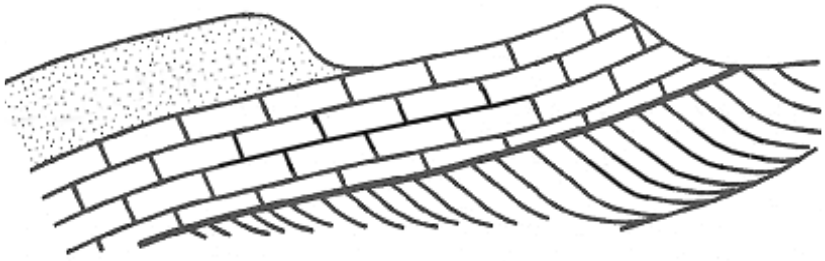
Farnham Geological Society

[www.farnhamgeosoc.org.uk]

Farnhamia farnhamensis



A local group within the GA

Vol. 9 No.3 **Newsletter** October 2006

INSIDE THIS ISSUE

Readers might just be interested to know that the Editor reached the 80-year stage since the last newsletter. As a society we have quite a few octogenarians and at least one nonagenarian, Veronica Kilgour, as members. It seems appropriate for a society that handles millions of years with consummate ease to have the human equivalent of, say, Cambrian.

Graham Williams' weekend field trips, for which he does considerable preparation, have continued to be very well supported. Your committee has decided not to include write-ups of each of these trips but Janet Phillips has written about the August visit to Wiltshire.

The Languedoc trip was a memorable one thanks to the efforts of Shirley Stephens in organising it and our excellent and knowledgeable guide Roger Suthren in leading us for the two weeks. An account of this trip is included in this newsletter with contributions from various members

Members' Evening was based on a rock recognition quiz prepared by Janet Catchpole, Mark Biswell and Graham Williams. We split into four groups to do the quiz and had great fun, despite many differences of opinion about the specimens. Thank you Janet, Mark and Graham.

You all must have had exciting holidays this year and it would be nice to have a few contributions for the next newsletter mentioning interesting geological matters as part of your account.

COMMITTEE

FGS monthly meetings - October to December 2006

Oct 13th — Title of talk to be advised
Dr Ranald Kelly, Integrated Geochemical Interpretation Ltd, Bideford, Devon

Oct 27th — **Society dinner at Farnham House Hotel**

Nov 10th — *Why is the Moon so big?*
Dr David Waltham, Royal Holloway College , University of London

Dec 8th — *Comets, their 'impacts' on Geology*
John Price, FGS & The British Astronomical Association …..followed by the Christmas Party

FGS field trips - 2006

April 2 - Severn Bridge; **29 April to 13 May** - Languedoc region, France;

June 2 to 4 - North Shropshire; **July 2** - Gloucester ; **August 6** - Avebury & Marlborough Downs;

September 3 - Swanage & Brownsea Island ; **October 6 to 9** - Western Normandy, France

Details of above trips can be obtained from the Field Secretary

The amazing all-new Wealden dinosaurs

Summary of May lecture given by Darren Naish, School of Earth Sciences, University of Portsmouth

Dinosaurs are often thought of as animals of far-flung places, and in particular (thanks to Tyrannosaurus and Triceratops and so on) are associated with the USA. But in fact the concept of the dinosaurs arose in England, and all of the key early discoveries were made, by English scientists, in England. The Lower Cretaceous rocks of the mainland Wealden have, historically, been among the most important British rocks in terms of early dinosaur discoveries. The stratigraphic terminology of the Wealden is complex and rarely explained clearly: the mainland Wealden consists of the Hastings Beds Group and Weald Clay Group, and both of these units are subdivided into formations (Radley, 2004). Several distinguished Victorian collectors are particularly associated with the Wealden, including Gideon Mantell (1790-1852), Samuel Beckles (1814- 1890) and George Bax Holmes (1803-1887), and many of the fossils collected by these men are still key specimens in terms of what they tell us about the respective taxa.

Some really interesting little-known tie-ins exist between Wealden dinosaurs and the world of archaeological forgery and science fiction. The 1909 acquisition of a Hastings Iguanodon specimen by the British Museum (Natural History) led to the little-known idea that William Butterfield (1872-1935), the then-curator of Hastings Museum, perpetrated the Piltdown hoax in order to make a fool of Charles Dawson (1864-1916), the discoverer of Piltdown man and extractor of the Iguanodon. Also intimated by some with the Piltdown story is Arthur Conan Doyle (1859-1930), novelist, physician, amateur detective (and sometime local golfer: incidentally founder of The Hindhead Golf Club – *app.* John Gahan). Supposedly, a conspicuous number of notable parallels occur between Maple White Land of Conan Doyle's Lost World and the English Wealden. Neither the cases against Butterfield nor Doyle have serious standing, and it has been easy to find gaping holes in them.

As for the dinosaurs themselves, the Wealden boasts a number of particularly interesting and significant theropods of predatory dinosaurs. In 1983, amateur palaeontologist William Walker discovered *Baryonyx walkeri* in the Weald Clay of Ockley, a specimen that proved to be a 'Rosetta Stone' for the interpretation of a hitherto enigmatic theropod group, the spinosaurids. Baryonyx specimens have since been discovered in the Hastings Beds Group and in the Wessex Formation of the Isle of Wight. Allosauroids group that includes Allosaurus and its close relatives represented by several Wealden specimens, most notably the tall-spined vertebrae from Battle known as *Becklespinax*. From the Wessex Formation is one of Europe's most complete theropods: *Neovenator salerii*, discovered in 1978. Diverse other theropods, representing the theropod group *Coelurosauria*, are also present in the

Wessex Formation. They include the probable *oviraptorosaur thecocoelurus* (represented by just half of a single neck vertebra!) and the tyrannosaur *Eotyrannus*, named in 2001. New data on *Eotyrannus* shows that it was rather more unusual than first thought when described in 2001, with unique notches at the tips of its lower jaw and distinctive lower arm bones. Sauropods (the giant long-necked dinosaurs), armoured dinosaurs and others are also well represented in the rocks of the Wealden, but were not covered in my talk for reasons of time!

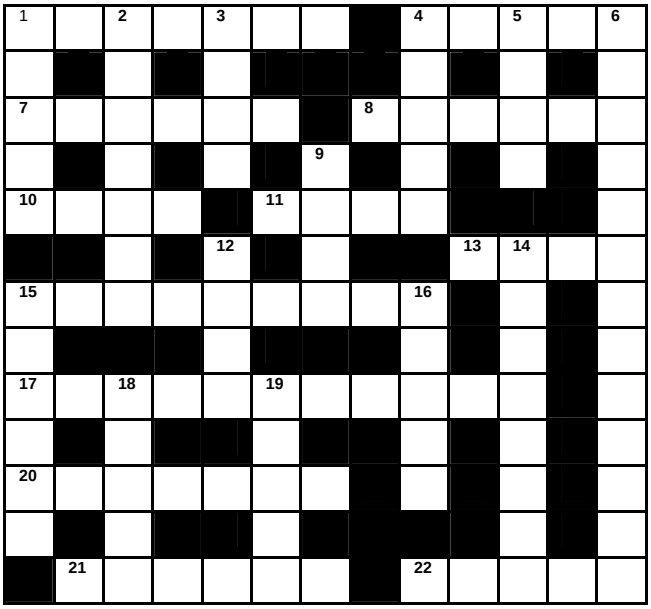
Reference:
Radley, J. 2004. Demystifying the Wealden of the Weald (Lower Cretaceous, south-east England). OUGS Journal 25 (1), 6-16.

Darren Naish

Peter's puzzle – No. 2

E	A	R	T	H	S	C	I	E	N	C	E	■
M	■	I	■	Y	■	O	■	T	■	R	■	■
P	A	V	E	D	■	P	A	N	G	E	A	■
L	■	E	■	R	■	P	■	A	■	E	■	A
A	I	R	■	O	R	E	■	■	S	P	I	N
C	■	■	■	L	■	R	■	■	■	■	■	D
E	■	H	■	O	■	■	M	A	R	B	L	E
D	■	O	■	G	■	S	■	R	■	■	■	S
■	G	R	E	Y	W	A	C	K	E	S	■	I
■	■	S	■	■	■	R	■	O	■	L	■	T
W	A	T	E	R	■	S	■	S	H	A	L	E
■	G	■	■	I	■	E	■	E	■	T	■	■
S	E	D	I	M	E	N	T	■	G	E	M	S

Solution to puzzle No. 1 – see June Newsletter



Puzzle No. 2 – clues below

Across:

1 For example, Brachiopod (7)
4 Where Silures & Ordovices lived (5)
7 SiO_4 (6)
8 ------ Iron (6)
10 Bottom of the Jurassic (4)
11 Type; considerate (4)
13 Centre of 16 down (4)
15 Mineral found in marine sediments (9)
17 Ancient waves formed them (6,5)
20 Result of fault (6)
21 A rift valley (6)
22 Lower -----sand (5)

Down:

1 New start conglomerate (5)
2 Magma spout (7)
3 Scottish water (4)
4 SE England landscape name (5)
5 Otherwise a vein (4)
6 Process of dumping material (13)
9 For example, Muscovite (4)
12 Gemstone of varying colour (4)
14 Hydrocarbon producing black rock (3,5)
15 Lets water through (6)
16 One of nine round the sun (5)
18 Biblical rock (5)
19 Wear it down (5)

Society dinner - Friday 27th October 2006

This year's annual dinner will be held at the *Farnham House Hotel* on **Friday 27 October**. The price of the 3 course meal, including coffee/tea, will be ~£19.25, 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 September and October monthly meetings; anyone who wishes to attend the dinner but cannot get to any of these meetings should let me have their name **by 13th October at the very latest.**

Michael Weaver - Membership Secretary

Visit to the Languedoc-Roussillon Region of South West France - May 2006

Geographical Setting

This region is bounded to the south by its border with Northern Spain and to the east by the Mediterranean Sea west of the Rhone Delta. To the north is the Massif Central, the large volcanic area visited by the Society in 1990, which has its southernmost part in the Montagne Noire mountain belt of the Languedoc. From east to west it is less than 100 miles; a further 250 miles to the west is the Atlantic coast. Later in this article reference is made to the Canal du Midi which, linking up to river systems, provides a water passage from the Mediterranean to the Atlantic.

Outline of the 14-day visit

Dr Roger Suthren of Derby University led the tour of this complex geological region. He has gained his knowledge both of the geology and the extensive wine growing over a period of 25 years. The Languedoc is the largest wine producing region in the world and Roger was able to tell us how its varied geology contributes to a great range of terroirs – the totality of the elements of a vineyard habitat – for vine growing.

He planned the tour using two bases, one in the south-west near Carcassonne at Alet-les-Bains, and the other in the north-east at Lodeve. From these two bases the group of 21 covered visits to 67 locations using a coach provided from Montpellier with 3 drivers, including an excellent young lady, to cover separate sections.

Geologically the Languedoc comprises 4 sub regions; the foot hills of the Pyrenees mountain chain; the Languedoc Basin; and the Montagne Noire mountain chain which is bounded to its east and north by a large high limestone plateau called Les Causses. These 4 sub regions will be covered separately in this write-up although our days' visits did not necessarily follow this sequence

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1 The Pyrenees and their northern foothills

Looking south from many places in the Languedoc one can see the distant mountain range of the Pyrenees which forms the border between France and Spain for much of its length. The Pyrenees are an early Tertiary mountain belt superimposed on an older structure. The event leading to the creation of the Pyrenees can be simply described as the collision between the Iberian Peninsular and France but its effect in terms of folding, faulting and crustal shortening were dramatic. A separate article devoted to this orogenic event will appear in the next newsletter because our two days visiting 12 locations in the foothills could only scratch the surface of the subject. One of the most notable features is the North Pyrenean fault which is a major break in the earth's crust to the south of the Massif d'Agly, the 'metamorphic mountain' created during the Variscan Orogeny. To the north of this is the Massif de Mouthoumet which borders the Languedoc Basin and to its south another range of hills, the Fenouilledes, with a gorge defined by limestone ridges to north and south of the valley. In the gorge there are thermal springs and many rivers flow eastwards to the Mediterranean.

At the various locations visited we saw a variety of rocks of various ages, including many metamorphic Ordovican exposures, gneisses, granites right through to Quaternary deposits. There were vineyards every where and some of the best Cotes de Roussillon vines were growing in almost solid rock. We saw a remarkable exposure in the valley of the river Tet called Les Orgues (Organ Pipes). **See photo** These are earth pillars eroded from soft Pliocene sediments which are in turn products of rotted granites located up the nearby hill. They are protected from erosion by cappings of coarse breccias. Further to the south is the Roussillon Basin which is filled with Tertiary and Quaternary deposits derived largely from erosion of the Pyrenees by major river systems.

2 The Languedoc Foreland Basin

This is an elongate sedimentary basin lying between the Pyrenean foothills to the south and the Montagne Noire to the north. It is called a "foreland" basin because its development was linked to the uplift of the Pyrenees thrusting against the continental plate. Most of the sediments in the basin are of late Cretaceous and Tertiary age and are derived from both marine and continental sources. In the west of the Basin are the Corbiere Hills, an important wine growing area, which we visited on two days. Our introduction to this area was a beautiful scenic drive through the High Corbieres which crosses a major fault separating the older Paleozoic rocks of the Massif de Mouthamet from the Tertiary sedimentary rocks of the Basin. There are many such unconformities around the Basin where its younger rocks rest against the Paleozoic sediments. It was at Ribaute north of the lovely medieval village of Lagrasse where Roger explained that the sedimentary rocks of the Basin were a mixture of river, lake and flood plain deposits grading into thick fossiliferous shallow marine sediments of Eocene age when the sea broke through into the Basin. In modern times flooding is a major hazard in many settlements along the river valleys and in Ribaute there was massive destruction in 1999 from the River Orbieu.

On the following day we visited locations round our base at Alet-les-Bains. At Argues in a road cutting there were examples of river channels, flood plain deposits and lake sediments. In nearby Rennes-les-Bains we saw how rainwater falling on the Palaeozoic and Triassic rocks of the Massif de Mouthamet emerged as warm waters rich in sulphate, calcium and chloride; this is similar to the warm water of Bath where "Roman Rain" falling on the Mendips has been heated at depth. To complete this day we paid a visit to a site of late Cretaceous dinosaur-bearing deposits in the Upper Aude valley. Here at Bellevue a skeleton of Ampelosaurus – known as Eva – has been found. On the climb up to the site there is a whole cutting where thousands of dinosaur eggs are exposed. A museum at nearby Esperaza contains displays and reconstructions relating to these late Cretaceous finds

Before moving to the eastern end of the Languedoc Basin we visited the superb city of Carcassonne, a much reconstructed fortified place where extensive use is made of the local sandstone known as the Molasse de Carcassonne. We had earlier in the day seen this rock at Moulin de St Jean in a section of the Canal du Midi where it cuts through these near horizontal beds of sandstone. **See photo** The construction of this canal by Paul Riguet between 1667 and 1687 was a fantastic achievement in those days using up to 12,000 men with picks and shovels. It was built to avoid ships having to sail round Spain; water for the canal was provided via a network of reservoirs and channels from the Montagne Noire to the north.

The eastern end of the Languedoc Basin runs into the Mediterranean and we visited two areas, one to the south of Narbonne and one around Beziers. Around Portel-des-Corbieres there was a gypsum mining activity until 1992 and this mine complex is now used for maturing wine. We visited this tourist attraction and sampled their wines. In a number of places around the Etang de Bages modern evaporites are being produced in evaporating pans and salt is an important industry. A road cutting at Durban-Corbieres showed striking striped and folded rocks of Triassic

age. These sediments consist of gypsum interbedded with siltstone, the gypsum acting as a lubricant in the folding process. Around Narbonne there was a lot of earth movement in late Eocene times and the geological structures are probably the result of the collapse of the eastern Pyrenees which caused a series of great faults and was instrumental in the creation of the Mediterranean.

3 The Montagne Noire

This Palaeozoic mountain belt was formed in the Variscan Orogeny in late Carboniferous times. It rises to a maximum height of 4000 feet and is cored by granites and gneisses. Our visits to the various parts of the Montagne Noire were made over 4 days, the western end being from our base at Alet-les-Bains and the east and northern sections in our second week at Lodeve. As in the Pyrenean foothills there is a wide range of rocks from Cambrian through to Tertiary. On our first day in the Caunes-Minervois locality we encountered Middle Devonian limestones with a red and white marbled appearance and quarried for use all over the world in famous buildings such as the Grand Trianon palace at Versailles. **See photo.** Roger pointed out in one quarry the different methods that had been used for cutting the marble.

Nearby is the Gouffre Geant de Cabrespine which is a massive cave system formed by one pothole collapsing into a second one in the Devonian limestone. It is 250 metres deep and, although clearly a tourist attraction, there was much geology to admire such as spectacular aragonite and calcite heliototes with different crystal structures – orthorhombic and rhombic respectively.

Some 20 miles to the east of these sites is the superb fortified mediaeval village of Minerve which was once a refuge of the Cathars who were a powerful group of religious dissidents which was, over time, exterminated by Papal Forces leaving many castle ruins on the tops of hills over a wide area. A feature of particular geological interest is a major unconformity to be seen in the gorge of the River Briant north of its confluence with the river Cesse where Cambrian limestone steeply dipping rests alongside Tertiary limestone, a gap of 500 m.a. Also in this area of gorges there is a cave where the bones of 10,000 bears have been found dissolved in phosphate forming a substance called Minervite - (b(e)arely believable)

After transferring to our north-east base at Lodeve we began a series of visits to the east and northern sections of the. Montagne Noire. What better way to start than making a north-south traverse through the mountains to reveal the core of granites and gneisses. In order to access a gorge created by the River Heric we had first of all to head west from Lodeve along a fault line in which there was a watershed where rivers such as the Orb flow east into the Mediterranean and the River Agoute flows west into the Atlantic. The Gorges d'Heric is one of a number of deep river valleys cutting into the Caroux Massif. As we climbed up the access track beside the Heric we began to notice schists, augen gneisses and pegmatites in the steeply dipping strata. Some of the large feldspar crystals and augen gneisses were over 10 cm long. **See photo** The reason for this stunning scenery was the late Alpine uplift of up to 1000 metres which exposed the granites formed some 440 m.a., the metamorphics some 330 m.a., and the pegmatites and aplites some 300 m.a.

After lunch taken high up in the gorge we went to St.Pons de Thomieres where marble of Devonian age had been quarried for the town buildings. Crossing the folded and faulted Paleozoic rocks of the Montagne Noire to Pierrue, we studied the dolomitic limestone of the Lower Jurassic in a complex contact zone of palaeokarstic bedrock with a mottled red and grey colour. This turned out to be bauxite representing tropical soils developed in the Cretaceous period when continental conditions existed. Further south in this very complex sequence of exposures we saw sandstone and conglomerate river deposits called the *Gres a Reptiles*.

The following day and at the northern edge of the Languedoc Basin in the Palaeozoic rocks of the Montagne Noire, grapevines grew in orderly rows on the rolling landscape of the St Chinian appellation. Underlying this famous wine growing area are mudstones and sandstones deposited during Ordovician times in deep water. The vines thrive in the poor sandstone and shale soils which stress them into producing larger and sweeter grapes. Our intrepid group walked along an excellent botanical trail created by the local school and observed the typical flora of these acid soils. We then visited the premises of the Berlou Cave Co-operative where, apart from wine tasting we were treated to a superb display of fossils found by the owner in the local area over many years from Ordovician, Cambrian and Carboniferous. The trilobite collection was the most stunning and varied. **See photo** Our return route took us through acre upon acre of vineyards, stopping at the picturesque village of Roquebrun perched above the River Orb where it has eroded its valley through Devonian limestones and Ordovician shales on its way to the Mediterranean. We visited an old marble quarry where a type of nodular red stone was extracted, having the local name of Griotte.

On the following day we left our hotel at Lodeve to make a series of visits around the Lodevois and Cabrieres hills. In a former opencast uranium mine at Mas-d'Alary, 5 km from Lodeve the quarry showed southward-dipping Permian red beds, mainly sandstones and conglomerates of continental origin. The disseminated uranium in these rocks has migrated from grey beds lower in the Permian succession. We examined beautiful examples of normal faults, and looked at mud cracks and cross bedding.

At Lac du Salagou an artificial lake around which the weathering of the Permian sediments has given rise to a 'badlands' topography with sparse vegetation. Near the village of La Lieude we stopped at a site where many reptile footprints are preserved on a bedding plane which represents the floor of a Permian lake. These footprints of Therapsid and other mammal-like reptiles, pre-date the appearance of the dinosaurs. The well-exposed alternation of red and green sediments with some ripple marks gave a striking appearance to the landscape. Nearby Jurassic dolomites showed deep karstic weathering.

In old copper and barite mines in the Devonian limestones near Cabriere, barite as white platy crystals were plentiful, but only specks of copper minerals were found. At another roadside locality we looked at Devonian nodular limestones ("griotte") containing ferromanganese nodules, an indication of deep-sea deposition.

From a hillside viewpoint near Neffies we could see for about 30 km and Roger pointed out the main geological features. Small hills marked the positions of Quaternary volcanoes rising from the Tertiary plain to the south and we could also see the Causse du Larzac limestone plateau to the east and the Montagne Noire to the west. In the hilltop village of Carlencas we walked through bauxited Jurassic limestones and Quaternary basalts. Near the summit a belvedere laid out by local conservationists explained the view with the help of large blocks of gneiss, sandstone, limestone, dolomites, bauxite and basalt and how they were distributed in the surrounding landscape

4 Les Causses

On our excursion to the Causses the great limestone plateaux to the north of Lodeve, we were able to see the Millau viaduct from many angles and to drive over this highest bridge in the world. Opened just over a year ago, it carries the A75 autoroute across the Tarn gorges by a cable-stay bridge 2.5 km long and 280 metres high. In Roquefort-sur-Soulzon we visited the caves – resulting from a partial landslip of the Jurassic limestone cliff – where Roquefort cheese is matured. Airflow from fissures in the rock is regulated to provide the steady, low temperature that favours the growth of different strains of Penicillium roqueforti in the cheese. At Montpellier-le-Vieux we wandered round a striking assembly of karstic pinnacles. **See photo**

Our last visit was to La Couvertoirade, a fortified

medieval town which still evokes the power of the Templars. It also provided a chance to examine a lavogne, one of the man-made dew ponds characteristic of the Causses. Despite all we learned during the day one mystery persisted – if so much Roquefort cheese is produced, where are all those famous flop-eared sheep whose milk is supposed to go into it?

Our Final Day

This was spent back in the eastern end of the Languedoc Basin where shallow marine sediments can be seen. Later in the Miocene the sea disappeared leaving the Mediterranean Basin dried out. Not until the Pliocene age was the Mediterranean re-connected to the Atlantic where the waterfall around Gibraltar must have been an astonishing sight.

The highlight of this day's visits was to the Oppidum d'Enserune, a fortified hill-top site occupied from about 600 BC with underground food storage silos dug into the bedrock. In Roman times the Via Domilia, an important road connecting Rome to its provinces in southern France, ran past this site. From the hilltop can be seen a remarkable pattern of fields running down to the valley. This is the site of a huge 400 hectares drained lake at the foot of which 13th century farmers dug drainage channels. We visited a site at the foot of this hill where today three tunnels have been cut through the Miocene rocks: one to carry the Canal du Midi, an upper one carries the railway and the third the drainage channel.

Returning to Lodeve to pack for the next day's flight from Montpellier to Gatwick we visited the village of St Thibery which is built on an eroded Quaternary volcano. Around the village there are many volcanic features such as columnar jointed basalt lavas, spatter cones and volcanic mudflow deposits.

Various members of the Society

A day of mystery and suspense in Wiltshire!

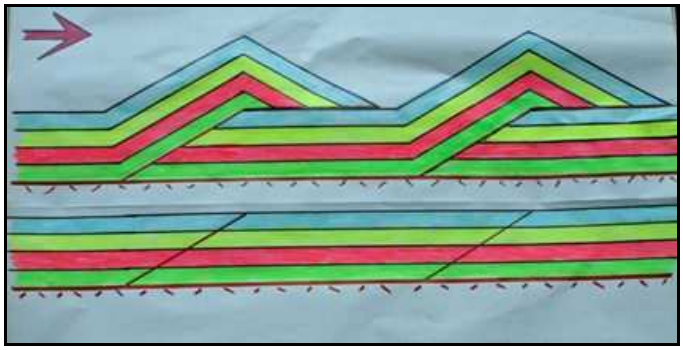
Twenty-one members rendezvous at a location near Marlborough for a day of mysteries. First, to investigate the Cold Grey Sarsen. The small valleys of Fyfield Down were littered with Grey Wethers of both kinds, sarsen and ovian. These enigmatic stones have the appearance of the oldest rocks but lie above the chalk. Graham Williams explains how a Palaeocene sandstone formation was transformed to silcrete during alternating wet (silica rich solutions) and dry periods (precipitation of silica cement around sand grains).

A modern stone run in the Falklands.
(Photo by Graham Williams)

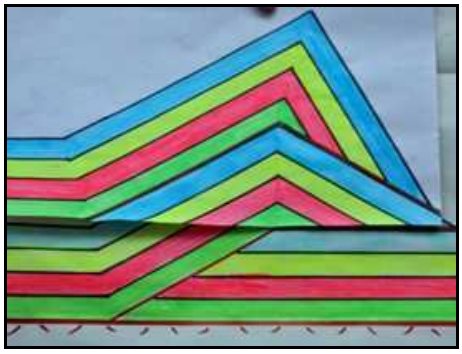
Sarsen stones in a valley at Fyfield Down

Mystery 2: To see a stone run. So why do these sarsen stones appear in the valley? The answer lies in the Falkland Islands which have only recently emerged from the Ice Age. Here, a similar formation was shattered by repeated freeze-thaw processes during the ice age; the fragments moved downhill by gravity, lubricated by summer melt, to form stone runs in the valleys. This is an extreme form of solifluxion.

Mystery 3 and Sites 2/3: The lost anticline. We lunch seated on an Upper Greensand ridge and then measure the dip of 15° N to 20° N . At the highest point of this E-W trending anticline we look north to see the Upper Greensand disappear under a chalk down. The Upper Greensand has high levels of glauconite and some marine oysters (Exogyra).



Under compression, the rock faults and Slides over the underlying formation to Form a symmetrical anticline.



If the process is repeated asymmetric anticlines can form

At Fir Hill the Upper Greensand dip is 5° N; this is an asymmetric anticline. G.W. explained the Thin Skinned Tectonic (Fault Bend Folding) Theory for the formation of anticlines..

Site 4: Have you seen a sand house? This was a sand church: St James's, Ansty. Dating from 1250 and built of three different seams of Upper Greensand. ***The photo*** *shows Shirley, Cath, Barry, Ian and Graham at the church.*

Sites 5: We have now passed from the Upper Greensand, over the Gault to the older central part of the anticline: the Purbeckian and then the Portlandian. There is no Lower Greensand in this area. Chicksgrove quarry remains open to provide Chilmark stone for restoration of local buildings, notably Salisbury Cathedral. Sir Christopher Wren, a local, wished to use Chilmark stone for St Paul's but limited supplies meant that he had to source it from Portland, hence the name change. Traces of fossils, including large ammonites, indicated the shallow marine nature of this formation. Site 6: This huge 14th century tithe barn was once built entirely of local stone. It now has a thatch roof and Chilmark buttresses.

Site 7: Lady Down and the centre of the anticline. Graham and Barry heroically beat down the sea of 8ft tall stinging nettles to lead us to a Roman quarry.

Evidence of algae

Here we see the earliest Cretaceous rock, a limestone with some small shells and algae – the middle Purbeck. Below our feet was the Jurassic. We were inside our anticline.

Reference Grids:

Site 1 SU 1598 6998 (car park)	Site 2 SU 0060 3225	Site 3 SU 0095 3155
Site 4 ST 9570 2620	Site 5 ST 9635 2985	Site 6 ST 9520 2970
Site 7 ST 9585 3065		

Janet Phillips

The Western Weald field trip for the Devonshire Association – 12th-14th May 2006

1.0 Introduction

Seven geological sites of Cretaceous rock formations situated around the Western Weald region were selected for investigation as set out in the attached itinerary. Arenaceous, argillaceous and carbonaceous marine formations of the Lower (LGS), Upper Greensand (UGS) and chalk formations were laid down in the region as a result of wide scale tectonic movements. Sea depths varied from periodic uplift and subsidence manifested in a variety of transgressions (cyclotherms) and regressions over ~60Ma culminating in the deposition of chalk in warm shallow eiperic seas towards the end of the Upper Cretaceous.

The domed Wealden anticline representing the Weald proper was uplifted and very probably eroded contemporaneously from tectonic pressures initially associated with the Hercynian Orogeny and later reactivated during the Alpine Orogeny in the late Tertiary. As continental drift moved the landmass of Eurasia to the north Pleistocene influences such as periglacial and temporal climatic effects (Holocene freeze/thaw conditions) vigorously mixed, scoured altered, exposed and removed many of the sedimentary formations that can be evidenced in and around the Western Weald today

2.0 Locations

The geological sites described here were planned to be visited in the order of superposition. That is to say commencing with the oldest deposits first: (1) Devil's Punchbowl, (2) Devil's Jumps, (4) Mellow Farm and (5) the Hawkley Landslip. Site (3), Waverley Abbey for its archaeological/historical interest and use of localised building stones while (6) Hartley Mawditt and (7) Lower Froyle Quarry were sadly not investigated due to time constraints.

2.1 Devil's punchbowl (Hindhead) – OS Landranger Series 891359

The dramatic Punchbowl panorama is seen from a high point facing NE along the ~1.6 km strike of the depression. In places vegetation changes variably from open heath and scrubland to ancient and secondary woodland along steeply dipping slopes of the punchbowl profile as a result of exchanges in soil materials derived from weathering and nutrient-rich organic matter. Outcrops of the LGS Hythe Beds (see handout) comprise orange-brown acidic sandstones of marine origin laid down during the Aptian (~110Ma) that overlay the stiff impervious Atherfield clays of similar age and marine origin. It is these differences in lithology that account for the so-called spring sapping that is unique to the Hindhead area and gives the *'punchbowl'* its name. Spring sapping occurs here at a boundary between a thin seam of clay and porous sandstones above. That is to say meteoric waters penetrate the Hythe Beds before being diverted along the clay base to reappear as spring lines which trickle-feed Smallbrook Stream that cuts the valley floor.

Origins for the formation of the Punchbowl are controversial but probably began during the late Quaternary (Devensian Ice Ages ~20Ka) and into the Holocene (Anglian) when parts of the British Isles experienced high-latitude glaciation. It is likely short hot summers (2 to3 months) brought about intense water flow condition from rapid melting of meter thick periglacial ice and snow cover that incised the (then more elevated) Hythe Beds to preferentially scour surface sediments that formed a series of valleys of which the Devil's Punch bowl is the largest. Fast flowing seasonal melt waters surged north to spill into the then much larger Blackwater River – subsequently captured by the River Wey from denudation of part of the chalk ridge (Hoggs Back) that lies to the east of Farnham. The spring sapping today is a trickle compared to Holocene times and only five springs can now readily be located.

2.2 Devil's jumps (Churt) – OS map ref: 875394

At first sight a typical acidic heathland truncated by rolling hills and a distinctive plateau interspersed with patchy outcrops of consolidated yellow/orange and white sands. These mottled sandy outcrops are the much coarser Folkestone Beds (see handout) contained within the UGS series of glauconitic quartose sandstones and pebbles. Scattered about the surface are irregular masses of dark ferruginous ironstone known locally as '*carstone*'. These are remnant ironstone seams that underpin or cap conical hills to form the so-called Surrey Hills in this part of the Weald (formation of the carstone within the Folkestone Beds is discussed in the Mellow Farm report - Site 4). It should be borne in mind that the Folkestone Beds are widely distributed within the Wealden Supergroup and unlike the Sandgate, Bargate and Puttenham Beds (not discussed here) also outcrop in this general area. Reference was made to the whiter sandstones or 'silver sands' that outcrop in dips and gullies between hills that are not limonitic

(iron-rich) which are widely exploited throughout the area as a cement mix in the construction industry. Some reference was made to the heavy minerals and mechanical analysis of the regionally diverse sandstones that may influence and account for the general geomorphology while at the same time provide evidence as to depositional orientations (flow direction in bedding planes and cross bedding) and their suggested origins (Barrovian index minerals ?).

2.3 Waverley Abbey – OS map ref: 867453

Waverley Abbey was the first Cistercian Abbey built in the 12th century with local building stones. Situated on the Folkestone Beds on an alluvial meadow inside a wide parabolic bend of the River Wey where clayey/peaty top soils are indicative of periodic flooding. The abbey ruins include building materials from the LGS such as carstone and UGS of the so-called *Reigate Stone* and not least (surprisingly) Melbourn rock (a chalk facies) and indeed Gault Clay bricks, Roman tiles and derived flints– anything the lay builders could get their hands in the construction of God's first English Cistercian temple. None of the Abbeys constructed latterly in England were particularly well built since they were prone to partial collapse and hence in a state of continual repair. This is evidenced from the Waverley ruins by the assorted materials used to plug gaps and holes or used in the support of edifices. '*Galleting*' of mortar with coin-sized carstone pebbles was a common practice and was not only thought to add strength to bonding materials but became an attractive supplement. Many centuries before with the departure of the Romans the secret ingredients of producing fast-fixing reliable mortars or cements went with them – to be rediscovered as late as the 18th century. Large buildings at the turn of the last millennium were few and far between and quite unreliable constructions (unlike in Rome). When Caenstone from Normandy was introduced by the Normans for the building of Westminster Abbey and the Tower of London (1067AD), mortar quality was still poor and as a result large precisely cut Caenstone blocks were hewn to size and placed one upon another and butted skilfully together by (French ?) masons to produce just a few large strong buildings.

2.4 Mellow Farm (Dockenfield) – OS map ref: 821388

A small roadside quarry in the face of a greensand escarpment used over-time for the extraction of carstone and silver sands. The quarry face displays bedding planes and cross-bedding in the Folkestone Beds. To the NW of the quarry (noting a recent rock-fall) the beds are extremely limonitic ($Fe_2O_3H_20$) supported in-situ by hard pans of mottled ironstone trapped inside the bedding planes and forming what are referred to as '*festoons*' and cylinder-like ironstone formations also made up of tabular iron pans of varying lengths and thicknesses that seem to penetrate the rock face. Leaching from the top by circulating ground-waters within the sediments washes-out the iron-rich glauconitic minerals ($K(Fe^{3}+,Al)_2(Si,Al)_4(0_{10}(OH)_2)$ that intermix with additional iron-rich (Fe_2O_3) organic compounds. These are derived from decayed or weathered matter at the surface and together they migrate into 'voids' or places of containment where the ironstone formations over long periods of time are cemented with quartz grains into solidified sill-like veins. Carstone controlling factors appear to be oxides to *rust* in moist warm conditions and do not form below 5/8m from the surface. This is probably because of leaching constraints, pore space capacity, temperature, mineral supply, chemical reaction and overburden compression. As stated at the time there is no definitive study of carstone available hence this would make a splendid PhD research project.

The silver sands to the SE of the quarry show pronounced cross bedding measured at 335^{o} in the direction of deposition of the Folkestone Bed sandstones. This is similar in direction to the same lithologies found elsewhere in the greater Wealden District.

2.5 Scotland Farm (Hawkley) – OS map ref: SU: 75529293

A landslip of elevated 'malmstone' escarpment material (UGS) onto the Gault Clay Vale below (to the SW) occurred close to the village of Hawkley in March 1774. The event was recorded by the Reverend Gilbert White in his memoirs *'The Natural History of Selborne'* (see Dr Chatfield's handout). This catastrophic geological event has not been thoroughly researched even though this and many similar historical landslips show up on the BGS map of the area. For the purpose of this report however reference is made to the geology of the area and how the landslip came about.

The UGS and Gault Clay are synonymous with each other or they are lithological variants of the same sequence. That is to say they were laid down during the same slow episodic transgression over a period of ~ 8Ma during the Lower Cretaceous. To the east of the village of Hawkley lies Scotland Farm which is located several kms to the SW of Farnham, and, like Farnham, is situated on a low relatively narrow seam of silty Gault Clay. This continues

in a southerly direction towards the market town Petersfield - in fact the Gault Clay more or less defines the boundaries of the entire Wealden District. At Scotland Farm the Gault Clay passes contemporaneously upwards into a thicker development of UGS now forming an escarpment upon which the village of Hawkley is located and Scotland Farm sits ~50m below. Due to the sheet-like structure of the stiff Gault Clay (a *phyllosilacate*) slip planes may be induced particularly when clays contains high amounts of silt as in this case. Silts allow the infiltration of water more easily into voids opened-up by silt-sized grains making the rock incompetent and liable to slip or flow. Gilbert White's first-hand account of prolonged precipitation prior to the landslip in March 1774 and the event itself are not be repeated here but well documented in his memoir and the handout.

As a matter of interest the Gault Clay on the Isle of Wight (Wealden Super group) is referred to as the 'Blue Slipper' and many landslips occur from time-to-time on the island. The nature of the Gault Clay there however is less silty and slides as a result of a combination of gravitational (south dipping) , tidal (undermining) and weather (sub-aerial) influences.

2.6 Hartley Mawditt – OS map ref: 754358

Unfortunately another group (Graham William's OU field trip) got to the roadside cutting before our group arrived. This does not prevent a brief description of the site which comprises excellent outcrops of the Upper Greensand. These outcrops are no different to the small one seen at Hutcher's Lane at Selborne but here they are referred to as *malmstone* in Dr Chatfield's handout during her excellent tour of Gilbert White's *'Natural History of Selborne'*.

As stated elsewhere the UGS are referred to as malmstone locally and *Reigate Stone* in towns situated in east Surrey and below the North Downs escarpment where the formation attenuates to no more than ~8/10m thick.

In the Selborne district the UGS is at its thickest (150m) and as a consequence was used as a building stone because of its ashlars-like qualities (able to be cut into blocks in all directions) even though the quality of the stone is not as competent or regular as the Reigate lithology laid down in deeper waters in the east of the Weald. In the Selborne area the rock has a tendency to be friable and as a result flakes in freeze/thaw conditions and if used should be selectively employed along bedding planes. Nonetheless the rock is extremely fertile and its looseness is ideal for the growing of apple orchards and fruit crops throughout the area.

It seems to me that if ever a rock was misnamed it was the Upper Greensand. Roderick Murchison (1792-1871) of pioneering geology fame named the sequence in 1826 following field work in the SW corner of the Weald in his very first geological paper. The lithologies are divided into three categories: Upper; a clayey sandstones, Middle; a siliceous malmstone and Lower; poorly consolidated siltstones. Mechanical analysis of the UGS latterly shows the bulk of the sequence to be composed of ~20% loamy quartz grains in a glauconitic-rich solidified siliceous (silica) ooze and that in the SW corner of the Weald (West Sussex where Murchison initially lived and worked) the sequence thins-out considerably and only the Upper clayey sandstone facies are prevalent. This more than likely accounts for the Murchison's misnomer. The original designation; *malmstone* (anon) more properly describes these chalk-like outcrops that were known to fizz in acid yet the calcium carbonate content was found to be derived from the overlying chalk sequences as a result of weathering and erosion. It seems that because of Murchison's influence and sway in later years (he went on to name the Silurian and Permian Systems and became President of the Geological Society) the term Upper Greensand (UGS) remains to this day. Paul Sowan (1975 – see reference) describes additional uses and applications of the UGS which are extremely interesting but not strictly relevant to this region.

3.0 References

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