The Island of Elba
Pot Luck - Kensworth Quarry
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Southern Thailand Gas Chimneys
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C Neutral Field Trips?
The Geologists’ Association

The 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 2007 are £40.00, Associates £30.00, Joint Members £58.00, Students £18.00.

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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.

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NOTICE CONCERNING FIELD MEETINGS:
The Association now has a mobile phone for emergency communications concerning field meetings (UK only). If you have to cancel on the day, or are lost or late for the start of a field meeting, please call the GA mobile phone (07724133290). The mobile phone will only be switched on just before and during field meetings. (For routine enquiries, please call the Field Meetings Secretary on the usual number.)

Cover picture:

‘Red Hot and Runny’ part of the winning photograph by Jenny Forest from the Festival of Geology. The complete photograph can be seen on the back cover.
From the President
As we begin a new year, and the year that precedes our sesquicentenary in 2008, now is a good time to spread the word about the GA. It is somewhat ironic that at a time when concern about the Earth is never been higher (2008 is also the United Nations ‘Year of the Earth’), membership of many earth sciences societies, including the GA, is either level or declining.

One of the best things our members can do is to use every opportunity to tell people about the GA and to invite people to join. If you plan to visit a rock or mineral show, or if you attend an adult education class, do ask Sarah in the office to send you a bundle of GA flyers for distribution.

If you have the energy to run a stall on behalf of the GA at one of these events, then do please contact Sarah in good time, so we can arrange for posters and other things to be sent out.

In other news, we think the GA, with its office in London, is a monolithic enterprise that will carry on regardless. That isn’t the case, and we need constant renewal and new ideas in order to keep going. In particular, we must maintain our membership so we can continue our work of education and information.

Plans for the Sesquicentenary are moving forward apace. Firstly, we are co-sponsoring with the Geological Society of the ‘Local heroes’ initiative which runs throughout 2007 and into 2008. If you check the Local heroes website at <http://www.geolsoc.org.uk/template.cfm?name=Local_Heroes_Initiative>, you will find events every month this year, and in every corner of the country, from an event in Leicester in March to celebrate the discovery of Charnia and other Precambrian fossils to a field trip in Yorkshire in October to look at Yorkshire’s geology, a one-day symposium called ‘Time Lords’ in September in Edinburgh to celebrate the work of James Hutton and Arthur Holmes, and a session in Bristol in May on ‘how volcanoes work’. Do support events in your area, or if you have been contemplating offering an event, please contact Joe Cann through the web site as soon as possible.

The GA will be leading on at least four of these initiatives, and can see that the GA is either level or declining. It is somewhat ironic that at a time when concern about the Earth is never been higher (2008 is also the United Nations ‘Year of the Earth’), membership of many earth sciences societies, including the GA, is either level or declining.

Of course all our usual activities - lectures, field trips and publications - will continue as usual. I hope you support these initiatives, and can see that the GA isn’t dead yet!

Mike Benton
President

Report from Council
Since there is no Council Meeting in November (the November meeting is a Local Groups and Affiliated Societies meeting) this report covers the December Council meeting.

Much of the meeting was taken up in considering the future of the GA. The Treasurer explained the problems of Risk Assessment facing the Association especially of a financial nature. A series of actions was agreed to mitigate or meet these risks which include consideration of the web site, the location of lectures, where the Festival of Geology should be held, publications etc. This is an on-going discussion for Council, as reported in the last magazine. There was much discussion of the role of the Proceedings and how its profile could be enhanced in terms of content and impact. The breadth of the subjects that are covered in the Proceedings is one of its great assets and many members want to keep in touch with the progress in geology but there is always the importance of achieving ‘International Respectability’.

The Festival of Geology at University College was a great success with many people attending. There were many entries for the photographic competition (see front and back covers). These were considerably more displays and stands and there was a hum of activity in the Rockwatch area. The lectures were well received and the field trips were well supported. It was agreed by all Council members that congratulations were due, particularly to the organisers - Mrs Brown, Dr Kirk and Mrs Stafford but also to the people of the GA and UCL who had given so much.

In view of the success of the Festival, there were suggestions that a Festival should be held at UCL every year. It was agreed that the Festival at Liverpool should be the event for 2007 but the idea of having more than one Festival a year at different locations will be considered for the future.

All Council members agreed that the Web Site is important and it was agreed that the Curry Fund should be approached to pay for updating the site (the person doing it at present is a volunteer who fits it in when he can). As can be seen from the Curry Fund report below, this money was approved and the web site is currently being redeveloped.

John Crocke
Curry Fund Report on Page 23

ANNUAL DINNER
FRIDAY MAY 4 2007

The Annual Dinner will be held in the lower library at the Geological Society from 7.30 - 10.00 pm following the AGM and Presidents Address. The cost will be £30 per person and the dinner will consist of a hot buffet, two glasses of wine, and coffee.

Please send your booking to Sarah Stafford at the GA Office enclosing a cheque made payable to the Geologists’ Association. Please be sure to book by 27 April and indicate if you have any special dietary requirements. The number of places is limited.

The GA Magazine of the Geologists’ Association Vol. 6, No. 1, 2007
In Genghis Khan's Footsteps - the Geology of Mongolia

Dickson Cunningham
University of Leicester

Friday April 13 2007
Geological Society, Burlington House
Piccadilly, W1V 0JU at 6.00pm. tea at 5.30pm

Mongolia is a vast country three times the size of France with less than 3 million people. It is a land of beautiful sweeping landscapes, seasonal weather extremes, scattered nomadic families living a traditional lifestyle, and relatively unexplored, but fascinating geology. We have been working in Mongolia for 12 years in the Altai, Gobi Altai and Hangay Dome regions of the country as part of a long-term project examining the distant effects of the Indo-Eurasia collision, and processes of intracontinental mountain building and basin formation. In this presentation, I will show what it is like to carry out fieldwork in Mongolia and review what we have learned about its geological evolution.

Mongolia is within the Central Asian Orogenic Belt which is Earth's largest area of Phanerozoic continental growth. The crust in Mongolia is composed of a large number of basement terranes that accreted throughout the late Precambrian and Palaeozoic. The accretion history imparted a structural grain that has affected all subsequent phases of continental deformation. Following Palaeozoic crustal assembly, major rift episodes in the Jurassic-Cretaceous led to the formation of clastic basins famous for their dinosaur fossils. During the Late Cenozoic, much of Mongolia has been tectonically reactivated due to compressive stresses driven by India's collision with southern Asia over 2500 kms to the south. This reactivation is expressed by a large network of active faults with widespread earthquake activity. It has also led to the uplift of the geologically youthful Altai, Gobi Altai and Hangay mountain ranges.

The Altai and Gobi Altai mountains belong to a class of mountain ranges that has not been documented before and so they are especially interesting orogens to earth scientists. In addition, the basins of the Gobi Desert have a complex polyphase history involving crustal extension and transpression resulting in a complex crustal architecture with important implications for hydrocarbon prospectivity in the region. Mongolia has rich metallic mineral deposits which are now being actively explored. It also has vast groundwater reserves and industrial mineral resources. The country is still such a geological frontier region that even new volcanoes and meteorite impact craters have been discovered in recent years. There are very few continental regions left where geologists can make big first-order tectonic discoveries and so Mongolia is a very special place for field research.

The Mineralogy of Dangerous Minerals

G.T.R. Droop
University of Manchester

Friday March 2 2007
Geological Society, Burlington House
Piccadilly, W1V 0JU
at 6.00pm. tea at 5.30pm

Of course, some would say that the most dangerous mineral is that large chunk of galena teetering on the top shelf of the display cabinet, poised to plummet .... But I am taking ‘dangerous minerals’ to mean minerals that are potentially hazardous to human health on account of their own intrinsic physical or chemical properties. Defined thus, dangerous minerals can be put into three categories: (i) toxic minerals, (ii) radioactive minerals, and (iii) asbestiform minerals. In my talk, I shall review these three groups, concentrating on the mineralogy, formation and usefulness of the minerals rather than their effects on the human body. If my talk has a conclusion, it is that dangerous minerals have been, and continue to be, very useful to people.
The biggest mass extinction of all time: pareiasaurs, isotopes and Russian bureaucracy

Michael Benton
University of Bristol

Friday May 4 2007
Geological Society, Burlington House
Piccadilly, W1V 0JU at 6.00pm. tea at 5.30pm

Presidential Address

The end-Permian crisis marks the largest known mass extinction of life. It is estimated that some 50% of families died out, which scales to a loss of some 80-96% of species, in the marine realm. The figures were probably comparable for organisms on land, but they have not been adequately calculated. These levels of extinction are for the global record; studies on a local and regional scale tend to support the higher estimates of species-level extinction.

Less is known about the event on land, partly because there are not so many localities available, and partly because it is harder to date the terrestrial rocks. Until recently, palaeontologists had focussed on the Karoo Basin in South Africa for their studies, a famous source of abundant skeletons of fossil amphibians and reptiles. For ten years, we have been working on similar-aged deposits from Russia.

In the Proceedings

In the following paragraphs, the Editor reviews forthcoming articles in the Proceedings of the Geologists’ Association.

A variety of interesting papers dealing with subjects ranging from Cambrian trilobites to Holocene salt-marshes appear in the next issue of the Proceedings, 118 (2). As an eminent geologist, David Henry Keen (1947-2006) made a significant contribution to the Association and was Editor of the Proceedings for 14 years. His life is recorded in an obituary by S. Harrison.

The value of re-examining past work and the importance of reliable field data are illustrated in the paper by A W A Rushton, M Williams, D Siveter & V Berg-Madsen who have identified a new mid-Cambrian trilobite fauna from Shropshire. Their re-investigation of the Acrothelida prima Shale, which had been thought to be of Early Cambrian age, has identified a diverse Middle Cambrian trilobite fauna. This fauna contains species not previously recorded from Britain.

Records of ash falls are used by D C Ray in The correlation of Lower Wenlock Series (Silurian) K-bentonites from the Lower Hill Farm and Eastnor Park boreholes, Midland Platform, England. He concludes that these bentonites represent ash falls from a subduction related, volcanic source, probably lying within 250km of the boreholes (based on analyses of the mineralogy of the clays and phenocrysts of twenty bentonites). By using the characteristics of the bentonites he makes a time line correlation in the upper parts of the Woolhope and Buildwas Limestone formations.

The contentious debate about the age of the earliest lowland glaciation in Britain will be stimulated by a paper by A Read, M Godwin, C A Mills, C Juby, J R Lee, A P Palmer, I Candy & J Rose on Evidence for Middle Pleistocene temperate-climate high sea-level and lowland-scale glaciation, Chapel Hill, Norwich, UK. They describe a temporary exposure and put forward sedimentary and fossil evidence for a marine sequence between the Lowestoft Till and the Corton Till. In addition to demonstrating a non-glacial period between these two tills, the elevation of the marine sediments is used to argue for neotectonic uplift.

The Pleistocene - Holocene palaeogeographical evolution of the region between the Central Massif and the Pyrenees is described by J-P Larue in Drainage pattern modifications in the Aude Basin (France): tectonic and morphodynamic implications. Through analyses of the sediments and terrrace profiles Larue provides an interpretation of the tectonic influences on the history of river capture and palaeodrainage systems.

Part of the de-glacial history of the lower Tyne Valley is reconstructed by L Yorke, I C Fuller, A J Howard, and D Passmore in Preliminary investigations of outwash environments in the Tyne Valley: implications for Late Devensian (Dimplington) deglaciation. Analyses of the glacioluvial sediments in the Crawford Quarry and the surrounding landforms indicate that they were formed within a supra-glacial, rather than sub-glacial, environment.

J R Allen & S K Haslett discuss the relative roles of global-al regional and local influences on tidal salt-marsh deposition in The Holocene estuarine sequence at Redwick, Welsh Severn Estuary Levels, UK: the character and role of the silts. They have used analyses of the sediment texture and foraminiferal assemblages to characterise the 10m thick Wentlooge Formation and identify a sequence of six, unequal, transgressive-regressive cycles of silts that grade up into peats.

Discovering Dorothea. The Life of the Pioneering Fossil Hunter Dorothea Bate traces the life of an independent woman who worked closely with, and eventually for, the Natural History Museum, during most of the first half of the twentieth century. M R S Creese reviews Karolyn Shindler’s book in this issue of the Proceedings.

Peter Riches
The Island of Elba - A Geological Jewel

The Island of Elba is the largest of the Islands which comprise the Tuscan Archipelago, and the third largest in Italy, after Sicily and Sardinia (Figure 1). Lying around 10km from the west coast of Tuscany, Elba enjoys a warm mediterranean climate which attracts European visitors throughout the year. Rather surprisingly, Elba has yet to be discovered by British holidaymakers, but for those wishing to sample diverse landscapes, history, food, and of course geology, Elba can offer all of this and more. The best time to visit is off-season during April and May or September and October. Most people arrive on the Island using one of two car-ferries which run frequently every day. The ferries dock in Portoferraio, the capital town of Elba, and an excellent place from which to explore the surrounding area.

Elba is most well known for playing host to Napoleon Bonaparte after he was exiled from France by allied forces following his abdication at the Treaty of Fontainebleau. Napoleon only stayed on Elba for 10 months during 1814 and 1815, but in his diaries he enthused about the majestic sea cliffs, clean golden beaches and secretive inlets which continue to draw visitors today as they did then. Napoleon used his short stay on the Island to improve and modernise many aspects of Island life, including commerce, agriculture and infrastructure. Extraction of Elba’s most famous geological export, iron ore, was increased dramatically, and before he departed Napoleon laid plans to systematically exploit the Islands’ extensive mineral deposits (Figure 2). Elba’s mineral wealth has been realised since the Bronze age, and the ownership and politics of the island have been inextricably linked to the history of mining. Copper was exploited by Bronze age civilizations, but it is iron ore, first mined in large quantities by the Etruscans, which has proven most significant in the last several hundred years. In terms of mineral resources, Elba can be broadly subdivided in to two halves. The eastern side of Elba is rich in iron ore and skarn minerals, and much of the recent iron ore production came from mines around the town of Rio Marina, until activity ceased completely in the early 1980’s (Figure 3). In contrast, the western side of Elba is famous amongst collectors for its tourmaline-bearing pegmatites associated with the Capanne monzogranite pluton (Figure 4). Indeed, the Island is the type locality for 9 mineral species, including the tourmaline elbaite.

Outline Geology

It is now widely recognised that Elba represents a key link between the geology of Corsica and the Apennines of Italy. Its central position in the northern Tyrrhenian Sea means that it has experienced the effects of Cretaceous-Miocene compression and later post-orogenic extension; the present exposures and the complex tectonic history visible on Elba represent a microcosm of Italian geology.

In 1950 the famous Italian geologist Louis Trevisan, along with colleagues from Pisa, began to systematically map the whole Island, and they proposed a tectonic subdivision which is still accepted and widely used to this day. His groundbreaking mapping provided a framework for subsequent research on Elba, and has influenced all geologists who have worked on the Island since. He suggested that the geology of Elba should be split into 5 tectonic ‘complexes’, each with a different lithological character and affinity, and currently found as part of a west-dipping stack of thrust sheets formed during the late Cretaceous-early Miocene Apennine orogeny (Table 1).

Complexes I-III are at the base of the thrust pile and can be reliably correlated with sequences on the Tuscan mainland, whilst Complexes IV and V are found at the top of the thrust pile and have an oceanic (Ligurian) affinity. Spectacular folds related to thrusting are visible within all complexes on...
Elba. The main thrust faults that separate the complexes are poorly exposed and usually contain highly sheared units of serpentinite. Post-orogenic extension has profoundly modified the geology of Elba, firstly by the formation of normal faults which crosscut and displace the pre-existing stack of thrust sheets, and secondly by driving the generation of two extensive plutonic bodies, the Capanne pluton which dominates the western side of Elba, and the Porto Azzurro pluton which lies at shallow depths beneath the eastern side of Elba. To fully appreciate the diversity of geology exposed on Elba, a trip of several days is recommended. Below, some of the highlights are outlined.

Let’s take a tour...

Setting off from the capital town of Portoferraio, drive west along Elba’s main coastal road towards Marciana Marina (Figure 5). The slopes of Monte Capanne (1017m) are visible from many places on Elba and provide a dramatic backdrop to life on the Island. A walk to the top rewards visitors with excellent views of the whole Island and of the Italian mainland. Just through the town of Procchio lies the sheltered inlet of Spartaia Bay (2). The rocky coastal exposures in this area are the best place to investigate the highly deformed metamorphic aureole surrounding the Capanne pluton. Continuing west, the road climbs steeply at points and weaves through the villages of Poggio and Marciana, nestled on the sides of Monte Capanne. Eventually the road descends and reaches Sant Andrea which lies on the northern margin of the Capanne pluton (3). Here, ‘mingling’ of different igneous units has created an incredible alien landscape which is enjoyed by geologists and sunbathers alike. The coastal road around the west side of Elba clings to the steep slopes of Monte Capanne and, on a good day, affords spectacular views of Corsica. Around the margins of the Capanne pluton at various places, including Pomonte (4), a thin skin of metamorphic aureole clings to the slopes above the Tyrhenian Sea. Drive east through Marina Di Campo, possibly after stopping at the famous tourmaline-bearing pegmatite localities in San Ilario- and San Piero-in Campo. The central part of Elba is heavily forested, but the coast provides the opportunity to view Cretaceous and Eocene flysch units of Complex V and the stacked laccoliths composed of Portoferraio and San Martino quartz porphyry. At Punta Di Zuccale (5), the extensional history of the northern Tyrhenian Sea is revealed in dramatic exposures of the east-dipping Zuccale low-angle normal fault. Here, the Zuccale fault juxtaposes basement schists of Complex I in the footwall, against Cretaceous flysch of Complex V in

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<th>Complex</th>
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<tr>
<td>V</td>
<td>Sandstone and shale flysch</td>
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<td>Dolomites, Limestones</td>
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<td>Calc-schists, marbles, porphyroids</td>
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<td>I</td>
<td>Schists and granite sheets</td>
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Table 1) 5 tectonic complexes of Elba recognised by Louis Trevisan on Elba in the early 1950s

Figure 5) A geological tour of Elba. 1) The monzogranitic pluton of Monte Capanne dominates the western side of Elba. 2) Deformed metamorphic aureole at Spartaia Bay. 3) Magma mingling at Capo St Andrea. 4) Metamorphic aureole at Pomonte. 5) Zuccale Low-Angle Normal Fault at Punta Di Zuccale. 6) Footwall extension at Capo Blanco. 7) Radial Hedenbergite clusters in Rio Marina. 8) Castello del Volterraio sits on a ridge of radiolarites. 9) Complex folding in limestones near Cavo.
are intruded by a series of granitic sills and dykes related to the underlying Porto Azzurro pluton, and are cross-cut by numerous small normal faults. The north-east of Elba is famous for its iron ore mines, and on the coast at Rio Marina, pyrite and hematite are found in close association with magnificent clusters of hedenbergite, up to 30cm in diameter (7). Climbing west towards Cima Del Monte (516m), the 13th Century Castello del Volterraio is encountered. It sits on a ridge of finely bedded radiolarites, part of the ophiolitic Complex IV (8). The small village of Cavo is less frequented, but it is here that outcrops of Complex III provide a key link between the Island of Elba and the extensive limestone successions found on the Tuscan Mainland. On the coast around Capo Castello (9), complex folding within limestones and radiolarites attests to the earlier compressional history of the northern Tyrrhenian area. Return to Portoferraio for an ice-cream or a well-deserved glass of wine!

Although this report can only provide a small glimpse of the superb and diverse geology to be found on Elba, hopefully it may encourage you to think of Tuscany when planning your next excursion. If you do decide to take the plunge, I guarantee you will not be disappointed. Whilst on Elba, why not take a day or two to explore the outlying Tuscan Islands – Giglio, Gorgona, Montecristo – or sample some of the many sports which are on offer. Alternatively, there is always the option of relaxing on one of Elba’s countless golden beaches. Finally, I must extend my thanks to the Geologists’ Association for generously supporting my PhD fieldwork on Elba.

For an introduction to the geology of Elba, see:


Isola d’Elba, 1:30,000 hiking map, published by Kompass

Steven A.F. Smith

Steven Smith carried out fieldwork on the Island of Elba in summer 2006 as part of his PhD research at Durham University. He was supported by the Middlemass Fund of the Geologists Association, and here he reports on the spectacular and varied geology of Elba.
POT LUCK - KENSWORTH QUARRY
Saturday 25th November 2006

Fourteen members assembled in the Kensworth quarry car park on a very wet Saturday morning. Rather than brave the torrential rain, hailstones and thunder, we all took cover in the plant’s control room where Mick Oates our leader for the day outlined the local geology and showed us some of the fossils he has collected from the quarry over the past forty years.

Kensworth quarry is located near Dunstable and is the largest working chalk pit in the UK. It exposes a section ranging from the Miocene Turonian to the lowest part of the Coniacian (New Pit Chalk Formation and Lewes Nodular Chalk Formation). Much of the chalk here is relatively unfossiliferous but at the top of the uppermost working face is the Chalk Rock composite hardground which in places is extremely fossiliferous. It contains reworked chalk pebbles and abundant Thalassinoides burrows, some of which have never been infilled with sediment. Echinoids and sponges are the most abundant macrofossils in this unit although it has in the past yielded an important ammonite, bivalve, gastropod and bryozoan fauna, many of which were epifaunal.

As the rain continued to fall, Steve Whitten, the Process Controller then gave us a brief talk on the history of the quarry and its production methods. Kensworth opened in 1964 and has another 40 years of reserves at the current production rate of 1.5 million tonnes pa. The chalk is pulverised, mixed with water from the local sewerage farm and then piped as slurry to a cement works 57 miles away. The pipeline is on average 10” in diameter and operates at an initial pressure of 1500 psi. By the time the slurry its destination this pressure has fallen to near atmospheric. The pipeline is buried approximately 4’ deep and is regularly inspected to ensure its integrity. Despite its size the quarry is not visually intrusive as it is hidden by the surrounding chalk downs. Restoration is carefully controlled with the abandoned faces being graded and the sub soil and top soil replaced. There is an active programme of tree planting and many rare orchids have been successfully introduced. The local wildlife (badgers, deer etc) is also taken into account with a large pond (not a usual feature in chalk country!) having been constructed.

As the rain had eased a little, the party left the shelter of the control room and first examined a preserved face exposing the Chalk Rock near the entrance to the quarry. The Chalk Rock is noticeably harder than the underlying white Chalk and the talus slope yielded several good specimens of Micraster sp.

We then walked along the upper bench of the main workings and more Micraster sp and Echinocorys sp were found in fallen blocks of Chalk Rock. Simon Penn found the only Holaster planus, index species for this zone of the chalk. Specimens of Inoceramus sp were also common. Mike Smith found what he thought was a gastropod but which on further examination turned out to be the rare, helically coiled heteromorph ammonite Euobostrychooceras saxonnicum, to which Mick Oates added a small, normally-coiled Lewesiceras mantelli. By this time the weather had cleared and we were treated to bright sunshine for the rest of the afternoon.

These upper workings provide excellent exposures of large solution hollows. The infill of these hollows is generally a very dark red to brown (ie iron rich) clay containing both unabraded and rounded flints, with rarer quartz pebbles. These range in size from pebbles to large cobbles. The sides of the hollows are often lined with iron-rich hard pans. The exact age of these hollows is uncertain and Mick collected some unoxidised infill sediment for palynological examination.

Continued on page 10......
Change to survive - Some thoughts after the Local Groups and Affiliated Societies’ Meeting November 2 2006

The Working Party, which grew out of the meeting last year, felt that GA Council should have a member who was responsible for liaison between it and the Local Groups and our Affiliated Societies. As that ‘coordinator’, following this year’s meeting, here are some ‘points to ponder’.

The GA is not alone in ‘ageing’ and having falling membership, recruitment is a topic which concerns us all. In order to keep up the interest of existing members and to garner new ones, we must invigorate ourselves; continue and extend what we do well, and come up with new, and perhaps challenging ideas for the future. This will undoubtedly mean tackling things which we may find initially uncomfortable, because they are not ‘what we usually do’! ‘Change’ needs to be embraced as a benefit, think what it might do to help us continue and thrive in the 21st century, and expand from the London fastness.

We have already had two very vibrant ‘Reunions’, away from home base (Liverpool and Cardiff). This ‘circulation’ of the Festival, helps us to meet friends and members from parts of the country which we do not normally reach, as well as giving those Local Groups and Affiliates who normally don’t manage to get to the Festival when we hold it in London, a chance to be part of a super event. Generously, Liverpool has offered to host next year’s ‘Festival of Geology’, incorporating the Reunion. Other areas or groups could participate in the future, we need offers to set up 2010. Which other parts of the country would you like to visit for the Festival? Think of the field trips your area can offer in tandem with the main event! Do you as Local Groups and Affiliates feel that the annual meeting before the ‘Festival of Geology’ is a good thing? It is costly to run, and we only touch a fraction of the overall numbers. How would you feel about having the Local Groups and Affiliates meeting as part of that event? I would like to see us having a lecture after the Groups’ meeting, with a social event of some sort to follow on the Friday before the Festival. This I think could encourage some of the groups we don’t see at the meeting to come and join us.

The North Staffs Group held an immensely successful ticket only ‘distinguished visitor’ lecture, advertising well in advance and having a great evening with a packed house. It would be wonderful to build on that ‘template’, to celebrate our 150th anniversary year. Could groups in different parts of the country, with help from me and GA Council, organize similar lectures, even better, a whole day of lectures, or a lecture coupled with a geological event? Individual lectures may be ‘themed’ over the year, or target a specific area of interest or concern. We have many willing and interesting speakers to choose from, you only need to look at the GA Circular for ideas. I think if we aimed for 4 spread out over the year, linking up with neighbouring groups in order to spread the cost, the publicity, the enjoyment and interest. Could we have ‘open’ lectures, admission by ticket, which would encourage interest from the public in our science, as part of this programme? This may well help with the vexed matter of recruitment, if people come and find that we are a friendly bunch of people (refreshments help there), they may be encouraged to join us. It may also help to ‘activate’ the members we all know are there, but that we never see, especially if those members are individually targeted as part of the publicity drive!

One of the best things we can do is communicate more frequently between individuals, groups and societies. Exchange ideas, subjects for talks and lectures, leaders for field trips, enjoy publicizing your ideas and events, encourage groups which are in your part of the country to join you, it will give your events more of a ‘buzz’ and enlarge your group’s compass and interest, and even more to the point, your group will make new ‘geological’ friends. Use the GA Circular, to find out what new subjects are being aired. Check with the other groups whether they enjoyed their talk or trip, get their recommendations.

The GA Magazine is ‘your’ magazine. Possibly, we could have a Local Groups’ and Affiliates’ edition once a year, or, in this age of the digital camera, a Groups’ page in every issue. That way we would be able to see what everyone is doing, where they have been, how much they enjoyed it, or how much they suffered for their interest (we’ve all been soaked to the skin)! Pictures with captions from every group during the 150th Anniversary year would be a great target. It will only happen though, if you make it happen. Get in touch with the Editor, he is waiting for your contributions - just one picture would start the ball rolling!

I hope that putting these thoughts down on paper, will stimulate your interest, encourage outward thinking and thus benefit the GA as a whole. Do get in touch; I’ve already had at least one interesting idea about the Friday lectures, from a member who can’t possibly get to them! That is what we need, ideas and enthusiasm from you. If the Local Groups and the Affiliates are all vibrant and active, and participating in ideas with ‘change’ in mind; recruitment will be encouraged, and hence interest in our science. We may make mistakes, some things won’t succeed the first time, but we should learn from those experiences and in the words of J F Kennedy: ‘Change is the law of life. And those who look only to the past or present are certain to miss the future’. We are in danger of the latter, if we do not think over a broader canvas.

Diana M Smith
Local Groups and Affiliated Societies Liaison

Close up of an infilled solution hollow which may have formed along a joint or fault

Pot Luck continued....

We then descended to the second bench, This is cut in more regularly bedded grey chalk with prominent marl partings. It yielded a solitary Terebratulid brachiopod, but the party also admired a continuous layer of limonite-stained sponge which traversed the face and wondered the two marl and occasional flint seams which are reputed to be traceable to the European mainland.

With the light failing we made our way back to the car park where Mick was presented with the customary GA bottle of something. Our thanks to Mick for organising the access to the quarry (not easy when you're based in Kazakhstan!) and for improvements to this report, and to Steve Whitten for his assistance. Look out for details of next year’s Pot Luck.

Geoff Swann
The Geologists' Association’s photographic archives

For many years, at the Association’s Annual Reunions, G.A. members have enjoyed reliving past Field Meetings and seeing familiar and less familiar faces. The collection is, however, more extensive and of wider importance than it might at first appear, as only a selection can be shown. The first albums to be placed in the archives were six volumes begun in the 1920s. In an advertisement printed in The Proceedings, members were asked to lend their negatives for prints to be made, and these now consist of black and white images of excellent quality, showing geological exposures dating from 1894 to 1937 which were fully indexed and are arranged stratigraphically. These form a valuable record of geological sections of historic exposures long destroyed, and which are often otherwise not available to current researchers.

A set of nine volumes of photographs were later contributed by T.W. Reader, an expert photographer, who had attended every G.A. Field Meeting between 1907 and 1919. His photographs are again black and white images of excellent quality, and again show sections often lost today. He used a heavy plate camera and tripod, and was apparently always to be seen trailing behind the rest of the party, carrying his heavy equipment.

The albums which attract most interest at G.A. Reunions are the two volumes bequeathed by Miss M.S. Johnston. These were her own private record of field meetings she had attended between 1890 and 1937. Although not usually a photographer herself, she asked friends to send her copies of their pictures. These are invaluable because many of the photographs consist of groups of G.A. members, usually fully identified. On a number of occasions in recent years, I have been able to help researchers by supplying photographs of some G.A. members taken from some of these groups, where there is no other known portrait of the individual.

There are also a number of other smaller photographic albums showing foreign Field Meetings, and some other past members’ personal albums. These include photographs and a field notebook of Mr E.E.S. Brown, past Secretary of the Association, and albums of photographs from Rosalie N. Yeates and E.R. Martin.

The collection also includes a few other items not in albums. The Weald Research Group were very active in...
the 1920s and 1930s. Sixteen menus from their Annual Dinners from 1924 to 1939 survive, complete with the signatures of their eminent members. Another unusual item is a "geological ABC of North Cornwall", by W.A. McIntyre and T.W. Reader, containing photographs of the long Easter Field Meeting of 1914, linked together with rhyming couplets describing various incidents that had occurred during the week.

Since I became G.A. Photographic Archivist in 1955, I have worked on two new volumes. The first begins with portraits of eminent G.A. members from the end of the 19th century and the first half of the 20th. These are followed by photographs showing a number of G.A. Field Meetings of the 1920s, 1930s and 1940s. There is then a much more complete record of the 1950s and 1960s. Mr H.N. Wright attended many Field Meetings in the 1970s, 1980s and the first half of the 1990s, and regularly and diligently donated photographs of most of them. Since then, contributions have been disappointingly few, and the records are very incomplete, with only the occasional Field Meeting represented.

The second volume has plenty of remaining space for your photographs. So please look out your photographs of long past and recent field meetings to maintain our photographic record, which already goes back more than one hundred years. For each photograph, we need to know on which Field Meeting it was taken, the location, date and if possible the identity of as many visible people as possible. Please send them to me at the address below and they will be gratefully received.

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Marjorie W. Carreck
GA Archivist

Erratum:

The Fossel Fest 4 report in the last magazine was written by Neville Hollingsworth and not by Geoff Swann as reported.
Southern Thailand - coast to coast

Geologists in the middle of the last century sought to explain the complexities of Southeast Asian geology by waves of mountain-building extending concentrically outwards from the core of what they called Sundaland. The present semi-circle of deep-sea trenches, earthquakes and volcanoes around the Indian Ocean margin of this continental block seemed to fit neatly into this model.

We now know that the picture is more complex than that. The ‘sixties brought the theory of plate tectonics, and at the beginning of the ‘seventies the notion that Southeast Asia may have been a part of the former supercontinent, Gondwanaland, was put forward. Although the details of that early Nature paper were wrong, it prompted a re-examination of the region. We now know that Sundaland (still a convenient term) is actually made up of several smaller continental fragments, each with a different history but some (if not all) having once broken away from the margin of Gondwanaland and drifted to their present positions where they fused together in the Triassic. A geological transect from coast to coast across Southern Thailand provides a clear record of the history of one of these former Gondwana fragments.

The island of Phuket (pronounced Poo-ket) is a good place to start. The Upper Palaeozoic sediments here contain thick sequences of an unusual mudstone. This, the Phuket Group, is generally poorly bedded and scattered through it are pebbles, and even cobbles, which appear almost to have floated there (Fig.1). Beds of pebbles might be easy enough to explain, but pebbles apparently randomly scattered through the mudstone are puzzling. It is tempting to see these pebbly mudstones as being of glacial origin – after all, we know that parts of Gondwanaland suffered glaciation in the Late Palaeozoic. But other geologists are less sure, seeing the immense thickness of the Phuket Group and the apparent association with contemporaneous faults as indicating sub-marine mass-flow deposition.

Thailand is crossed by a series of North-South chains of granite plutons. Field evidence and radiometric dating indicates that most of the plutons were intruded in the Triassic, at the time the component micro-continents of Sundaland collided and fused together. The westernmost of these chains of plutons intrudes the Phuket Group but radiometric evidence suggests not a Triassic date of intrusion but Cretaceous. The question arises: is that Cretaceous date to be relied on, or are these granites Triassic like the rest, the radiometric clock having been reset perhaps by a heating event to give a spurious younger date? The west coast of Phuket is a good place to study this granite.

This coast was badly affected by the 2004 Boxing Day tsunami and many lives were lost. Some signs could still be seen nearly two years later: a destroyed coastal footpath along the granite shore, and in the resort town of Patong Beach areas the size of a football pitch where all that remains of former restaurants, bars and hotels are their concrete floor slabs.

Moving east through towering jungle-covered karst limestone mountains where monkeys can sometimes be seen, we cross the major Khlong Marui Fault which bounds the Phuket Terrane and coincides with the pronounced kink in the outline of Southern Thailand. Mylonite within the fault zone contains some fine examples of en echelon quartz veins which invite debate on the sense of movement of the fault – was it normal or reverse, dextral or sinistral (Fig.3)?

We have now left behind the apparently bottomless...
thickness of the Phuket Group, and the Palaeozoic succession has a more normal feel. The Lower Palaeozoic sediments are marine with a shelly fauna and the massive Satun Limestone forms another region of spectacular jungle-covered karst pinnacles (Fig.2); they are well exposed on the Andaman Sea island of Ko Tarutao (once a penal colony) which is reached by fast boat from the mainland. In the Devonian there was a change from shallow-marine to euxinic deep-marine conditions and the black carbonaceous shale above the Satun Limestone is locally rich in graptolites and the strange cone-shaped fossils called Tentaculites. The affinity of these fossils remains in doubt, but some workers consider them to be molluscs akin to nautiloids. Higher up the section shallower-water conditions returned and red shales with abundant bivalves give a Carboniferous age.

Although the typical Phuket Group is absent from this eastern part of the peninsula, there are nevertheless local occurrences of mudstone with scarce pebbles suspended in the fine-grained groundmass. They are of various lithologies and many of them are well-rounded. If it is hard to imagine them having been dropped from glaciers it is equally hard to see them as mass-flow deposits – a recipe perhaps for some lively debates at the outcrop!

Across much of Thailand the Permian contains a thick limestone unit called the Rat Buri Limestone. The tropical climate has resulted in karst scenery onshore and we saw it as we left Phuket. The sheer cliffs frequently have caves and grottos at their base and these are favourite sites for Buddhist shrines and sometimes immense golden images of the Buddha. Offshore the limestone forms clusters of islands which, because of the solution notch at sea level, appear to float on the sea surface. Leaving behind the sandy beaches and seafood restaurants of Krabi, a trip by long-tail boat from this laid-back resort allows a close inspection of these weird-shaped islands and the chance to look for fossil corals and brachiopods, and for snorkellers the pleasure of swimming among the teeming fish life of the present-day coral reefs.

A belt of low-lying Mesozoic rocks crosses the peninsula from north to south and rubber plantations blanket much of it – every house and cottage seems to have an old-fashioned mangle and a line of washing in its backyard, but in fact the mangle is for rolling the raw latex into sheets which are then hung out to cure before being sent away for further processing. Although the detailed palaeogeography of the Mesozoic has yet to be worked out it is clear that conditions were frequently non-marine. There are outcrops which in Britain we might mistake for the Keuper Marl and the Bunter Sandstone; elsewhere lagoonal deposits with coal seams, mudstones, sandstones and thin limestone beds have yielded Jurassic vertebrates including dinosaur remains; and bedding-planes crowded with oyster shells point to periodic marine transgressions.

In the vicinity of Krabi are outcrops of Cenozoic sediments which provide some insight into the habitat of the commercially important gas and oilfields beneath the Gulf of Thailand. Poorly consolidated sands and conglomerates with variegated clays predominate, but beds crammed with non-marine gastropods including Viviparus are a notable feature on the coast (Fig.4) and provide the area with one of its more unusual tourist attractions – look for signs saying “Gastropod Cemetery.” Lignite seams locally reach a thickness of many metres and are an important resource for power generation.

Our coast to coast traverse takes us over a second chain of granite mountains where attractive waterfalls draw the local people who enjoy bathing in the cool clear pools. For geologists there is the additional attraction of unweathered outcrops of coarse-grained hornblende granite with big feldspar phenocrysts, as well as country rock metamorphosed to hornfels.

The traverse ends at Songkhla on the Gulf of Thailand. A bronze mermaid reminiscent of Copenhagen sits atop an outcrop of hornfels and gazes out to sea (Fig.6), but
A bronze mermaid reminiscent of Copenhagen sits atop an outcrop of hornfels and gazes out to sea (Fig. 6), but for those who by now have seen enough rocks the town also boasts a museum. It is housed in a Chinese-style 19th Century villa with curving roofs which belonged to one of Songkla’s early worthies, and is well worth a visit before we catch the overnight sleeper train to sway our way back to Bangkok.

The Geologists’ Association Field Trip to Southern Thailand is planned to depart London on Wednesday 21st November 2007 and arrive back in London on Wednesday 4th December. It will be led by Dr Mike Ridd and it is hoped that Dr Assanees Meesook of the Thai Department of Mineral Resources will join part of the trip. Further details will appear in the Circular. Meanwhile, please register your interest with Sarah at the GA office.


The reconnaissance fieldwork on which this article is based was generously funded by BP

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BOOK REVIEW

A Pocket Guide to the London Clay exposed on the north shore of the Isle of Sheppey, Kent
by Adrian Rundle

I haven’t been to the Isle of Sheppey since I was a student, and that was many aeons ago. All that I remember is that it was grey, damp and windy, and there was a lot of mud. The lovely colour photograph on the front cover of this little Guide, showing a group of Rockwatchers, obviously enjoying themselves, with Adrian in the centre, on a gloriously sunny day, lays that particular memory to rest in no uncertain terms.

There is much to like about this Guide and it was good to see the fitting Dedication on Page 1 to Austin Lockwood, who did so much for Rockwatch, including running field trips to this very location. The general layout is straightforward, with sections on the London Clay Formation, London Clay fossils, and some of the different fossil groups. The section on Techniques was particularly worthwhile (although I’m not altogether sure how well my lady friends will appreciate my search for “a fine tea strainer and lady’s stocking material”), and the line drawings of fossils will undoubtedly assist in identification.

But there are some little niggles. The map of the north Sheppey coast, Figure 1, not only lacked a scale, which was important as its function was partly to aid location, but would have been more helpful with labelling of parts of the beach to visit. The caption to Figure 2, another map (also lacking a scale), showing the location of the Hampshire and London Basins, contains a typographical error; and presumably the shaded area denotes ‘London Clay’ - if so, why does it not include the north bank of the Orwell Estuary and coastal Suffolk as far north as Bawdsey, where there is at East Lane a good exposure? Apart from describing the London Clay as “...a monotonous grey clay...” and mentioning scattered bands of concretions, little or no mention is made of lithological variations, however small, or bedding characteristics, or explanations for the apparent uniformity given. And although some environmental conditions are mentioned in passing, it would have been nice to have had a page devoted solely to describing the environment in more detail and painting a sufficiently vivid picture of the conditions to stir and capture the minds of the young audience at whom this Guide is aimed.

Maybe I’m being pernickety, for this is, after all, a Pocket Guide. There is much to be admired about this, the first in what is hoped will be, a series of Guides (I understand locations in South Wales and East Anglia are being considered for the future). Adrian - and Rockwatch - are to be congratulated on producing a useful booklet, easy to use in the field, which at £3.50 for GA and RW members and £3.95 for non-members, is a snip and won’t make too much of a dent in the pocket money.

Roger Dixon
What are Gas Chimneys?

Introduction

Gas has been known to naturally seep from the Earth’s surface for centuries and more recently leaking gas has been identified in the subsurface on seismic sections. A considerable amount of work has been carried out on surface features such as pockmarks and mud volcanoes linked to gas seeps, but little attention has been paid to subsurface features. One of the most commonly detected gas seeps on seismic sections are seeps linked to the degassing of hydrocarbon reservoirs. The gas travels along sub-vertical pipes from the reservoir towards the surface and these features are known as ‘Gas Chimneys’. Although their presence, approximate size and shape are all reasonably well known, the processes and mechanisms responsible for their formation are still a matter of debate. My task when I began my PhD. research at Imperial College, London was to attempt to settle the debate using an integrated approach which combined seismic investigation with analogue modelling and field work.

Seismic Investigation

A gas chimney is the name used by the oil industry to describe subsurface leakages of gas from hydrocarbon accumulations. They appear on seismic sections as areas of poor data quality or push downs as gas absorbs the seismic wave energy. These zones of poor data quality which are attributed to leaking gas occur in a variety of shapes and sizes. They range from poorly defined, large irregular cloud shaped bodies (e.g. Fig 9. Løseth et al., 2003) to more obvious thin vertical structures (e.g. Fig 4. Løseth et al., 2003).

Seismic sections from Block 34/10 in the Northern North Sea show what has been interpreted to be a gas chimney lying above the Gullfaks South Field reservoir. Primary wave data from this zone is very weak or absent, and this is interpreted as being the result of the sediments being full of gas, i.e. gas absorbs seismic wave energy rather than reflecting it. This interpretation has been vindicated by wells drilled through this zone which confirm the presence of over pressured gas.

In addition to the usual, vertical seismic sections that are generated for seismic data it is also possible to generate horizontal sections. These horizontal slices are known as attribute maps and by generating a series of slices through the gas chimneys at different depths and by combining these with the vertical sections, the three dimensional geometry of the chimneys can be established. In the study area, numerous attribute maps have been made at various levels from the Base Cretaceous unconformity up through the Post-Jurassic sediments. Figure 1 shows an attribute map located between the Base Cretaceous and Top Balder horizons. The relatively-
undisturbed portions of the beds are coloured yellow and those which are gas charged and more disturbed (i.e. those with lower attribute values) are coloured pink and blue depending on the amount of gas they contain.

It can be seen from Fig. 1 that a gas chimney trending southeast-northwest occurs in the central and eastern portion of the map. This chimney is at least 5km long and 3km wide, though its actual size is likely to be bigger as it clearly extends beyond the edge of the data set. Part of a second neighbouring gas chimney can be seen to the west, on the western edge of the map and data set. Above the Top Balder horizon interval attribute mapping suggests the lateral extent of the gas chimney decreases and that it splits into at least two vertical columns.

The seismic images discussed above are not the only evidence of leaking gas from the Gullfaks South Field. A number of mounds and cones can be detected along the Top Mid-Miocene Hordaland Group reflectors (Fig 2). Overlying sediments onlap onto these features indicating they formed at the surface (i.e. the sediment/water interface) during this time. The mounds are typically in the region of 50m high and over a kilometre in diameter. They are thought to represent doming of the surface caused by gas-induced mud mobilisation within the underlying Hordaland Group. In contrast the cones tend to be a little taller but are only a few hundred metres wide. Vertically underneath these cones, are narrow columns of weak seismic signals bounded by truncated and discontinuous strong seismic reflectors, inclined at abnormally steep angles. Although the seismic data is not good, these columns can just about be seen to extend right down to, and through, the Top Balder horizon interval and material being brought up from depth to infill the pipe.

Liquid gelatin was poured into the models which were left to set. The gelatin was found to preferentially percolate through the parts of the layers disturbed by blow out activity leaving a cast of the chimney beneath the spot where bubbling occurred on the surface (Fig 4). Sections of the model reveal features which correlate with both seismic and field observations such as the arching of the layer boundaries over the point of failure and material being brought up from depth to infill the pipe.

The above has shown how field data combined with modelling has helped us improve our understanding of the formation of gas blow out pipes. However these are just one type of gas chimney imaged on seismic sections. Clearly different processes and mechanisms are likely to have formed chimneys with obvious different characteristics such as large gas clouds. Thus more detailed investigation is required into different types of chimneys before these seismic features are truly understood.

With thanks to Tove Midtun for drawing figure 3 and to Statoi for financial support.


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On Friday Oct. 27, in the Senckenburg museum, we had seen excellent examples of the fantastically well-preserved fossils from the Messel Pit (Grube Messel) 20 km south East of Frankfurt (as reported in the last edition of the magazine). The next day, Dr. Wilde, of the Senckenburg Institute lead the group to the Messel Pit.

The pit was originally dug in 1859 for iron ore but in 1875 oil shale was discovered and mined until 1972. The oil shale contains ~40% water, 35% clay minerals (the most important one of which is smectite) and 25% organic substances. The organic part consists of kerogens (a hard bituminous substance) which come mainly from algae. About 8% of the shale could be liquefied by high temperature carbonization to produce crude oil which was very important to the economy of Germany during the two world wars.

The oil shale was deposited in a freshwater lake approximately 1km diameter during the warm period of the Middle Eocene (fig 1). The algae grew in large numbers near the surface of the lake. As dead algae and other organic remains fell to the bottom of the lake, decomposition used the oxygen leaving anaerobic conditions ideal for the preservation of animals and plants. Since there was little or no water movement their skeletons remained complete.

On microscopic examination, the oil shales are found to consist of alternating layers of light (clay minerals) and dark (organic) layers, the individual layers being known as 'varves'. Each pair of layers represents the deposition during one year. As the oil shale is approximately 190 m thick this means that the shale was deposited over 1.2 million years.

There has been controversy over the origin of the lake. Originally it was thought that the lake was the result of subsidence between the fracture zones of the Rhine rift valley (graben) but recent boreholes have revealed that the pit is the remnant of a filled-in caldera (Fig.2).

With the closure of the pit for oil production there were plans to construct a waste disposal site in the pit and there are still remnants of disposed material (fig.3). However a 20 year campaign by all the interested parties, resulted in the plan to construct a waste disposal site in the pit and there are still remnants of disposed material illegal by the State. In 1995, the site was designated a UNESCO World Heritage Site.

The Messel Pit became world famous because of the large number of well preserved and complete fossils found in the oil shale: e.g. feathers were found on birds,
stomach contents of animals and foetuses in pregnant females have been preserved. A remarkable diversity of species have been discovered - marsupials, insectivores, ant-eaters, primitive carnivores and many more. Probably the most famous of the Messel fossils is the primitive horse, *Propalaeotherium* (Fig. 4).

The main technique of finding fossils is to split the slabs with thin blades. When a fossil is found, especially a large one, great care is taken to avoid the shale drying out and cracking with the consequent fragmentation of the fossil. Once found, a large block of the shale is removed to the laboratory where it can be kept damp. For vertebrates, the shale on top of the fossil is carefully removed from around the fossil and when as much as possible is exposed, a number of layers of synthetic resin are poured on. The solidified resin can now support the fossil. The slab is then turned over and the underlying shale is removed to leave a free standing fossil. The fossils so exposed show remarkable detail.

We had seen the results of this careful preservation in the Senckenburg Museum the previous day such as the snake *Palaeopython* (Fig. 5). Other techniques involved replacing the water with glycerine and also X-raying the specimens to look at internal structures which may help later preparations.

The information centre at the Pit also had a display of fossils from the pit (Fig. 6) giving an indication of the whole incredible range of fossils found there.

Information on the fossils found is stored centrally and the Senckenberg Research Institute has set up a digital data base.

Later we, the group, went by coach and ferry across the Rhine to the town of Nierstein where we had lunch and sampled the wine for which the town is famous. Not only does Nierstein produce wine but it houses a treasure - the Palaeontological Museum - which houses the life-time collection of Arnulf Stapf and his son Harald. In it is an amazing collection of excellent fossils. An extended report on this museum will be in the next magazine.

**John Crocker**
The history of the Scunthorpe (Frodington) Ironstone

Eleven members met at the North Lincolnshire Museum in Scunthorpe on Saturday 10th June. Our host was Steve Thompson, Keeper of Natural Sciences at the museum and the theme for the day was the relationship between the industrial development of the town and its geology. We started with Steve giving an illustrated talk on the geology of this part of Lincolnshire and the history of the iron and steel industry in Scunthorpe.

The geology of Lincolnshire is relatively simple. All the rocks exposed are Mesozoic in age, ranging from Triassic to Cretaceous. They are more or less undeformed and flat lying, with a gentle dip to the east. The topography is generally low, the highest point in the county, at 168m, being Normanby Top, to the south of Caistor. The relief consists of three north-south trending ridges, formed (from west to east) by the Frodingham Ironstone (Lower Lias), the Lincolnshire Limestone (Middle Jurassic) and the Chalk. Of these, the Ironstone ridge is present only to the north of Scunthorpe, but the Middle Jurassic Lincoln Edge and the Chalk escarpment stretch right down through Lincolnshire.

Although the grain of the county, in terms of the major topographical features, runs from north to the south, the ridges are cut in a number of places, most notably at Ancaster, Lincoln and Barnetby, by gaps that represent the routes of rivers diverted in an easterly direction by glacial advance.

The rocks are mainly either limestones or mudstones, although there are a number of sandstone horizons, such as the Spilsby Sandstone. These have been valuable in the past as a source of building stone in a county where there is little such material. However, the Spilsby Sandstone is a poor building stone; it is poorly cemented and weathers easily. The Elsham Sandstone was also used as building stone in the north of the county. The limestones tend to form the higher ground in the county, the mudstones forming the vales, such as the Ancholme Vale. The River Ancholme forms a broad valley in the northern Lincolnshire, but this valley meets that of the River Witham, which broadens out to form the fens in the south of the county.

The Jurassic horizons thin greatly in the north of the county. During the Jurassic, there was uplift in the Market Weighton area, and the surrounding seas shallowed as they approached it. This resulted in a greatly condensed sequence in the north as compared to the south, a feature less obvious in the periods before and after. This activity was by no means uniform throughout time, and combined with sea level changes of a broader nature, gave rise to considerable variation in rock type, and substantial lateral variations, particularly noticeable in the Middle Jurassic. By the Cretaceous
there seems to have been much greater stability, and a relatively thin horizon, the red chalk is a prominent marker horizon from Yorkshire down to Norfolk, and also eastwards onto the continent.

The only rocks in Lincolnshire younger than Cretaceous are the glacial deposits. The county is covered by a variety of glacial sediments, and there are many glacial features to be seen, if sometimes rather subtle. The sequence of events is by no means well understood, and research continues at the present time.

The Frodingham Ironstone is Lower Jurassic Sinemurian in age (c 200 million years old). It is an ooidal and bioclastic ironstone with the iron occuring in the matrix of the rock as siderite (FeCO₃) and the clay mineral chamosite. The average iron content is c 23% so that it is a low grade ore, attempts to use it elsewhere in the area failed. The ironstone reaches a maximum thickness of 30’ in the Scunthorpe area.

Although the term mining has always been used, almost all of the iron ore has been produced by quarrying. The earliest mining is believed to have been carried out by the Romans at Thealby. The ironstone was then “rediscovered” in the 1850’s and mining took place around the local railway built to take the stone away. The workings moved outwards, first south and then north following the outcrop. The southern part is now covered by the steelworks. These early workings were by hand and workers known as Sanders and Chuckers stripped a bench 9 feet wide (plus a strip to work in). They used highly dangerous plank roads to access the benches and remove the ore. The ironstone was hand drilled and then blasted with black powder. Some mines were still being worked in this way into the 1930’s.

However, the first mechanisation came in the mid-1880’s and this meant that 30’ strips were needed for the mechanical diggers. This was too large an area to remove by hand so that mechanical stripping was also necessary. The volume of overburden was much more than that of the ore so the main changes were in the stripping operations. Grab cranes, then dredgers, shovels/transporters and finally drag-lines were used.

As the mines moved down dip so the volume of overburden increased. Eventually quarrying became uneconomic due to the cost of removing the overburden. In 1938 the first deep mine opened at Santon, 325’ below the surface. The Dragonby mine, 260’ deep opened in 1948. These mines used the pillar and stall method with the top 6’ of ironstone having to be left as roof because of the softness of the overlying shales. This meant that, at best, only 36% of the ore could be removed so that these mines were only ever marginally economic. The last deep mine closed 1981. The last quarrying was at Crosby Warren which itself closed in 1987. Many of the quarries are now filling up with domestic waste, much of which comes from Manchester.

After the talk members first examined a selection of typical local fossils from the museum’s reserve collections. Steve then took us on a behind-the-scenes tour of the museum’s facilities.

We then drove to abandoned Crosby Warren mine passing on the way the “nodding donkey” that marks the Crosby Warren oilfield. A single well currently produces c 40 barrels (c 6 tonnes) of oil per day from the Namurian Beacon Hill Flags at a depth of c 1600m. The oil is exported to the Immingham refinery. Gas is also produced with the oil and this is sold to the steelworks.

In the quarry we were met by David Elford, a former British Steel (now Corus) geologist who explained the geology exposed around us. Although it is being back filled and the faces are degrading the quarry still provides a good section above the Frodingham Ironstone – the Middle Lias Marlstone Rock, clays and the Pecten Bed ironstone. The main ironstone is no longer accessible.

We then drove to the “rock store” to finish off the day. This is a field where the local Council have put 25,000 tonnes of Frodingham Ironstone for educational purposes. Although it is now due to be “turned over” it still yielded many Gryphea sp, some nice specimens of the bivalve Cardinia sp and several ammonites.

Our thanks to Steve for organising the day’s activities and for supplying the material on which this report is based, to Corus for allowing us access to Crosby Warren and to David Elford for showing us around the quarry.

Geoff Swann
Every GA member recognizes the special value that geologists, be they either amateur or professional, attach to field-studies. Were this not so, the GA would not produce its excellent range of field guides. Today many of the most alluring locations for field excursions are abroad; the weather is more agreeable and no frills charter flights often cost less than domestic travel. But we live in an era of unsustainably rapid growth in leisure air travel, marketed at prices that fall far short of its environmental costs (RCEP, 2002). In its 1994 report *Transport and the Environment*, the Royal Commission on Environmental Pollution (RCEP) warned of the prospect of ‘irreversible damage to the Earth’s atmosphere from the growth of air transport, or at least serious and dangerous changes of a long-term nature’ (RCEP, 1994). The unconstrained growth of air travel thus threatens to degrade the climate we hand on to our children (see box), and it follows that every scientifically informed citizen in other words, every GA member has a responsibility to reflect on the environmental impact of air travel they undertake, and to minimize that impact. This means asking yourself two questions before flying:

(a) is my trip really justified? (if not, stay at home) and

(b) if it is, what can I do to mitigate the carbon emissions arising from the trip?

This responsibility also bears heavily on the authors of field guides that lure GA members to visit distant parts by air! When finalizing the GA Guide to Tenerife (2nd edition, December 2003), I wanted to include a paragraph inviting readers who visit the Canaries to ‘offset’ (as explained below) the carbon emissions associated with their flight to Tenerife and related motor travel. Unfortunately, my enlightened paragraph was excised by the Guides editor without a word of discussion. This article is my invited response. What spurred me to complete it (in early 2005) was an editorial in the eminent scientific journal *Nature* (Anon 2004), that highlighted the enormous volume of air travel associated with scientific conferences, urged the scientific community to offset the carbon emissions associated with their conference travel. When such a pillar of the scientific establishment urges carbon offsetting, perhaps we should all take note. What applies to the conference masses surely applies to the leisure fieldworker too.

What is ‘offsetting’? For the air traveller it entails calculating the total kilometres travelled on a return ticket and multiplying this distance by the CO₂ emitted per passenger kilometre (see box). Having established the CO₂ emissions associated with the trip, one can volunteer a monetary contribution (a self-imposed environmental ‘tax’) to finance activities that will prevent future emission of the same amount of carbon by investment in fossil fuelsaving measures, such as the construction of biodiesel plants in India. (The same principle of paying a voluntary charge to mitigate carbon emissions can of course be applied to other forms of transport and to domestic energy consumption too.)

As the *Nature* editorial observes, there is now an expanding international market in carbon-offsetting services. Some organisations target the increasing number of corporations whose public posture is to make their overall operations ‘carbon-neutral’ in this way. Others provide on-line CO₂ calculators for private individuals to calculate emissions from their various carbon-emitting activities, and contract to fund appropriate offsetting projects on the client’s behalf. This intriguing voluntary carbon economy is summarized on the National Geographic web site. At present the market is unregulated, and *Nature* advises clients to make appropriate enquiries before committing - who scrutinizes the projects the contributors pay for? ClimateCare is one UK provider (based in Oxford) that submits its projects to such auditing.

Simply calculating the carbon emissions associated with an air journey, however, underestimates the climate-change impact of the flight. The Royal Commission on Environmental Pollution found that the total radiative forcing of aviation (its overall contribution to climate change) is actually about three times that of the carbon dioxide emissions alone (RCEP 2002 p.36). Other studies suggest even this may be an underestimate (Lee et al., 2002). Indeed, if the true impact of climate change has been hidden by ‘global dimming’ as many now believe, the effects of aviation growth may prove to be even more damaging. The ethical offsetter may wish to adjust their CO₂ calculator entry accordingly (or they may prefer not to fly at all).

Some will argue that offsetting an individual’s air travel for a one-off trip to Tenerife is but a drop in the ocean. Indeed it is, and little progress of substance will be made until the 1944 Chicago Convention (prohibiting the taxing of aviation fuel) is superseded by a treaty more in tune with 21st-century reality. But for the individual, doing something sure beats doing nothing at all. The answer, it seems to me, is to tell your friends about it and get them to offset their holiday flights too, or better still to travel by train instead where that is practicable. What depresses me most is watching those who ought to know better (including some ‘environmental’ professionals) jetting all over the place without a care for the consequences. We in the West cannot remain in denial for ever about our individual role in climate change. Enrenced attitudes will change only when large numbers of us start to take environmental responsibility for our actions. Offsetting your overseas fieldtrip is an easy first step you can take in that direction.

Note added in press

Since the original article was written, more providers have entered the market, but they vary considerably in quality. The key things to check are the *additionality* of their products (does your money buy genuinely new carbon-saving activity, or are you being charged for an

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1 See www.ecobusinesslinks.co/carbon_offset_wind_credits_carbon_reduction.htm.

2 See for example www.climatecare.org/about_us/.

3 See for example www.cyberium.co.uk/carbonneutral.htm and www.carbonneutral.com.

4 See for example www.climatecare.org/about_us/.


6 www.bbc.co.uk/tn/vradio/programmes/horizon/dimming_prog_summary.shtml

7 http://environment.guardian.co.uk/travel/story/0,,1993377,00.html
activity that would happen anyway?) and external auditing for sustainability. The UK government plans to regulate offsetting providers in the UK. Cairns and Nelson (2006) provide an excellent up-to-date review of aviation carbon emissions.

References


N.B. Robin Gill was senior lecturer in geology and director of the MSc programme in Environmental Analysis and Assessment at Royal Holloway, University of London before opting to take early retirement

Editor's Comment. This is the opinion of the author. If you have any comments on this article please write to the Magazine Editor via the GA office.

The statistics of aviation growth and its CO2 emissions

According to the Civil Aviation Authority (CAA, 2001), passenger-kilometres flown from UK airports increased from 125 billion in 1990 to 260 billion in 2000. This growth rate seems set to continue and air traffic forecasts show passenger numbers at UK airports rising inexorably from 160 million in 1998 to 400 million in 2020' (RCEP, 2002).

The potential climate-change impact of air travel is expressed in terms of global 'radiative forcing' (IPCC, 1999 para 6.2.1). Aviation accounted for 3.5% of total anthropogenic radiative forcing in 1992 but, even allowing for the better fuel economy of present and future jets such as the Airbus 380, this percentage is projected to rise to 6-10% by 2050 (RCEP, 2002 para 3.41), so it will contribute increasingly to what Houghton (2004) calls 'the fact of human-induced-climate change'.

Fuel consumption and CO2 emission per km are higher for short-haul flights as a result of high consumption during take-off and fall to a minimum at one-way distances of around 4000 km and then rise again slowly, reflecting the weight of fuel carried early on that is needed to power the later stages of a long-haul flight (RCEP, 2002, Fig. 4-II). In the simplest terms, a typical emission rate for a short-haul-flight (up to 3000 km) in a modern passenger jet would be about 0.18 kg CO2 per passenger km, dropping to about 0.11 kg for a long-haul flight (>3000 km). A round trip from southern England to the Canaries, for example, would generate about 0.7 tonnes of CO2 for every passenger.

Curry Fund Report

The last Curry Fund meeting of 2006 received eight applications for funding. Six of these were funded, one deferred pending further information and one refused.

£500 was awarded to the Dry Stone Walling Association (DSWA) for updating and reprinting of its information leaflet. On a recent visit to Cuba, I noticed many dry stone walls there and it caused me to wonder if the DSWA has developed international connections. It might be interesting to do so, if it hasn't. The Scientific Exploration Society was awarded £1632 to enable the distinguished Mongolian, Professor Perle, to visit this country to present a series of seminars and meet dinosaur researchers in this country. I hope that his busy schedule will allow for a public lecture during his visit in February. The Welsh Stone Forum has been granted £602 towards the cost of publishing bilingual promotional leaflets about its work. The Time Team students from Cambridge University were awarded £500 to update their materials for their Science Week activities with local schools in March 2007. The Geologists' Association was granted £5,741 towards the cost of Field Guide production. £1000 was awarded to the Geologists' Association towards the cost of updating its web site. A decision of an application from Paul Kabrna for a book commemorating the work of John Milne as part of the Geological Society's, the GA's and the International Year of Planet Earth's Local Heroes celebrations was deferred pending further information. Finally, a request for funding a student field project was refused as it fell outside the remit of the Curry Fund Guidelines, but it was referred to three more appropriate funding bodies.

The Curry Fund supports many wide-ranging geological initiatives that would find difficulty in getting funding elsewhere and we are justly proud of that support, as I believe recipients are. Therefore it comes as something of a shock to read in geological publications of projects that have received financial support from the Curry Fund, but this support is not mentioned in the report. In many cases, it is clear that the project would never have been started without Curry Fund monies, in others, it could not have been completed. So, please, recipients, do remember to thank the Curry Fund for its support when you write your articles for publication!

Susan Brown, Curry Fund Secretary.
The winning photographs from the Festival of Geology photographic competition.

Above : First Prize - ‘Red hot and runny’ by Jenny Forest Formation of pahoehoe lava in a 1176 degree Centigrade flow from Pu’u O’o vent of Kilauea volcano.

Below : Second Prize - ‘Pebbles on the beach’ by Carol Gregory