The Geologists' Association

This Association, founded in 1858, exists to foster the progress and diffusion of the science of geology, and to encourage research and the development of new methods. It holds meetings for the reading of papers and the delivery of lectures, organises museum demonstrations, publishes Proceedings and Guides, and conducts field meetings.

Annual Subscription for 2003 are £34.00, Associates £24.00, Joint Members £52.00, Students £14.00.

For forms of Proposal for Membership, and further information apply to the Executive Secretary, The Geologists' Association, Burlington House, Piccadilly, London W1J 0DU. (E-mail: Geol.Assoc@btinternet.com) Telephone 020 7434 9298 Fax: 020 7287 0280

Website: http://www.geologist.demon.co.uk

President: William French
Executive Secretary: Sarah Stafford
Honorary Vice Presidents:
Professor Allan Rogers FGS
Baroness Young of Old Scone

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LAST Copy dates for the Circular
March Issue January 14th June Issue April 22nd
September Issue July 22nd December Issue October 21st

Please note that the dates given are for the Circular. They also represent dates at which the magazine will go to press. However, because of the greater time required to set the magazine, items should be submitted as soon as possible and not targeted on these dates. We welcome contributions from Members and others. We are currently limited to 24 pages. Pictures for publication can be as slides, photographs or high resolution digital images - preferably on CD.

Advertising Rates
Full Page £360
Quarter Page £100
Half Page £190

Cover picture - an image of the Hoodoos of Willow Creek Alberta - See page 17.

PRODUCTION TEAM
In order to facilitate publication of the GA magazine a team has been established as follows.
Susan Brown will seek and look after items from the universities.
Paula Carey will look for and edit research items. Mark Campbell will coordinate items relating to conservation, and Tony Iles will seek items from the Museums. Mark Campbell and John Crocker will help Bill French with the general setting and editing. A set of instructions for authors is being prepared.

ADVERTISEMENTS
While precautions are taken to ensure the validity of advertisements the Association is not responsible for the items offered, for any loss arising or for their compliance with regulations.
REPORT FROM COUNCIL

This report is for the Council meetings of March and May, there is not a Council meeting in April.

Money has been a major talking point at both Council meetings since this is the time of the year when last year’s accounts have to be approved and next year’s budget agreed. We are now in a time of increasingly tight financial constraints. The Association’s investments have reduced in value due to the considerable decrease in the value of shares on the stock market. In addition interest rates have been declining thus reducing our return on investments. Of course there is the inevitable effect of inflation. All of this has meant that the Association finished the year with a deficit. In order to rectify this deficit the Treasurer proposed to Council that the subscriptions should be increased by £3 a year. A special meeting for members to agree this increase will be called. Although this increase seems a lot, in fact over half this increase will be swallowed up by inflation, increased National Insurance contributions and the imminent rise in the postal rate, so that only half of the increase will go towards reducing the Association’s deficit. It is likely that this will not be enough unless savings can be made. Here the membership can help in a way which does not affect their pocket. Firstly, if all members were to sign up to gift aid their subscriptions the Association’s deficit could be almost eliminated. In addition if members could encourage other people to join the Association then our finances would improve. To assist recruitment a pamphlet has been produced and it was agreed that a Councillor would be responsible for publicity and recruitment.

The possibility of having corporate sponsorship has been discussed and is being actively pursued. However Council agreed that this system requires very careful planning before being launched.

One of the lecturers in the programme has had to withdraw which raised the topic of what to do if this occurs at very short notice? It was agreed that Council members should have a short 10 minute talk ‘in their pocket’ that they could give in an emergency. A speaker had to be found suddenly for the December meeting and Council agreed that this could be combined with a book signing. It is possible that this meeting could be very popular, hence in order to lock out members who may have come long distances (the lecture theatre can only take 180), it was decided to try an experiment of making this an all ticket meeting with members writing in for tickets.

Because the Rules of the Association have not kept pace with how the Association has developed, they need revision and hence could not be sent out with the list of members as they usually are. A committee is revising these rules which will have to go to the Charity Commission and then be ratified by members.

Rockwatch continues to flourish, although there is always the problem of funds. The current magazine was well received and of course one of its editors has been awarded the Halstead medal this year.

A number of GA guides will be published this year. With publications like these which contain so many diagrams there is always a problem of obtaining copyright permission to publish them.

The retiring Councillors were thanked for their hard work and efforts to make the Council so successful.

John Crocker
Honorary General Secretary

CURRY FUND REPORT

At the March meeting there were five new applications, considerably fewer than the ten received at the December meeting.

Two applications were deferred, one was refused and two were funded. £1330 was granted for optical luminescence dating techniques on Pleistocene deposits from Eastern England as part of an ongoing study on these important deposits. Scarborough Museums and Gallery was awarded £450 towards the cost of preparation and conservation of a Specton Pleistocene. The work is to be done in the museum during the summer of 2003 so that the public can see the careful and painstaking work required in fossil collection and preparation.

Decisions were deferred, pending supplementary information, on an application for support for analysis of a small reptilian coprolite found in the Lower Permian in Cornwall and on an application from the British Institute for Geological Conservation towards the purchase of an endurophyte that was from the Charmouth Heritage Coast Centre for funding for producing a video of fossil cleaning was refused.

Of the ten applications considered in December, eight were funded, one was deferred and one refused. Funding was granted to the GA for £2000 for publication of Guide No. 42, “The Geology of Jersey”; to Hugh Prudden, £217 towards the cost of producing a bibliography of Somerset geology to be available, on completion, to whomsoever may wish to use it; to Allan Pentecost, £500 towards the cost of production of a monograph on Travertine to the Craven Museum, £600 towards the cost of setting up a collection of geological materials for children’s activities for the Bristol Naturalists Society, £588 to produce two banners to publicise rock and fossil events; to Dr. Bridgland, £1300 for publication of a colour map to accompany his paper in the PGA and to Dr. Edmunds, £1020 for publication of a series of black and white plates of ammonites to accompany his paper in the PGA. An application from the Lancashire Muses Service for salary and travel costs in researching a proposal for teaching aids was refused. A loan of £10,000 was made to Kent RIGGS towards conservation work at Aylesford Pit — an SSSI containing important Pleistocene vertebrates.

This report shows what an interesting range of applications are received by the Curry Fund. This GA grant fund is perhaps unique in the country, in that it supports amateur and professional geologists on a huge variety of geological projects. Information for applicants can be downloaded from the GA web-site www.geologist.demon.co.uk or from the GA office at Burlington House. We look forward to hearing from you.

Susan Brown, Curry Fund Secretary.

RULES REVISION 2003

A thorough modernisation and simplification of the rules was approved by the membership in November 1985 and further revisions were approved in January 1995. Since that date, several developments have taken place in the organisation of the GA and its subsidiary charities and these are not reflected in the Rules as published (in 1997) and issued to the membership.

The Rules Revision Group has recently addressed these issues and later this year will be putting to the membership a raft of proposals to allow the publication of a revised set of Rules. The main changes in a new version of the Rules will relate to the following issues.

1. Incorporation of material already fully approved by the Charity Commission and ratified by the membership. This material includes the Regulations for the Richardson Award; the addition to the Rules to allow the appointment of Honorary Vice Presidents; the modification of the Curry Fund Regulations; and the change of the due date for the payment of membership subscriptions from 1st January to 1st November.

2. Provision of Regulations for new subsidiary charities of the GA. Such Regulations are required for Rockwatch, the Japce Fund and the Middlemiss Fund. These Regulations will also require the approval of the Charity Commission before being presented to the membership for ratification.

3. Simplification of the Rules to bring them into line with current working practices of the GA, to allow a more flexible approach to management, or to respond to changing legislation affecting the activities of the GA. Areas where such modification is envisaged include the creation of a Medals and Awards Committee to simplify the processes of nomination and selection in connection with the GA’s awards; recognition of the Magazine as a publication of the GA and a benefit of membership; composition of the investment group; and the delegation of responsibility for management of Field Meetings.

Full details of the proposed Rule changes will be published in the September Magazine in preparation for a Special General Meeting to obtain the approval of the membership. The date of the proposed SGM has not yet been decided.

Christopher Green

GA MEETINGS - June

Paul Ensom
Dept of Palaeontology,
Natural History Museum,

Dinosaur tracks and where they have led on the Isle of Purbeck, Dorset

6th June 2003
Geological Society, Burlington House, Piccadilly, W1V OJU, at 6.00 pm, tea at 5.30

The Purbeck Limestone Group of the type area in Dorset straddles the Jurassic - Cretaceous boundary dating from around 144 million years ago. These strata, resting on the fully marine Portland Limestone Group, are composed of a varied series of clays, shales and limestones representing terrestrial to marginal marine environments. The Purbeck Limestone Group has long been known for the impressive flora and fauna it contains, amongst which the vertebrates have received considerable attention since the 1890s. In recent years the tetrapod fauna has been recognized as one of the richest mid-Mesozoic assemblages known.

The discovery of a multiple dinosaur trackway site in Swanage in 1981, with which I became very involved, was a turning point for me. Since then, fieldwork on these strata has yielded an increasing variety and stratigraphic range of vertebrate trace fossils and in 1986 a footprint site produced the tracks of quadrupedal dinosaurs. Subsequent sieving of the lake clay (3 tonnes of it!) in which these animals had walked led to the discovery of a wide range of microvertebrate remains including amphibians, reptiles and mammals. In addition seven distinct types of reptile eggshell have been recovered. Continuing fieldwork has led to the discovery of further microvertebrate and eggshell producing horizons at new localities.

With hindsight, it is clear to see that the 1981 discovery of a trackway site at Townsend Road was a portent; tracks lead in not just one but several directions! This lecture will describe the 1981 and subsequent discoveries.

Above: Casts of footprints across the overturned slab of cherty freshwater Member limestone at Sunnydown Farm, nr Swanage, Dorset, 1986/7. Below: Excavating overburden at Sunnydown Farm, in 1986, in preparation to uncover footprints...and a great deal more!

Above: One of the in situ 'new' footprint casts found at Sunnydown Farm, near Swanage, Dorset, in 1986. Scale bar is 10 cm.
Right: The bulk clay sieving machine at the Dorset County Museum which helped reveal a hidden world in the clays in which dinosaurs walked across the Isle of Purbeck 144 million years ago.
Granites and granitic magmas are unique to the Earth in this solar system. They have caused geologists to debate long and hard over their genesis. Let us accept that granites solidify from granitic magmas. There are enough areas of interest and potential debate left in the magmatic realm to last us for a long time yet. In the presentation I will show a variety of mineralogical, textural and other peculiarities displayed by granitic rocks – the sorts of features that can fascinate and puzzle the observer, and potentially spark vigorous argumentation. Following this, I will try to summarise the current state of knowledge on granite petrogenesis, dealing with the following questions (which are but a few of the more important ones that could be asked). The answers may hold some surprises.

Where do granitic magmas come from?

They are generated mainly by fluid-absent partial melting of common continental crustal rocks, at mid to deep crustal levels, during granulite-facies metamorphism, in tectonic settings other than continental collision.

What are their important physical/chemical properties?

Temperatures vary greatly, but initially were between 800 and 1000°C. Melt H₂O contents normally range from about 2 to 6 wt%, so this results in viscosities that are only 10 to 1000 times more viscous than a mantle-derived basaltic melt.

How do they move through the lithosphere and how fast?

The magmas do not move as diapirs or by percolation or by assimilation or even stoping. All these mechanisms can be modelled but none is energetically favourable. Granitic magmas are transported vertically in the crust mainly by self-propagating cracks (dykes), at surprisingly fast speeds, typically in the range of 1 cm/s.

How and where are they emplaced?

The shapes of large granitic plutons are mostly flat and sheet-like. Batholiths do not extend down very deeply. They were mostly probably emplaced by the formation of an initial horizontal sill-like body that evolved through a laccolith-like stage into the full-blown batholith. A variety of final emplacement mechanisms have been shown to be viable and individual plutons may show elements of floor depression, roof lifting, ballooning, stoping, etc., etc. The only mechanism for which there seems to be little or no evidence is diapirism.

How long does granitic plutonism last?

Partial melting of the crust can be fast and efficient, if the heat is brought in by multiple sheets of mafic magma, leading to magma production typically in thousands of years. Using the modelled ascent rates for granitic melts in dykes, it turns out that the magmas punch their way upward through the crust in just months and take only thousands of years to build batholiths. Cooling, crystallisation and differentiation are much slower processes.

A short tale of two pegmatites. The cream one (below) is from Corsica and the red (above) from southern Finland, near Espoo. Examination of these two lovely coarse-grained rocks reveals an interesting difference. In the Corsican rock, euhedral alpha quartz crystals are surrounded by anhedral alkali-feldspar. In the Finish rock, the situation is reversed, with euhedral alkali feldspar surrounded by anhedral quartz. This is clear evidence that natural granitic magmas are not formed on eutectics or minima. They are not ‘minimum melts’. Instead they start crystallizing at much higher temperatures, but evolve towards similar, low temperature end products by following quite different evolutionary paths.
October Meeting:

'The Geological Cat Walk: Models & Super Models - Exploring the Earths Crust in 4 Dimensions'

Prof. Stuart D. Burley

1: Exploration and Development Geoscience, BG Group, 100 Thames Valley Park Drive, Reading, RG6 1PF
2: Basin Dynamics Research Group, School of Earth Sciences, University of Keele, Keele, Staffordshire ST5 5BG

Exploration for hydrocarbons has always been an exciting past-time. Whether mapping desert outcrops, sampling source rocks in far-off exotic lands, or logging drilling mud on an exploration rig in the inhospitable North Sea, the quest for hydrocarbons has had the feel of being at the 'frontier'. For the latter day petroleum geologist that frontier has moved into the virtual realm of the computer, but it's still exciting stuff!

Petroleum geologists reconstruct subsurface sedimentary basins in 3D, through time - so-called '4D' - with powerful computers to aid exploration, well planning and production strategies. Immersive computer projection technology enables teams of geophysicists, geologists and engineers to wander through their virtual subsurface space as never before. Basin modelling has become a powerful tool for investigating the whole basin-scale hydrocarbon system, imposing a rigorous, systematic approach to prospect evaluation and provides new insights on the processes of hydrocarbon migration, including flow rates, migration distances and charging histories (Figure 1). 'Super models' of sedimentary basins can be built with 100's of millions of cells, each populated with geological properties, at a metre scale resolution, and simulated in a few hours. The ability to run multiple simulations of these models, particularly where data are scarce, allows the explorationist to pose 'What if?' questions to investigate the sensitivity of any petroleum system to critical parameters, such as source rock properties. At the reservoir scale, multi-million cell geological models of the reservoir structure, geometry and properties (Figure 2) are up-scaled to sophisticated flow simulation models containing 100's of thousands of cells that are used to plan the optimal location of wells and define the production history of the field.

The petroleum geologist of today still needs a 'geological sixth sense', but is now more interdisciplinary in outlook and more computer literate than ever before. Its still an exciting time to be a petroleum geologist, and reveal more about the nature and behaviour of the Earth's Crust.

Figure 1: (right) A large 200,000 cell model of an oil and gas charged sedimentary basin showing predicted migration pathways in a seismic data cube.

Figure 2: (left) A 3D stochastic model of a reservoir showing predicted distribution of sedimentary facies.

November - the Annual Reunion

The Annual Reunion this year is at University College.
It will be held on Saturday 8th November 2003 from 12.30 to 4.30 pm.

We expect to see exhibits from individual GA Members, Local groups and Affiliated Societies, Entries into a photographic competition, the GA archives, slide shows, and much more including a Rockwatch activity room - bring the children.
19th September-2nd October 2002
Derek Brumhead and
Richard Moody

Two leaders and 18 members, set out very early from Heathrow on the 19th for a two-week excursion to Tunisia, with the promise of a four-day safari into the Sahara Desert. Before leaving Tunis for Djerba and the ‘Star Wars’ town of Tataouine on the 20th, the group visited Carthage, the most famous Phoenician-Roman site of all. Sadly it is disappointing. The ancient city is broken up into a dozen or so sites scattered among the villas of the affluent Tunis suburbs. The baths of Antonius, on the edge of the sea are probably the most dramatic of all. A poignant site nearby is the Tophet, a cemetery for sacrificed children.

On arriving in Djerba, we were met by a virtual caravan of four-wheel drive vehicles. However, we were only allowed one night on the island of the Lotus Eaters before crossing the broad, flat sandy Jeffara plain towards Tataouine. En route, immediately southwest of Medenine, outliers of folded Lower Triassic red shales, of the Mastaura Formation, overlap unconformably by horizontal Jurassic dolomites marked the front of the Saharan Platform. Further west lies Djebel Tebaga a WSW-ESE trending mountain range capped with bioturbated limestones over 100m thick: a fault bounded pass through this ridge providing a unique section through Upper Permian strata.

The hills west and southwest of Tataouine and Medenine have long been the centre of Berber culture. Trogloodyte homes and fortified villages such as Ksar Hallouf characterize this unique region. Ksar Hallouf is a typical Berber hilltop village, fortified and with its own granary. The distinctive ghorfas or long, narrow vaulted cells are built in rows three or four storeys high to form a stockade around a central courtyard. The boundary fault between the Jeffara Plain and the Saharan Platform is picked out along the base of a 300-400m scarp just north of the village.

During the Jurassic and Cretaceous dinosaurs roamed across the floodplains that marked the front of the Saharan Platform and superb plant remains of ferns and the gymnosperm Ginkgo were found in shales of the Merhab el Asfer Formation (Lower Cretaceous) just south of Tataouine. Near Chenini, deep valleys have been cut into the Chenini escarpment revealing details of the Cretaceous succession. The Chenini Sandstone (Lower Cretaceous) forms a distinctive horizontal ledge below a great escarpment capped by Tuvironian dolomites of the Gattar Member (Zebrag Formation). The coarse sandstones and grits are cross-stratified into superb truncated sets, representing fluvio-deltaic conditions.

Ksar Hallouf is a typical Berber village found in southernmost Tunisia. Most such villages occupy defensive positions on hill tops. This village occurs to the west-south-west of the Jeffara fault which essentially separates the Jeffara Basin from the uplands of the Saharan Platform.

Strangely, the area south of Oued Zar, on the southern flank of the Dahar Plateau, is pock marked with circles! These have been interpreted on occasion as impact craters, giant teepee structures or more readily as unusually small, symmetric antiforms and synforms.
The party enjoyed themselves seeking out the liberal fragments of fossil wood, crocodile, freshwater fish, and dinosaur bones. Staying at this stratigraphic level, the next locality was in cross-bedded sandstones below the Gattar dolomites (Turonian). This was by far the best dinosaur locality, with dinosaur fragments, washed downstream from the Saharan platform, found in friable sands and abandoned channel clays. Sharks teeth were also found - our leader pointing out that they then swam up the rivers as they do in Australia today. There were large chunks of fossil wood lying around at this locality - a broken-up tree.

In contrast just north of the village of Ksar Hadalah, (the hotel used for many scenes in the original Star Wars films) a roadside/wadi stop revealed 4 way closure of well developed biospheric mud mounds typical of the Middle Jurassic Ghoummassen Member (Tataouine Formation).

East of Tataouine, just west of the village of Kirchaou, thick evaporites of the Bilir Formation (Lower Jurassic) crop out. They are mainly sabkha-type deposits of gypsum and chicken-wing anhydrite outcrop on the top of the Triassic. Further east, south of Smar, and closer to Libya, sections in the Ouled Chebbi Formation (Middle Triassic), exhibit a sequence of fluvial deltic clastic rocks capped by barchan dune deposits. Subsurface, under the Saharan platform, these rocks (TAGI) represent the main reservoir rocks for hydrocarbons.

Nothing can be certain when you want to enter a prohibited military zone and it was somewhat typical that arrangements to leave for the Sahara were postponed owing to unforeseen difficulties with our documentation at the last checkpoint. What followed was a splendid piece of negotiation by our host Jean-Marc Houssaye, the resident manager of CGG in Tunisia and we were able to leave Tataouine about midday on the 24th. Our adventure onto the Saharan platform began immediately south of Remada. The front of the platform is marked by wonderful isolated mesas capped by massive Gattar dolomites. The latter are up to 80m thick and underlain by red clays and yellow-white sandstones of Lower Cretaceous age.

A long drive southwards, took us to the completely isolated, legionnaire-type fort and prison of Béni Bouregba. White against a blue sky the fort stands high above the surrounding plateau. It is built on a residual fragment of a dolomite resting on red and mottled claystones of the Aleg Formation. We were now above the Gattar dolomites for the first time on the trip.

Driving south there is an almost imperceptible climb up-succesion from Turonian to Upper Maastrichtian. Standing on the highest scarps it was possible to discern extraordinary ring structures, circular to elliptical folds either synform or antiform, and of problematic origin. They have been interpreted as possible giant tepee structures and even impact craters; typically they are 85-125m in diameter.

Our arrival at our desert camp revealed a number of surprises, as the superb facilities provided by CGG included 2-4 person tents, a truck mounted kitchen, toilets, showers and a terrific staff. Our dinner table (with wine) was waiting for us, laid out under floodlights. Beyond, the desert stretched away into the night - unforgettable.

During our four days in the desert we followed numerous tracks and seismic lines, visiting structures such as the Sanhra antline, the odd isolated nodding donkey or major oil field, and studied various types of superficial deposits including dunes, gravel plains, recent fluvial sands, and crust, a recent semi-lithified to indurated breccio-conglomerate.

At one locality a gully cut into alternating limestones and shales yielded hundreds of superb quartz geodes. The nodular horizons marked the presence of precursor evaporitic nodules, most were of museum quality. The drive south was full of simply amazing geology but eventually we reached our furthest point south in the country, with a spectacular view over the great sand sea, and a photo opportunity of our drivers standing in front.

One locality, at the edge of the sand sea, which for days had been held up before us like a carrot, Ross counting down the kilometres with the aid of his GPS, was particularly memorable. Fossil dunes locally stripped away revealed myriads of beautiful desert roses in situ. The site is that of a former playa lake, the site of early hominids. There is much evidence for early man, with lakeside dwellings and remains of fires. Many worked chert flakes and cores were found on the surface (perhaps 15 000 BP) and one member found an arrowhead.

Our final night in the desert was marred by huge sandstorms and the leaders opted for us to spend the night in a desert pumping station, an oasis of modest luxury in an inhospitable environment.
The drive north commenced the following day. There were beautiful views all round, with isolated hills in the Upper Limestones sitting on the ochreous beds. Late afternoon brought us to the remarkable oasis of Ksar Ghilane, a former Roman desert outpost. Hot springs bubble up feeding a small pool shaded by tamarisk trees, while date palms provide shelter for a variety of fruit trees and vegetables. The journey was long and arduous with hour after hour of driving over and through a myriad of sand dunes.

Overnight, after the great drive, were spent in sheer luxury in Douz, a tourist town at the edge the desert. From there we drove northeastwards into the region of the Chotts and onto Chott Jerid, an immense salt lake of almost 5000 square kms. The absence of recent rain allowed us to walk over the surface to study the evaporites deposited under sabkha-type conditions noting the presence of well-developed salt polygons and the tepee structures.

At the end of causeway across the Chott, looking north, you observe a number of mountain ranges. The mountains in this region run W-E parallel to the margin of the Saharan platform. The ranges are cut by a number of fantastic gorges such as the one at Chebika, 16 kms south of Tamerza. Vertebrate fossils from Lower Eocene phosphates, Lutetian lamellichead limestones and a spectacular view of the Sononian/Palaeocene unconformity make this a memorable stop. The Tamerza region was made famous by the film 'The English Patient'. The Berber village was destroyed in a three-week period of torrential rains in 1969, and now the remains stand deserted, a remarkable 'ghost village'.

Around the oasis town of Tozeur steam from hot water, arsienes wells and their cooler systems are common sights. From Tozeur the final few days travelling back towards Tunis and the flight to London concentrated on several localities around Sbeitla and Kairouan. En route we crossed the line of the Gafsa Fault (WNN-ESE) and observed that the mountain ranges swing round to either a NNE-SSW or N-S alignment as we journeyed towards the north east. South of Sbeitla, on the southwest flank of Djebel Kebir, we stopped to study reefs of the Merfeg Formation (Campanian-Maestrichtian). These were built of spectacular rudists, large coral-like, aberrant lamellicheads including Hippurites and Vacitites.

Sbeitla, the Roman city of Sufetula, is still at the centre of a rich olive growing region. The Roman town is a stupendous site with magnificent remains, particularly the paved forum with its three temples and the Antonine Gate.

The mountains of the North-South Axis start just north of Sbeitla, the lack of vegetation helping the passing geologist to recognize a host of features including faults, folds and unconformities. Wadis and gullies cut west-east across the chain and at Fourn el Gueltla the palaeontologists amongst us became satiated and laden down with a huge variety of perfect ammonites, bivalves, gastropods and echinoids.

Over forty sites were visited in fourteen days and our last day ended in the area around El Houareb, where there has been extensive quarrying of the massive dolomites of the Jurassic Nara Formation. A fine roadside section here provided an appropriate background for a photograph of our two leaders.

Above: View west-north-westwards along the Chebika Gorges, on the eastern flank of the complexly folded Chebika-Negeb mountains. The rocks in the gorges are of Late Cretaceous-Lutetian age.

Below: Sites of special interest are now commonplace in the area of Tataouine and Chenini with several locations yielding wonderful samples of Early Cretaceous ferns, gingkos and other 'dinosaur food'. (Mebah el Asfer Fm)
MALLORCA - a field trip organised by the Reading Geological Society

A personal impression by John and Jo Crocker

To many people the name Mallorca conjures up images of beaches, big hotels and lots of tourists. Away from the sand and the sea the geology of the island is of great interest as we saw in the 7 day field trip organised by the Reading Geological Society. Each member of the group was allocated a half day to write what they had seen. These reports were assembled and published as a Special Proceedings of the Reading Geological Society. This article is our impressions of some of the highlights of the trip.

Thrusting
The Tramuntana mountains which form the north-west coast of Mallorca have been formed by thrusting from the south-east towards the north-east during Miocene times. This has produced a mountain range with extremely steep sea cliffs and few harbours. We stayed at the only sheltered harbour - Port de Soller. From a vantage point near the coast it is possible to see there thrusts and the associated Jurassic, Lias, Rhaetic and Keuper Marl beds.

Landslide
The huge Talat landslide is northeast of Port de Soller. This landslide is of the wedge type in which two major faults form an acute angle down which the rock slips. From a path crossing this landslide it is possible to look down to the coast and see a promontory of the Muschelkalk, which underlies the whole area, covered by Miocene turbidite. This is seen more easily from the sea on the boat trip between Port de Soller and Sa Calobra. The Miocene turbidite is overlain by the various thrust blocks of Liassic limestone and Keuper beds. The Liassic limestone has broken off as large blocks which then slid down the underlying Keuper rather like icebergs calving. The blocks of Lias are now separated by rubble debris. The debris between fallen blocks can be used to date the landslide if organic material is incorporated in it. The island of S’Iletta just off the coast may in fact be a fallen block. Further along the path there is a fissure field in which the fissures in the ground are about a metre wide, 20 or more metres long and of unknown depth - perhaps as much as 100 metres. It is obvious that the whole area is unstable.

The cause of the landslide and its date are unknown. Possible causes could be increased lubrication by water in the past or perhaps earthquakes although there is no evidence of seismic activity in the area. The earthquake zone at present is further east on the fault zone between the Tramuntana highlands and the plain.

Figure 3: (below) Promontory of Muschelkalk with Miocene turbidite cover. A boulder of debris can be seen in the foreground.

Karst Landscape and Caves
Of course, with so much limestone - Lias, reef and Santanyí - and with a rainfall of 2000 mm/year in the northern mountains there is considerable dissolution of the limestone producing typical Karst features. Caves occur in all these limestones. Very large caves in the Lias, exposed in cross-section in the mountainous cliffs north of Soller, can be seen from the sea on the boat trip from Soller to Sa Calobra (highly recommended!). In the Tramuntana mountains above Sa Calobra and near the Monastery of Lluc, the limestone has been dissolved to produce spectacular Karst features including a karstic depression, a polje, about 1 km by 1.5 km surrounded on all sides by steep limestone walls while the vegetated base of this depression is Keuper. On a walk over the surface of the Liassic limestone small-scale features characteristic of Karst scenery can be seen. Small hollows called dolines are common and an assemblage of dolines can form a polje. Much fretting of the bare limestone rocks also produces fascinating scenery.

Figure 4: (below) An upright block of broken off lias with the rough ground of fallen rocks in the foreground.
Also in this area major faults in the Lias limestone have weathered to produce a steeply sided gorge - the Torrent de Pareis. Near the sea the gorge has walls with a 200 m vertical drop and is 50 m wide whereas further inland the walls reach 300m and in places they are only 5m apart! The seaward entrance to the gorge is best seen from the sea at Sa Calobra.

On the eastern coast at Cueva del Drach there is a commercial cave which is a fine example of an underground Kars system. The caves are near the sea hence the water table is controlled by the sea level. Stalactites which hang down into the lakes in the cave start to collect deposits on their sides at the water surface and these deposits grow into disc-shaped ridges. Sometimes there are several of these small ridges up the side of the stalactite indicating the differing positions of the fossil sea level. Using dating methods on these stalselites it is possible to work out the fluctuations of sea level over the past 2-3 million years.

Reef Exposures

A reef complex, containing spectacular corals (often up to half a metre in diameter) overlain by the Santanyi limestone, is exposed on both the south-east and south-west coast of the island. On the south coast of the island at Cala Pitià, in a cliff face it is possible to get right up close to these large corals, and admire their intricate structure with individual polyps of 4-5 mm. Near the centre of Palma, the capital, the huge stromatolites in the Santanyi limestone, can be seen in an easily accessible exposure (beside the road) at Porto Pi, a promontory on the coast. Some of the domes of these stromatolites have been measured as large as 15 m wide and 4 m high. On the south-east coast the reef is exposed as a wave cut platform with a cliff face of Santanyi limestone. It is therefore possible to see a cross-section through the various beds. The top bed containing oolites overlays the laminated stromatolite bed which in turn overlies a bed showing nodular systems which it has been suggested is due to mangrove roots - hence it is called the “Mangrove Unit”.

This excellent field trip was particularly fortunate in having Dr. Rosa Maria Mateos Ruiz (Director, Geological Survey of Mallorca) as a leader for three of the days and organising the leaders for the other days.

The above account is only a brief outline of the field trip. A full account is in the “Special Proceedings of the Reading Geological Society, Field Trip to Mallorca” which is available from the society.

An essential guide to accompany any field trip to Mallorca is the GA’s “A Field Excursion Guide to the Island of Mallorca” by H.C. Jenkyns, B.W. Sellwood and L. Pomar.”

Figure 7: (above) Torrent de Pareis seen from the sea.

Figure 8: (below) Stromatolites at Porto Pi.
PROPOSED GA DATABASE OF FIELD TRIP LEADERS

The Geologists' Association has recently re-issued its list of volunteer speakers who can be called on by societies and groups for their lecture programmes. In response to requests, it is now proposed to extend this resource by creating a database of volunteer field trip leaders. This will enable organisations to supplement their own list of contacts and, in particular, identify possible leaders from other regions or disciplines.

The creation of such a database relies on volunteers to come forward or for suggestions of possible volunteers who can be approached. We hope to include all types of field meetings - trips appropriate for beginners through to advanced, day trips or longer, mainland UK and overseas - in fact, anything that might appeal to budding geologists. Subjects could include soft rocks, hard rocks, fossil collecting, building stones, history of geology, even industrial archaeology for instance, providing it has a geological aspect.

Potential leaders will need to agree to their details being held on computer and issued to third parties. The Geologists' Association will manage the database and issue it on request. Of course, leaders will not be committed to fulfil all enquiries that arise from this list. If you are willing to be listed as a volunteer field meeting leader or know anybody who might be approachable, please contact Sarah Stafford, the GA Executive Secretary, at:

Geologists' Association
Burlington House
Piccadilly
London W1J 9DU
E-mail geolassoc@btinternet.com

DAVID BONE
Field Meetings Secretary

FIELD MEETING TO BUCKENAY FARM PIT, ALDERTON, SUFFOLK
SATURDAY 29 MARCH 2003
LEADER: Alan W Lane

Thirteen members attended a very successful visit to Buckenay Farm Pit on Saturday 29 March 2003. We were fortunate in having warm, sunny weather.

The Red Crag formation rests unconformably on older deposits including the Eocene (London Clay) and the Cretaceous (Chalk) and outcrops over a wide area in East Anglia from the Norfolk coast down to Walton-on-the-Naze in Essex. It consists of poorly sorted, cross-bedded medium to coarse-grained, shelly sands, which at outcrop are oxidised to a reddish-brown colour with ferruginous iron pan, which is well-developed in the Buckenay Farm pit. The old tripartite division of the Red Crag into Waltonian, Newbournian, and Butleyan has fallen into disuse and the Red Crag is nowadays divided into two members - the Pre-ludhamian Sizewell Member which is overlain by the Ludhamian Thorpness Member.

The Sizewell Member comprises up to 13m of grey-green glauconitic sands, inter-bedded with clays containing fine silt and sand laminae. The Thorpness Member, 20-30m thick, comprises coarsening cycles of fine to coarse-grained sands, containing cross-bedded sets 3-5m thick with a few bands of silty clay. A depositional depth of up to 25m is implied by these sedimentary structures, but the Red Crag also includes sediments which have drifted and deposited in banks, which were piled up near the shores of landlocked bays through the action of the prevalent easterly gales. Unlike the older Coralline Crag, the Red Crag contains cool-water species such as the extant bivalve Arctica islandica. Aragonitic fossils are usually preserved intact, and the mollusc-dominated fauna has a very different aspect to the bryozoan-dominated fauna of the Coralline Crag.

The party collected a wide range of Red Crag fossils, including several derived sharks' teeth from the London Clay formation.

The visit was by courtesy of Mr Peter Mann, the owner of the farm.

A. W. Lane

FROM THE LIBRARIAN

It is always an immense pleasure to open a package to find enclosed a donation to the Library. I have written about Malta before and three gems have come our way via the kindness of the authors.


This excellent and beautifully illustrated 169 page hardback describes the tectonic setting of the islands, the surface geology and rocks, faulting, caves, geomorphology and developments during the Quaternary. The text is clearly written with sections, diagrams and photographs on every page, nearly all of which are in colour, plus an extensive bibliography.

The same authors and publishers have also produced a complementary booklet entitled Geological itineraries in Malta & Gozo, ISBN 99909-0-319-0. The 64 pages, which would slip easily into a pocket, include a short introduction, six itineraries, and references for further reading. Again it is well illustrated with diagrams and coloured photographs.


Dr Maempel, a long-time GA member, has crowned his career in Maltese geology with the development of a modern exhibition at the Museum. His article explains the significance and importance of Ghar Dalam and conducts the reader through the new museum illustrated with excellent photographs.

However, publications do not have to be published to be of use to us. As the accompanying letter to the maps listed below said "The enclosed were gathered on my last visit to Australia and, rather than toss them away, I thought they might be of use in your library." Indeed yes, thank you.

Australia 1:1,000,000 geological map: Victoria. Reprinted 1993
Palaeozoic stratotectonic and structural map of Victoria. No scale but about 1:1,000,000. No date but post 1988.
Minerals of Victoria 1:1,000,000 1993
Our members are great travellers so remember while you might have polished off an area there are others keen to go and mapping for information.

ELAINE BIMPSON
Librarian

The past few months have been busy for Rockwatch. The club has been “on the road” at museums in Hertford, Gosport and Cambridge and at the British Geological Survey in Keyworth. Hundreds of youngsters have enjoyed a range of Rockwatch activities at these venues – making their own plaster casts of ammonites or trilobites, echinoids or brachiopods; producing 3-D masterpieces of Jurassic or Carboniferous landscapes; racing trilobites; making wax crayon fossil rubbings and seeing, at first-hand, just how geology impacts on the weekly shopping!

We’ve also discovered some astonishing young wordsmiths who have excelled at our word puzzles and games and who have put many an adult to shame!

At the Family Fun Day at the Sedgwick Museum in Cambridge, Dr. David Norman, the Director, delighted the audience with his talk “Working with Dinosaurs”. But I think that he, in turn, was delighted to discover that not one of his questions, posed to the mainly Rockwatch audience, fazed them, and all were answered by the children, who were rewarded with chocolates thrown to them by David! The event had a special significance for Rockwatch in that Sean McMahon, one of our members, has been involved in the refurbishment of the Oak Wing at the museum, making the displays more accessible to all visitors. I can recommend a visit to the museum and I’m delighted that the Rockwatch event brought in almost 450 visitors during the day – greatly enhancing the annual visitor total!

Our summer programme of field trips is ready for take-off and, according to our members, it is the field meetings that really excite them. And, of course, there is no better way to learn geology than to be out in the field, discovering for oneself the excitement of finding a fossil that has not seen the light of day for 50, 100 or more million years; of seeing structural relationships in the field or finding that near perfect mineral specimen. The field trips really are one of the strengths of Rockwatch. As well as one day events, our longer field meetings are being run again this year as they were so successful last year, but places are strictly limited – first come, first served.

To find out more about Rockwatch e-mail: rockwatchaga@btinternet.com or write to: Rockwatch at the GA, Burlington House, Piccadilly, LONDON W1J 0DU and you can visit our web-site site: www.rockwatch.org.uk

Susan Brown, Chairman.

Susanna van Rose showing a Rockwatcher how to make a 3-D geological map at the Sedgwick Museum.

Rockwatch at Hertford Museum casting fossils in plaster.
BOOK REVIEW

WHEN LIFE NEARLY DIED
Professor Michael J. Benton
Published by Thames and Hudson, 2002.
ISBN 0 500 05116 X £16.95

Michael Benton, Professor of Vertebrate Palaeontology and Head of the Department of Earth Sciences at the University of Bristol.

This book of some 300 pages is extremely hard to put down — only the occasional quotations from others slow you down. Nevertheless, the book gives you much to think about and is worthy of many hours of study. It is much more than a review of fossils and extinction — more a history of geology from the point of view of the development of life coupled with the story of evolving geological investigations and arguments.

Like Professor Benton I was taught uniformitarianism, but it is not obvious that the evidence for uniformitarianism comes about through repeated catastrophe — surely a life assemblage must have been brought to its untimely end by some catastrophe — at least it was catastrophic to those entombed.

This raises the question of the meaning of termic to me as 'the uninitiated' the demise represents an exomeration because of a particular process. Extinction may or may not come about because of the catastrophe. A corollary of this question is that, if we are talking about an exomeration occurring over a short period of time in geological terms, then there ought to be somewhere collections of faunal assemblages representing the event. Alternatively the event might be so catastrophic that even no death assemblage is left to be studied.

Professor Benton illustrates Phillips' diagram of the divisions of time — Palaeozoic — Mesozoic — Cainozoic — representing the diversity of life with the boundaries marking huge reductions in diversity and abundance. They also mark changes in the overall nature of faunas. However, the curve defining the reduction in species slopes down as the end of the preceding period is approached. Towards the end of the Palaeozoic clearly the faunas knew their time was coming. They jumped before they were pushed, before the time of mass extinction (or mass exomeration).

Should Phillips' diagram be redrawn to show a more abrupt change for example at the end of the Palaeozoic? The minima on the curve show a progressive increase in life with time, even at the 3 or 4 low points, with an even greater increase at the three main maximums. It would appear that we now have on this basis the greatest faunal diversity of all time for the Earth — despite the various exominations. Would the faunal assemblage have been even richer without the extinction? Is it not that there is a conservation of life that allows new species to develop in keeping with the changing conditions?

Much of the book deals with the controversy between uniformitarianism and catastrophism. Lyell's four principles are quoted in an interesting review. The first two principles Professor Benton accepts — the last two not. The first, the uniformity of law, the laws of nature are constant through time. Even gravity cannot change. However, it is not true that the Earth is in perpetual change in some respects. It changes in position with respect to the solar system, it changes in position with respect to the galaxy. Is it within the scope of uniformitarianism to believe that for nearly 5,000 million years the surface of the Earth has been unchanging in terms of the laws and processes that affect the surface? In 1969 I came across a paper by Steiner (1967 — see Issue 3 of this magazine) which showed that big G changes with the position of the Earth in the galaxy — with the galactic year and that this reflects many geological changes.

At the time I was privileged to dine with Professor Fred Hoyle and asked his opinion of this idea — that big G can change and that this will have effects on the Earth. His response was simple and straightforward — 'of course!'. The principles of relationships are defined and change is part of the relationships. How then does this fit with the maxima and minima in the demise of species, with the diagram given by JohnPhillips? The galactic year roughly corresponds with the cycles of Earth history, the beginning and end of the Palaeozoic and the end of the Mesozoic, each corresponding with the beginning of the galactic year. Perhaps there is a relationship between the position of the Earth in the Galactic year and the incidence of impacts from extraterrestrial sources — or even volcanic events.

Professor Benton gives a figure for the typical period of life of particular species. Each species tends to become extinct in a few million years. Might not the effect of galactic change, as well as global change, be to apply a constraint on the faunal assemblages determining the qualities that are beneficial? In chemistry Le Chatelier's law says that if a constraint is applied to a system, the system will change to minimise the effect of the constraint. Is this applicable to the relatively short-term changes that we see in the faunal assemblages?

On page 117 reference is made to melting of limestone and salt. What is the composition of this glass? Calcium carbonate would not produce, even if heated to very high temperature, a glass. It would be interesting to know how the glass is formed from the compositions mentioned. Later, there is a section on the statistics of extinction. Reading this I found myself in total disagreement with the interpretations with the description of the statistical relationships and the interpretation. In fact, it seemed to me that the statistical data could be better interpreted in the opposite sense, to show that all the supposed special maxima of extinction corresponding with catastrophe are not of the normal extinction range. The distributions are not Gaussian and particularly in more recent geological times are strongly asymmetrical. The occurrence therefore of a few sporadic large numbers of extinctions would be fully in keeping with the asymmetry of the distribution. I was thinking as I read this section of approaching Richard Howarth to ask for his expert opinion on these principles, but was then delighted to find that Professor Benton comes to the end of the section saying that the interpretation has in this case been seriously criticised by those with statistical expertise.

The book reviews the data relating to the elucidation of the marking of the beginning and end of the Permian. These chapters are engrossing and show how quickly geological thought and information can change. At a recent GA meeting, Professor Paul Wright showed the differences between complete faunal assemblages and the more usual imperfect records. Even where the form of fossils is moderately high, the full assemblage for that time was shown to be substantially different from the partial assemblage often found. It would therefore be interesting to know if there are places at the interfaces between the Permian and the Trias say, where the faunal assemblage is maximal and where it is clear that there is an abrupt and significant change in the assemblage.

As a reader who left palaeontological studies behind on graduation I found this book both stimulating and controversial and leading to much deliberation. It can be read quickly, but needs re-reading frequently and encourages the reader to delve into the quoted literature. I am sure that I have misunderstood some parts and look forward to Professor Benton's talk to the Association in December when hopefully he will also be able to sign copies of the book.

Bill French

Michael Benton will be lecturing to the Association on this topic at its Meeting - on 5th of December, 2003
Tickets will probably be needed - from Sarah Stafford at the GA office - and an announcement about this will be made in the next GA Magazine.

Comment from Professor Benton

Bill French poses many questions, and some of them so profound that I cannot begin to answer them. He suggested that after his review of my book, he would like a comment on any issues I’d like to highlight. I have nothing to say on ‘big G’ and ‘galactic years’. I am a humble palaeontologist and can only focus on fossils, rocks, ancient environments, and what these mean.

I do find the history of geological thought interesting, but more than that. In the case of mass extinctions, impacts, huge volcanic episodes and the like, it is clear to me that we have been profoundly constrained by the debates of the 1830s. Many historians of science have commented on Charles Lyell’s work, and the uniformitarianism vs. catastrophism debate. I recall being taught that uniformitarianism means everything happens slowly and calmly. A very British view of things perhaps – nothing too revolutionary or continental in that. When you re-read Cuvier though, he talks a great deal about ‘revolutions’, but this, in French, perhaps means something a little different from in English. Despite the propinquity at that time (1812) to the French Revolution, I think Cuvier’s ‘revolutions’ which happened every few centimetres through his rock successions (at every change from mudstone to lime-
BOOK REVIEWS

FOSSILS OF THE CHALK
Andrew B. Smith and David J. Batten


Since it was first published in 1989, as the second of an excellent series of guides produced by the Palaeontological Association, ‘The Fossils of the Chalk’ has proved very popular. Primarily intended for amateur geologists, the layout is very straightforward and is very easy to use. Edited by Andrew Smith, it had a short introduction to the chalk by Ellis Owen followed by a faunal guide covering most of the macrofossils likely to be found laid out in chapters of separate phyla, each dealt with by different experts in their field. Clear photographs of specimens, mostly from the Natural History Museum, are accompanied by a short description, stratigraphic range and distribution.

The expanded second edition of this guide follows much the same format as the first but with some changes. The introductory chapter has been greatly expanded by A. S. Gale and W. J. Kennedy to bring the reader up to date with the latest thinking on chalk. In its 25 pages it covers reasonably comprehensively the sedimentary environment in the chalk seas, including sections on the composition of chalk, rhythmity, Milankovitch cycles etc. (touching on climate change), bioturbation and trace fossils. It also includes sections on early diagenesis, hard ground formation and the nature of the sea bed and a discussion on the origin of flints. The different types of fossil preservation to be found are well covered.

Chalk stratigraphy is very well explained. Both biostratigraphy and lithostratigraphy are covered historically up to present day standards accepted by the BGS and others. Variations in the chalk facies and faunas across Britain during different stages are described with explanatory maps.

There is a list of further reading for anyone wanting to follow up any of the points raised in the introduction.

In the new edition, most chapters have been revised to some extent, some photographs improved and three new chapters added to cover corals, nautiloids and serpulid worms which were not included in the first edition.

I think the second edition is probably worth buying for the introduction alone. The revision and enlargement of the identification key to include 434 species in 67 plates is a bonus, which I feel makes it good value for money and well worth buying for the first time or updating your old copy.

Geoff Toye

MINERALS OF SCOTLAND – Past and Present” by Alec Livingstone.

This beautifully illustrated book detailing the minerals of Scotland is continuing the tradition of museum publishing on minerals of the British Isles. First came the Minerals of Cornwall and Devon in 1987, followed by the Minerals of Caldey Fells and then the Minerals of Wales. Now it is Scotland’s turn.

Alec Livingstone sets the context for his book with a very brief account of Scotland’s physiography. This is followed by the geological evolution of Scotland, illustrated with excellent colour maps and photographs. Readers are then treated to a comprehensive account of collectors and collections. It is here that one learns about the many Scottish scientists and collectors in the seventeenth and eighteenth centuries who were instrumental in the development of Scottish mineralogy. This section is well illustrated with many fine old photographs and prints of collectors and their catalogues and equipment and adds hugely to the interest and enjoyment of the reader. Some sixty collectors are profiled, including twelve contemporary ones. Livingstone peppers these accounts, and those of the minerals later in the book, with delicious vignettes, giving the reader a rare insight into the lives and times of the period.

So we are treated to a splendid mini-biography of Matthew Heddle, Doctor of Medicine, Professor of Chemistry, mineralogist and, in 1851, President of the Geological Society of Edinburgh, the same year that he graduated in medicine! As well as many other accomplishments, Heddle is justly famous for his treatise on The Minerals of Scotland, published in 1901, some four years after his death.

From this point onwards, the book concentrates on the minerals. Sixty one minerals native to Scotland are profiled, many beautifully photographed. Alec Livingstone’s knowledge of Scottish minerals and their mining history is clearly evidenced in this section. For example, we read here of the Hilderston silver mine: a mineral lease was taken out from the Crown by the owner of the ground, Sir Thomas Hamilton, in January 1607. Very shortly afterwards, a profit of £500 per month was recorded, with silver selling at 4s-6d per ounce (22.5p per ounce now money?). This was reported to the Privy Council and the King, James VI, immediately nationalised the mine which was taken over by the state in 1609! Then follows forty eight exquisite colour photographs of some common and unusual Scottish minerals, all with details of their provenance.

If there’s perhaps one omission, it is the lack of a separate section on Scottish mines. The information is in the book, but tucked away, arising where particular minerals have been mined in Scotland. Now, minerals mining in Scotland may not have been so high profile as, for example, in Cornwall and Devon, but this reader at least, would have found a chapter or two on the mines useful for context and history.

There are three appendices, meticulously compiled by the author. The first, a comprehensive glossary of the 552 known Scottish mineral species; the second dates the discovery of the 29 minerals originally discovered in Scotland from 1791 to 1987, and the third highlights 33 minerals (32 species) that are now listed in Appendix 1 that the author became aware of, between 1991-96. The book concludes with an extensive bibliography and reference section, so interested readers can readily forward their own researches.

This book is a must, for amateurs and professionals, not only for those who are interested in the history of Scottish mineralogy, but also in its practice. It is a useful reference book and an interesting read.

Susan Brown.

The Hoodoos of Alberta

A little while ago I had the pleasure of a guided tour of the geology of the Calgary part of the Rocky Mountains - shown round by local geologist Eddy Bell. One of the many spectacular features of the region are the Hoodoos of Willow Creek which is off the Red Deer River near East Coulee. These are described in a guide produced by the provincial Museum of Alberta (Mussieux and Nelson). They consist of erosional features on a scarp in the local Cretaceous. The columns are rather friable clayrock and sandstone of the Horseshoe Canyon Formation which was deposited in deltas and tidal flats. The caprocks are of the same lithologies but are strongly cemented by calcite. The columns stand on the brown marine shale of the Bearpaw Formation. Images of some of the Hoodoos are shown here (right) and on the front cover.

Bill French

In the following paragraphs the Editor reviews the forthcoming articles in the Proceedings of the Geologist’s Association vol. 114 part 1 and part 2 (2003)

The Editor has drawn up a comprehensive set of new Guidance notes for authors, set out as though it were itself a ‘paper’ as an additional aid. A great deal of emphasis has been placed on copyright requirements for authors who make use in their illustrations of material derived from British Geological Survey (BGS) and/or Ordnance Survey (OS) maps, as this often seems to be a cause of confusion. BGS and OS now have stringent, mandatory, requirements for the use of material derived from their maps and authors must take heed of these. Many of our contributors appear to be under the misapprehension that a map ‘redrawn after...’ is sufficient to get round copyright restrictions, but this is certainly not the case. As well as regular articles, the guidelines also cover: Short Communications, Comments (invited by the Editor on papers of particular interest), Field Meeting Reports, Correspondence, Essay Reviews (short book reviews now appear in GA) and Obituaries.

In The evolution of the River Medway, SE England, in the context of Quaternary palaeoclimate and the Palaeolithc occupation of NW Europe, David Bridgland produces his definitive account of a river which now forms one of the most important tributaries of the Thames. However, he believes that they were entirely separate during the Early Pleistocene, the Medway having been formed by the uplift of the Weald at a time when the London Basin was still a marine embayment. His paper describes in detail the subsequent evolution of the river system and the many terrace deposits, which now lie both within and beyond its present catchment. The lithostratigraphy and correlation of the terrace sequence are discussed in detail, taking into account their relationship to Palaeolithc sites.

Glaucolithic spherules bearing curious internal textures, such as spheres within spheres, in erosional troughs along the unconformable top of the marine Clifton Down Limestone (Lower Carboniferous) in a quarry near Bristol were first discovered by Anthony Kirkham in 1973. Their nature has long been enigmatic. In his paper, Glaucolithic spherules from the Triassic of the Bristol area, SW England: probable microtekite pseudomorphs, Kirkham describes the evidence, including the presence of shocked quartz in the interstitial sediments, which leads him to believe that the spherules represent the diagenetically-altered product of fall-out from a previously unrecognised (?Triassic) impact event, whose location is at present unknown.

Smaller-scale events are analysed in Alistair Curry and Ross Black’s study of the Structure, sedimentology and evolution of rockfall talus, Mynydd Du, south Wales. Their detailed sedimentological analysis of the rockfall talus sheets formed on the north-facing Old Red Sandstone escarpment of Black Mountain, supported by radiocarbon-dating of the paleosols, reveals a history of debris flow, slopewash deposits and the occasional development of peaty soils. These deposits reflect episodic, secondary reworking of rockfall debris since at least 4.8-4.4 cal ka BP. Their findings rule out the role of glacialic and aeolian origins for the fine fraction of the sediment and support models of talus evolution that stress the importance of mass transfer as well as rockfall deposition mechanisms.

In The ammonite biostratigraphy of the Lower Lias ‘Armatum Bed’ (Upper Sinemurian – Lower Plenishbachian) at St. Peter’s Field, Radstock, Somerset, three non-professional GA members, Murray Edmunds, Mark Varah and Alan Bentley, provide a definitive account of the ammonite fauna of the Armatum Bed. Although the Lias of Radstock has been examined by geologists for over 100 years, many of the exposures became unavailable, or fell into poor condition, as mining and quarrying in the region ceased. Recent temporary exposures have provided an opportunity for a detailed bed-by-bed study which, the authors believe, has provided a clearer view of the Armatum Bed than was available to Tutcher and Trueman in 1925. Because of the recent importance of biostratigraphical study of the Echioceras rarioctatum and Uptonia jamesoni Zones at other European sites, a biostratigraphical review of the Radstock deposits seemed desirable. The systematics of Apodocereas are discussed; three ammonite horizons, typified by A. trirnatum, A. hamiltoni and A. sparsinodum, have been recognised within the jamesoni Zone. The occurrence of a new species, Tetraspidoceas westfieldense, is also described. The authors’ copious illustrations are important in showing stratigraphically-collected examples of the Armatum Bed fauna for the first time.

Field Meetings: Johnathan Radley reports on the June 15-16, 2002 Field Meeting to study selected examples of the Triassic – Lower Jurassic succession of mid- and southern- Warwickshire and David Lloyd describes a visit, led by members of the Dorset GA Group, for members of the United Kingdom Offshore Operators Association to the first UK Natural World Heritage Site, established on the Dorset coastline in December 2001.

The life of GA Council Member (1999-2002) Roy Clarkson (1926-2002), a member of the Association since 1979, and a key member of the Lancashire GA Group for many years, is recalled in an obituary by Iain Williamson.


In New exposures of the Amphill Clay near Swindon, Wiltshire, and their significance within the succession of Oxfordian/Kimmeridgian boundary beds in southern England, John Wright describes the results of the first study of this Upper Oxfordian succession, and its ammonite fauna, since the beds were first exposed during the construction of the Great Western Railway through the area in the 1840s. Detailed comparisons are made between the succession at South Marston, near Swindon and those at Wootton Bassett, Westbury, and exposures on the Dorset coast at Ringstead bay and elsewhere. The ammonite fauna of the Marston Ironstone is described. It is shown that the sequence accumulated during a substantial late-Oxfordian transgressive episode.
Ammionite faunas are again to the fore in Roger Bristow’s contribution Notes on fossiliferous localities in the Gault between Leighton Buzzard, Bedford and Aylesbury, Buckinghamshire. This shows how much useful evidence can be obtained from material collected from brash in an area in which exposures are often obscured by drift deposits. Bristow establishes correlations with the detailed Gault stratigraphy previously established in pit exposures in the Leighton Buzzard area.

The first of a series of papers arising from the Association’s joint meeting with the History of Geology Specialist Group of the Geological Society ‘The Amateur in British Geology’ appear in this issue. Geoffrey Tresse describes the work of George Morton, Henry Beasley and Triassic footprint classification. Trackways found in Triassic rocks in Warwickshire and Cheshire in the 1830s were attributed by Richard Owen in 1842 to footprints made by rynchosaurs and labyrinthodont amphibians, respectively, and this view held sway throughout much of the 19th Century (although neither is now believed to be correct). This paper describes how in the years between 1895 and 1904 Morton (who worked most of his life as a painter and decorator) and Beasley (a bookseller), both amateur members of the Liverpool Geological Society, developed a more rational basis for classification of the footprints found in these Triassic rocks, now commemorated by the illustration of the ichnospecies Chiroteuthis storiformis on the Silver Medal of the Liverpool Geological Society. The following paper, by David Bone, recalls the life and work of his friend Edmund Martin Venables (1901-1990), amateur geologist and natural historian. Venables was first employed as a fruit and poultry farmer and later as a local museum curator and, as a part-time journalist for a local newspaper, he published over 2,500 articles on natural history. In a lifetime of collecting from, and investigation of, the Eocene London Clay where it is exposed (but only under favourable tidal conditions) along the Bognor Regis coastline, west Sussex, Venables documented the macro- and micro-fauna, thereby much refining what was known of the stratigraphy of these beds. He identified some 450 taxa, including several new forms (one genus of beetle and 14 species, including a bird, a fish, molluses, barnacles and seeds, were named after him) and donated some 14,000 specimens to the Natural History Museum, London, including an important collection of pyritised fossil beetles.

In the second of our occasional series of Essay Reviews, Jake Hancock discusses the book British Upper Cretaceous Stratigraphy by R.N. Mortimore, C.J. Wood and R.W. Gallowis (Joint Nature Conservation Committee, Peterborough, 2001). His review should be essential reading for anyone interested in this topic.

It has always been the policy of the PGA to publish obituaries of both non-professional and professional geologists, and the editor of the Proceedings welcomes all such contributions. However, we are now encouraging the submission of longer notices where such is required in order to do adequate justice to the scope of a subject’s life and work. It should not be forgotten that obituary notices are often invaluable sources of information for historians of science when researching a subject many years after their death. In this issue, we commemorate the lives of Professor Robert Miller Shackleton, 1909-2001 and his third wife Gwenviudd Margaret Peigi Wallace, 1941-2001 who, sadly, died only 13 days after her husband; and Roy Clarkson, 1926-2002, who played such a major role in the Lancashire Group of the GA, in notices by Bernard Leake, Ted Nield and Iain Williamson.

Jonathan Radley and David Lloyd report on field meetings held in June and September 2002, respectively, in The Triassic and Jurassic of Warwickshire: report of a 2002 Weekend Field Meeting, which looked at exposures at Southam Cement Works Quarry and Edgehill Quarry in southern Warwickshire and around the town of Warwick itself; and Dorset GA Group supports multi-national oil industry field excursion to Britain’s first Natural World Heritage Site, where the sites visited included the Wych Farm oil field near Corfe Castle, stone-quarries at Portland, the Bridport sands at Burton Bradstock and Kimmeridge Bay.

Because of current international interest in evidence for past impact-events (a conference on this topic was held in the USA this March), the editor decided to publish Anthony Kirkham’s paper Glauconitic spherules from the Triassic of the Bristol Area, SW England: probable microtekite pseudomorphs as rapidly as possible after receipt, and it appeared in the last issue (PGA 114, 11-21, 2003). The Invited comments by Billy Glass and Christian Koeberl on the paper appear here, together with Kirkham’s Rejoinder. Invited Comments by Mike Sambler, Gilbert Green and Desmond Donovan on the paper The Chalfield Oolite Formation (Bathonian, Middle Jurassic) and the Forest marble overstep in the South Cotswolds and the stratigraphical position of the Fairford Coral Bed (PGA 113, 139-152, 2002) by Reg Wyatt and Richard Cave also appear in this issue, together with the author’s Rejoinder. Both the Kirkham and the Wyatt & Cave papers are, for different reasons, controversial, and it is hoped that readers will find these discussions of interest.

Richard Howarth

Stepping back in time
Walks and events programme

A walks and events programme has now been published for the Dorset and East Devon Coast World Heritage Site covering the rest of 2003. There are over seventy walks and events on the geology, fossils and landscapes of the Dorset and East Devon World Heritage Coast. The walks range from exploring the coastal scenery and landscapes, to fossil collecting and quarrying for local stone.

Nearly 70% of the walks and events take place out of season, as this is the best time to explore many of the interests. The leaflet is available by sending a stamped, self addressed envelope marked ‘Walks and Events programme’ to the World Heritage Team, Dorset County Council, County Hall, Dorchester DT1 1XJ. Alternatively, the programme is available on the World Heritage web site at www.jurassiccoast.com.

Richard Edmonds,
(Earth Science Manager, World heritage Team)
Recently, clearance work has taken place to re-expose part of the classic coastal cliffs in Pegwell Bay, southwest of Ramsgate of the Isle of Thanet in Kent. The work, initiated by English Nature under their *Face Lift* programme, was organized by Thanet Council and used a local contractor. Kent RIGS Group also provided assistance. Interest is focused on three aspects of the degraded cliffs:

1. 0.9km stretch of Palaeocene sediments with overlying Pleistocene brickearth in cliffs below the car park at TR 350642
2. Palaeocene-Cretaceous unconformity at Redcliffe Point, TR 354644
3. adjacent Pleistocene filled channel.

Pegwell Bay has a long history of accretion and cliff abandonment. Whitaker (1872) refers to the cliffs as “much overgrown and hidden by fallen earth”. Rapid growth of scrub followed construction of the Hoverport in the 1970s. A further section was lost under the access road. In contrast, Redcliffe Point was actively eroded and the section there was “probably better exposed than for some time previously” (Ward 1977). However, siltation returned and currently the unconformity and channel are almost totally obscured.

Phase One has seen the removal of scrub and talus from three 30 metre sections below the car park.

This reveals at the top of the cliff up to 4 metres of brickearth (loess) which stands in a typically vertical face with rough prismatic jointing. Its upper metre or so is decalcified and reddish brown in colour, whilst the lower part is yellowish brown and calcareous. Here, one of the early investigations into loess took place, (Pitcher et al 1954). The deposit has recently been dated as Late Devensian, 15-18 ka (Parks and Rendell 1992). Its junction, with the underlying “Thanet Sands” is often marked by a line of small black flint pebbles, orientated by frost action. Together with the cliffs at Reculver, Pegwell Bay provides the international stratotype section for the Thanetian stage of the Palaeocene, although currently no GSSP, [Global Stratotype Section and Point] has been defined. The youngest sediments preserved are the Reculver Silts, a series of yellowish grey fine silty sands, with some drifts of comminuted bivalve shells. Various authors have commented on the lines of prominent doggers formed within the beds of clean fine sand. These appear to represent storm events.

At the base of the cleared sections, Pegwell Marls have been re-exposed for the first time in many years. These are dark greenish-grey marls with mica flakes and glauconite. Bivalves, such as the ubiquitous *Arctica morrisi* occur throughout, as do various foraminifera (Burrows and Holland 1896).

It is hoped that Phase Two will begin later this year with further clearance in the Lower Pegwell Marls, including the “Black Band” of Burrows and Holland (1896) with its “abundant foraminifera” and then enhance the lowest sediments of the Palaeocene, the Stourmouth Clays and the Bullhead Bed at Redcliffe Point.

The Bullhead Bed of solution-pitted, green-coated flints in a sandy marl matrix, marks the famous Palaeocene/Cretaceous unconformity. Knox (1979) has shown that originally the flints were set in a montmorillonite clay derived from scoria of at least the upper bed is from the same origin. He suggests a possible origin in the Hebridean Volcanic province. Below the unconformity, soft white Upper Chalk of the *Marinepis testudinaria* zone is currently almost totally obscured. At the north-east end of the unconformity, the chalk becomes increasingly shattercd as the filled channel is approached. In 1977 the 10th International Quaternary Association Congress visited the site and a diagram showing complex filling of the valley was produced for the field guide. It shows the valley to be steeper on its western side and filled with various gravels, chalk drift and loams with strong cryoturbation. Brickearth completes the fill in the south-west, but to the north-east a fossil soil dated at 6,123±7 b.c. is bounded upon it, but buried by hillwash, (Shepherd-Thorn and Wymer 1977). Currently much of this section is also obscured, but beyond, erosion cleans the famous white chalk cliffs of Thanet.

Phase Three, in keeping with the *Face Lift* programme, will be the erection of interpretation boards, so that the general public can experience some of the excitement felt by geologists who visit this classic site in Kent’s geology.

**Peter Golding**

References.


In Britain it would undoubtedly qualify as a Site of Special Scientific Interest, but it is much more than that. It is a natural, even national, monument illustrating geological processes that have affected the Lucerne region through Tertiary and Quaternary time. The Glacier Garden, virtually in the centre of Lucerne, Switzerland, a city noted for its high quality (and highly expensive) international musical festivals, oompah bands and overlooked by the majestic Mount Pilatus, not only comprises well-protected rock outcrops showing classic evidence of ice movement such as striated surfaces, glacial erratics and sub-glacial potholes, as much as 9.5 metres in depth and 8 metres in diameter, but also a museum with a range of geological displays.

The Garden is located on an old quarry, a sloping site cut into the fine grained Lucerne Sandstone of Miocene age, about 20 million years old, and laid down in a northern offshoot of the warm Tethyan seas. The sands, part of a thick piedmont molasse succession, were swept into the sea via deltas and consequently carry a wide range of shallow water marine and quasi-marine fossils plus drifted plant debris, such as sub-tropical palm and cinnamon leaves, and the remains of cypress and fig trees. Examples of all these are on display in the museum. Incidentally, the sandstone can be sculpted easily and near to the entrance to the Garden is an 1821 carving known as the Lion Monument, a splendid recumbent lion commemorating the death of 850 Swiss Guards who fell defending the residence of King Louis XVI in the Tuileries, Paris during the French Revolution of 1792. It is at this monument that you can see the effects of the late Miocene early Pliocene tilting of the sandstone to about 50 degrees to the north, a consequence of the last major phase of the Alpine upheaval.

But above all the Garden is noted for demonstrating some of the effects of the last major glaciation of the region between 15,000 and 20,000 years ago (Wurm; Weichselian Glacials). These are not necessarily unique in the world at large, nonetheless they are spectacular and a great draw for visitors including innumerable school parties. It is estimated that Lucerne was buried beneath an ice crust thickness of 800 metres at the time, the main glacier tongues moving roughly northwest away from crystalline massifs and nappes of the northern Alps. In the canopied part of the Garden, very effective in wet weather, the effects of the boulders and other ground morainic materials, especially sand, locked into the base of the glaciers is demonstrated by beautifully polished and north-south striated rock surfaces on which a range of well-rounded erratic blocks rest. The latter include siliceous and nodular limestones, granites and sandstones, some glauconitic some quartzitic, of Permian, Cretaceous and Tertiary age all transported from a southern hinterland. Erratics also occur at the bottom of the giant glacial potholes, which are undoubtedly the major attraction of the site. One erratic weighing over 6 tons was removed from a pothole in the mid-1870's.

The potholes were ascribed, in Medieval times, to the wild practices of witches and primeval giants, an attractive hypothesis but not quite in keeping with more recent scientific work, commencing in 1872 with their re-discovery during the excavations for the foundations of a house. Their origin is far from straightforward. Originally it was thought that they were created by melt waters at the base of the glacier scouring out irregular depressions in the softer parts of the bedrock, these then being progressively enlarged and deepened by the grinding activities of large boulders, somewhat similar to the situation along the rocky bottom of many present mountain streams. However, the size of the Lucerne potholes is such that a more sophisticated hypothesis was eventually arrived at based on the fact that subglacial melt waters, moving through tunnel-shaped channels, can flow at a much higher jet-like speed and pressure than in stream or river waters. The speed of transport of material in suspension and particularly in vortices within embryonic depressions thus created can reach as much as 200 km per hour (125 miles per hour). Hence, the erosive power of such is relatively high, especially as the waters are also usually very turbulent allowing more material to be carried in suspension than is the case with even the most powerful of streams and rivers. As a consequence, it is now considered that it is mainly morainic sand, released from melting ice and being swirled around in the depressions by the channelled jet flow, that scours out, sometimes quite quickly, the deep potholes. The movement of any morainic boulders which have inadvertently dropped into the holes is of minor importance they if anything, also being sand-blasted and progressively rounded and reduced in size. Their scouring activities appear to have been minimal.

Anyway, it is all there – rocks, fossils, minerals, geological models and maps plus interesting historical and topographical information about the Lucerne region and the Alps - awaiting your 2 to 3 hour visit, including a distinct pause for hot chocolate on the patio of the adjacent museum and souvenir shop.

Trevor Greensmith
Four new or revised guides are close to publication - Jersey (Channel Islands), The East Midlands published jointly with the East Midlands, Geological Society, Teneriffé, and The Geology of the D-day Landings in Normandy. Here, two are reviewed.

**JERSEY GUIDE**

Visiting the ancient site of Caesarea, a name to conjure with, does not sound too attractive a proposition at the present time. On the other hand, if the Caesarea we have in mind is located just across the English Channel and not in the eastern Mediterranean then that changes things more than somewhat. The Roman name for Jersey, the largest of the Channel Islands covering some 115 square kilometers, was Caesarea. This is just the preamble to introducing the considerably revised 2nd edition of the geological field guide to Jersey, which is No. 41 in the series. Jersey is well known for its flowers, tomatoes, fruit, cattle, World War 2 concrete defence works and mild maritime climate, but it is also noted for its splendid coastal scenery. Cliffs reaching a height of 148 metres along much of the coast with spectacular views whereas elsewhere there are rocky headlands and sandy bays (see picture below). Inland the island is largely a plateau mantled by superficial deposits such as loess and has deeply incised valleys.

It is along the wave swept coast, where the tidal range is considerable, that the bulk of the best clean exposures occur which the authors, Clive Bishop, David Keen, Stan Salmon and John Renouf, have concentrated on in compiling their detailed and well-illustrated itineraries, ten in all.

The rocks of Jersey have an affinity with those of Brittany and parts of Normandy and are predominantly igneous in character extending from coarse granular granites via diorites to gabbros (and variations on such) to volcanic rocks and dyke swarms. Working out the detailed relationships of these rocks, which came first etc, can be a very entertaining pastime on warm sunny days. Low grade metamorphic rocks also occur and then there is the amazing Rozel Conglomerate of Cambro-Ordovician age, a massive fan deposit. All of these rocks appear to be associated with a major episode of subduction and mountain building, known as the Cadomian Orogeny, over a period extending from 700 to 400 million years ago.

It is intriguing that later Palaeozoic, Mesozoic and Tertiary times are not represented on the island, though they are known on the adjacent mainland and at the bottom of the English Channel. So, the next deposits recognizable, are of Quaternary age and represented by patchily distributed fossil-bearing raised beaches, blown sand, loess, peat and loose reworked material known as head, a quarryman's term first used by De La Beche in 1839.

Ease of access from Britain and elsewhere, ease of access to the locations once you get there and with this guide in your hand, which includes a Glossary defining some of the trickier terms, there is no reason why you cannot have a fabulous time for a few days, or even longer, in at least one ancient Caesarea.


**THE HEART OF ENGLAND**

**East Midlands Guide**

By and large we all know what is meant when someone mentions the Midlands of England although we may not be too clear as to what the region encompasses geographically, physiographically or geologically. Travelling northwards up the M1 or A1 from London into the Midlands the scenery is not too inspiring until in the vicinity either of Leicester or Grantham where we perceive the craggy Precambrian outcrops in the vicinity of Charnwood or the scarps and dip topography of the Jurassic succession, exemplified by the Lincolnshire Limestone and the Middle Lias Marls on which Belvoir Castle is built. Nonetheless there is some very good and fascinating geology to be seen in several parts of the region and its peripheral areas. So, it is welcome news that the Geologists’ Association in collaboration with the East Midlands Geological Society are about to publish a field guide to the Geology of the East Midlands, No. 63 in the GA Guide Series.

The Geological History of the East Midlands and 11 detailed excursions are the work of several authors and the excursions extend stratigraphically from the re-exhumed inselberg landscape formed by the Precambrian Charnwood Forest with its structural, age and petrological complexities, through the highly fossiliferous Lower and Upper Carboniferous strata bounding the southeastern part of the Peak District National Park, including the mineralization, then onto the Permian Triassic deposits of Nottinghamshire, including a grand tour of Nottingham itself, the Liasic of the Vale of Belvoir and, finally, the gently dipping Middle Jurassic limestones, clays (cyclic in part), sands and ironstones of South Lincolnshire, Leicestershire and Northamptonshire. The last includes visits to the famous Clipsham quarry (shown above) and Ketton quarry in the vicinity of Stamford in Lincolnshire.

By the time you have sampled most of the localities you will begin to appreciate that there is much more to the geology of the rather flatish Midlands than there appears to be at first sight. A region sometimes said to be characterised by a monotonous succession of hedgerows, pastures, scattered farm houses and villages, and mantled by flood-plain and glacial deposits, is far from that beneath the skin, and this brand new geological field guide will show you why.

Trevor Greensmith
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