CHARNIA

Newsletter of the

Geology Section

Of the Leicester Literary and Philosophical Society

June 2020

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Editor's Notes

We live in difficult times and the Geological Section has to think about how we can continue in the next few months whilst keeping our members safe. Our last committee meeting was held on Zoom where these issues were discussed. The first casualty has been the summer visits which have had to be cancelled due to safe distancing. As restrictions are lifted there may be opportunities to arrange something local in the autumn and Robert Tripp will let members know if that becomes possible.

The second issue concerns the programme of winter lectures. The University is planning for the return of the students on a much reduced scale of live lectures and will not permit the use of our usual lecture theatre for the numbers of our members that regularly attend. Many of our speakers are from academia and are under pressure over their normal duties, limiting the time that they could give to preparation of our talks. However some may have "oven ready" presentations that could be used remotely and this is being followed up. The means of presentation being discussed is to use Zoom again. I expect many members have already used Zoom themselves, or maybe Skype or other means of video conferencing. For those unfamiliar, it is a free piece of software that runs on most electronic devices including PCs, Macs, iPads and smart phones. The committee recognises that this approach would not be available to those without one of these devices but only 5 members do not have an e-mail address so it is assumed that the majority could take part. Zoom does not collect and exploit personal details in the way that social media platforms do. It works by the organiser of the meeting sending an e-mail invitation to members to take part and the recipient responds at the appropriate time. Complete instructions will be provided if we follow this route. In the meantime Roger Latham welcomes any comments on this proposal at roger.86latham@btinternet.com or by post via the Secretary.

On a positive note, members have been taking exercise and Roger Latham has written up two walks with a geological theme – the first of which is included in this edition - and Roy Clements has been excavating his garden. This is also are included in this issue. Diana Sutherland has also reported on her visit to White Island – before the eruption a few months ago. As Roger suggests in his foreword, these are examples of contributions that I would welcome for future editions of Charnia. Please send your contributions to bdh2o@hotmail.co.uk.

In the meantime, keep safe and well and hope that we can meet up again soon.

Front cover picture

Members next to the Triassic – Jurassic boundary on a visit to Bantycock last summer.

White Island - New Zealand

In the news on 9th December 2019, this small volcanic island, 80km east of North Island, erupted, apparently without warning. The rising ash cloud was witnessed by a tourist boat just as it was leaving the island; it promptly turned back to rescue some of the others trapped by the eruption. Many of them were very badly burned and several died later.

In March 2006 my husband (John Milne) and I enjoyed a great holiday in New Zealand, including a boat trip to White Island, 50km from Whakatane. The island (2.4x2km) had been so named by James Cook in 1769 observing its clouds of vapours; at present it rises 321m above sea- level, but the volcano stands a total of 760m from the sea bed. The summit crater was breached to the south-east, and is accessible from relatively low ground in that direction (Figure A).

Figure A The breached crater

We were told the crater had last erupted in 2000, and was currently occupied by a lake of rainwater 60m deep. Steam was rising from the porous rocks, though fumaroles were said to be temporary and changeable. Some rock surfaces were coloured a sulphurous yellow by a film of algae (Figure B). Rivulets wound their way down the slope, eventually colouring the sea a greenish yellow. The steep back wall of the crater (Figure C) was built up variously with ash and andesite lava by successive eruptions of the cone, with some masses slipping down into the crater.

Figure B Fumaroles

Figure C Back wall of the crater

The volcano's activity is constantly monitored: by seismometers (a solar panel could be seen on the rim); pegs in the ground for surveying; gases checked; temperatures taken; and the crater photographed by cameras every half-hour.

There had been several attempts from the 1880s to obtain sulphur for the manufacture of fertiliser, but in 1914 a landslide at the crater killed a group of 10 workers. A final venture from 1923 sent crushed rock to Tauranga for processing, but the sulphur content was too low, and it finished by 1933. Some rusty remains of the works were visible on our visit. The island is uninhabited but privately owned, and administered by the Department of Conservation.

For us it was a memorable day out. I now know how lucky we were.

Diana Sutherland

Charnia geological walks foreword.

In the peculiar circumstances that we face, the possibility of field trips this summer, especially for the palaeontologists among us, is looking increasingly unlikely. But for those of us who are not "self-isolating" having a walk to see geological features is possible, and now we have slightly more freedom to drive to locations for a walk I've been encouraged to do so.

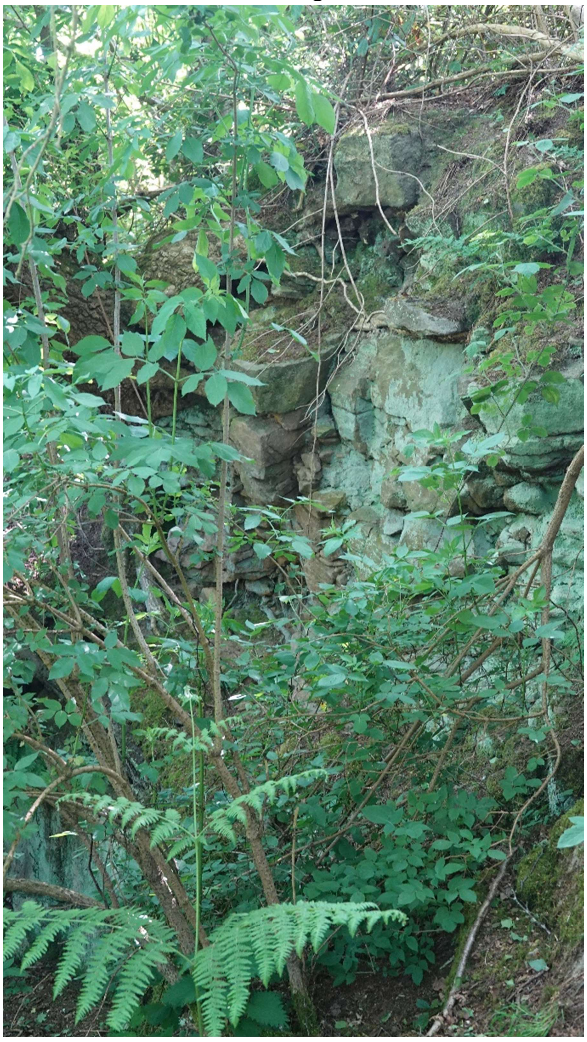
I've been following the guidance in two BGS publications – Exploring the Landscape of the National Forest, and Exploring the Landscape of Charnwood Forest. I've written these up as brief articles for Charnia, alongside other walks which have geological interest. Over the next few publications of Charnia I'm hoping that the editor will be interested enough to publish them. So, even if we can't take a field trip as is the LLPS Geology Section, we might be able to do so individually.

You might be doing the same, or you might have walks that you've done in the past which have geological interest. Can I encourage members to write these up and send them into Brian Waters, our Charnia editor and maybe if there are sufficient entries, we could even publish them as a geological walks pamphlet.

Roger Latham
Vice Chair

Foremark Reservoir (about 5/6 miles)

This walk covers sedimentary sequence of sandstones from the Bromsgrove sandstone through the Kidderminster formation to the millstone grit of Carver's rocks. The millstone grit was formed in the Carboniferous when sea level fell, and



major river deltas deposited the gritty sandstone which was from time to time inundated as sea level rose. In the Triassic, following severe erosion of the Permian, a major river flowed from north France towards where the Charnwood Forest is now, depositing coarse sands and gravels which appear as sandstones and conglomerates. Those of the Kidderminster formation show a gradation of pebbles from large to small representing the formation of sandbars on the riverbed which deposited the heavier heavily material first topped with lighter gradations of pebbles. The Bromsgrove formation is a pure sandstone.

Beginning at the car park at the Foremark Reservoir work along well-defined path towards Carver's rocks (well signposted) which undulates over several spurs. At the top of one of the spurs there is an exposure of the Bromsgrove sandstone just off the path to the left. However, as these are closer to the SSSI of Carver's rocks, and have protected flora, they have not been cleaned and the face can be difficult to see. (See 1). From the spur you drop down towards Carver's rocks which are to be found in the quarry beyond the steeper slope to your left as you reach the footbridge that crosses the top of the reservoir. The millstone grit has been quarried for building stone and has been known by various names – Repton rocks, Dawson's rocks, but on the OS maps Carver's rocks, after Lawrence Carver of Ticknall. Judging by the number of graffiti which have been scratched onto the surface they could easily have been described as carving rocks. They are massive millstone grit which is towards the top of the millstone grit sequence which covers much of the Peak District. (See 2),

and in places there is a layer of sandstones with numerous quartzite inclusions which must have added to the grinding quality of these rocks (see 3).

Leaving the rocks the path crosses the footbridge and taking the right-hand fork leads out of the wooded area up a steep slope to a farm devoted to “horsey culture”. Turning right on the little road you pass by the mobile telephone mast and when the road bends off to the right you carry on the footpath to the left passing a stand of woodland on your left called Repton Shrubs. Continue along the main path keeping to the left as the road bends to the right and you pass into a “Green Lane” which eventually gives way to an access road to two farms.

Continuing down this road which becomes a “Holloway” with particularly good exposures of the Kidderminster formation on the right-hand side (see 4 and 5).

This clearly shows the gradation of the pebble in the formation and occasional sandstone layers of less active sedimentary deposition.

Continue down the lane to the road at the bottom, turn right, and at the top of the hill take the footpath on the right across the fields to join a small access drive. Turn left at the drive and after a short distance turn right onto the Repton Road and walk about three quarters of a mile back to the car park entrance at Foremark - fairly busy.

The final part of the walk involves walking alongside two busy roads – Robin Hood Ln and the Repton Road. If you want to avoid this hike back, then at Carver's rocks you can retrace your steps back to the car park and take your car back to the main road, turning left and left again at the crossroads onto Robin Hood Ln. As you come over the top of the hill there is a pull in to the left where you can park the car, and turn left up the access road to the farms to observe the Kidderminster formations on your left hand side.

Treasure in the Tilth

This year (2020) will undoubtedly be remembered as the year of Coronavirus or Covid 19; ugly words which for many will evoke ugly memories. Hopefully, we can create a more positive memory. Section C has already suffered from cancelled indoor meetings in the first part of the year, and, at the time of writing, the autumn programme looks uncertain. The field season has had to be abandoned, and it is in addressing this deprivation that the following positive, but not entirely original, suggestion is made.

Many of us will have gardens, or perhaps access to tilled ground. In our local region many of these soils will contain hard lumps – "stones", which may have surprising geological interest. In some places you may find:

(1) fossils and pieces of rock derived from the solid geology underneath; more commonly in our area

(2) there will be solid debris derived from the erratics or other exotic materials in the Quaternary Drift beneath the soil. Other possible materials are

(3) "contaminants" brought in by the activity of man (not least the people who built your house!); and yet others

(4) may be purely man-made artefacts – bricks, concrete, slags, etc.

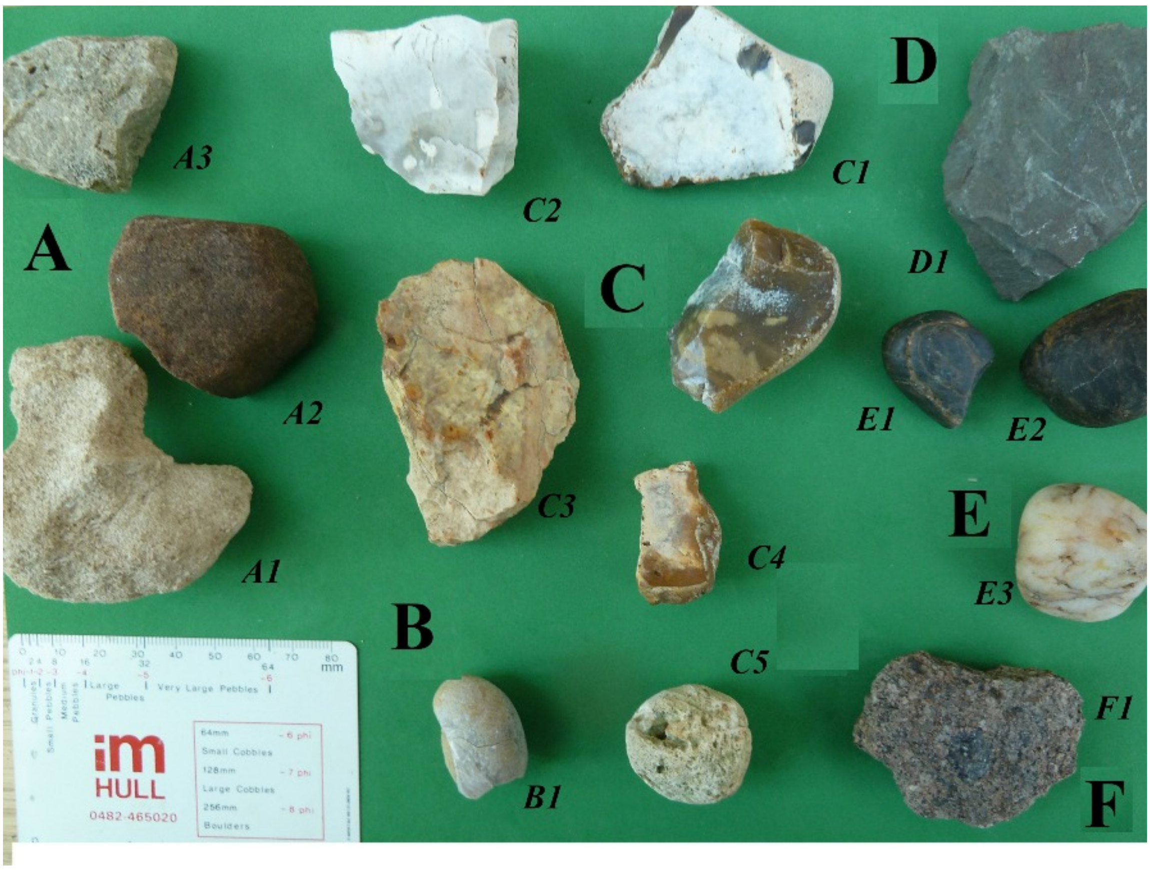


Fig. 1: Selection of "stones" from the author's garden, collected Spring 2020.

All have potential interest, but in the context of my chosen example - my garden – I shall concentrate on (2) and (3). Fig. 1 shows “a selection” of things that caught my eye during a few recent bouts of weeding my patch. (I might say that I have quite a choice of “stones” in my plot!) You will need a bit of equipment. By the nature of them having survived to be found, the “stones” are pretty robust, so much can be achieved by cleaning with a stiff tooth brush and soapy water. You will also need a good hand-lens, and have your hammer and chisel in reserve. I have a good compact camera, with built-in close-up facility – focussing down to a few centimetres. I also have a laptop (with “Paint” programme) for playing with the images. I am also lucky to have cheap-and-cheerful plug-in digital microscope, and a simple binocular microscope – but both of these are far from essential.

Returning to fig.1, the materials illustrated are typical of, but not entirely representative of the variety of “stones” that can be found in my garden (I have excluded all of group 4 material (above), as well as the more obvious group 3 material). They are reasonably consistent with having been derived from the Oadby Till Member (and nearby Thrussington Till Member) of the Anglian stage of the Quaternary. This is as expected from my local geology. In the figure:

Group A represents limestones (A1 – oolitic limestone, Jurassic(?); A2 – dolomitic(?) Limestone , Carboniferous(?); and A3 – crystalline limestone – Carboniferous(?));

Group B – just the one rather tatty member of the *Gryphaea arcuata* complex – Lower Jurassic;

Group C (C1-C7) – all flints and all ultimately from the Upper Cretaceous Chalk Group, it is normal that this should be the largest group;

Group D – a mud/silt grade fissile piece of Charnian(?);

Group E – two banded quartzitic pebbles (E1 and E2), and one pebble of vein quartz (E3); and, finally,

Group F (F1) – a quartzo-felspathic medium-grained igneous rock with a xenolith – possibly Charnian.

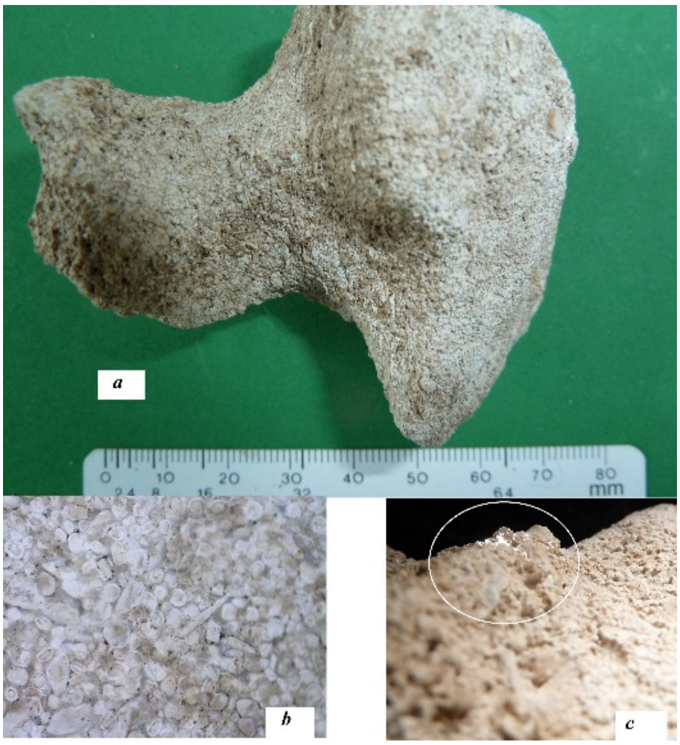


Fig. 2: Specimen A1 – oolitic limestone.

At least four of these specimens warrant further discussion – they will give some idea of the possibilities! Specimen A1 is a typical piece of oolitic limestone, presumably derived from the Middle Jurassic, and is illustrated in fig. 2. The main image (fig.2a) shows the irregular rounded form that has been produced by erosion/corrosion. The rock is far from being a pure oolite, there are pellets and tiny shell debris as can be seen in the enlargement (fig. 2b). Perhaps less obvious, the specimen shows a phenomenon called “lustre mottling”. Thus when the specimen is rotated in directed light, it shows patches of reflected brightness.

The ooliths and other debris are cemented together by large calcite crystals – a sparite cement, and it is reflections from the perfect cleavage surfaces of the individual crystals that causes the mottling. Each of these calcite crystals encloses many grains, a texture called poikilitic or poikilotopic. Hence the "spottiness" of the individual "mottles" that I have tried to capture in fig. 2c.

Specimen C3 is a much-travelled piece of flint, presumably from Upper Cretaceous Chalk Group outcrop. It is but a fragment of a larger flint nodule, and the brown colour (as opposed to an original dark grey) represents oxidation of originally reduced iron compounds to produce this staining.

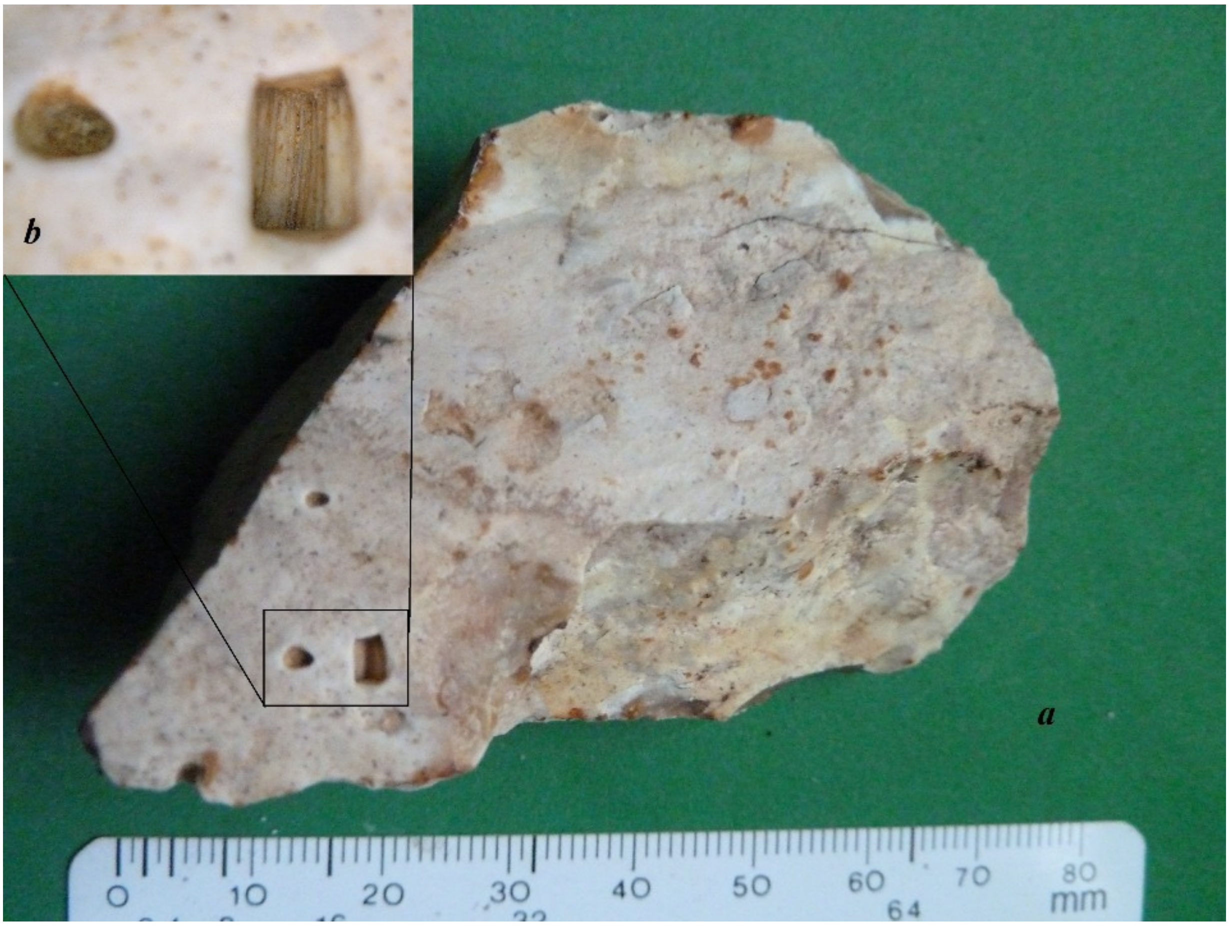


Fig. 3: Specimen C3 – flint with *Inoceramus* prismatic shell layer "crumb"

The flint (fig. 3) also shows mouldic cavities of objects originally made of calcite, which resisted the silicification that produced the flint, and which subsequently were leached away. The rectangular object (shown in the enlargement, fig. 3b) shows a structure of parallel, striated prisms. It represents a fragment of the outer shell layer of prismatic calcite of the bivalved mollusc *Inoceramus sp. s.l.*. These bivalves are typical of, and abundant in, the Upper Cretaceous of the UK. In *Inoceramus* this shell layer is unusually thick, and, *post mortem*, is so prone to disintegrate that the debris makes up a significant proportion of the sand-grade material in typical Chalk.

Another piece of flint, specimen C1, is less weathered than C3. It shows not only some of the original form of the nodule from which it came, but fresher-looking dark grey flint on some of the smaller fracture surfaces (fig. 4a). However, for the most part, the outer surface of the specimen has a white, "bleached" appearance, this surface includes two large fractures (one shown in fig. 4a, and one sub-parallel to this on the other side of the specimen). These two fracture surfaces do not show the typical conchoidal patterns associated with flint breakage.

However, in highly oblique lighting, a complex, and quite regular pattern of sub-parallel lines appeared (fig. 4b). These looked superficially very much like a bivalve shell - *Inoceramus* - yet again! Yet, under similar lighting conditions, a similar pattern could be seen on the second large fracture surface (fig. 4c) – and the patterns on the two surfaces seem to match up. It would seem that the lines represent an agate-like, three-dimensional structure, perhaps *Liesegang* rings, penetrating the specimen.

Fig. 4: Specimen C1 – flint with patterned fracture surfaces

The final specimen (specimen C5) is a smallish angular fragment of brown-stained flint (fig. 5, with a, b, c and d as different views). The photographs clearly show a series of sub-cylindrical and globular cavities, which clearly represent patches in the original chalk that resisted the silicification process that led to the formation of the flint. The shapes of the cavities suggest something organic – burrows or coprolites perhaps. Clearly any original chalk has gone, and all that remains is a pale lining of partially silicified chalk from the "silicification front".

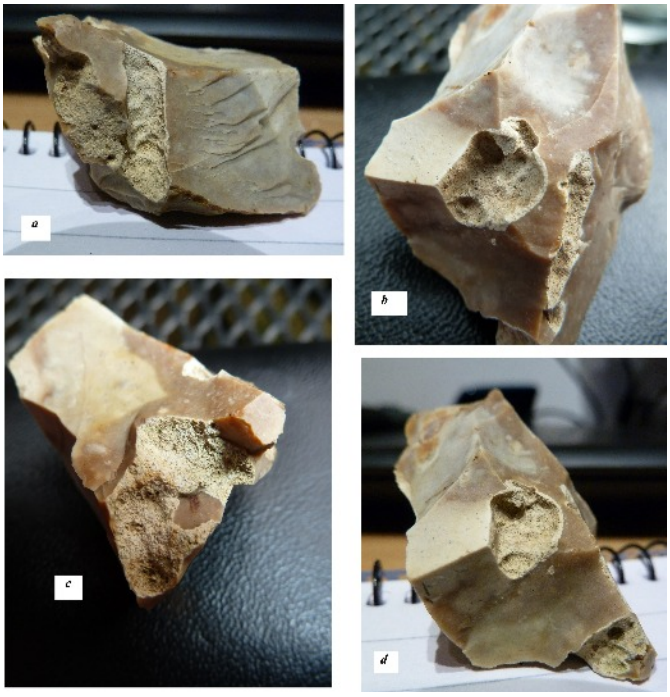


Fig. 5: Specimen C5 – flint with non-silicified borrow or coprolite voids

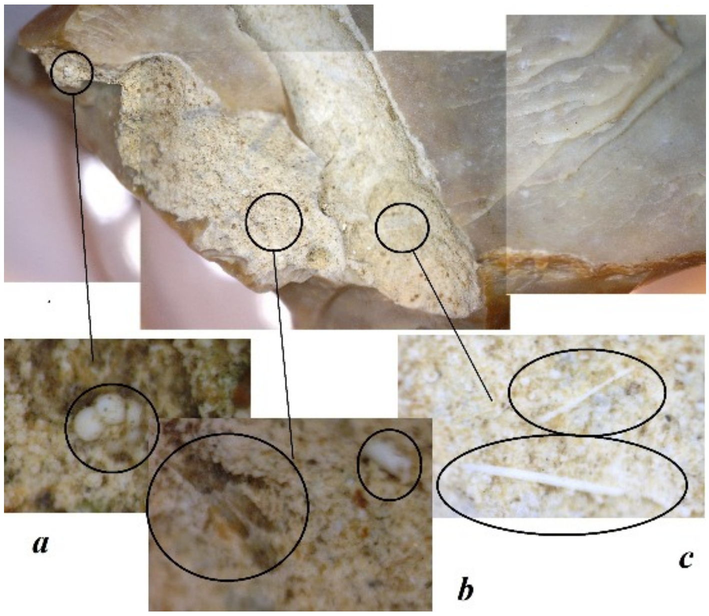


Fig. 6: Specimen C5 (continued) – flint voids with microfossils.

Amid the debris there are pretty little fossils – fig.6. Fig. 6a is one of a number of tiny foraminiferans. The one illustrated has an outer spiral circlet of six spherical chambers so it has the morphology of a typical planktonic form; its diameter is about 200 microns. Fig. 6b shows some rather indeterminate tube-like structures – possibly bryozoans, and with a diameter of 110 microns. Finally, fig. 6c shows two sponge spicules; the smaller is about 740 microns, the larger is about 1.11 millimetres. These simple rod-shaped spicules are referred to as monaxons. The Porifera are a major component of the fauna of the Chalk Group, and their spicules (at least the siliceous ones) may well provide a source for some of the silica that may "fuel" the growth of flint nodules.

In conclusion, whilst such "stones" fail all the tests for adequate geological and geographical locality/context data that is normally expected to accompany geological specimens, they do provide the opportunity for making important observations that may well lead onto other things and, if nothing else, will challenge and keep in trim ones observation skills! So in addition to a supply of cool beer, and an easy chair, add a hand-lens to that list of essentials for summer gardening.

Roy G. Clements

Bringing the North Sea to Leicester

As the chapter closes on one of the UK's largest offshore gas fields, another exciting opportunity arises at the University of Leicester. The Pickerill gas field is located in the UK Sector of the North Sea (Fig. 1) and between 1992 and 2018 supplied 98 million standard cubic feet of gas per day to the UK energy network. That's a whole lot of gas!

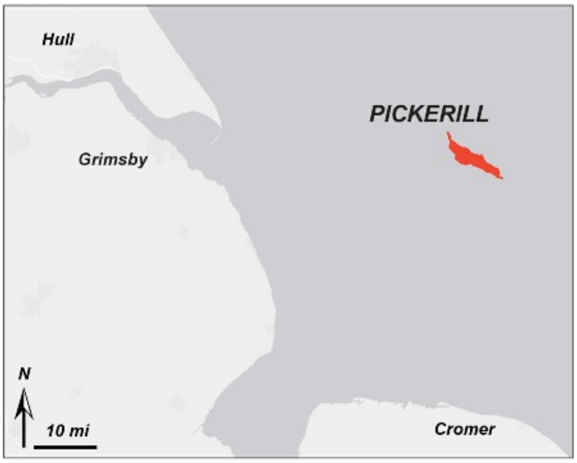


Figure 1 Location of the Pickering Gas

But things cannot last forever and in 2018 the field entered its decommissioning phase, overseen by Perenco UK Ltd. In the summer of 2019 as things were winding down, Perenco contacted the academic community asking if anyone would like some free core and production data. Free data! That's a rare thing. I, and other academics in the School of Geography, Geology and the Environment, quickly saw this opportunity and got in touch to reserve some of this material. We were lucky enough to receive over 100 m of core free of charge, which is now stored in the Bennett Building at the University of Leicester (Fig. 2).

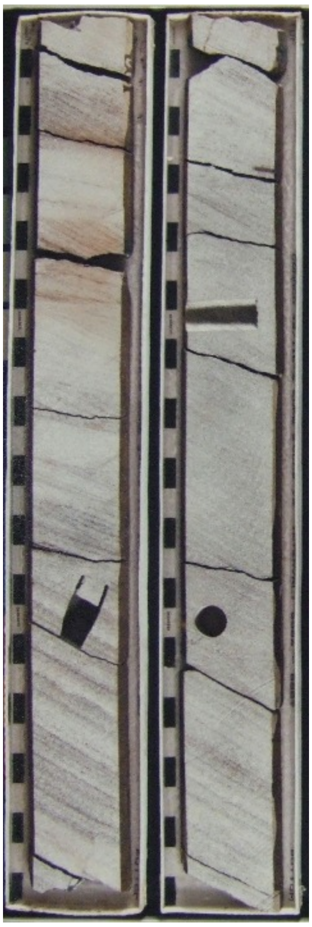


Figure 2 Sandstone core from production well 11b/6. A further 40 m can be found in storage

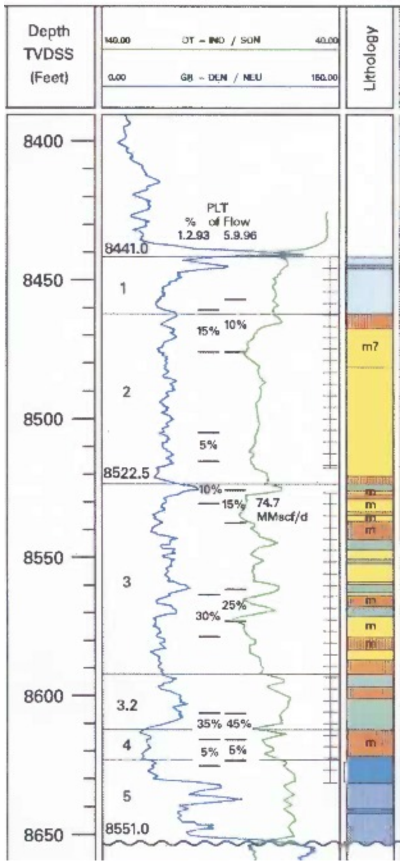


Figure 3 An example of the geophysical data provided with the core. We'll be getting students to use this alongside the rocks.

Pickerill was a conventional gas field and the reservoir comprised of Permian aged sandstones of the Rotliegend Group. These sandstones were deposited under aeolian settings on the supercontinent Pangea after the Variscan Orogeny. They're generally clean (low clay), high porosity and high permeability sandstones which made them excellent reservoir rocks. The gas within the reservoir was generated from Namurian (Carboniferous) aged black shales, examples of which you can go and visit today in the Forest of Bowland or the North East coast of the UK. These rocks were deposited under anoxic conditions which led to the preservation of organic matter in great abundance; in some cases up to 10 % of the total rock volume.

The core and digital data supplied with it (Fig 3.) are a fantastic resource and will be integrated into a range of undergraduate teaching courses. We're also aware of the changing global energy environment and the climate crisis and there are plans to use this material for hydrogeology, stratigraphy and other non-hydrocarbon teaching. So if you want to come take a look at some pristine, 280 million year old core, come to the Bennett Building and take a look at the Pickerill core!

Kieran Blacker
Kieran can be contacted using – kjb44@leicester.ac.uk

Abstracts from winter meetings 2020

27 January, 2020: Fire and Fury in Iceland: Tracking Molten Rock from Deep in the Earth to Eruption at the Surface.

Professor Bob White FRS(Professor of Geophysics, Bullard Laboratories, Cambridge).

Joint lecture with the Geology Department

Volcanic eruptions in Iceland have fascinated writers for centuries. In 1775 Benjamin Franklin correctly identified the cause of the terrible weather that summer in Europe as caused by an eruption in Iceland, which turned out to be the biggest known historic eruption. In 1864 Jules Verne based his 'Journey to the Centre of the Earth' on a presumed volcanic conduit beneath the Icelandic volcano Hekla. In 2014 we were fortunate to capture the largest eruption in Iceland since 1775, this time with modern instrumentation. We were able to track the molten rock as it travelled sideways underground for 50 km before erupting in central Iceland, using the 50,000 tiny earthquakes it generated as it cracked its way forwards. I will describe our work in one of the remotest areas on earth tracking the molten rock, with videos of the eruption and advancing lava flows taken from within touching distance of the molten rock.

Wed 29th January 2020: Geophysics, Leicester and I.

Professor. Aftab Khan HBM (University of Leicester)

The 1950's is often referred to as the decade of geophysics, with good reason. Within that time I experienced the transformation of the science of geology from an observational one concerned with studying minerals, fossils, rocks, structures and making geological maps to a physical quantitative one describing earth's structure and evolution based on a variety of global geophysical observations on land and sea.
I had a career in oil exploration in mind but there were no taught degree courses in geophysics or professors of geophysics in the UK, so I read geology with physics and mathematics at Birmingham. There were no undergraduate lectures on Continental Drift (CD) which geologists proposed early in the 20th century but which physicists proclaimed was physically impossible. The debate continued at many meetings and conferences and ended in stalemate at the start of WW2. It was resumed with vigour after the war, largely by physicists. Instruments able to measure the weak magnetisation of rocks emerged from Blackett's famous negative experiment became available, and showed that the polar wander paths were different for each continent. The highlight of the decade was the International Geophysical Year (1957–1958), mankind's most comprehensive international scientific undertaking. The Soviet Union launched the first two space satellites, Sputniks I and II in the latter part of 1957. East-West relationships were not good. The United States (1952), the Soviet Union (1953), and Great Britain (1957) detonated their first hydrogen fusion bombs (H-bombs) during the decade. They had to be stopped. Nuclear test-ban talks started at Geneva, Switzerland, during 1958. Monitoring systems for these treaty talks were vital so Great Britain and the United States launched a "new seismology" heavily based on the use of receiver arrays and digital computers. Much later, in 1989, the British Seismic Verification Research Project (BSVRP) funded by charities was run from Leicester and demonstrated that it is possible to verify a test ban treaty with suitable distribution of seismic stations.

By the time I came to start geophysics at Leicester in 1963, the physicists had explained the different polar wandering paths of the continents in terms of CD, although the mechanism was still not clear. It was about this time that new kinds of data were emerging from world wide exploration of the ocean floor and below from ships. There was already a wealth of data from magnetometers which were developed to detect submarines during the war. The Sea Floor Spreading hypothesis was proposed to explain the topography of the ocean floor and the world wide system of mid-oceanic ridges. This was convincingly supported by the Vine-Matthews hypothesis proposed in 1963 to explain the symmetrical linear magnetic across the ocean ridges in terms of reversals. The rock magnetic data and those from seismology on the distribution of earthquakes and the structure of the ocean basins led to the Plate Tectonic hypothesis on how the earth works. Universities were expanding in scope. In 1963 LU was about 800 students, largely arts based. The university had a plan to double in size mainly by increasing its science numbers. It seemed a formidable undertaking. The first Bennett Professor, Peter Colley Sylvester-Bradley, a micropalaeontologist, was also a polymath who saw the emergence of geophysics as a major new subject in its own right. He decided to appoint a geophysicist. New imaginative courses were needed. I proposed a new geophysics degree and after a year of local and national argument it was accepted – the first in a geology department in the UK. I had a plan to continue in palaeomagnetism but Peter talked me out of it and urged me to think bigger – about Africa where a new departmental volcanic programme had just started. I had read about Sir Edward Bullard's gravity work in Africa with pendulums in the1930's and his conclusion that the rift was formed by compression which was fashionable at the time. With his help I started my lifetime of gravity and seismic work on the Kenya Rift culminating in the Kenya Rift International Seismic Project (KRISP 85-95). The rift which had baffled geologists since it was first described by Gregory had acquired a new significance in the global plate tectonic model and the discovery of rifts on other planets. We were lucky to be able to recruit the excellent Peter Maguire, who did his PhD on Africa without having been there, and Ian Hill, a former student with interests in near surface geophysics. We have participated in other major projects in Europe and especially in Cyprus.

Over the years we have had excellent undergraduate and PhD students who had distinguished careers of their own. The success of the geology-computing cricket team in winning the University championship 5 years running was hugely beneficial academically. The highlight was in 1989 when the first national review of a major science was carried out as an experiment. Geology was chosen and three departments were graded as being outstanding, Cambridge, Leeds, and Leicester.

26th February 2020: Using corals to understand climate change.

Prof. Jens Zinke (University of Leicester).

Shallow-water tropical corals are a key archive to constrain past climate variability – on the timescales most relevant to human societies – and offer data for systematic reef monitoring programs and instrumental observations of climate. Jens' research on coral-core-derived multi-element and multi-isotope geochemical records is utilized to retrospectively monitor a whole suite of environmental factors (nutrient loading; turbidity; sedimentation) interacting with thermal stress during coral bleaching events and global warming characterising the Anthropocene. Jens' talk will give an overview how corals can be used to understand past and present climate change.

11th March 2020: Fertile Ground for Mobile Phones.
Dr Eva Marquis (University of Leicester)

The mobile phone has become a pervasive feature of modern living. Gone are the 'bricks' of the 1980s replaced by ever more complex versions, containing more and more elements in their fabrication. High-strength magnets employed for in phone speakers contain neodymium, one of the 15 lanthanides or 'rare earth elements' (REE). These magnets are further used in turbine generators used in renewable energy technologies, and in hybrid and electric vehicles. As such, the REE play an important role not only in our everyday lives but also in our pursuit of a low carbon future.

The REE are not, as their moniker suggests, all that rare - being more abundant earth's crust than many other precious metals. However, sourcing these elements in recent decades has cause economic, environmental and social strife. A major outstanding question for REE deposits, and other critical metals, is how do we extract these elements in a responsible and sustainable manner? This talk will give an overview of REE deposits, focusing on ion adsorption deposits, a key source of heavy REE (Gd-Lu), and discuss some of the challenges for sourcing critical metals needed in current and future technologies.

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