GEOBROWSER

Charnwood bricks for Eurohub

One of the most valuable UK brick contracts of the year has been awarded to the Charnwood Forest Brick Company. A national search for suitable matching materials has led to their quarry being chosen to supply the almost 700,000 bricks needed to restore the world-famous edifices of St Pancras station, and adjoining Midland Grand Hotel (at present known as St Pancras Chambers). This highly prestigious project is part of a massive redevelopment of the St Pancras and King's Cross stations, which will become the principal London terminus for Eurostar trains. The relatively unassuming brick pit nestles against the northern slopes of Charnwood Forest, close to Shepshed, and exploits Triassic 'red beds' of the Mercia Mudstone Group, just above the Precambrian unconformity surface. An historic cycle involving the movement of bricks from Nottinghamshire and Leicestershire to London has now come full-circle. It started back in the late nineteenth century, when the Midland Railway network to London was completed with the opening of St Pancras station in 1868 (only three years after the plans had been accepted!). All that remained was the construction of the Midland Grand Hotel, for which the stunning brick Gothic revival design of the architect George Gilbert Scott was chosen. Spurning the more local Oxford Clay resource, most of the bricks were manufactured from Mercia mudstones, from pits such as that at Mapperley, as well as Tucker's brickworks, which is now part of the Charnwood Water recreational area on the outskirts of Loughborough. That particular pit was opened immediately adjacent to the Midland Railway (later the Great Central Railway) line, not only ensuring the rapid and easy transport of bricks to the building site, but perhaps also safeguarding for the future the unique importance of this local resource.

St Pancras station frontage

Glaciers can melt rock

A valley or ice-cap glacier evokes pictures of a frozen wasteland with temperatures only occasionally rising above freezing point to form meltwater streams along the ice front. But the bases of glaciers are commonly 'armoured' by rock fragments, which grind against the underlying rock to produce the grooved and striated surfaces frequently seen in recently glaciated regions. These processes involve very significant friction, and when friction is present, heat is generated. We cannot directly observe it for modern glaciers, but observations on the basal contact of Precambrian (Marinoan) tillites in Norway (*Journal of the Geological Society,* 2006, p.417) have shown that where in contact with glacially-embedded rock fragments, the bedrock has developed a cataclastic foliation, with individual quartz grains 'healed' or sutured together – a type of fabric indicative of either melting or instantaneous recrystallization. In fact, the temperatures estimated for these rapidly transient, high friction episodes are around 2200ºC, which is well above the melting point of silica at around 1 kbar pressure. Computer modelling shows how stresses at the base of a glacier 1 km thick can be suddenly released, resulting in movements of 13 metres over 40 seconds, sufficient to cause the 'flash' temperatures demonstrated by the rock fabrics. Such 'stick-slip' events are analogous to those responsible for generating tectonic earthquakes and indeed 'glacial earthquakes' are commonly observed phenomena around the margins of the modern Greenland ice-cap.

More insights on K-T boundary extinction

The 'Great Chicxulub Debate' and its role in causing the extinction of dinosaurs 65 million years ago continues, and for those interested there is now a special website, www.geolsoc.org.uk/Chicxulub. The latest work, reviewed in *Geoscientist* (May, 2006, p.16), was carried out on spherules, or fragments of melted rock, ejected from the Yucatan Peninsula impact crater and it shows that the Chicxulub impactor struck the planet some time before dinosaur extinction. Thus the famous layer enriched in cosmically-sourced iridium – and the current marker for the K-T (Cretaceous/Tertiary) boundary – actually occurs above the spherule layer attributed to the Chicxulub strike. All of this points to a protracted, multicausal scenario of events, as noted in *Geobrowser* for 2004, with these themes emerging:

1. The Chicxulub impact was certainly catastrophic and can now be linked in time to the extinction of the ammonites, although this all happened 300,000 years before the dinosaurs died out.
2. As reviewed in *Geobrowser 2004*, the Chicxulub strike probably did not cause a significantly long 'impact winter', nor globally extensive wildfires (*Journal of the Geological Society*, 2005, p.591). It

could nevertheless have resulted in acid rains and high global sulphur dioxide contents, sufficient perhaps to seriously alter sea-water chemistry, thus affecting marine creatures such as ammonites.

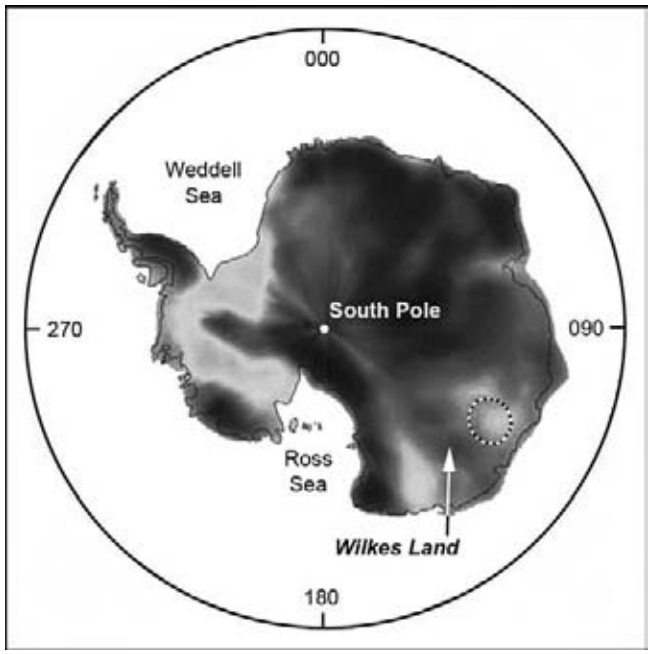
3. It now seems that the K-T boundary layer and the dinosaur death-beds probably do not reflect a single large impact, but point to a time when the Earth was passing through a layer of cosmic dust, laden with meteorites that broke up in the atmosphere and released iridium that was rained out and deposited in lakes and oceans. There is the intriguing possibility of other, as yet unknown, climatic consequences of this type of bombardment, which perhaps were exacerbated by the large amounts of carbon dioxide produced by the voluminous volcanic eruptions of that time (*Geobrowser*, 2001).

An even greater catastrophe

Theories implicating climatic factors, however caused, as the main trigger for mass extinctions have found support from a less well-known, but even more catastrophic episode than that defining the K-T boundary. About 250 million years ago, at the Permian-Triassic boundary, the biggest catastrophe to have affected the Earth killed off 96% of all marine creatures and 70% of land animals, possibly paving the way for the rise of the dinosaurs (*The Great Palaeozoic Crisis*; D H Erwin, Columbia University Press 1993). Up to now, little light has been thrown on the physical record of this event in terrestrial rock sequences, which are seldom greatly fossiliferous. However, these strata commonly contain fossil pollen, and a recent article in the *Journal of the Geological Society* (2005, p. 653) argues that pollen grains from two widely separated sequences straddling the Permian-Triassic boundary in China and Siberia show signs of stress. They exhibit significant defects, which could, it is argued, be attributable to the types of atmospheric pollution associated with acid rain and increased ultraviolet radiation. This in turn could be linked to voluminous basaltic eruptions that were occurring across Siberia and China at that time. The really big question, whether these effects were globally distributed, was not answered; however, a previous article (*Science, February 2005*), based on work done in the Karoo basin of South Africa, had presented evidence that the culprit for the end-Permian "Great Dying" was probably atmospheric warming due to greenhouse gas emissions from erupting volcanoes.

….And the world's largest impact?

The causes of the end-Permian disaster have been debated for some years, and as with the K-T boundary extinction a complex scenario of events has frequently been suggested - an unfortunate coincidence of several destructive factors such as volcanoes, climate change



Geophysical map of Antarctica showing crustal thickness based on gravity data, whereby dark equals thicker crust. The impact site in Wilkes Land shows as a pale area of thin crust, and the dotted circle traces the rim ridge mapped from radar profiles. (Image from Ohio State University)

caused by tectonic plate reorganizations and, perhaps inevitably, an asteroid impact. There has been little evidence for the extraterrestrial dimension to the problem, but this is set to change following the 'discovery' of a vast crater-like structure, possibly the 'scar' of a meteorite impact, concealed beneath the ice sheet in the Wilkes Land region of Antarctica (*New Scientist website*, 2006). This circular feature was revealed by a positive gravity anomaly on surveys by NASA satellites. It was then found to match a poorly defined circular ridge that could be seen on radar images of the rock surface beneath the ice. The feature is interpreted as a crater that overlies a post-impact upwelling of dense mantle material. It is estimated to be 500 km wide, and to have been caused by an impactor measuring 50 kilometres (30 miles) across, against which the Chicxulub body, with an estimated 9.5 km diameter, looks positively puny. So much for the hype, but there are still some serious points to be addressed: does the structure indeed have an impact origin or are other interpretations possible, and does the time of impact 'fit' that of the mass extinction? It seems unlikely that the researcher's wish to drill through the ice cap into this structure will readily be granted in such a region. Instead the evidence will probably have to come from studies of other less environmentally sensitive stratigraphical sections around the World. As some of these are already showing encouraging evidence for a discrete 'event layer', coinciding with the Permian-Triassic boundary extinction, we must expect many more articles, and much heated debate, in the forthcoming year.

Conservation of Nottingham's finest cave

The most spectacular of the many caves carved into the sandstone under Nottingham is Thomas Herbert's ornamental cave within The Park. Though rarely visited (as it lies beneath a private house) the life-size statues of "Daniel in the Lion's Den" are a treasured part of Nottingham's historical and geological heritage. They have however been suffering undue weathering, as their cave has open entrances in the hillside. Daily and seasonal changes in humidity and temperature break down the sandstone's weak clay cement, so that sand grains steadily fall away from the carved surfaces.

The features of the statues were slowly being lost, but the simple remedy was to build doors and shutters across the cave entrances, without damaging the rock structure. This was done, late in 2005, in a project funded entirely by the EMGS (appropriately enough, from income from sales of the Society's book, *Sandstone Caves of Nottingham*). This appears to have been very successful. Monitoring of the site is in progress, but preliminary results suggest that weathering of the cave walls has been reduced to less than 10% of its original decay rate; results will be reported in the next issue of *Mercian Geologist*.

Sandstone cave in Warwick

A cave carved into sandstone under Warwick is notably similar to the many that are well known under Nottingham. It was recently found beneath a public house, at the foot of a flight of stairs that reached deep enough to leave a solid rock roof over an almost traditional pub cellar, with barrel thralls along part of the walls. One section of roof is formed by masonry, but the rest is an almost flat surface cut in bedrock; masonry and brickwork of various structures and ages also form parts of the walls. The cave is cut into the Bromsgrove Sandstone Formation, slightly younger than the Nottingham Castle Sandstone, but also within the Sherwood Sandstone Group. It is a massive sandstone, buff and locally red in colour, with only widely spaced joints, and compares closely to the Nottingham rock as an ideal material for cave excavation.

Thank you to Patrick Mohan for this brief report.

Conservation of geological sites

The Department of the Environment, Food and Rural Affairs (Defra) has overall responsibility for the conservation of sites valuable to natural science and environmental diversity. It has now produced guidance to promote more transparent and consistent approaches in the operation of Local Sites systems across the country. This outlines the purposes of Local Sites systems, and proposes frameworks, standards and roles for their operation as well as for the selection, protection and management of the sites.

There are currently a number of different terms in use to describe sites of local importance, including Regionally Important Geological Sites (RIGS), and Defra recommends that the term Local Site should be used as a standard generic term, optionally distinguishing between Wildlife and Geological Sites.

Although no formal equivalent to Biodiversity Action Planning currently exists for geological sites, action for such sites is now being developed and promoted widely. Local Geodiversity Action Plans have been prepared in some areas, and these aim to set local objectives to deliver geological conservation that build on the nationally important Sites of Special Scientific Interest (SSSIs), the local RIGS and geology in the wider environment.

The Geological Conservation Review provides the documentation of the country's geological SSSIs. It has been developed for local application through the RIGS system, which also reflects the educational role of local geological sites. The Association of UKRIGS has produced a Field Record and Site Assessment form for recording site details for evaluation (available at www.ukrigs.org.uk).

Traditionally, partnerships supporting Local Sites systems have organised themselves in various ways. The new guidance draws together best practice from within existing systems. Its aim is to create a more consistent sense of the value and importance of Local Sites by securing broader awareness and support for their protection. The guidance is available on www.defra.gov.uk/wildlife-countryside/ewd/local-sites.pdf There are now more than 35,000 Local Sites in England, though geological sites are fewer than biological sites.

Geology Today

From its launch in 1985, *Geology Today* was intended to be the "popular" magazine for geologists both amateur and professional. Well illustrated and without heavy writing, it features up-to-date topics, explanatory series, overviews and locality reports. It was a great success for about 15 years, but then started to lose its edge. A new editor in 2003 generated its revival, and the magazine went into full colour printing at the start of 2006. It is now a really good geo-magazine. Published by Blackwells, along with their various academic journals, *Geology Today* does suffer from a rather high cover price. But starting in 2007, the subscription rate has been reduced for members of geological societies (including EMGS). Visit the website for subscriptions and for free downloads of various articles; "geology today" in Google (UK pages) is quicker than the cumbersome web address.

This may look a little like advertising, and the Editor of *Mercian Geologist* admits to being also on the Editorial Board of the magazine, but many members of EMGS could find the revamped *Geology Today* a very welcome resource of armchair geology.