Farnham Geological Society

[http://homepage.ntlworld.com/mjweaver/fgs.htm]

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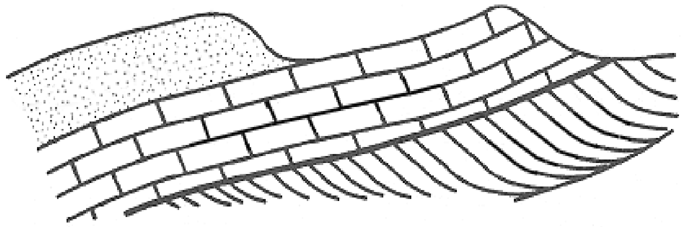

A local group within the GA

Vol. 5 No.2

Newsletter

June 2002

INSIDE THIS ISSUE

Editorial

This is the first FGS Newsletter to be produced by the newly formed Editorial Committee, comprising: Peter Cotton (Editor), Lyn Linse, Shirley Stephens and Mike Weaver. As you will see from the names of the various contributors to this issue, there has been a favourable response to the pleas for more involvement by members of the Society in producing suitable "copy". I ask you to keep it going; items do not need to be long as there is always a real need for "infillers".

An important feature of Newsletters from now on will be the inclusion of summaries of lectures given to the Society since the last issue. In this issue summaries of the March, April and May lectures are included. We need a few more volunteers to undertake the summarising for one lecture per year; surely not too much to ask? Having done the May one myself I can vouch for it making the lecture even more instructive.

Peter Cotton

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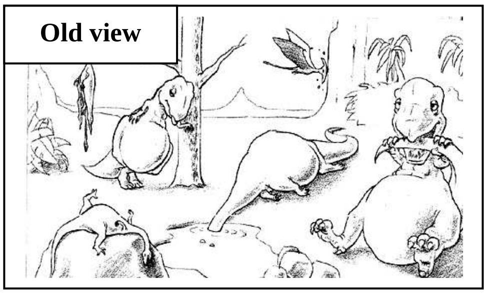
Urchfont Manor College: 22 - 24 February 2002

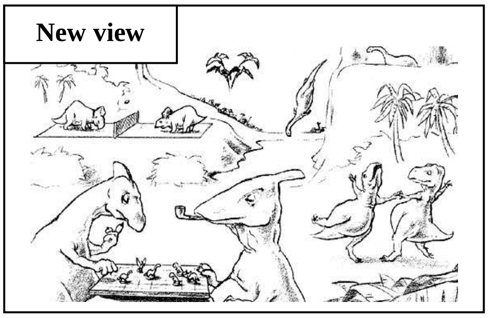
Eleven members of the Farnham Geological Society met at Urchfont for a weekend studying evolution with Dr Paul Davis (Natural History Museum and Farnham Geological Society) We were joined by nine others. I think Paul was surprised to see so many familiar faces.

We started our first session in small groups; trying to decide what characteristics we could use to classify the members of the class. It wasn't easy and came down to such things as gender, eye colour, left or right handedness; age, height and weight in bands. It was designed to show us the difficulties of allocating animals and plants to appropriate groupings. Those of us who had studied Biology in our youth were amazed at the number of Phyla into which animals and plants are now divided. I remembered about 6 animal Phyla, including Mollusca and Arthropoda and lost count at 20. Plant Phyla seem to have changed less.

Paul gave us a time scale for the development of the early Earth and life based on a calendar year. Things began to hot up on the 12th December with the Coal Measure swamps and by the 29th December they were racing ahead with the first apes. By 11.59 pm on the 31st December there appeared Neolithic Man. Thereafter changes were happening every few seconds. Caesar came to Britain at 11.59 and 46 seconds, Christ was born at 11.59 and 47 seconds, Henry VIII came in at 11.59 and 57 seconds and Darwin wrote on the Origin of Species at 11.59 and 59 seconds.



Dinosaurs have traditionally been pictured as slow, stupid and lethargic. Recent thinking suggests that they may in fact been intelligent, active and well adapted to their environment.



We covered the ways in which fossils can be formed; the evolution of the early atmosphere; plant development from archaeobacteria, through cyanobacteria, algae, stromatolites, ferns, cycads and conifers to flowering plants, the 20+ invertebrate phyla and evolution of the fishes, reptiles and mammals.

We had a slide quiz based on Darwin, museums, and characters in the story, important sites, forgeries and other evolutionary subjects. If we didn’t know the proper answer we were encouraged to think of suitable amusing alternatives.

There was a question and answer session on the Sunday morning and questions came from all directions on the many ideas we had absorbed and others that had been thrown up by those ideas. Paul fielded them all and gave us very comprehensive and well-illustrated answers. Reg Bradshaw came in for the Sunday afternoon session with slides and specimens that many of the group recognised.

The college is in lovely grounds with comfortable accommodation, super food and helpful staff. They run geology weekends in February/March. Come along next time. We had a thoroughly good time and Paul was an excellent tutor.

Cath Clemesha

Lasers, lakes and caves - novel approaches to climatic change

Summary of Society's March 2002 Lecture given by Dr David Mattey, Royal Holloway College.

Dr Mattey gave a very interesting account of how ratios of the stable isotopes of hydrogen, carbon, nitrogen and oxygen in both stalactites and 'fossilised' mammalian teeth can be used to ascertain the overall climate in the fairly recent geological past. These data can then be related to other climate estimates made, for example, by studying ice-cores taken from the Greenland ice-sheet.

In the analysis, much use is made of the ratio of Oxygen16 to Oxygen18 in rainwater, which from current day studies, can be related to average temperature, latitude and climate. In the case of stalactite analysis, it is assumed that the groundwater that percolates through any limestone to form stalactites is the dominant provider of oxygen in the calcium carbonate deposited. As climate changes, so will the O^{16}/O^{18} ratio in rainwater, which is subsequently reflected in the oxygen ratio in the stalactites formed.

The novelty of Dr Mattey's approach to the analysis of stalactites is that he uses a laser to take samples at very small distances apart (as opposed to the older technique of drilling), thereby allowing changes in climate to be monitored over much shorter time scales. In the case of mammalian teeth analysis, it is assumed that the oxygen in the phosphate in teeth is derived from the mammal's drinking water, which in turn is governed by rainwater, and hence climate.

The studies have revealed that there was a sudden drop in the UK's average temperature of around 15 degrees Celcius some 84 thousand years ago, a drop which suddenly recovered to normal values after a period of about 40 years. The climate in the UK during this time would be similar to today's Siberia! A possible explanation for the change is that the Gulf Stream, which bathes the shores of the UK with warm equatorial water, was diverted elsewhere; this may have been associated with the sudden melting of the Canadian ice-sheet, a phenomenon which would have sent large amounts of cold, fresh, melt-water into the Atlantic ocean. Food for thought in today's worries over climate change, should the Gulf stream suddenly decide to change its habits!

Michael Weaver

Mud volcanoes, shale diapirs and melanges

Summary of Society's April 2002 lecture given by Dr Tony Barber, Royal Holloway College.

Despite the competing attraction of the Society's Italian Volcanoes field trip, there was a high turnout of Society members to hear a stimulating and entertaining lecture by Tony Barber on a topic which broke new ground for many in the audience. Mud Volcanoes are cold (ambient) structures, typically 2-5m in height, resembling miniature volcanoes, emitting liquid mud and gas, and often contained in an enclosing crater. Diapirs provide a conduit for a body of material which has become buoyant and risen through overlying layers, whilst Melanges are chaotic assemblies of blocks of lithified rock of varying size and shape in a matrix of mud (clay or shale).

Dr Barber's interest in the subject was stimulated by his observation of similarities in structures occurring in otherwise differing landscapes. The structures of interest were located in areas as widely separated as the cliffs on the St Lawrence River, Quebec (chaotic limestone blocks in a clay matrix); in NW Anglesey (pre-Cambrian quartzite blocks in a fine grained matrix); and in the island of Timor and the surrounding area, where Dr Barber and colleagues carried out work in the 1980s.

Mud volcanism and associated melanges occur where accretionary complexes are formed from continentally-derived sediments scraped off a subducting tectonic plate. Chaotic melange deposits have commonly been interpreted as the product of large-scale gravity slides, or submarine slumping. Dr Barber identified difficulties with this approach however, pointing out that submarine slumping does not occur on a sufficient scale to explain the quantities of melange seen in ancient accretionary complexes, and that some rock types found within the melange have no obvious source within the complex because they are derived from underlying rocks which may not be exposed at the surface.

The landscapes produced by the accretionary complexes occur on a massive scale. Mud diapirs occur widely in the region around Timor, north of the Australian continental shelf, where the Australian plate is subducting beneath the island chain of the outer Banda Arc. A more convincing interpretation of mud volcanism and rock melanges is afforded by an understanding of the mechanism of mud diapirism.

Evidence for the processes involved is provided by the results from sea-floor mapping exercises carried out from survey ships. The process is tectonically driven, and diapirs occur in front of the accretionary complex when the high hydrostatic pressures generated within subterranean layers cause material to burst upwards to the surface through wrench faults. Rocks from the underlying strata are incorporated into this material and are carried to the surface to form a chaotic arrangement of melanges within the shale diapir. The mud volcanoes formed at the surface are temporary structures due to the escape of water and gas from the underlying diapir. Eruptions can occasionally be both spectacular and dangerous if significant quantities of methane gas within the diapir are suddenly released from pressure; the resultant rapid expansion of the gas can blow blocks of rock hundreds of metres into the air.

The process is widespread in the region to the north of the subducting Australian plate, and also occurs widely within accretionary complexes at various sites around the globe: another major example of mud diapirism is found in the Barbados accretionary complex.

The interest stimulated by the subject was evident from the number and variety of questions at the end of the talk. Janet Burton thanked Dr Barber for the lecture and expressed the evident appreciation of the audience.

Robert Gott

Newspaper snippet: Flood proof raises chance of life on Mars

Evidence of hot water eruptions on Mars has increased chances of finding proof of life on the red planet. Images from the Viking Mars missions 20 years ago indicated that flood water had carved out huge channels on the surface ~2 billion years ago. New images from the Mars Orbital Surveyor spacecraft point to far more recent phenomena in an area near the Martian equator where a fissure system provides geological evidence of more recent floods, say 10Ma ago. Such geothermal sites could provide the heat and water necessary for supporting life forms.

The Times, February 2002, from a paper published by an American research team.

Radioactive Waste Disposal

Summary of Society's May 2002 Lecture given by Prof J D Mather, Royal Holloway College.

Professor Mather had a rather important family matter to concern him on Friday 10th May; he was, on that day, moving house to Exeter! Despite this, he motored back from Exeter to give his talk to an appreciative and large audience.

To many of us the problem of radioactive waste disposal was thought to be concerned with the highly dangerous by-products from nuclear power stations. This material such as spent fuel rods is, of course, a major problem for which no country has found an acceptable solution. Deep burial on land, in ocean trenches, under the Arctic ice cap or down into subduction zones have all been suggested and turned down. In the UK this highly radioactive material is stored above ground inside borosilicate glass which can withstand the high temperature created by the nuclear material.

Professor Mather pointed out, however, that there are many other places where lower level radioactive products are produced such as laboratories, defence establishments, hospitals, etc, as well as many of the items of clothing and equipment used on nuclear power station sites. These materials far exceed the volume of the highly active materials and their disposal is the responsibility of NYREX. As with the highly dangerous material, however, no progress has been made in finding an acceptable solution over the past 25 years since the 1976 Flowers Report, The disposal of this less dangerous material is a highly emotive issue to which no UK government has been prepared to give an authoritative lead and which, of course, has met with fierce opposition from environmental groups and indeed from local citizens when a proposed site conflicts with their “Nimby” perceptions.

Dealing with these less dangerous materials; they are compressed to reduce their bulk and sealed in concrete. It has been hoped for many years that an acceptable solution could be found and indeed in the 1980s there appeared to be a glimmer of hope. This involved the construction of a vault 500 metres underground at a site south of Sellafield called Grigg. It would have provided storage for 2 million cubic metres of waste (3 million tons) over 50 years. Over this period the half-life of the radioactive materials would have meant a reduction from 100% to below 10% in radioactivity. At this level of risk, countries like Canada, Sweden and Finland have gone ahead with the construction and operation of disposal vaults in suitable geological structures. But not in the UK.

In considering sites for possible underground storage of the medium and low risk materials the important consideration is to block the passage of groundwater through the underground silos. In principle this requires the construction of storage silos in stable basement rock which is lying below a thick layer of high water-flow. The upper layer drains off the ground water leaving the basement rock dry. On the face of it the south Lake District area with its Borrowdale Volcanic basement and Permian sandstone capping should be ideal. But in 1992 new technology allowed boreholes to be sunk to 1200 metres and, to the dismay of NYREX, it was discovered the ground water was seeping through faults in the basement rock which effectively ruled out this solution.

Needless to say there has been an enormous cost involved in all this work to find an acceptable solution. When one compares the residual risk which NYREX is targeted to achieve for relatively small amounts of low radioactive material with the 30 million tons of domestic waste estimated to arise over the same period of years, it does seem the UK should follow the example set by Sweden and Canada. At some point the government must act and accept that there will be some political fall-out which can be minimised by explaining the facts of the issue rather than letting the environmental lobbyists win the day.

Peter Cotton

Newspaper snippet: Guided fossil walk at Lyme Regis

The Philpot Museum (01297 - 443370) at Lyme Regis now runs a guided fossil walk. Geared to small groups, the walk offers a real opportunity to learn about the geology of this part of the Dorset coast . Duration is around 2 hours and the cost is £8 for adults and £5 for children, including entry to the museum (entry normally £1.60 adults, 60p children). Other attractions in or near Lyme are the Marine Aquarium (entry £2 adults, £1.50 children & OAPs), the Dinosaurland Fossil Museum (entry £2.50 adults, £2.50 children) and the South West Coastal Path towards Golden Cap, which at 600 feet, is the highest point on England's South coast.

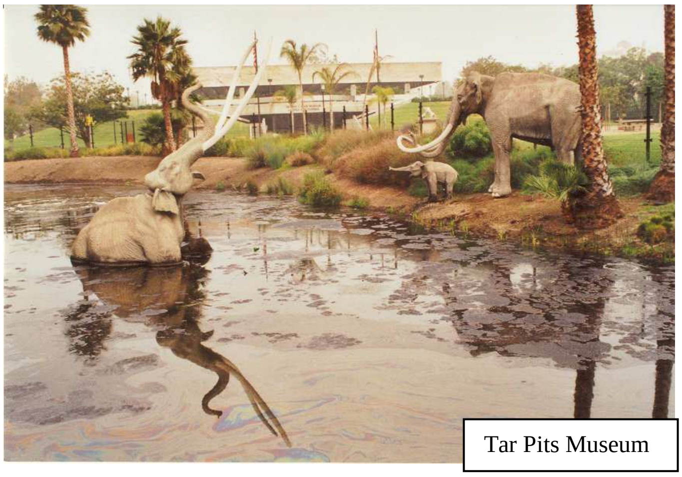
Fiona Terry, Independent on Sunday, 24 March 2002

GA Fieldtrip to New Zealand from 7th - 29th Nov 2001 organised by Prof. R. Moody.

Two Days in the Los Angeles Area

Thirty-one members flew from Heathrow to Los Angeles and spent two nights there. We had a full day's trip to the south east of Los Angeles following the San Andreas fault system for 150 miles (to within 50 miles of the Mexican border.) The main fault has numerous associated fault planes, which are usually near vertical and shallow. (four to ten miles in depth) In southern California the fault began 12 million years ago (late Miocene) and is a very complex system. We travelled through the San Gorgonio Pass into the Coachella Valley and reached Salton Sea, 232 feet below sea level, as the sun set. En route we diverted to various locations where the vegetation indicated that the water level had been disturbed by the various branches of the fault system. We stopped for lunch at Palm Springs, an oasis in a desert location, to the east of the San Jocinto Mountains that are over 10,000 feet high.

On the second day in Los Angeles we spent the morning at the Tar Pits Museum at Rancho La Brea. This is in the heart of Los Angeles and shows the material found in one of the world's richest sites of Ice Age fossils of Pleistocene age. They represent the remains from 40,000 to 10,000 years ago. Pools of asphalt form when crude oil seeps up to the surface, and animals are trapped in these deposits. One tar pit is just outside the museum building. The museum opened in 1977, and shows some of what has been reclaimed over the last 80 years. Rebuilt skeletons of many animals are displayed, such as bison, dire wolf, sabre tooth tigers, mammoths, mastodons, well preserved vultures and condors and other now extinct animals. That evening we flew to Auckland, arriving in the early morning, having lost a day because we had crossed the International Dateline.

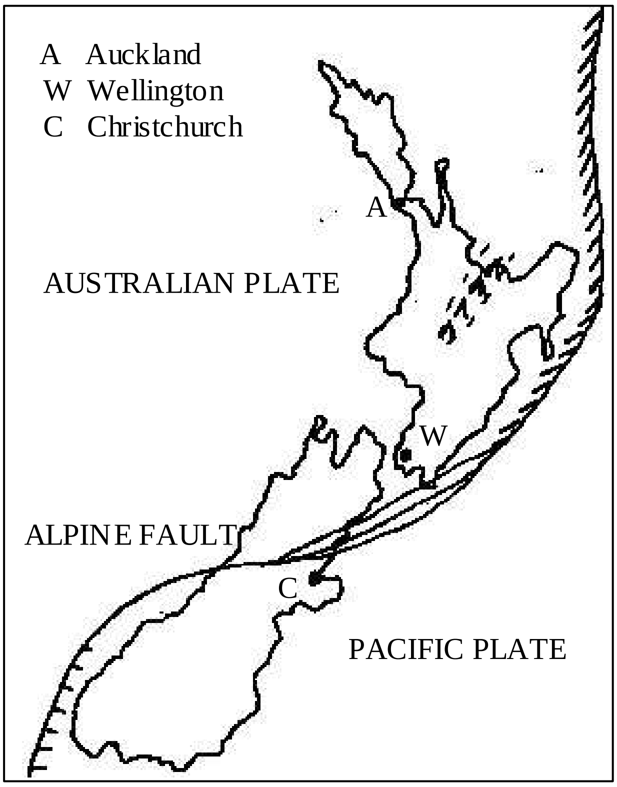


Tar Pits Museum

General discussion of New Zealand's Geology.

Most of the basement rock of New Zealand is below sea level. This consists of rocks formed off Gondwana in Precambrian times but only small areas of this age are above sea level today. The process of sedimentation and uplift, can be divided into three main periods. The first is from 600-380 million years ago, where Tuhua rocks seen in the Western Province of the South Island are the only example at present above sea level. Phase 2, from 300-130 million years ago, was when New Zealand was uplifted because of the collision between the Pacific and Australian plates. The third period is since 85 million years ago, when New Zealand detached from Australia and the Tasman Sea opened up. Then the land was weathered down until 25 million years ago when most of New Zealand was under the sea again. Thereafter there has been renewed uplift, with a blanket of sediments overlying older rocks.

There are two distinct geological processes resulting from the west- ward movement of the Pacific Tectonic Plate. In the North Island the Pacific Plate is being subducted under the Indo-Australian Plate, which has resulted in a large amount of volcanic activity, forming large volcanoes, minor intrusions and the formation of thermal areas. The largest volcanic eruption occurred in 186 AD to form Lake Taupo. Down the centre of the South Island the alpine fault is where the plates are colliding (this process is called 'crystal shortening') forming the spine of the Southern Alps. At present the rapid rate of erosion is balanced by continuing uplift, of the order of 10 mm a year.



North Island.

Columnar jointing in Auckland

Our field trip on the North Island lasted from 11th-18th of November. The first day started with a visit to the War Memorial Museum that had a good display of the Natural History of New Zealand. It being Armistice Day, we heard the Last Post played there. After lunch we climbed Mount Eden in the centre of Auckland, which gave us a fine overview of the peaks of volcanic activity over the last 100,000 years. There are over 50 outlets of basaltic lava, many of which were pointed out to us in glorious sunshine. Later we examined a disused basalt quarry in the grounds of a school to see a good exposure of columnar jointing.

12th Nov. We spent all day around Auckland. The first stop was to Takapuna Head at Belmont in NE Auckland, where we saw a fine example of a fossil forest exposed on the beach. Next we went a little further north to St Leonard's Beach to see examples of faulting and turbidites. After lunch we walked up Mount Mangere, the largest scoria crater in the area (400m diam and 70m deep) that was formed 18000 years ago. The local geologist pointed out all the features of this type of eruption to us. Our next stop was at Ihumatao, where we saw the remains of two fossilised forests on the foreshore, preserved by volcanic ash.

Fossil forest at St Leonards Beach

13th Nov. Having spent two nights in Auckland we travelled south to the South Auckland Volcanic field, which was active from 1.2 - 0.3 million years ago, and is associated with pre-existing faults. All Auckland's volcanoes had short lives with once only eruptions. We then travelled NE to the Coromandel Peninsular over wooded, igneous deposits to the Pacific Coast at Hahei. We had a coastal walk past rhyolite to see ignimbrite in Cathedral Cove. The night was spent at Taurua.

14 th Nov. Travelling south through an old gold mining area, we stopped at Waimana Bay, an area of volcanics on the margin of a caldera; then continued south past Rotorua Caldera, which erupted 140,000 years ago. Many features of the development of this caldera were pointed out to us and we couldn't help but notice the hydrogen sulphide gas in the district! Stopping at Waiotapu 30 km south of Rotorua, we saw numerous examples of the geothermal area, such as mud-pools, callapse craters, hot springs, fumeroles, and hydrothermally altered rocks, all in pouring rain, so umbrellas brightened up our many photos! We reached Taupo for a two-night stay.

15 th Nov. We were privileged to visit the Waiabei Research Centre at the Taupo Volcanic Observatory, where we were shown how earth movements over a wide area are recorded. Afterwards we stopped at Huka to witness a huge waterfall from Lake Taupo that has an average discharge of 160 cu m/sec. After lunch we travelled to the SW of Lake Taupo to the skiing village of Iwikau just north of the highest volcanic mountain of Ruapehu that was snow capped. (2797m) We enjoyed a walk up to Meads Wall on Mount Tongariro, a dike structure thought to be a remnant of the oldest cone of Ruapehu and also saw an area of lahar mounds deposited 9500 years ago following a shutdown of an active phase of Ruapehu.

Cape Kidnappers Beach

16 th Nov. Then to Napier over Triassic-Jurassic formations, beyond the spread of ignimbrite from Taupo, to reach Lower Pleistocene deposits inshore from Napier. We saw evidence of the 1931 earthquake in Hawkes Bay when there was an uplift of up to 2m. We were taken by tractor and trailer along the beach towards Cape Kidnappers past eroded cliffs of bedded sands and conglomerates. We had a picnic lunch close to a gannet colony situated on a shore platform cut 2,300 years ago. After a wine tasting, we enjoyed a walk before dinner, into the centre of Napier, renowned for its Art Deco buildings restored after the 1931 earthquake.

17 th Nov. From Napier over a complex geological area in the vicinity of the Waipawa River that was much disturbed, and still has significant earth movement we continued southwards on the main road to Masterton, and diverted east to the coast at Castlepoint. Here we saw interbedded coquina limestone and shelly sandstone of Plio-Pleistocene age in a very windy situation. Nearby on the foreshore we saw good Bouma sequences in the turbidites of mid Miocene age. After a long day we reached our hotel in Wellington at 7pm. A few days before, an earthquake of 4.8 on the Richter scale had shaken an area just north of Wellington - bad timing!

South Island

18 th Nov. After a calm crossing over Cook Strait to the South Island, we landed at Picton and drove in glorious sunshine through Permian greywackies to Blenheim where we had a super lunch at Montana Vineyard. There we saw how the wines are produced and stored, and tasted the products. At Blenheim Museum we learnt how the aquifer in the wine growing area is controlled.

19 th Nov. The geology around Nelson has rock types of many different ages including volcanics in the form of ash layers, with basalts, sandstones and mudstones, all much altered. We left in a SW direction to see Lake Rotoiti, then went east to Blenheim, going round the Richmond Range, and following the Alpine Fault which runs eastward here, noting glacial features of late Quaternary age along the Wairu Valley. Thence we travelled south along the coast road through greywackies of late Jurassic to early Cretaceous age of siltstones and sandstones. We stopped south of Kekerengu to see a conglomerate that included enormous angular blocks.

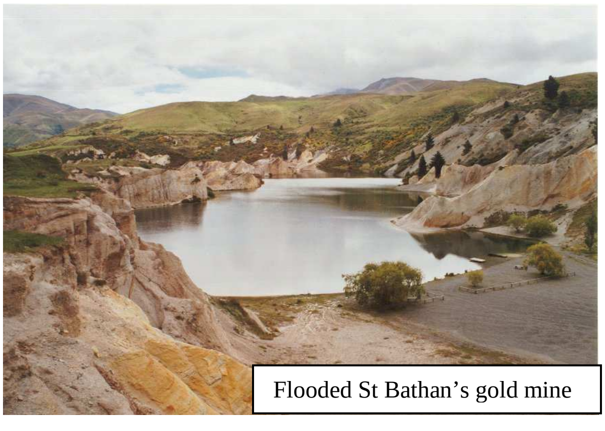
20 th Nov. After a night at Kaikoura, which is situated on a peninsular, we boarded a craft soon after 8 am for whale watching, and returned at 10.30am. However we saw no whales, but did see numerous marine birds, such as albatross, petrel and shearwater plus a few dolphins, and several fur seals along the coast. We could not see the range of the Seaward Kaikoura Mountains because of low cloud though we'd seen the fantastic snow capped panorama the previous evening. We travelled south along the coast road to Christchurch through more recent geological strata, and passed several very wide outwash rivers in drizzling conditions.

21st Nov. In Christchurch we had a rest from geology. It poured most of the day. We visited the former University of Christchurch, now the Art Centre, where Rutherford carried out his early experiments in his "den" and went into the Cathedral, the Canterbury Museum and the Art Gallery situated in the Botanical Gardens, and fitted in some shopping too.

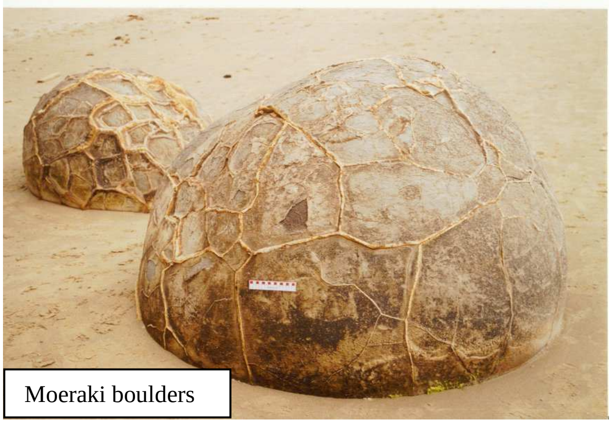
22nd Nov. This was a drizzly day, turning to rain. We visited the extinct volcanic complex forming the Banks Peninsular, south of Christchurch. This area erupted from 9.5 to 5.6 million years ago, and is still seismically active. We studied lava flows near Shag Rock of Eocene age and the area around Governor's Bay in Lyttelton Harbour. Several lava flows have formed this long sheltered harbour. Leaving Christchurch we travelled across the Canterbury Plains via Timaru to stay in Oamaru.

23rd Nov. On a dull day, we visited sites to the south of Waitaki River, with stops at Kokoamu Cliff of Oligocene age, uplifted sandstone of Gondwana age with greensand and limestone boulders. We returned SE to Camerons Pit for Cretaceous sands with plant remains and then to Parkside Quarry, where Oligocene limestone is sawn out of the face for building purposes, as we saw in Malta. After lunch we went south of Oamaru to Gees Bay to see Eocene fossiliferous limestone and nearby at Kakanui Head mineral breccia of the same period and later walked along the beach to see more recent limestones of 34 million years age. That evening after a meal, we saw dozens of blue penguins coming ashore near Oamaru harbour, as it grew dark.

24 th Nov. We left Oamaru southwards and called at Katiki beach and Shag Point where fossils were found, limestone boulders and more Kakanui breccia derived from great depth in the Eocene period. After passing Palmerston, we went NW through Oligocene limestone into a gold mining area around Ranfurly. We continued further to the partly restored mining village of St Bathans, set high among the hills of Otago. There we saw the water filled gold mine in Miocene quartz-pebble conglomerate. From Pukerangi we travelled to Dunedin by train for a spectacular run down the Taieri Gorge, through Otago schist.

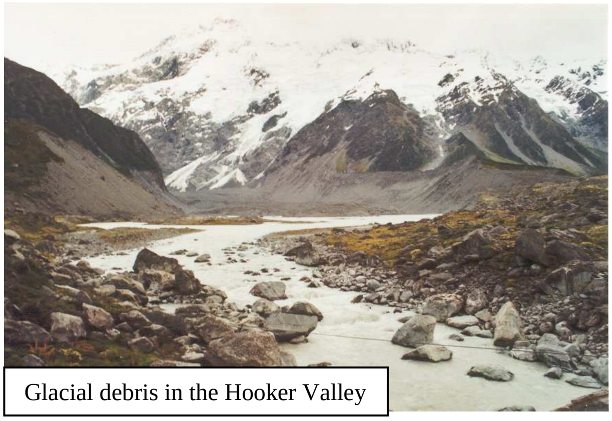


Flooded St Bathan's gold mine



Moeraki boulders

25 th Nov. After a short tour of Dunedin, we travelled north, stopping to see the Moeraki boulders on the beach. These are spherical concretions formed about 4 million years ago at shallow depth in marine mudstones. We later travelled NW over kaarst scenery formed in late Oligocene to see an expanse of huge boulders of weathered limestone called Elephant Rocks. Next we stopped to see an area of Maori rock art. We diverted from the main road to see a rock-fill dam which created Lake Benmore, below which we saw excellent outcrops of folded and faulted Triassic mudstones. Stopping at Lake Pukari we had a superb view of Mount Cook. Finally before reaching Mount Cook Village some of us were fortunate to obtain a helicopter flight. We landed on a snow covered ledge east of the Tasman Glacier, then flew over the glacier to the east side of Mount Cook, seeing every example of glaciation below. We stayed in the Hermitage Hotel in Mount Cook Village with fantastic views of Mount Cook.



Glacial debris in the Hooker Valley

26 th Nov. We had a walk along the start of the path to the Hooker Valley over glacial debris to see the Mueller Glacier with good examples of lateral and terminal moraines, and returned south to the end moraine of Lake Pukaki, which showed many features of glaciation including "drop stones," as we saw in Aberdeenshire last year. Continuing to Tekapo where masses of wild lupins were very well established at the southern end of the lake, we travelled over huge thicknesses of Triassic deposits before dropping down to the Canterbury Plain. At the Cavendish Quarry near the town of Mount Somers, late Oligocene limestone is quarried for agricultural uses. This limestone is overlain by very fossiliferous sandstone. Our next stop was partway up the road to Mount Hutt ski field for a grand view over the Canterbury Plains before returning to Christchurch.

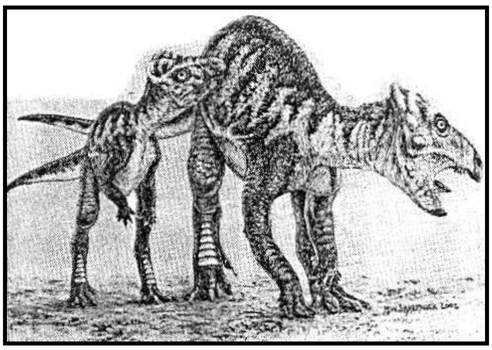
27 th Nov. In the morning we visited the most interesting Antarctic Research Centre at Christchurch, and the Willowbank Wildlife Reserve where we saw kiwis in a nocturnal house. Our flight left mid afternoon for Auckland, where we changed to a flight back to Los Angeles.

27 th Nov. Having gained an extra day, we all spent the afternoon at Universal Studios and were mad enough to go on the rides!

28 th Nov. After a leisurely breakfast we caught an afternoon flight to Heathrow, having had a most enjoyable field trip thanks to Dick Moody and the excellent local geologists who joined us.

David and Shirley Stephens

Newspaper snippet: Primitive horned dinosaur was a real pussycat



Research done at the Field Museum in Chicago describes a dinosaur a little larger than a family cat which was probably an ancestor of the huge three horned *triceratops*. Fossils found in China belong to a species of dinosaur that is by far the smallest and most primitive member of the family. This small ancestor is called *liqorceratops* and it lived some 130Ma ago, whereas *triceratops* and *tyrannosaurus-rex* lived in late Cretaceous times. Scientists engaged in the study of *liqorceratops* say that it is a far more significant find than the later dinosaurs because it gives a window on the early evolution of horned dinosaurs. It stands at the head of a lineage called the *ceratopsions*, which includes its better known descendant *triceratops*. Both were herbivores and this recent find has a bone structure which includes small horns facing sidewards under each eye and a short neck trill that seems to support powerful jaw muscles; both of these features are more prominently displayed in the much later *triceratops.*

The Times, March 2002, from a publication in *Nature*

Where archaeology, geology and speleology come together

In the March 2002 issue of the Surrey Archaeological Society there is an article which summarises the work being done in relation to the use of "Reigate" stone as a building material from Roman times up to the 19th century. Reigate stone is the name given to the Upper Greensand in the Redhill area of the county. In this area;, between Dorking and Godstone , a very flourishing building stone industry existed from the 17th to the 19th centuries, the stone being extracted from an underground network of passages driven into the escarpment face and down the gentle northward dip under the North Downs. The local name for this rock was "firestone" and the workers were known as "firestone miners" because, apart from its use as a building stone, it was used as a refractory material for lining furnaces. The remains of 20 or 30 disused mines are known to exist in the area.

The research work being done into the use of Reigate stone, which is described in the Surery Archaeological Society journal, is being undertaken and funded by Historic Royal Palaces who have responsibility, inter alia, for the care of Hampton Court and the Tower of London. The "Reigate Stone Research Project" involves the scientific testing of Reigate and geologically related stone samples from 17 buildings in London, Kent, West Sussex and Surrey. In London the Tower of London is one of the buildings tested and in Surrey Farnham's Parish Church is included. Samples from the buildings are then being compared with core stone samples taken from the East Surrey underground quarries. This work in the underground caves is being undertaken by the Wealden Cave and Mining Society as the speleological input to the project

Optical microscopy and X-ray diffraction analyses are the techniques being used to identify and quantify various mineral phases with a view to establishing the relative porosity and dimensional stability of the samples, both of these qualities being of the utmost importance in assessing the use of the stone for building purposes. Indeed, Sir Christopher Wren made some uncomplimentary remarks about the stonework of Westminster Abbey, describing the material as "an unhappy choice, no better than the Caen stone used by the Normans for which Rygate stone was substituted because of its lower cost."

Results from the research into the mineral composition of Reigate stone confirm Wren's perception that it is not an ideal building stone. The data produced shows that Reigate stone contains quartz, feldspar, muscovite, glauconite, calcite, amorphous silica, smectite and cristobalite. Although the samples vary considerably in the percentage of these elements they are predominantly cristobalite (a silica polymorph deposited in high temperature conditions) whose structure of bladed micro-crystals is similar to snowflake obsidian. The important thing is that the porosity of all these samples is high and the dimensional stability (a measure of swelling and contracting on wetting and drying) is poor compared with other building stones such as Carboniferous sandstone or Jurassic limestone. Significantly though, the samples from Farnham's parish Church show a very high calcite content of 40% and those from Bignor's Roman Villa show a predominance of quartz: the stone for these buildings would have come from more local sources such as Selbourne for Farnham and Midhurst for Bignor.

The varying constituency of the Reigate stone mined in eastern Surrey and the marked difference from the outcrops of Upper Greensand in the Western Weald demonstrate the fact that the lithology of this stone shows great variety in which three broad rock types can be recognised. Poorly consolidated siltstones are at the base adjoining the Gault clay; these are overlain by sandy beds containing some clay and silt; the top layer of the Upper Greensand comprises clayey sandstone speckled with glauconite which are dark olive green when fresh but weather to grey and brown. It was probably because of this coloration that William Smith, the founder of English Stratigraphy, called the stone "Greensand" when he saw it between the Gault and the chalk in western England. Subsequently the extensive exposures of sandstone between the Gault and the Wealden clay were also called Greensand. A clever solution to this terminological impasse was to call the upper layers above the Gault "Upper Greensand" and those below the Gault "Lower Greensand"!

Returning to the lithology of the Upper Greensand, it is the middle section described above as comprising sandy beds with some clay that is usually known as Malmstone in the Western Weald and Reigate stone in the east. It is this layer of stone which is the subject of the archaeological research project. Malmstone or Reigate stone is a pale coloured rock containing abundant sponge spicules and a high proportion of soluble silica with clay, calcareous matter and some mica. The more detailed analysis of this stone has already been described but there is, in addition, another variety of Malmstone known as Hearthstone which is a soft, friable greenish-grey calcareous sandstone which was formerly used for whitening hearths or stone steps. In fact at the time that the demand for the harder Malmstone (Reigate) stone for building purposes was being severely reduced by competition from Bathstone and brick, the quarries in the Redhill area were turning over to producing Hearthstone for use by proud housewives – or their servants – for whitening their stonework. This trade continued well into the 20th century and the product was being marketed under trade names such as "Snowdrift Step Powder".

One final point about the Upper Greensand deposits in the Weald is the variation in their thickness as one moves from west to east whether along the line of the North or South Downs. The Upper Greensand is thickest in the west reaching a maximum of around 200 feet at Selbourne and about 100 feet at Midhursst. Moving east to Guildford on the North Downs the strata thins to 80 feet and disappears altogether further east in Kent. Similarly along the South Downs the thickness at Eastbourne is about 30 feet and then vanishes into Kent. This thickening towards the west is possibly due to the fact that both the Gault and Upper Greensand were laid down in a marine transgression which swept northwards and westwards pushing back the coast line of the Lower Greensand sea.

This article has dealt with one aspect of the economic geology of the Wealden district. Hopefully some other economic uses of Wealden deposits will be dealt with in future articles; there's certainly plenty of material to be covered including coal,clay, cement, gypsum, iron, chalk, Fuller's earth, and, of course, aquafers for water supplies.

References: Surrey Archaeological Society Article, March 2002
British Geological Survey 4th Edition
The Wealden District Geological Field Guide, "The Weald"

Peter Cotton

Field Secretary report

The Italian trip: Many of us have just returned from a very successful trip to Italy and judging from the kind letters that I have received from those who went, everyone had a really good time. It was not without incident, however, with Sally Hurst ending up in hospital in Scilla, although I am pleased to tell you all that she returned to England a few days after we all returned and is now making a speedy recovery. Etna even managed a small eruption for us, but to learn more about the trip, look out for the special articles which are due to be published in October's newsletter.

Field trips 2002:

North Wales – 16th – 23rd August with David Cronshaw.
Peter Luckham, who is organising this trip, has 20 people for this trip but still has a few places left. If you are interested in going, contact Peter Luckham direct.

Portugal – with Lyn Linse.
Week 1 : 21st – 28th September
Week 2 : 28th September – 5th October
Week 3 : 5th –12th October
There are still places available for week three so please phone Dorcas or Lyn if you would like a place on this great trip. The final payment of £275 for Portugal is due by the July meeting at the latest, Friday 12th July. Please make your cheques out to Farnham Geological Society and either post or give them to Peter Luckham.

Field trips 2003:

Aegean – 2nd-17th May with John Williams.
Details have now been sent out to those on the Aegean list and to confirm your place on this trip, return the form to Peter Luckham. If you were not on the list but would like details sent to you, contact me at my new address - see below.

Tenerife, possibly February with Dr. Roger Birch.

Field trips 2004:

USA - Grand Canyon with John Williams
If you wish any further details or would like to put your name down for any of the trips contact Dorcas Cresswell (Field Secretary) at my new address (see below)

Change of Address: As some of you know, David and I will be moving to Wales in early June. From June 7th our new address will be:-

Tara,
Felindre,
Brecon,
Powys.
LD3 0TB.
Phone:- 01497 847262
My e-mail address will stay the same:- *dorcas.cresswell@dial.pipex.com*

I will be continuing as Field Secretary until the end of the year, but we have asked you to return cheques for Portugal and forms for the Aegean to Peter Luckham whilst we are in the process of moving.

Dorcas Cresswell

FGS programme of meetings 2002

Jan 11	AGM followed by DrA Rundle, Natural History Museum *Fish otoliths*
Feb 8	Chris Jones, Natural History Museum K*aleidoscope of colours - minerals under the microscope*
Mar 8	DrDavid Mattey, Royal Holloway College *Lasers, lakes & caves - novel approaches to climatic change*
Apl 12	Dr Tony Barber, Royal Holloway College *Mud volcanoes, shale diapers & melanges*
May10	Prof J D Mather, Royal Holloway College *Radioactive waste disposal*
Jun 14	Dr Hillary Downes, Birkbeck College *A field trip to the mantle*
Jul 12	*Members evening & presentations*
Aug 9	Summer break - no meeting
Sep 13	Richard Butler *Caen stone - its history & use*
Oct 11	John Cooper, Booth Museum of Natural History, Brighton *Amber - a window on the past*
Oct 18	**Society dinner**
Nov 8	Dr Derek Rust, Brunel University *Palaeoseismology of the big-bend of the San Andreas fault*
Dec 13	David Bone, The Geological Association *Hunting the shark - search for Medieval building stone*
Jan 10	AGM 2003

Other Societies' lectures & events

Southampton Geology Field Study Group, held in Room 084/02 of the School of Ocean and Earth Sciences (enter through dock gate 4) at 7.30pm		
June 21st	Travels with my Hammer: Collecting Zeolites on the Deccan Plateau (India)	Mike Brooke
Sept 20th	Geology of Hampshire	Curator: The Curtis Museum, Hampshire

Hertfordshire Geological Society, held at the Verulamium Museum, St Albans at 7.30 pm		
July11th	Tracking down Time and Temperature in Rocks	Dr Tony Hurford; University College, London
Oct 10th	The GA goes to Gondwana; Geology of Peninsular India	Roger Dixon; Norwich

Horsham Geological Field Club, held at Forest Community School at 7.30 for 8pm		
July 10th	Evening Walk T B A	

Harrow and Hillington Geological Society, held at the Cavendish Pavilion, Field End Road, Eastcote at 7.30 for 8pm		
July 10th	'Carry on up the Jungle' – Geology & Fossils in Belize	Dr Paul Davis
Sept 11th	Curating a Geological Collection	Paul Emson
Oct 9th	Penguins and Granodiorite: How not to study Jurassic fossils in Antarctica	Prof Peter Doyle

The GA, held at the Scientific Societies Lecture Theatre New Burlington Place, W1 at 5.30 for 6pm		
July 5th	Vibrations: Induced Seismicity in Britain	Prof Peter Styles
Oct 4th	Geological and Climatic Controls on English Wines	Prof Dick Selley

Ravensbourne Geological Society		
July 9th	Microscopy – Taking rocks apart	Chris Jones
Aug 13th	The Elemental Earth	Peter Golding
Sept 10th	Mineral Extraction and the Countryside	Dr Brian Marker

Newspaper snippet: Isle of Wight find is a monster clue to Europe's past

Two palaeontologists from Portsmouth University have investigated a fossil vertebrae found on the Isle of Wight in 1888 by the Rev. William Fox and housed in the Natural History Museum since then. Their conclusion is that the fossil is from an *oviraptor*, a feathered and beaked dinosaur dating from mid-Cretaceous times. Though well known in Asia and North America, an *oviraptor* fossil has not been previously found in Europe. The specimen is one of the oldest reported *oviraptors* and, at 5 metres, longer than most specimens. The name *oviraptor* means 'egg-thief' and they were swift movers with strong arms, big hand claws, S-shaped necks and probably toothless.

The Times, March 2002, summarising a paper from *GA Proceedings.*