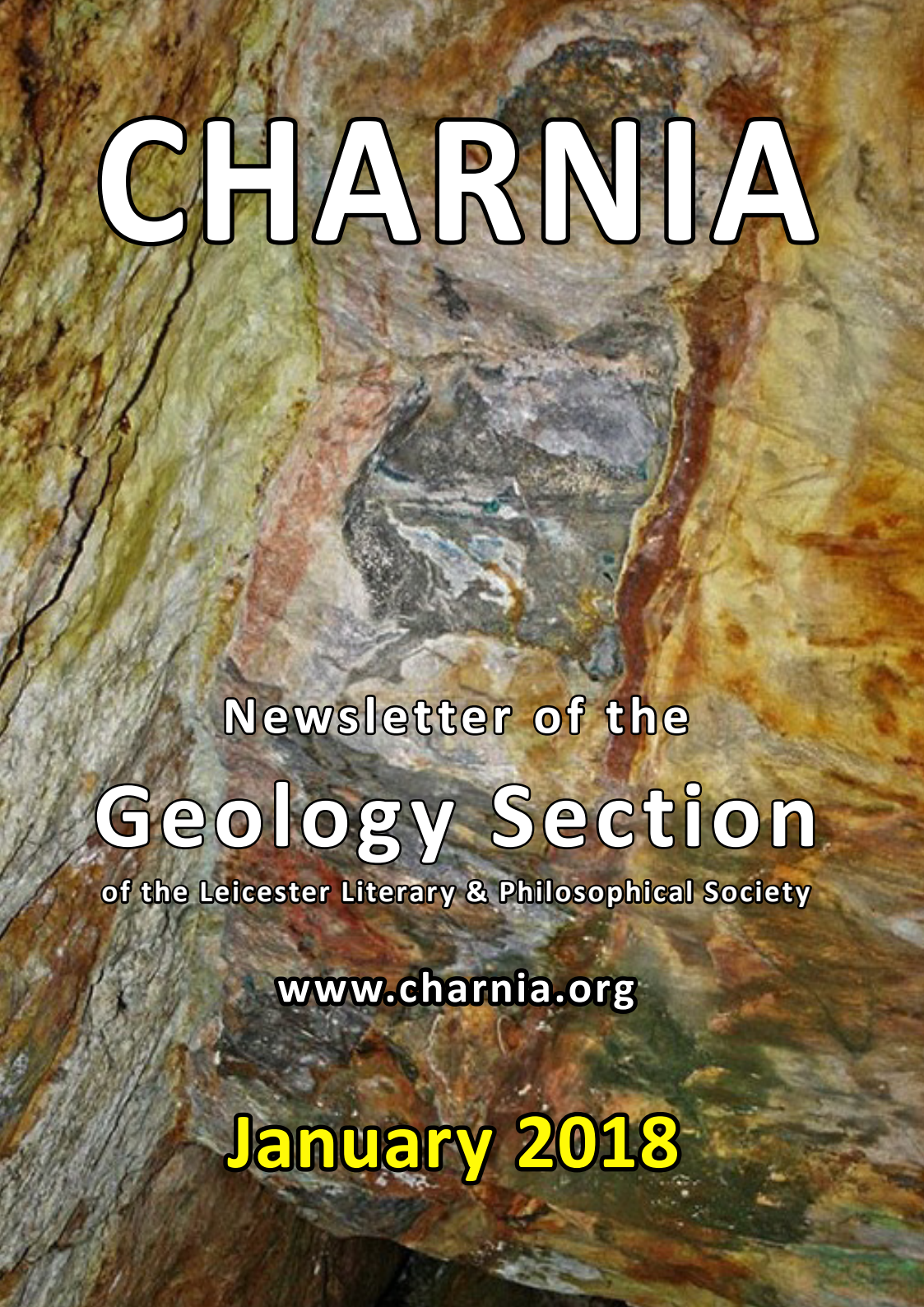


CHARNIA

Newsletter of the

Geology Section

of the Leicester Literary & Philosophical Society

www.charnia.org

January 2018

EDITOR'S NOTE

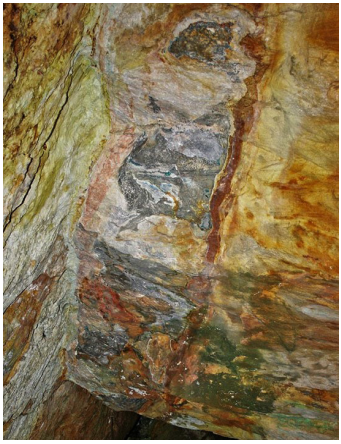
The first signs of spring? Well, hardly, on a wet and windy January day; but the days are lengthening and the hazel catkins are showing, so it must be time to start looking forward to the long, lazy, field-excursion days of summer 2018.

First, though, there's the rest of the winter programme to enjoy (p. 8), including marking the 50th anniversary of the recovery of 'the Rutland dinosaur' in 1968 at the Saturday event on March 10th. There may be some nomenclature to be changed: *Cetiosaurus* was always a slightly tentative name because of the difficulty of matching ours to the type material in Oxford. Come along and hear the latest thinking, as well as the story of the lucky accident of "Ceti's" discovery.

We have a good selection of members' contributions in this issue of *Charnia*. Keep sending them in!

John Martin

Charnia editor



COVER: See **page 2**

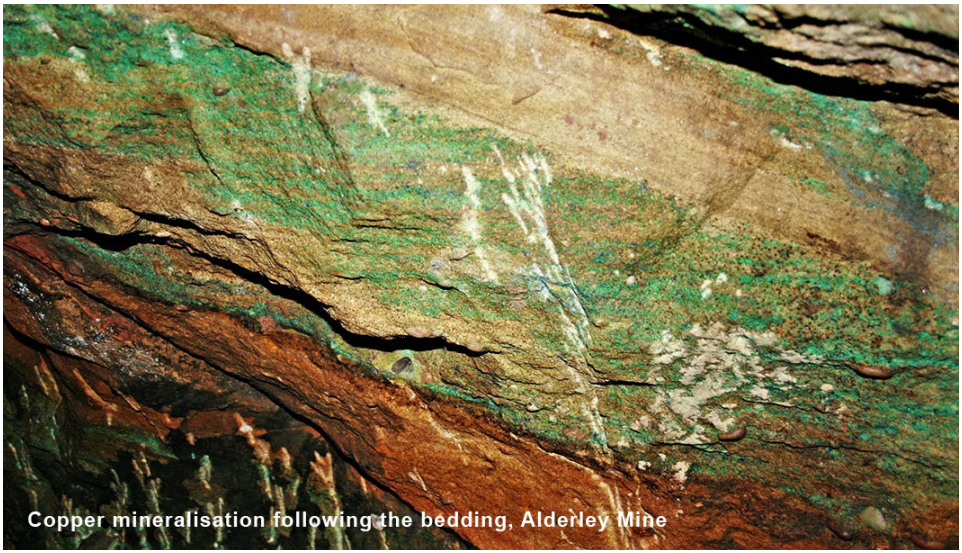
Lead and copper minerals underground at Alderley, Cheshire. Photo: Geoff Warrington

Mineralisation in the Cheshire Basin

Talk abstract - Wednesday February 21, 2018

Geoff Warrington

In the Cheshire Basin sediment-hosted mineralization comprising barite and localised copper-dominated polymetallic deposits occurs mainly in the Mid-Triassic Helsby Sandstone. Copper ores were mined principally in the Alderley district, NE Cheshire, but also in W Cheshire and at sites in N Shropshire. Small amounts of lead and cobalt ores were also recovered, mainly at Alderley. At Alderley mineralization occurs at three main levels in the ore-bearing succession. These are accessible in about 15 km of disused mine workings. The form of ore bodies at each level differs and reflects control largely by host rock facies (fluvial or aeolian) and partly by faults.



Copper mineralisation following the bedding, Alderley Mine

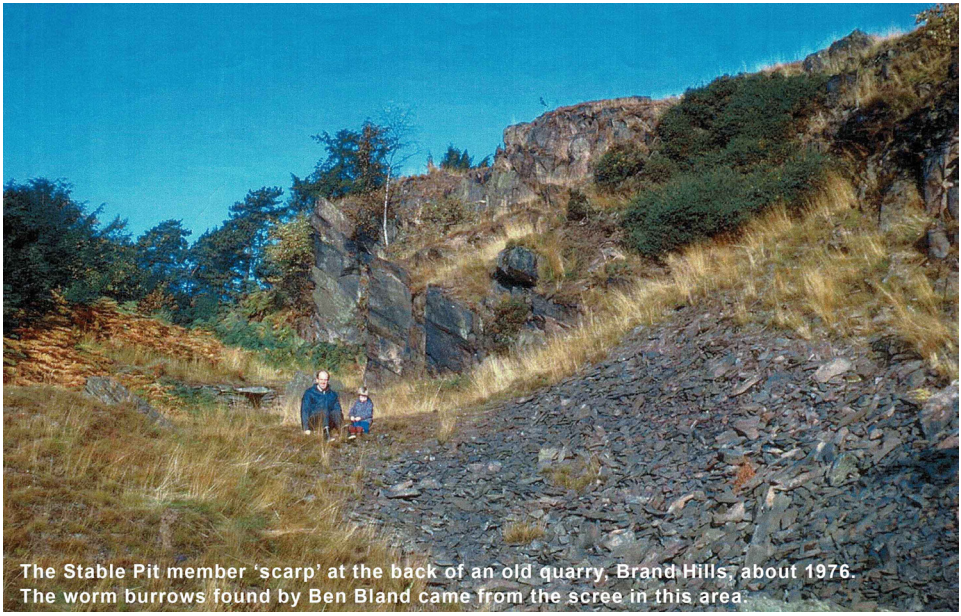
In 1977 I proposed that minerals at Alderley were precipitated from intrastratal brines in a structural trap capped by the Mercia Mudstone, possibly in a reducing environment created by hydrocarbons that migrated into the same trap. Subsequent studies have substantiated and refined this basic process. The mineralization in the Cheshire Basin is now envisaged as the product of a multistage diagenetic process in latest Triassic to Early Jurassic time (c. 205 to 175 Ma); it is now represented by numerous, mostly secondary, species.

The Brand – my work there, 1972 to the present

Helen Boynton

The Brand is a large Victorian house (1876) designed by Alfred Waterhouse. It was owned by the Ellis family (who quarried slate in the area). An earlier house was demolished because it was said to be haunted; it lay parallel to the stable pit arenite scarp – the subject of this article – at right angles to the present house, which passed to the Martin family who now own it.

I first visited the grounds in 1972. It was a perfect May day, with the wild daffodils out. I was entranced by it and went back many times over the next few years later to look at the geology, which included the type succession of the Brand Hills Formation (Cambrian) consisting of arenites, slates and conglomerates quite different from the hard grey slates of the Precambrian



The Stable Pit member 'scarp' at the back of an old quarry, Brand Hills, about 1976. The worm burrows found by Ben Bland came from the scree in this area.

Bradgate Formation below. It soon was apparent that somewhere in the Brand must be the boundary between the Precambrian and Cambrian, and this became my next aim, to find fossils and the boundary. I found one fossil but it turned out to be a slate fragment. Sir Andrew and Lady Martin died and their son Robert and his family took over the property – and, valuing the scientific importance of their property, remain welcoming to bona fide research geologists.

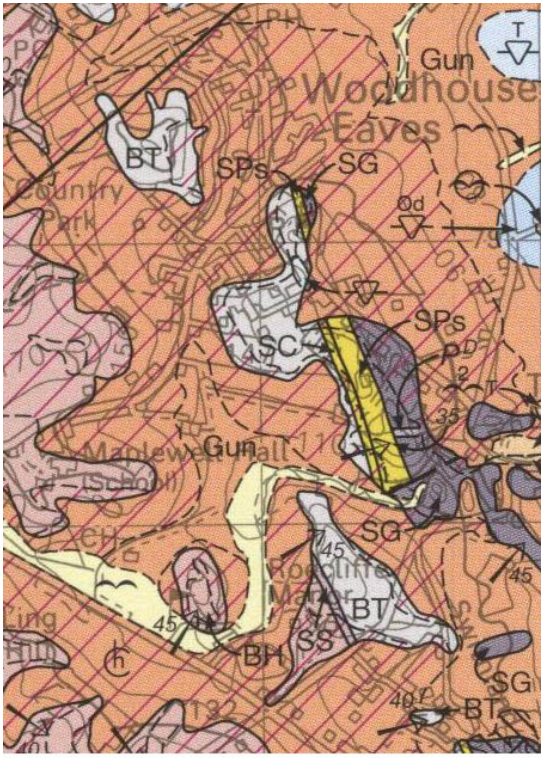
In 1996, I went back with Roger Mason, John Moseley , Ben Bland and Roland Goldring to try to solve the mystery by searching for two lines of evidence: a basal unconformity and the first signs of worm burrows

Outcrop of the Stable Pit member in the now-overgrown 'scarp', Mapped by the author as the unconformity in 1996, the angular contact (above the hammer handle) may actually be a channel at the bottom of a Bouma cycle (see text).

Photo HEB

(thought to be a global marker for the Precambrian to Cambrian transition). We thought we might have found the boundary but eventually decided it was the bottom of a Bouma cycle of sedimentation *(these are sequences of upward-fining turbidite deposits, which if complete - not having lost it through erosion at the start of the following event – are characterised by an upper layer of fine-grained, worm-burrowed sediment – Ed.)*. Unfortunately the channel at the bottom of a Bouma cycle can be confused with a more major unconformity, such as can mark boundaries of greater significance, like that (perhaps) between the Precambrian and Cambrian.

In the meantime Ben Bland had found tiny worm burrows *Arenicolites* in loose material in an old quarry in the right area of the Brand; Martin Brasier



How BGS maps the Brand. Extract from sheet 155. Yellow stripe is the 'scarp'. BT: Bradgate Fmn (Precambrian); SPs: Stable Pit sandstone (Cambrian); SG: Swithland Slate (Gun: Triassic Mercia Mdstn Gp.)

believed them to be from very near the base of the Cambrian, below the Teichichnus beds in the succeeding, definitely Cambrian, Swithland Slates. In 1996 I wrote a paper with John Mowsley in the Transactions of the Leicester Literary & Philosophical Society describing our mapping and the possibility of the Precambrian/Cambrian boundary being within the Brand estate.

However, fieldwork for new mapping by BGS in the 1990s assumed the boundary was concealed below the surface and faulted.

So this is my part of the story to date. In 2016 Robert Martin informed me that vegetation had been cleared from the crucial areas and that some of the rocks were well-exposed again, and would benefit from another investigation.

A group including Susan Cooke, Mike Howe, Gill Weightman and others are currently undertaking new fieldwork in the cleared areas and analysing samples; an update is promised for a later edition of Charnia.

Ben Bland, Roland Goldring and Trevor Ford looking for worm burrows in a wall at The Brand

Exploration for Nickel in Zambia and southeast Africa
Sourcing the power for the electric car revolution

Dave Holwell, University of Leicester

Abstract of talk on January 10th, 2018

The massive increase in the predicted shift to electric cars in the coming decades means that the demand for metals used in batteries is increasing significantly. One of the key metals required in lithium ion batteries, used to power electric cars is nickel and thus battery makers s are increasingly turning to nickel to help power growing global electric car sales. Nickel, along with other key environmentally significant elements used in the automotive industry (platinum group elements – PGE - in catalytic converters) are found in very specific geological environments. Nickel, copper and PGE are found in magmatic setting where mafic and ultramafic magmas host metal-rich sulfide deposits.

Key locations for these are around the margins of ancient cratonic crust, and one such area – between the Congo and Kalahari cratons – is a key potential site for discovering new deposits of these technologically important metals. This talk will cover the future demand of Ni and the PGE by the changing automotive industry, and by way of using Zambia and its neighbouring countries, show the key geological controls from the mantle up into the crust that are required to produce these deposits, and how we can use knowledge of these to make predictive exploration models.

SOFT-BODIED VIRTUAL FOSSILS FROM A SILURIAN VOLCANIC ASH

Abstract of talk on November 1st, 2017

David J. Siveter

School of Geography, Geology & the Environment, University of Leicester

Our understanding of the history of life on Earth relies heavily on the fossil record, and especially on rare cases of exceptional preservation, where soft parts of animals and entire soft-bodied animals are preserved. Such exceptionally preserved fossils provide an unparalleled view of animal palaeobiology and the true nature of animal biodiversity.

On-going research has recovered spectacular fossils from Wenlock Series Silurian rocks (~430 million years) of Herefordshire in the Welsh Borderland. Representing one of the rare Silurian exceptionally preserved fossil deposits, this biota of global importance contains representatives of many major groups of animals, including molluscs, echinoderms, brachiopods, polychaetes, and most especially a range of arthropods. The animals preserved are primarily epibenthic, but infaunal and nektobenthic forms are also represented. The fossils are preserved as three-dimensional calcite void-fills in carbonate nodules and are impossible to extract by standard methods. The specimens are studied using tomographic techniques to produce high fidelity three-dimensional virtual fossils that yield a wealth of palaeobiological information. These fossils are crucial in helping to fill a gap in our knowledge of the history of life and to resolve controversies about the relationships and evolution of animals still alive today.

WINTER PROGRAMME 2017-18

SPRING 2018 MEETINGS

All at 7.30 pm in lecture theatre 3, Ken Edwards Building, University of Leicester, unless shown otherwise. Doors open and refreshments served from 7.00 pm.

Details: Mark Evans 0116 454 0231 markevans@leicester.gov.uk

Wednesday February 7th

Members' Evening. Held at New Walk Museum, Leicester, LE1 7EA

Wednesday February 21st

Dr Geoff Warrington (University of Leicester) ***Mineralization in the Cheshire Basin***

Wednesday March 7th

[To be announced]

Saturday March 10th

Our Annual Saturday Seminar, University of Leicester Campus

To mark the 50th Anniversary of its discovery: ***The Life and Times of the Rutland Dinosaur***

Wednesday March 21st

The Annual General Meeting and Chairman's address by Dr Mark Evans

Tales of collapsible skulls of the Oxford Clay and more: the Cryptoclidid plesiosaurs.

What the Devil!

Roger Latham

Our ancestors when faced with unusual geomorphological features were happy to interpret them diabolically. So, in Sussex a deep dry valley on the northern border of the South Downs becomes “The Devils Punchbowl”. In the United States in Wyoming a deeply weathered basaltic intrusion becomes “The Devils Tower” and so on. So in the Eocene of Nebraska when palaeontologists discovered an unusual corkscrew formation in the sandstones they properly named it “The Devils Corkscrew”, but promptly gave it the Latin name of *Daemonohelix*.

The Cenozoic era of Nebraska was a time of increasing desertification. Around the end of the Cretaceous the rising mass of the Rocky Mountains, together with increased volcanic activity had bestowed on the northern Great Plains a very rich environment of volcanic soils leading to the creation of a savanna with small trees and bushes within which great herds of plant eating mammals and predators roamed. But as the Rocky Mountains continue to rise they blocked the westward flow of moisture bearing winds and in the Miocene the area increasingly became arid. Droughts were increasingly frequent, streams dried up and grasses withered. Around the few waterholes that remained animals gathered but died off in their hundreds and thousands leaving their skeletal remains as a boneyard to be uncovered later.

And as the climate dried up so in the ancient soil horizons the Devils corkscrew began to appear more frequently. But it was only when animal remains were found at the bottom of one of the corkscrews that it became clear that these were created by an early ancestor of the Beaver. *Paleocaster*

dug its burrow deep into the earth to get away from the scorching heat and the spiral was its staircase to the surface where it could graze in the cooler part of the day.

Paleocaster and its burrows can be found at the Agate Fossil Beds National Monument in Nebraska in the valley of the Niobrara River between Mitchell and Harrison off Highway 29. We visited it on the day when the US was celebrating a hundred years of its National Parks, and they were pleased to be able to reveal one of the rare finds of a skeleton of Paleocaster which had been recovered from the much-eroded remains of its burrow. With the animal was also found fragmentary remains of an early rat, although whether this was a cohabiting of the beaver's burrow or a later scavenger is not clear.

Petrophysics in the kitchen
Cooking and baking tips for the festive season

Mike Lovell, University of Leicester

Abstract of talk on November 15th 2017

*Petro*physics is strictly, *rock* physics, and is the study of rocks at varying temperatures and pressure, over a period of time; the importance of the fluids cannot be overstated. Many of the concepts also apply in the kitchen, where a chef or cook can conjure up through art and/or science, a magical feast from seemingly simple ingredients. The range of food produced by an eminent chef, whether he is the angry one or the mad-scientist one, or she be the Nation's treasure or simply a domestic goddess, is staggering. But this phenomenal range is perhaps equalled only by the strange and unusual behaviour in nature, in the distribution of gas, oil and water within a reservoir formation.

This talk looks at how *Petrophysics* is at times analogous to the physics and chemistry experiments we undertake in the kitchen and how understanding the properties of the components and their behaviour with temperature and pressure is the key. From stale bread to that perfect soufflé; a soft boiled egg to a perfect cold beer; all are underpinned by the interaction

of solids and fluids at varying temperatures and pressures. And of course, we shouldn't forget the peculiar properties of water which also affect the behaviour of reservoir fluids, and how the addition of salt to water may be significant, or not.

So come along for some topical tips on how to survive the festive season in the kitchen and an introduction to the wonderful world of petrophysics.

Rest assured, while there may be such a thing as a naked chef, on this occasion there will be no naked petrophysicist!

An Edwardian photograph by W. W. Watts, the first official Geological Survey mapper of Charnwood Forest. It shows the Stable Pit Member 'scarp' at The Brand, which has been studied since 1972 by Helen Boynton and others in a project to establish the location (if it exists) of the important Precambrian / Cambrian boundary in Leicestershire. See p.3

Previously unpublished photograph in the BGS archives, courtesy Mike Howe

A mammoth task

Roger Latham

"Take me back to the Black Hills/The Black Hills of Dakota" sang Doris Day in the film Calamity Jane. To the south of the Black Hills there is the town of Hot Springs – so-called because of its hot springs, surprise, surprise. And in the town of Hot Springs there is a most unusual site – a mass graveyard of mammoths which is being excavated. So far 61 mammoths, mostly Columbian mammoths but including some woolly mammoths have been uncovered.

The Black Hills stand out from the Great Plains because from a distance they look black – largely because of extensive pine forests – against the beige brown vegetation of the plains. They are a denuded anticline – see the sketch geological outline – and at the core are intruded granites shouldered by schists. The granites protrude through the overlying Palaeozoic limestones, which in their turn were overlain by Triassic sandstones. Orientated north-west to south-east they are 125 miles long and about 65 miles wide, the centre of the dome being about 3000 to 4000 feet, with the highest point at Harney Peak at 7242 feet. Where the Triassic sandstones meet the limestones, there is a broadly oval valley around the Black Hills heavily utilised for transport, and known as the "red racetrack".

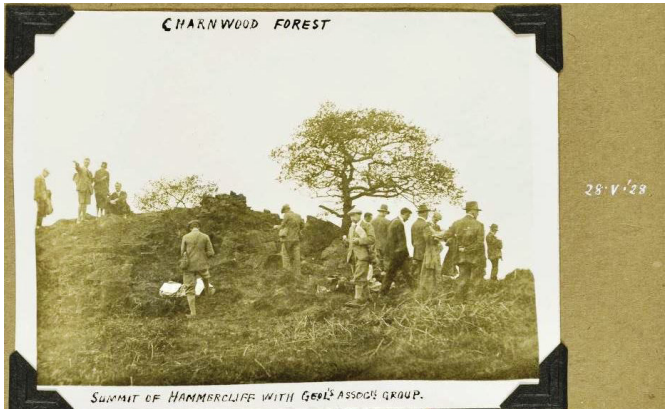
Hot Springs lies at the very bottom of the oval in the "red racetrack", but only a short distance away from the limestone plateau. Like all limestones the plateau has been heavily eroded with complex cave systems such as the Wind Cave National Park that was revered by the Native Americans, for whom the Black Hills represents a sacred site. Hot Springs is founded at the point at which the water flowing through the limestones emerges on the surface to flow into the Cheyenne River, and given its crystalline core the springs are warm, which allowed the development of a spa -like town.

The mammoth site which lies just on the outskirts of Hot Springs was created where a limestone sinkhole collapsed inwards as the water flowed below the surface to a spring, and the sandstone and overlying Loess clays of the Great Plains collapsed into the sinkhole creating a muddy waterhole. About 26,000 years ago this waterhole proved an immense attraction for mammoths that grazed on the Great Plains area created by the Loess deposits that came from the wind blowing off the sheet glaciers to the north. These mammoth plains constituted a dry cold desert, the result of a constant wind blowing over a landscape where precipitation was tied up in ice. The problem was that the mammoths could easily get down into the waterhole to drink, but unfortunately when they tried to get out the clay slippery sides meant that they were unable to climb back onto the plain. Over the years numerous mammoths of all sizes and shapes died and their bones were scavenged before falling to the bottom of the sinkhole to be covered with fresh clay deposits. The predators, who are not extensively found at the site, were clearly able to scramble back out of the waterhole when the mammoths could not. Apart from the mammoths the only other animals found extensively at the site are short faced bears which being around 50% bigger than the average grizzly bear sometimes equally found themselves unable to scramble back out.

The site was discovered in 1974 when the area was purchased for housing development. Almost as soon the excavators had started they hit mammoth bones, and when it became clear that this was a major palaeontological site a publicly spirited developer donated the site to the town of Hot Springs and excavation began. When I went there back in 2016 I was completely ignorant of the size and nature of the site, and missed out on the opportunity to join in one of the daily palaeontological excavation opportunities that a commercially minded museum offers to children and adults alike. The site is truly spectacular, and continues to give up mammoth bones, which are largely male, probably because herds of mammoth were largely matriarchally led, with a single bull mammoth, which meant that large numbers of juvenile and adult males roamed independently of the herds, and so there was no help for them when they fell in the mud and got stuck. So many mammoths have so far been recovered that the site is able to show a full range of eruption of mammoth teeth from juveniles through to adults.

Seen in *Earth Heritage* 48

The Carreck Archive is a record of the Geologists' Association (GA) field activities from the 1890s to the present. It is mostly albums of black and white photographic prints from a range of GA field meetings, with named locations, sections, and pictures of GA members on those excursions. Other material includes albums of negatives, bundles of photographic prints and other ephemera relating to the GA, e.g. menus from the annual dinners, postcards, letters etc. — all very interesting material for historians of geology.



Some of the photographers have Leicestershire connections, and some of the excursions were to sites in our region.

The Carreck archive is at: https://www.geologistsassociation.org.uk/archive.html

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