CHARNIA

Franz Josef Glacier, South Island, New Zealand

The newsletter of the Geology Section (C) of the Leicester Literary & Philosophical Society

October 2010

www.charnia.org.uk

Editorial October 2010

The UK has absolutely splendid geology, we are all agreed, but apart from geomorphological processes and sedimentation in our seas and water bodies, the greater glories of actuo-geology (if I may be permitted to invent a new word) are largely denied to us. By actuo-geology I mean glaciers, plate boundary phenomena (i.e. volcanoes, earthquakes, thermally active areas), etc, actually doing their thing before our very eyes, now, as we witness it. The most recent UK volcanism, for example, took place 50-60 million years ago. However, the world being a wonderful place, if one is prepared to travel, almost any geological process can be seen happening right now. And nowhere, in my opinion, beats New Zealand for sheer breadth of experiences available to the geo-tourist. What this is leading up to of course, is an excuse for me to tell you about our holiday to NZ for the month of September. Joanne was to deliver a talk at a conference in Auckland, so we decided that if we were travelling all that way, we might as well stay for a month, hire a car and see as much as we could. We knew generally what to expect from background reading, but nothing prepared us for the sheer spectacle and thrill of standing in front of the Franz Josef Glacier (or the Fox Glacier for that matter) and getting an on-the-spot tutorial of exactly how glaciation works. To see U-shaped valleys in the course of formation, moraines being dumped, hanging valleys being created, outwash gravels and sands being deposited at my feet, was an awe-inspiring experience for any red-blooded geologist. Just the scale of it all is overwhelming, but then it is realised that this is only one little glacier in a shrinking field. I tried extrapolating it in mind's eye to a glacial landscape from horizon to horizon, and got just the merest glimpse of what the Pleistocene and other periods of global ice really meant.

From that cold world it was possible only a day or so later to experience quite the opposite, where it is heat and magma that drive the landscape. As everyone knows, a major plate boundary runs along the western side of the South Island and then dodges somewhat to the east of the North Island, and the interraction between the two plates is responsible for the creation of the Southern Alps and all the earthquake and volcanic activity. The volcanoes are largely quiescent these days, and significant eruption has almost ceased, but there is lots of other activity, particularly around Lake Taupo (itself a magnificent example of a crater lake on a vast scale) and Rotorua. You ain't heard nothin' until you've listened to the contented plooping and plopping of a bubbling mud pool. And to watch a geyser suddenly going off before your eyes, or see the wonderful multicoloured terraces created by mineral-rich steaming streams and springs, is a special experience.

But living near a plate boundary can have serious drawbacks, and we received a salutory lesson in just how vulnerable NZ is when we heard about the Christchurch earthquake as we woke on our second day in Auckland. The whole country was buzzing and wondering what it could do to help. 7.1 is quite an earthquake, but incredibly no-one was killed. It wasn't expected, at least not along the faultline whose movement was responsible, but aid was rapidly mobilised and the dedication of the aid-teams was remarkable. We arrived in Christchurch a week after the 'quake hit, expecting devastation everywhere, but the place appeared almost normal. That was deceptive, as much of the damage was not immediately obvious, being in the form of insidious but structurally significant cracking in superstructure, drains, sewers, etc. That's not to say there weren't any collapsed buildings, there were, but the pattern tended to be that vulnerable and old buildings were picked out for destruction, while all around, the majority remained standing.

As if the glaciers and plate tectonic landscapes weren't enough, there is seemingly an endless supply of other 'wow' scenery and geology, far too much to go into here. The west coast fjords for example and the wild almost deserted coast further north, or the untouched primeval forest that covers large areas, particularly in the wonderful South Island. Only 4.1 million people live in NZ, and 1.4 million of them in Auckland, so it is very easy to imagine you are the first person to set foot in some of these special landscapes. My favourite? Well, none of the obvious choices, but a very remote, bewildering and beguiling area known as the Rangipo Desert, north of Waiouru and south of Taupo. I'd never seen anywhere like it, it is crossed by only one road, State Highway 1, which is known there as the 'Desert Road'. The area consists of hundreds of square kilometres of plateau created by the activities of neighbouring volcanoes, completely empty and wild with a spectral beauty. Not a tree, just low scrub and barren volcanic soils for as far as the eye could see.

Turning briefly to other matters, the Section broke new ground, at least in our recent history, by having a field excursion in October. That wasn't as intended, but bad weather earlier in the summer meant that our trip to the Ancaster area had to be re-scheduled for October 9th. A report on the day will appear in the next Charnia, also one for the Bradley Fen trip in September.

Andrew Swift

Winter Programme 2010-2011

All talks begin at 7.30pm in Lecture Theatre 3, Ken Edwards Building, on the main University of Leicester campus, except where stated. Refreshments served from 7.00pm.
Details: Chairman Mark Evans, 0116 225 4904, mark.evans@leicester.gov.uk or Publicity Officer Joanne Norris, 0116 2833127, j.e.norris@ntlworld.com

2010

Wednesday October 20th
Dr Jeff Liston (Hunterian Museum, University of Glasgow): **Skullduggery: How big was Leedsichthys?**

Monday November 1st
Parent Body Lecture, New Walk Museum, Leicester.
Dr Hazel Rymer (Earth and Environmental Sciences Dept, Open University): **Predicting the next Icelandic ash eruption.**

Wednesday November 3rd
Dr Philip Wilby (British Geological Survey, Keyworth): **Diversity in the deep: new insights into the Ediacara biotas of Charnwood Forest.**

Wednesday November 17th
Tim Wright (Earth and Environment School, University of Leeds): **Fast and Furious: witnessing the birth of Africa's new ocean.**

Wednesday December 1st
Ken McNamara (Earth Sciences Dept, University of Cambridge): **Stromatolites: Microbes Making Rocks.**

Wednesday December 15th
Christmas Meeting, New Walk Museum, Leicester.

2011

Wednesday January 12th
Rob Sansom (Dept. of Geology, University of Leicester): **The impact of death on the tree of life: Experimental decomposition and the origin of vertebrates.**

Wednesday January 26th
Dr Sanjeev Gupta (Earth Science and Engineering Dept, Imperial College, London): **Catastrophic megaflooding in the English Channel and on Mars.**

Wednesday February 9th
TBC

Wednesday February 23rd
Members Evening, New Walk Museum, Leicester.

Wednesday March 9th
Prof. Peter Rawson (UCL, University of Hull and Scarborough Museums Trust): **From Yorkshire to Argentina: an ammonitologist's odyssey.**

Saturday March 19th
Annual Saturday Seminar, University of Leicester: **Theme**: Glaciers, Ice Ages and Climate.

Wednesday March 23rd
Annual General Meeting and Chairman's Address
Mark Evans (New Walk Museum, Leicester): **Some new plesiosaur discoveries.**

Winter Programme Abstracts

Wednesday October 20th

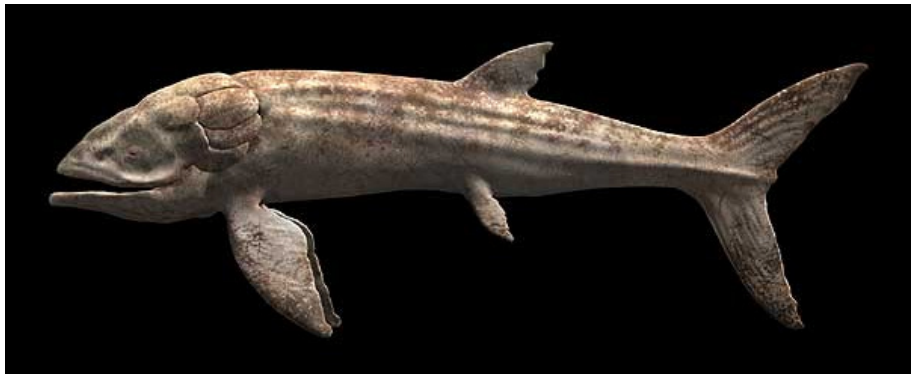
Skullduggery: how big was Leedsichthys?

Dr Jeff Liston (Hunterian Museum, University of Glasgow)

For as long as the fauna of the Oxford Clay sea has been known, the presence of the large suspension-feeding bony fish *Leedsichthys problematicus* served to distinguish this marine ecosystem from any other. Intriguing and cryptic fragments of the very large yet paradoxically thin bones of this animal, along with its occasional "rib-shaped" elements, have been emerging from Peterborough's clay brick pits for over 125 years. However, recent research has shown that although this fish represents the acme of osteichthyan suspension-feeders, it is but a single Middle Jurassic genus from a highly successful Family (the Pachycormidae) that straddled the Mesozoic Era as both carnivores and planktivores. But how does one define large size in an ecological sense, and determine what that figure might precisely be for a given specimen of this fish, when the animal always preserves poorly and in a disarticulated and fragmentary fashion?

This talk will explore what lies beneath earlier estimations of the size of *Leedsichthys*, indicating the new information that the 2002-2003 Star Pit (Whittlesey) dig to retrieve the specimen nicknamed "Ariston" revealed. It

will also show how knowledge of a simple parameter such as standard length can illuminate many other aspects of the ecology of an extinct fish, and compare it with other suspension feeders both extant and extinct to see how well *Leedsichthys* really measures up.



The big boy himself

Monday November 1st

Predicting the next Icelandic ash eruption

Dr Hazel Rymer, Dept of Earth & Environmental Sciences, The Open University

The recent, relatively minor ash eruption from Eyjafjallajökull volcano in Iceland served as a stark reminder that the UK is vulnerable to volcanic eruptions even though we have no active volcanoes in the British Isles. As the eruption progressed and the air travel ban played havoc with travellers and the daily business of millions of people worldwide, two key issues emerged. It became clear that better models for the pathway taken by ash from the erupting volcano towards the UK were needed and also a better understanding of the shallow 'plumbing system' of the volcanic area was needed. There was speculation, based on historical 'twinned' eruptions and interconnected faults and eruptive fissures that activity at Eyjafjallajökull and neighbouring Katla are linked. There are several other 'paired' volcanoes further north along the same active Icelandic Eastern Volcanic Zone. It may be that pressure changes from below at one of the volcanoes triggers activity at the other but we don't yet have any evidence that the same magma erupts from twinned volcanoes. What we do know though, is that activity in Iceland seems to be increasing, partly as a result of the release in pressure as the ice retreats. There are many active volcanoes in Iceland and strenuous efforts are made to monitor them and provide early warning of increased activity. In this talk I will present recent evidence for magma movements beneath Askja volcano in Central Iceland, which last erupted in 1961.

Wednesday November 3rd

Diversity in the deep: new insights into the Ediacara biotas of Charnwood Forest

Dr Phil Wilby, British Geological Survey, Keyworth

The late Neoproterozoic strata of Charnwood Forest have yielded the type specimens of several iconic Ediacara taxa, including *Charnia* and *Charniodiscus*, but the biotas have generally been considered of low diversity and abundance. A major new programme of moulding and casting by the BGS and Natural England – the largest attempted anywhere in the world – has led to the identification of over 1000 new specimens and at least 6 new species. These include a number of 'giant' forms as well as species previously considered endemic to the broadly coeval Mistaken Point formation of Newfoundland.

A high proportion of the fossils in Charnwood are preserved complete, with their discoidal holdfast, stalk and frond intact. Typically, all of the fossils on a bedding surface are mutually aligned, suggesting that each assemblage records a population that was killed *en masse* and preserved *in situ*. As such, they provide an opportunity to investigate every aspect of the structure and composition of these earliest deepwater communities.

Wednesday November 17th

Fast and furious: witnessing the birth of Africa's new ocean

Tim Wright, School of Earth and Environment, University of Leeds

During a violent week at the end of September 2005, the remote Afar desert was struck by a series of powerful earthquakes. Fissures opened that were wide enough to swallow camels, faults moved by several metres over night, and a volcanic eruption turned the sky black for three days. By examining satellite radar images of the area, we were able to show that a massive volcanic dyke was intruded into the upper 10 km of crust. The dyke stretched for 60 km along the boundary between the African (Nubian) and Arabian plates, which locally were forced apart by up to 10 metres. Enough magma was intruded into the dyke (2.5 cubic kilometres) to cover London and the

area within the M25 by a metre thick blanket of rock. I lead an international consortium that has been using modern geophysical, geological, and geochemical tools to monitor and investigate the area ever since (http://see.leeds.ac.uk/afar). I will show the latest results from our team, and specifically show how magma is playing a critical role in the break-up the African continent.

Wednesday December 1st

Stromatolites: microbes making rocks

Ken McNamara, Department of Earth Sciences, University of Cambridge

The earliest evidence of life on Earth are sedimentary structures found in Western Australia called stromatolites, with the oldest coming from rocks dated at about 3,460 million years. These stromatolites, consisting of simple conical domes constructed by microbial communities, are the beginning of a microbial evolutionary history that extends from deep in Archaean times to the present day. Not only is Western Australia home to these and a range of other Precambrian stromatolites, but it also has the most diverse range of modern stromatolites on Earth. In this talk I will discuss both the fossil and modern examples, and show not only how the modern ones are shedding light on the environments in which stromatolite-forming microbes have flourished for billions of years, but how they are sensitive indicators of environmental perturbations. I will also look at British examples of fossil stromatolites and show how the study of the modern forms can reveal much about the environments in which these fossil ones lived.

Field Excursion Reports

All written by Helen Jones

Isle of Wight
Friday 4th June – Sunday 6th June 2010

Fourteen members attended the weekend excursion to the Isle of Wight and we were promised a weekend of good weather, on this occasion the forecast did not disappoint.

For the 'early birds' the weekend started with a visit to the west coast of the island, Alum Bay and the Needles. This offered the opportunity to look at the massive chalk of the Headon Beds, offering a complete sequence of the uppermost part of the chalk group through to the late Palaeocene to late Eocene beds. The rocks at Alum Bay represent one of the most stratigraphically extensive Tertiary successions in western Europe. The Headon Beds pass through to the Reading Formation (London Clay), where *Pholadamya* was found, through to the Becton Sands, in all representing fifteen million years of geological time. Other finds in the Headon Hill beds included *Turritella* and *Potamides*. As we sat eating our sandwiches the azure sea glistened and the boats leaving from the small jetty brought the Greek islands to mind!

On the Saturday morning traverse photo Dave Haywood

The full group later convened at the Fernside Hotel, Sandown at 8pm for an introductory chat and handout, given by the Field Secretary, which outlined the itinerary. Saturday morning found us, bright and early, at the beach car park at Yaverland where we met our leader Steve Radforth, (IOW Museum) who gave us the pleasant news that in his view hard hats were not needed. We set off eastwards towards Culver Cliff. This stretch of coast from Yaverland to Whitecliff Bay offers an almost complete stratigraphy of the Cretaceous and we duly kicked off with the basal Wealdon beds comprising the Wessex and the Vectis members. The Wessex member represents a warm wet climate alternating with warm dry intervals during which the area was subjected to forest fires, charcoal and fossilised wood was in evidence. The Lower Greensand Beds include the Atherfield Clay Formation and the Ferruginous Sand Formation, the former displays clay draped ripples and the

latter repeated fining upwards cycles and trace fossils/infilled burrows representing the beds at the bottom of a shallow sea.

Passing through a red-brown sandstone, the Carstone we met the Gault Clays which represent a transition into deeper poorly oxygenated waters and finally the Upper Greensand. The chalk at this point becomes unstable and slippery and so we declined to scramble over this and made our way up one of many rotational landslips that litter the cliff face and took the coastal path to Culver Down.

No Comment! photo Dave Haywood

We lunched beneath the monument to Lord Yarborough and then continued along the path to Whitecliff Bay. The massive chalks that we encountered at Alum Bay were again in evidence and form the backbone of the island. In Whitecliff Bay evidence of folding is very evident, a monoclinal fold is represented by a steep limb of almost vertical beds. At this point the Reading Beds give way to the Thames Group, black lignite highlighting the ripple patterns. The Bagshot Sands follow and comprise both marine and estuarine deposits, giving an opportunity for collecting. The Bracklesham Group yielded the bivalve *Cordita* and the foraminifera *Nummulities*. Rotational slipping was again observed in the Barton Clay. The Bembridge Limestone represents a freshwater lake deposit and both *Galba* and *Planorbina* sp were found in significant quantities. Star finds were a shark's tooth from an erratic beach boulder on Whitecliff Bay and a vertebrae, possibly of a fish. It was a long hard slog back along the clifftop path broken only by panoramic views of Sandown and Shanklin.

Saturday evening found us back at Culver Hill, the restaurant offered a very good meal and panoramic views which as the coastal mist rolled in became quite atmospheric, the ships lights shining silently in the Channel like ghost vessels. Dennis Gamble thanked the Field Secretary, who in turn toasted the Section and absent friends. Members adjourned to the terrace and observed the ships moving through the English Channel on this balmy night.

On the coastal path on the Saturday photo Dave Haywood

Sunday dawned fair and we met at Shepherds Chine, dodged the bullets of a rifle club, and descended onto the shingle beach. The Perna Bed member of the Atherfield Clay (Lower Greensand) yielded many fossils including *Exogira*, a giant oyster found along with *Holocytes* and the brachiopod *Terebratula* in the boulders on the beach. The clay yielded some nodules of *Deshayesites* (ammonite), the stratigraphy became a little confused further into the Chine due to the large number of slips. However we were keen to find the Lobster Beds, the Lower Lobster beds yielding *Myeria*.

Members departed for ferries just after midday and those that remained had lunch on the beach and thanked the leader. After a brief sojourn in Cowes we returned to Leicester where the contrast in weather couldn't have been more marked, thunderstorms and heavy downpours, our memories an island dream!

Evening Excursion to Tilton Railway Cutting
Tuesday 22nd June 2010

The mid-summer evening field trip attracted some 28 members and friends including two children and a dog! Our leader for the evening was Dr Roy Clements ably assisted by Jan, his wife and his mellifluous tones introduced us to the geological background of the immediate area. The cutting represents a younging upwards sequence of Lower Jurassic rocks of the Lias Group. The sequence begins at the silty/sandy mudstones of the Dyrham Formation, runs through the whole of the Marlstone Rock Formation (successively its Sandstone and Ironstone members, ending with the bottom few metres of the Whitby Mudstone Formation, now covered by boulder clay at the surface).

Before we started Dr Clements identified two local inliers of younger rocks at Whatborough Hill and Robin-a-Tiptoe Hill. Currently the cutting is an SSI, managed by the Leicestershire and Rutland Wildlife Trust, and we were asked not to hammer the face, only the fallen debris. Fortunately the faces had been recently cleared of vegetation by volunteers and this enabled us to examine the Dyrham Formation, the ammonite A*maltheus* was found. Approximately a metre above an irregular pebble bed forms the base of the Marlstone Rock Formation.

The large turnout for Tilton photo Ron Johnson

But it was the shell band, the Sandstone Member, which attracted most interest with members finding the brachiopods *Tetrarhynchia tetraedra* and *Lobothyris punctata,* many of which were found along with belemnites. The Ironstone Member yielded cross-bedded bands of crinoid debris. As we moved along the cutting using the walkway members found the ammonites *Dactyloceras* and the eponymous *Tiltonicerous* in the weathered zone at the top of the ironstone. Finally in the mudstones of the Whitby Mudstone Formation members were able to collect harpoceratids and dactylioceratids.

It was at this point, approximately 8.45 pm with the natural light fading and an air of dampness starting to pervade the group that the Field Secretary, thanked Dr Clements and his wife for a Midsummer Night's Dream! The excursion finished back at the car park with a look at the specimens pertinent to the site from long-standing member Denis Gamble's collection.

Bardon Hill Quarry
Saturday 3rd July 2010

The Bardon party ready for the off photo Ron Johnson

A group of 16 members met in the car park of the quarry at 10.30am to be briefed by our leader for the day Frank Ince. All around us the bustle of the quarry was evident with lorries both laden and empty moving at speed, but slowly as 11.00am approached things calmed down as production wound down. We were joined by Derek Jelley of Bardon Aggregates who was to

oversee the visit, he outlined the Health and Safety requirements of the quarry.

In the bowels of Bardon, note Triassic filled wadi photo Ron Johnson

Bardon Hill, at 278m, is the highest point in Leicestershire. Precambrian rocks have been quarried here for over 100 years. It is thought that the igneous rocks of Bardon Hill constitute the roof of an ancient volcano and comprise of volcanoclastic deep water beds with later extensive intrusive and extrusive activity. The entire sequence has been affected by tectonic acitivity causing shatter belts, thrusts and faults which carry a number of dykes and quartz lenses. It is these dykes and fault systems which host the most interesting mineralisation. The quartz rich dykes and faults contain quartz, chalcedony/jasper veins, epidote, albite, anastase, muscovite, dolomite, haematite, pyrite, chlorite and ... gold. Within the Precambrian-Triassic unconformity native copper, cuprite, malachite and azurite occur, amongst others. It was specimens of these minerals that we had hoped to find as well as exploring the unconformity. The unconformity represents millions of years of non-deposition and erosion during the Triassic period. The resulting wadis give the unconformity an irregular profile which can be seen in the upper reaches of the quarry. Members were successful in finding examples of barite, azurite and malachite amongst other minerals, but unfortunately no gold!

The Field Secretary thanked the leader and Mr Jelley and the excursion closed at approximately 2pm.

Faringdon Sponge Gravels of Oxfordshire
Saturday July 17th 2010

A dozen members assembled at the entrance to Wicklesham Pit on a fine summer day to be briefed by leader Owen Green of Oxford University. Owen is a true friend of the Society, his enthusiasm and itineraries of geology mixed with history and archaeology. A perfect day in the beautiful county of Oxfordshire.

Let the fossilling begin – Wicklesham Pit photo Dave Haywood

Deposition of the Lower Greensand sediments in the Faringdon area commenced approximately 110 million years ago when a rise in sea level resulted in a transgression across southern England. The name derives from the green mineral glauconite which characterises the arenaceous sediments. However not all the sediments in the Greensand Formation are either green or sand, with the lowermost deposit being the Faringdon Sponge Gravels and a conglomerate facies comprising red and yellow gravels. Members collected calcareous sponges, molluscs including bivalves, ammonites and belemnites, echinoderms (especially spines), brachiopods and encrusting bryozoa. We enjoyed coffee and biscuits at Sudbury House Hotel whilst listening to presentations by Owen and Prof Snelling of Oxford University. Walking through to the rear of the hotel we climbed the hill to The Folly Tower (447

feet above sea level) from the base of which we could view the Vale of the White Horse and pick out features on the surface of what is predominantly Upper Greensand.

Next stop was Roger's Garden stone which offered an opportunity to buy concrete ammonites for the garden! However behind the garden centre is a disused pit which enabled us to view another part of the sequence. Here, sponges were less common and generally smaller than at Wicklesham but there were finds of faunal assemblages containing sponges encrusted with all manner of life form, a great insight to life on the sea floor millions of years ago. Lunch was taken at Bradbury Hill the site of an Iron Age hill-fort, built and occupied from around 600BC. The Hill offers a great view of Faringdon and the surrounding area and on this particular Saturday the Farndon Air Show. Moving on we visited the Great Barn at Coxwell thought to have been constructed just after 1300. Built by the Cistercian monks of Beaulieu Abbey to store agricultural produce it is constructed from local Cotswold limestone with a Stonesfield slate roof. The magnitude of the barn was cathedral-like although completely lacking in ostentation.

The Oxfordshire group photo Dave Haywood

We were able to examine the Yellow Gravels at Fernham Gate and the Coxwell Pit SSI which is now the site of a modern housing estate. The cliff faces have been preserved with the help of Profs. Snelling and Watts and access has been preserved with a sequence of double gates around the edge of the quarry in the back gardens of the new houses. Local residents were pleased to allow access and to listen to the background of their back gardens! The day finished at the hamlet of Radcot at the Swan Inn around which three bridges span the River Thames and mark the crossing point between Mercia and Wessex. The Field Secretary thanked Owen for a fabulous day with its exciting mix of disciplines with an accompanying first class handout.

Bradley Fen, Whittlesey
Saturday September 4th 2010

Bradley Fen Pit in 2009

Our penultimate quarry visit of the 2010 season was to Bradley Fen near Whittlesey, which replaced the advertised visit to the new Must Farm locality due to the incomplete opening up of the latter. One for next year! The weather was fair and a large turnout was expected, this being our joint visit with the Warwickshire Geological Conservation Group. In all 19 people attended, a mixture of members from Warwickshire, Leicester and the Stamford group. Leader Cliff Nicklin ran through the risk assessment with us and then led us to the far end of the quarry, the most recently worked face. I say the most recent face, the quarry is actually mothballed and works have been transferred to Must Farm. However the scouring effect of the recent

heavy downpours meant that members soon got to work digging out finds including scales from fish and crocodiles, and coprolites. The coprolites on closer examination contained the hooks from the feeding apparatus of belemnites, other exciting finds included fish jaws, appearing like rock shards until examined closely, and bivalves including *Nucularia.* As expected, it was 'bed 10' of the Oxford Clay sequence that was the most prolific, although brachiopods and belemnites were plentiful everywhere.

The day's haul of fossils fascinated the leader and amateur and professional geologists amongst us, and Cliff was happy to stay on with the dedicated amongst us after others had drifted off.

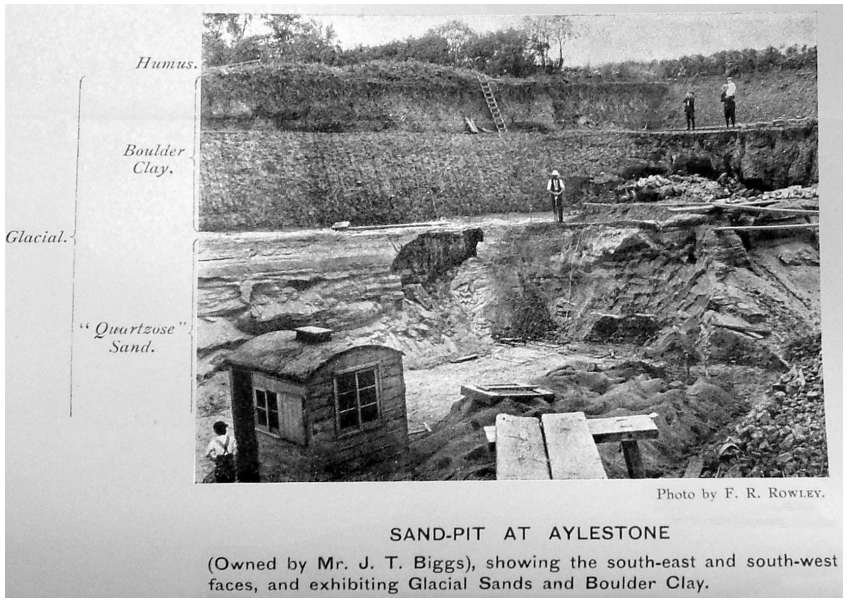
Leicester's extractive industries

It may come as a surprise to readers that Leicester once had thriving extractive industries within the city limits. Notably these were the extraction of clay for brick-making, gypsum for plaster, sandstone and sand for building, as well as limestone quarries for the manufacture of mortar. Little surface trace of these remains today.

A glance at the geological map (BGS sheet 156, description by Carney *et al*. 2009) shows that there is a band of Mercia Mudstones (formerly Keuper Marl) running roughly north to south through the area of Leicester city (see also Horwood, 1913). The western half of this band is largely covered by the River Soar and its alluvial floodplain, where quarries would be impractical owing to flooding. But to the east the red mudstones underlie the higher parts of the city where they could be quarried in the hillsides. Just inside the city boundary there were the extensive New Star brick pits and kilns north of Thurmaston Lane (= Humberstone brick works?), later levelled and an industrial estate built on top. There were brick-pits in nearby Gipsy Lane, of which little remains, though I remember visiting them in the 1950s. Spinney Hill Park was developed on the site of large brick-pits filled with rubbish. According to Harrison (1877) there was a brick pit "near the cemetery", presumably that at Welford Road. Other brick-pits were adjacent to the nearby cattle market and on the site of Wyggeston Girls School (now Regent College). To the south there was a large quarry and brick kilns at Knighton Fields (also known as Knighton Junction works), long since filled in and now the site of the University of Leicester student flats (Nixon Court) behind the Homebase store. I have vague memories of seeing derelict brick kilns there in the 1950s. West of the railway junction there was another brick works on Saffron Lane and the site later had the sports stadium built on it. Outside the city boundary near the Wigston railway junction there was a brick-pit at Glen Parva; later this was filled in and the Young Offenders Institution built on top. Again, just outside the city boundary there were extensive brick-pits and kilns at Blaby, west of the County Arms pub.

All the above worked the upper part of the Mercia Mudstones in the 19th century when there was a high demand for bricks to build the terrace housing for factory workers. The import of mass-produced bricks from the Oxford Clay brickworks of Bedfordshire saw the gradual demise of Leicester's brick industry.

Sandstone was quarried from the Upper Keuper Sandstone (= Hollybush Sandstone, Carney *et al*. 2009) in Dane Hills, now within Western Park, though much was too crumby for building and the sand was used in mortar.

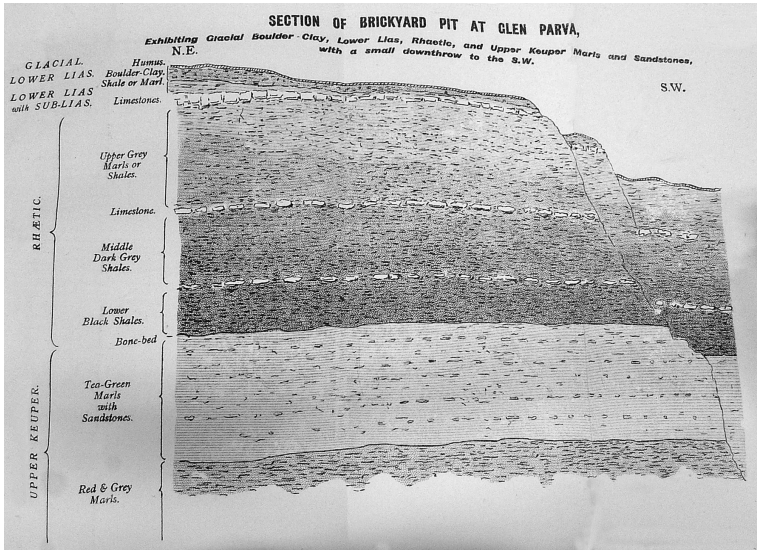


From LLPS Transactions 1901

Sand and gravel were also excavated from glacial outwash deposits at various locations along the Soar Valley, particularly at Thurmaston (now with an ASDA store on top), near Humberstone and at Aylestone, and most villages outside the city had their own sandpits. I recall visiting a house built in one at Thurnby in the 1960s, just north of the A46.

At the base of the upper Mercia Mudstones gypsum was worked on a large scale in Nottinghamshire and along the Trent Valley. A reduced thickness of

the gypsum bed extended through north Leicestershire (it was recently mined near Barrow-on-Soar) into Leicester (Carney et al., 2009), where several borings recorded gypsum beds (Fox-Strangways, 1903); Fox-Strangways quoted Jukes (1838) as saying that there was a gypsum pit at Regent Road, Leicester, possibly now part of Wyggeston Girls School playing fields. Gypsum was also found in the footings for Knighton railway tunnel. There was a local demand for gypsum to make plaster for the burgeoning terrace housing. Small quantities were raised at Gipsy Lane and gypsum was also excavated from beneath the brick clay at Spinney Hill with mine workings apparently extending beneath Mere Road – an old shaft collapsed in a backyard there in the 1970s.



From LLPS Transactions 1901

The Hydraulic Limestones at the base of the Lower Lias were quarried around Barrow-on-Soar and there were small quarries at Crown Hills, near the Leicester General Hospital (see sketch map in Fox-Strangways, 1903). One limestone quarry was close to Ethel Road and the site was later redeveloped for a Waitrose store (Boynton, 2004). To the south of the city boundary, there were limestone quarries near Kilby Bridge. The limestone was used fro the manufacture of lime, much of which was used in mortar for building terrace housing. There were tramways to convey the limestone to kilns in the Willow Brook valley but nothing remains of them. The quarries were long ago filled with rubbish and a housing estate built on top.

The above survey is by no means exhaustive, and I suggest that some member might like to take up the subject as a research project. A start could be made by examining the 19th century editions of large scale Ordnance Survey maps and then scanning the various commercial directories: early Geological Survey publications add some detail (e.g. Fox-Strangways, 1903). Most of these are held at the Leicestershire Record Office in Wigston. Who worked which pits and when? How many bricks were produced? Who were the builders? Who used the bricks? Were there any other gypsum mines? And were there any other quarries in the Hydraulic Limestones? Some details of the brickworks can be found in Boynton (2003).

The manufacture of bricks, plaster and mortar required coal for kilns; this was brought in from northwest Leicestershire by rail, but a local source would have been better, so in the 19th century the Evington Coal and Lime Company drilled deep boreholes at Crown Hills in search of a hypothetical concealed coalfield: they did not find any coal and the boreholes terminated in Lower Palaeozoic rocks directly below the Trias (Fox-Strangways, 1903; Carney *et al*., 2009).

Finally we might note that most sites of these extractive industries have been obliterated by later development but they should not be forgotten as old quarries filled in with rubbish may not form the best of foundations for new buildings.

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