Madeira has been the scene of detailed investigation over several years, starting with cores bored some 35 metres into Quaternary turbidite layers but later extending to hundred metre cores. From these investigations it has been possible to establish what processes have contributed to the different layers of the cores and also importantly to show that the deposits from more recent events as shown in the 35 metre cores follow the same pattern as the older events "frozen" into the deeper cores.

Backing up these investigations, laboratory experiments have been conducted to show how water containing large quantities of material flows down a slope to produce wider and wider spreads of material but these are then overlaid by subsequent flows which basically follow the same channel systems. The processes are exceedingly complex and the end result is a fining upwards sequence of deposits. It was also pointed out that when examining the ocean bed the turbidite deposits surmount pelagic sedimentation which will have come from sea mounts round the area. The pelagic deposits can be distinguished from the turbidites by the burrowing that has taken place in the former.

Another important observation is that the turbidites in this area have varying chemical compositions. Dr. Jarvis had some exceedingly good pictures to show the reasons for this variation which depended on the origin of the material. As already mentioned, calcareous layers denote material derived from sea mounts whereas other layers clearly demonstrate a volcanic origin.

Dr. Jarvis finished by relating the investigation of turbidite flows to the evolution of the Canary Isles where a hot spot was responsible for the succession of islands from east to west where newer islands were to the west. The differential shape of the islands was the result of both volcanic processes and turbidity flows inter-reacting.

Peter Cotton

GA Reunion in Cardiff

Twelve of our members thoroughly enjoyed the GA Annual Reunion in Cardiff in November where 19 Societies were represented as well as a number of conservation bodies including UK RIGS and the Countryside Council for Wales, and some commercial enterprises selling books, minerals and geological equipment. Six of us travelled down on the Friday in order to set up our display entitled “Volcanic Experiences” in the afternoon.

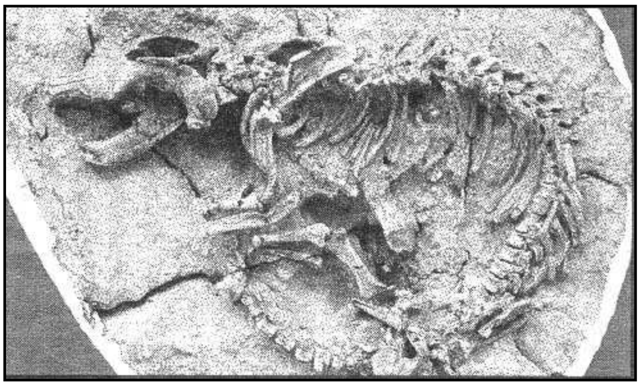
The geology section of the National Museum of Wales hosted the reunion on the Saturday where there were two lectures during the day and a rare chance to visit the Geology Department’s laboratories, and mineral and fossil collections. Children and families were well catered for in the “hands on geology” Rockwatch Room, searching for microfossils and identifying them under microscopes etc. Four coaches left for field excursions on the Sunday. Some of our members went to see some coastal geology; others to see the local building stones, three to visit the castle and three visited the Big Pit at Blaenavon on the way home.

I attended the AGM on the Friday at which 13 Local and Affiliated Societies were represented. There was a discussion on the possibility of having regional GA meetings in addition to the reunions held in London, widely spaced around the country. Local groups would be expected to organise these. The next 2005 Annual Reunion will be in London at University College on November 5, with the possibility of one in Liverpool in 2008 when it will be the GA’s 150th Anniversary. Liverpool will be the European Capital of Culture that year too.

Shirley Stephens

Newspaper snippet - Dinosaur-eating dog

It not only walked with the dinosaurs, it ate them. The beast in question was a dog-sized mammal that lived more than 130 million years ago when dinosaurs were supposed to have no serious competition as land-based predators. Scientists have found fossilised remains of the primitive creature that lived at the same time as the dinosaurs and was big enough and powerful enough to cat their young. A study of the remains, which were unearthed in China, has revealed that the last meal this individual enjoyed consisted of baby, parrott-beaked dinosaurs - swallowed almost whole.



Meng Jin, the curator of palaeontology at the American Museum of Natural History in New York, and Wang Yuanqing of the Chinese Academy of Sciences in Beijing, describe the remains of the mammal, called *Repenomamus*, in the journal *Nature*. Although it does not closely resemble any mammal living today, *Repenomamus* grew to more than 3ft long and weighed up to 30lb.

The discovery upsets the conventional view, which sees early mammals as small, shrew-like creatures that fed on insects and that they were only able to grow more formidable once the dinosaurs had become almost extinct.

"This new evidence of larger size and predatory, carnivorous behaviour in early mammals is giving us a drastically new picture of many of the animals that lived in the age of the dinosaurs", Dr Jin said. The last meal of *Repenomamus* was a juvenile psittacosaurus or "parrot lizard. Wear marks on its teeth showed that it was not an embryo, which ruled out the idea that *Repenomamus* had raided a nest. Some of the psittacosaurus' bones were still connected, suggesting that *Repenomamus* had swallowed the young dinosaurs in chunks.

Steve Connor, Science Editor, The Independent, 13 January 2005