Buckinghamshire Geology Group

Newsletter No 35 September 2020

Hands-on ammonites

Brief Encounters at The Lee

Bucks in a 100 Objects

Refreshing the past at Great Linford

Membership and Events News

Our first event of 2020, a 'hands-on ammonites' workshop, went ahead as planned. Our second event, a trip to Northmoor Hill, was delayed (only for a couple of weeks, we thought) due to high winds and then lockdown brought everything to a shuddering stop.

With this interruption to the 2019-20 membership year we decided (obviously) not to seek membership renewals on 1st April 2020, deciding instead to roll membership over another twelve months to 31st March 2021 in the hope that we would be able to recommence our events programme at some point in the year.

Jill is ahead of the game here, having already run a socially distanced field meeting to Great Linford for the MK Parks Trust. We are hoping to run a few field meetings in the coming weeks and months along with a talk on volcanoes via Zoom in lieu of the hands-on volcanoes workshop originally planned for this autumn. More details to follow.

From the Editor

Write-ups of events usually makes up a large part of each newsletter. While we do have three write-ups in this issue, two from the tail end of 2019 and our first event of 2020, it was clear that for this issue we would need to look elsewhere for content. I am pleased that members have helped by providing a range of articles for this newsletter. In fact, I have had more than I can squeeze into this issue and so, have saved some for the next newsletter.

Articles include a review of what Bucks has to offer geologically, an intriguing fossil find at one of last years field meetings and geological observations from members' wider travels.

Two new projects have also provided further copy.

Looking at ways in which the Group can join in with wider county-based projects leads us to ***Bucks in a 100 Objects*** and provides an opportunity for us to fly the flag for our local geological heritage.

And looking at how individual members can discover and share aspects of the local geology all around us leads us to ***Brief Encounters with Bucks Geology***. I hope, with the help of members' participation, to produce a regular column for successive newsletters, building up into a compendium and gazetteer of local geological miscellanea.

So, read on. And if this newsletter prompts any ideas for future articles, short or long, please do send them in.

Mike Palmer

From the Museum

A fairly common question asked of the Group is *'where can I find fossils in Bucks?'*. While we fully intend to produce a short article on this topic, I thought a complimentary approach would be to share some of the fossil enquiries I receive as Keeper of Natural History and Geology at the County Museum.

A classic Portland Limestone fossil

I was recently emailed photos of four fossils found in and near Aylesbury, three from fields near Coppice Park on the north eastern edge of the town and a fourth near Stone.

One of four fossil bivalves found in and near Aylesbury

All were examples of *Protocardia dissimillis*, a characteristic bivalve fossil of the Portland limestone. These are reasonably- sized fossils with examples in the Museum's collection measuring between 5 – 9cms wide. I remember a previous identification request leading me to the

site manager's portacabin on the, then, building site for Haddenham Business Park to find several *Protocardia* being used as paperweights for the site plans.

Protocardia are described as infaunal bivalves, meaning that they burrow into the seafloor sediments. They date back around 144 million years to a time when 'Buckinghamshire' was covered by a warm, shallowing sea in which limestones and sandy sediments were being laid down. Today, Portlandian strata form the mid vale ridge that runs across Aylesbury Vale from Brill to Aylesbury.

This enquiry demonstrates that if you look around areas underlain by Portland limestone you may, if lucky, come across a range of Portlandian fossils including *Protocardia.* Examples found within the soil are likely to be the result of previous excavations and building works.

For examples of typical Portlandian fossils visit the Group's website (www.bucksgeology.org.uk), click on the Bucks Geology tab, select Portland Formation and scroll down to see a small selection of fossils which, somewhat surprisingly, doesn't include *Protocardia*!

Protocardia, like many of the Portlandian fossils, are commonly found as internal moulds. While alive, the animal would open its shell slightly to allow filter feeding, closing tightly when threatened. When dead, this ability would be lost and so small gaps between the two valves would allow calcium carbonate-rich sediments to enter and, over time, preserve the internal form of the shell. Over more time, the original shell slowly dissolves leaving only the internal mould as a record of the animal. As such, we can only guess what the external shell looked like.

Mike Palmer

From the Ashes

Not all geological finds are so straightforward. A couple visiting the Museum Resource Centre at Halton prior to lockdown brought in a small, reddish, disc-shaped object found while cleaning ash out of their fire-grate. Unusual markings on the surface led them to wonder if this was part of a fossil plant.

On seeing the object several questions came to mind. Firstly, how did it get into the ashes of a coal fire? We can only assume that the object came in with the coal, either within a piece of coal or covered in coal dust, so as to go unnoticed. Unfortunately, the source of the coal was not known and so, no clues there.

Secondly, did the marking represent some form of fossil preservation. In short, the markings bore no resemblance to any fossils in the collection. Circulating the image to committee members confirmed the view that the markings were more likely the result heat from the coal fire.

The final question was the most difficult – what exactly was this object? Both the colour of the object and the reddish streak when scraped on the back of a tile pointed to a high iron content. Suggestions included Limonite and an iron-rich clay, however, internet image searches on these failed to provide anything matching the object in hand. And so, for the time being at least, we are left with educated guesses with some form of Ochre being the best. Ochre is an iron rich pigment produced by heating iron oxide or iron-rich clays. It is perhaps most famous for its use by Palaeolithic man in cave paintings.

Not all enquiries have straightforward answers but hopefully, at some point in the future someone will be able to come up with a more definitive answer.

Mike Palmer

Bucks in 100 Objects

Bucks in 100 Objects is a new project developed by *Buckinghamshire Culture*, a partnership that is looking to promote the creative, cultural and heritage sector within Buckinghamshire. Their website describes the project thus: -

'Buckinghamshire has a rich collection of artefacts dating back over 300,000 years held in Museums, stores, archives, National Trust properties, stately homes, landscapes and gardens across the county. Taken together these objects tell the story of Buckinghamshire. And there are even more objects which help to define us and tell our story – many of these might be sitting in our high streets, riverbanks or in people's work-places – or even hospitals.

Buckinghamshire Culture has created an online campaign in response to Covid-19 that feeds into a larger project idea to develop the story of ***Bucks in 100 Objects****. Eventually, we want to create an exhibition, publication, county trails and a website sharing the wonderful objects and heritage that can be found across Bucks, but for now we want to use this idea to develop connection, a sense of community and local pride. We have asked a handful of proud Buckinghamshire residents to nominate objects they would like to see included in the final 100 and will be sharing these via social media, inviting further nominations and discussion.*

Eventually, we hope to hold a public vote to help decide the final 100 objects. This is just the beginning…'

You may have noticed the opening line *'Buckinghamshire has a rich collection of artefacts dating back over 300,000 years'.* Rocks, fossils and minerals may not be artefacts in the literal sense, but I think they have something to contribute the '*story of Buckinghamshire'* and so, we can really push back further in time.

You can see the nominations to date by simply clicking on buckinghamshireculture.wordpress.com/bucks-in-100-objects or simply typing *Bucks in 100 objects* into an internet search. Some inclusions seem to stretch the definition of 'an object'. Have a look and see if there are any geological objects you would like to nominate for the final vote. The project states that the nominations must be for:

- *Physical objects in within Bucks* (I have checked, Bucks means historical Bucks rather than the current administrative area covered by Buckinghamshire Council)
- *Objects that hold some kind of heritage, cultural or community value* ('Heritage' used to be our middle name, in the days of the Bucks Earth Heritage Group.
- *Available to be photographed/videoed if not actually on display*
- *For objects suitable for people of all ages*

To make a nomination simply send a description of the object and why it is important to Buckinghamshire (up to 500 words) along with a digital image (up to 4MB) to culture@buckscountymuseum.org

Caldecotte Ichthyosaur, Milton Keynes Library Reference Library

Geological nominations so far include a Roman puddingstone quern (geology meets archaeology), the Marsworth Ice Age lion jaw (both of which will be displayed in the new Discover Bucks Geology gallery) and the Caldecotte Ichthyosaur that hangs on the wall of Milton Keynes' reference library.

Roman puddingstone quern from Hambledon

But what of the Soulbury erratic, on display in the middle of a village road, the Watermead Pliosaur, discovered as a result of plans to build a dry ski slope in Aylesbury, or the numerous *Titanites* ammonites displayed in walls and building across mid Bucks. Or why not really push the clock back with the piece of Tremadoc Shale, dating back 490 million years ago, retrieved from the bottom of a 1,200 foot deep borehole sunk in Calvert in 1911. You may have your own ideas of what to nominate. Unfortunately, there is only one nomination per person. Whichever way, let's fly the flag for Buckinghamshire's geological heritage.

Mike Palmer

Geology in Bucks

Many years ago, when talking to a Scottish geologist about our passion for walks in our local area looking at geology, they enquired where I lived. I told them Buckinghamshire and their reply was "oh you poor thing!". Their impression was clearly that there was no geology to be seen in the County. Admittedly it is not as open and exposed as some more rugged areas or counties that have coastal exposures, but there is plenty to be seen. You just have to hunt a little for it. The age for our geology ranges from Jurassic to Quaternary for the rocks directly under our feet, but also with lots of geomorphology and building stones. To this mix you can add the beautiful scenery which would enhance any visit to Bucks by my Scottish friends. Nature is very influenced by soil type and, of course, rocks make soils. This is a common theme on our walks.

Thinking about this comment recently, while in lock-down during the COVID pandemic, I realised we have a lot of new members who may not know why the Bucks Geology Group started (which was in the early 1990s). We were called the Bucks Earth Heritage Group then – the name reflecting our interest in the natural history that lived amongst, on, or in the geology. It encompassed all our heritage from old brick kilns, quarries, cement industry to drovers and other ancient trails. We still work to that remit, just with a more friendly name!

The group has always been a conservation group. At the time of my chat with my Scottish friend I was lecturing geology with the Open University (and still am). I became aware of fewer and fewer sites available to take my students to for training. I also led geology walks for the general public and schools, but open geological sites were degrading over time or being infilled. We were losing our local geology – so time to move!

Combs Quarry during the 2007-8 clearing work

Having assisted Bedfordshire in setting up their group, I turned my eyes on my home county. Natural England advised on criteria to record the geology county by county and thus the RIGS groups were set up nationally (Regionally Important Geological and Geomorphological Sites). Since that time the RIGS sites have become called Local Geology Sites (LGS) to fit alongside the biological scheme (LBS). Getting on the system at the local councils is important meaning that the group is notified of any danger to a site that comes through the Planning Department.

The aims of the group were set up to combine three key elements after locating the best sites in Bucks to work with:

1. To undertake conservation work ensuring we manage our geological heritage for the future.

2. To research key themes such as the Ice Age, site recording and stratigraphy, and chalk streams as examples of many.

3. To educate the public and scientific communities through visits, workshops, talks and published papers.

Over the years we have been busy undertaking regular site reviews, conservation work, lottery-funded projects, running open events for the public and geology talks and walks, amongst many other activities.

The Bucks Geology Group now has 33 designated Local Geology sites with 26 in modern-day, administrative Bucks and 7 in Milton Keynes. Some of the key sites are listed here:

Buckinghamshire:
Beacon Hill, Ellesborough
Bradenham Sarsens
Brill Hill
Buckingham Sand Pit
Burnham Beeches Gravel Pit
Cliveden Caves
College Lake
Coombs Quarry, Thornborough
Downley Common
Hartwell Estate Walls
Holtspur Bank LNR
Ivinghoe Beacon to Incombe Hole
Northmoor Hill
Soulbury erratic
Stowe, Home Farm Pit
Whiteleaf Cross Nature Reserve
Whiteleaf Quarry

Milton Keynes:
Bradwell Abbey
Great Brickhill, St Mary's
Great Linford stone circle and quarry
Haversham Mill River Bank
New Bradwell Railway Cutting
Stony Stratford Nature Reserve
St Peter and St Paul's, Olney

College Lake - a BBOWT nature reserve in an old chalk quarry, and with a fascinating history. Here the gravels overlying the Chalk show a really good ice wedge.

Many of these sites that may be visited (either as individuals or as a guided group) are on our website www.bucksgeology.org. We often arrange trips to the most accessible sites and regularly open up those sites that need permission to visit.

Great Linford Quarry after the 2018 re-opening work (to be repeated this year hopefully!)

We will continue with our conservation work and visits later this year – opening up, maintaining and enhancing sites, and providing interpretations such as leaflets or web information sheets. This year's special recording site is Home Farm Pit at Stowe which will be a guided recording session (suitable for all abilities and more details to follow). This site is definitely Ice Age, but we do not know what environment laid down the sediments on site. Our recording work will hopefully lead to a more informed interpretation.

Our walks range from adventurous half to full day treks for the ramblers amongst us, to short 1-hour walks in the countryside often incorporating a quarry visit and/or buildings stones walks. These are a great way to appreciate the geology beneath and above our beautiful Buckinghamshire landscape.

Beacon Hill – no exposed rock here, it is all lumps and bumps of the landscape which can be interpreted.

As soon as we are released from lock-down we have an exciting and varied programme on offer. Keep your eyes on our events page – as I am sure you will want to join in! Happy geologising!

Jill Eyers

Brief Encounters with Bucks Geology

Brief Encounters… is a title for what I hope will become a regular and ongoing column in future newsletters aimed at exploring the numerous and varied small aspects of Bucks geology dotted all over Buckinghamshire. It is very much a working title and was itself preceded by *I Spy Bucks Geology*. While I feel both have a catchy plagiaristic ring to them, whatever the column ends up being called is less important than the body of knowledge that I hope, with your help, we can compile issue by issue - as described in the editorial, a compendium and gazetteer of Bucks geological miscellanea.

It could be said that the newsletter has been exploring aspects of Bucks geology since its inception back in 2008 through the many write-ups of field meetings, town walks and quarry visits, etc. While this is true, I am looking to explore those small pieces of geology that crop up as you're walking down the road, cycling through a village, or visiting a historic building – ammonites in walls, puddingstones in parks, rough-hewn commemorative monuments on village greens.

A puddingstone compilation on the village green at the Lee. When, where were these put here and by who?

Examples of some of these have already featured in our geological walks but there are far more out there than will ever be covered by the Group's event programme. Uncovering further examples will rely on a local eye and inside knowledge to provide the background stories. And so, this project will rely on your help and the input of the wider membership to flag up further examples and furnish what is already known.

Having spent time looking into various local geological manifestations and starting draft gazetteers, questions start to arise.

For example, how many large, wall-mounted ammonites are known in Bucks? What does their distribution tell us? Are they found beyond our borders? What is known of their history? What is known about the ammonite itself?

Bowel stone and ammonites at wall of Hartwell House

What else can you find displayed in walls? Past Group events have revealed bowel stones and, more commonly, pieces of puddingstone. Closer inspection shows that not all these puddingstones are the same. What different types can be found?

Larger lumps of puddingstones are also found on village greens and in town parks. Some, such as those seen on last year's trip to Bradenham, have been moved from their original location to the edge of the village green for convenience, while others have been specifically placed to create a local feature. Past surveys of puddingstones have been undertaken, both by BGG members and independent researchers. What information can be distilled from these works to aid wider understanding?

The Soulbury erratic. What other 'wandering stones' can be found in Bucks?

The Soulbury erratic, a 300 million year old piece of Carboniferous limestone, is also a notable local geological feature that made the national news in 2016 when an insurance claim by a car driver threatened its continued middle of the road position. Are there any other Ice Age erratics in Buckinghamshire?

What of the more common modern 'travelled' stones. Numerous memorials, roughly hewn from local, and sometimes, not so local stone, can be found across Buckinghamshire mimicking ancient menhirs. What rock are they made from? Why was this rock chosen? Does this link to their purpose?

Are there any real prehistoric standing stones in Buckinghamshire? How old is the Dog Stone, standing adjacent to High Wycombe's Guildhall? Why was it put there? What is it made from?

How long has the Dog Stone stood in the middle of High Wycombe?

Stones have often been used as boundary markers. What local examples are known? Some stones acquire names that suggest forgotten stories. What is the story behind the Witch's Stone at Highwood Bottom near Speen? Or the roadside stone marking the 'King of the Gypsies Grave' near Pitchcot? What rock-types are involved?

Geology is reflected in our local buildings. The Group have been involved in building stone surveys in the past with close inspection of assorted stonework forming a key part of group-led town walks. From a *Brief Encounters* point of view, I am interested in identifying local buildings that stand out as being different, interesting designs featuring local and / or introduced geology. Where are our most interesting buildings, geologically speaking. The geometric patterns of chalk and flint employed in the Chequerboard House in Princes Risborough, visited on a Group trip several years ago, is one candidate. Another is Husborne Crawley church with its surprisingly green Lower Greensand blocks. I know that Husborne Crawly is in Bedfordshire but it is so close to the county border that I am happy to include it (along with any other near-Bucks examples for this project).

Exceedingly green Lower Greensand at Husborne Crawley church

I am also happy to explore imported geology, whether it is the introduced limestone outcrop at Waddesdon Manor, the exotic stone of the Stowe Gardens Grotto or the slate of Richard Long's 'stone circle' at Ascott House.

Representations of prehistoric life in art may be loud and proud – see the Milton Keynes Triceratops for example – or it may be hidden away in the detail of a stained-glass window like

the ammonites at Little Missenden Church. What other examples can be found in or near Bucks? What are their stories? Why are they here (and there)?

Ammonites at Little Missenden Church

I hope that this article provides some idea of the geological avenues I am hoping to explore in future newsletters. There are many lines of investigation, more than can be covered in this summary. If you know of any examples you feel might fit the bill, please send them in.

In the next newsletter I am planning to provide a provisional gazetteer of *Titanites giganteus* ammonites found in walls around parts of Buckinghamshire along with any currently known information. If you have any examples, images or information relating to these please send them in.

We will also discover why rocks from Switzerland have found their way into Quainton churchyard and begin the search for Buckingham Marble.

Mike Palmer

What's in Store, Saturday 19th October 2019

The limited space within the geology store at Bucks County Museum's Resource Centre meant that numbers had to be restricted to a select few on a first-come, first-served basis. However, the plan is to run this look behind the scenes on an annual basis to allow more members to explore these hidden collections.

The County Museum Resource Centre at Halton started off as a temporary store in 1989 while the Museum in Aylesbury underwent major renovation works. It was soon realised that if the stores stayed at Halton there would be more space for public galleries and so, the bulk of the collections have remained behind the scenes at Halton ever since.

Looking into the geology store

Walking down the long central corridor past room after room, attendees were able to visualise the building's former use as a 1930s-built primary school. On reaching the classroom-sized geology store Mike estimated the main collection to number around 7,500 rocks, fossils and minerals. These had been amassed over the last 140 years by a combination of individual donations, collection bequests and fieldwork by former staff and associated individuals including from current BGG members.

Mike began by looking at the Ice Age mammal collection. While this includes material collected from across the County it is massively augmented by fossils excavated from the former Pitstone Cement Works, Quarry No 3 near Marsworth, perhaps better known today as College Lake Nature Reserve. Most of the specimens are boxed, however, Mike was able to reveal two-star items - a lower jaw of a Woolly Mammoth, complete with two molars, and the lower, right jaw of a Steppe Lion.

Lower jaw of a mammoth from College Lake

This collection is of international importance for providing evidence of a previously unknown interglacial episode around 200,000 years ago. Mike noted how the collection had provided a resource academic research. Recent examples included the variation in the size of Ice Age horses and the use of vole teeth for dating deposits. Over the last few years researchers from the Natural History Museum and Oxford University have identified two different species of mammoth in the collection from studying molars. It was thought that Steppe mammoths died out before the Woolly Mammoths arrived in Britain but evidence from this small, former classroom show that the two species co-existed at the foot of the Chilterns 200,000 years ago.

Moving on to the numerous drawers housing the Jurassic and Cretaceous collections, Mike compared an Ichthyosaur vertebra with another from a Plesiosaur, the former being thinner and distinctly concave. Both were dwarfed, however, by the massive vertebrae from the Pliosaur (*Pliosaursus* sp) found at Watermead in 1987.

Some of the most impressively preserved fossils were of bivalves from the Hartwell Silt Member. These included specimens collected by Dr John Lee for his private museum at Hartwell House in the mid-19th Century.

Thracia depressa bivalve from the Hartwell Silt Member. Note the fragmented preservation of the original shell, a 150 million years later!

The quality was, in part, due to the sealing effect of the clay during fossilisation, helping to preserve the real shell material. But it was also due to their means of collection. Lee would have spoken to local workman excavating clay from the local pit by and paid them for any nice fossils they came across. It is good to know that due to the combined efforts of the workmen, collectors and former curators, that these marvellous fossils can still be seen today 170 years after their collection (and a 150 million years after their original deposition).

Particularly notable fossils were the Type Specimens of a prehistoric fish, *Pleuropholis serratus*, again, collected by Dr John Lee in Purbeck Limestone at Hartwell. Type specimens are key to defining species of plants and animals, past and present. Every species known to science should, in theory, have a description based on a Type Specimen stored in a museum.

Type specimen of Pleuropholis serratus fish from Hartwell

Further drawers were opened revealing a range of fascinating Bucks fossils, rocks and minerals before Mike moved on to the 'Historic Collections', a term used to describe non-Bucks specimens collected by people with a strong Bucks link.

Imprints of raindrops from the Connecticut River valley in America

Amongst many fascinating examples was a specimen of '*fossil raindrops imprints from the Connecticut Valley'* collected by Gideon Mantell, a geologist most famous for nearly being the first person to describe a dinosaur (before the term

dinosaur had even been coined). Unfortunately, his description of an Iguanodon (1825) came just after that of William Buckland's Megalosaur identification in 1824. So how did this unusual fossil raindrop fossil make it into the collections of Bucks County Museum? Once again, we have the inimitable Dr John Lee of Hartwell to thank for this.

Before leaving the store, Mike pointed to a large number of boxes located in the upper reaches of the racking. These contained the museum's handling collection comprising a range of material which, for reasons of provenance, data quality or duplication didn't fit the criteria of the Museum's collecting policy for the main collection. The collection, however, includes individual specimens of geological merit along with a pool of handling material with potential for use in school activities and public events (including those run by the Bucks Geology Group). And it is to this end that that committee members Jill Eyers and Ian Hudson have been working through and refining this collection. If you would like to join them in this work let me or Jill know.

A 400,0000 year old Palaeolithic hand axe from Burnham made by an ancestral Neanderthal.

The visit ended with a look at some flint specimens – a selection of Palaeolithic hand-axes kept in the Archaeology store. Mike explained how some examples from Burnham had been found in Ice Age river terraces dating to 400,000 years ago. These pre-date the arrival of our own species in Britain 40,000 years ago, and where made by ancestral Neanderthals.

And so, some ninety minutes into the hour-long tour, our visit came to an end.

Mike Palmer

Stories in Stone, Saturday 16th November 2019

Ten members and guests joined Jill at the County Museum's Resource Centre, Halton for this hands-on- rocks workshop, a follow-on to Jill's *Wonderful World of Minerals* workshop at the beginning of the year (see Newsletter No 33, July 2019).

Jill began the session with a quick look at some common minerals and their identification noting that because rocks are made from one or more minerals, identifying the component parts is essential for identifying the rocks themselves. Important characteristics to look for included mineral hardness (1 to 10 on the Moh's hardness scale), lustre, cleavage (lines of weakness), crystal shape, twinning and streak (the colour produced when rubbing the mineral along a slightly rough surface such as the back of a tile). The application of dilute acid (5% Hydrochloric acid is best) helps to identify carbonate minerals such as Calcite (Calcium carbonate) with bubbling, as a result of the release of carbon dioxide providing an affirmative answer. Colour can also be useful but is not always reliable as mineral colours can vary with impurities, e.g. the many colours exhibited by quartz. With this information in mind the group worked through a flow chart to identify seven common minerals found in rocks.

Moving on to rocks, the first question was how to tell if the rock is sedimentary, igneous or metamorphic. As a rough guide, if the rock can be seen to be made from particles or grains (i.e. the sediments that have collected to form the rock) then, it is sedimentary. If the rock contains fossils, then, it is certainly sedimentary as fossils would not survive the heat involved in the formation of igneous and metamorphic rocks. Igneous and metamorphic rocks have a crystalline texture although this can be difficult to spot in rocks with extremely small crystals. If the crystals are arranged randomly this would suggest the rock was igneous while if the crystals appear to be aligned then it is likely to be metamorphic, however, this is not always easy to see.

Three sedimentary rocks

Top: *Millstone grit*
Middle: *Fine grained sandstone*
Bottom: *Crinoidal limestone with visible fossil content*

Looking more closely at sedimentary rocks, Jill described how the component grains can be cemented together in different ways. For example, silica, calcite or iron are common cements while, albeit more rarely, clay cemented rocks also occur. The size of the grains is also helpful to name the rock – grains visible with the naked eye suggest sandstones and conglomerates, those visible through a hand lens being finer sandstones, and those not visible being mudstones including clays and shales. The application of dilute acid was, again, useful for identifying limestones (and the calcium carbonate therein). Assorted sedimentary rocks were handed out for the group to work through using a flow chart.

Moving on to igneous rocks, Jill noted these are all derived from molten magma but occur in a number of forms such as ash, ignimbrite, lava flows or intrusions. Rocks that have formed from magma that has reached the surface, such as basalt, cool much more quickly leaving little time for crystal growth. As a result, they have very small crystals. These are called extrusive igneous rocks. On the other hand, rocks that form from magma that cools underground (in magma chambers), such as granite and gabbro, cool more slowly allowing the component crystals to reach larger sizes and are generally visible to the naked eye. These are called intrusive igneous rocks

Two intrusive igneous rocks exhibiting large crystal size

Top: *Granite.* Bottom: *Gabbro*

Jill humorously suggested that making igneous rocks was like cooking. The magma - with the ingredients being the different chemicals and minerals present can be processed numerous ways. A broad division within igneous rocks can be based on the levels of these ingredients.

Felsic rocks (as in **Fel**dspar and **S**ilica) such as granite are rich in silica. **Mafic** rocks such as gabbro and basalt are rich in **Ma**gnesium and iron (denoted chemically as **F**e). Rocks that fall in between these two extremes, such as Andesite, are known as intermediates.

As a result of the different minerals present, colour can be a useful tool for identifying igneous rocks. Mafic rocks may have a lot of pyroxene, giving them a black colour, and olivine, giving them a green colour. Felsic rocks have a lot of feldspar and quartz giving them a whiter or pinker appearance.

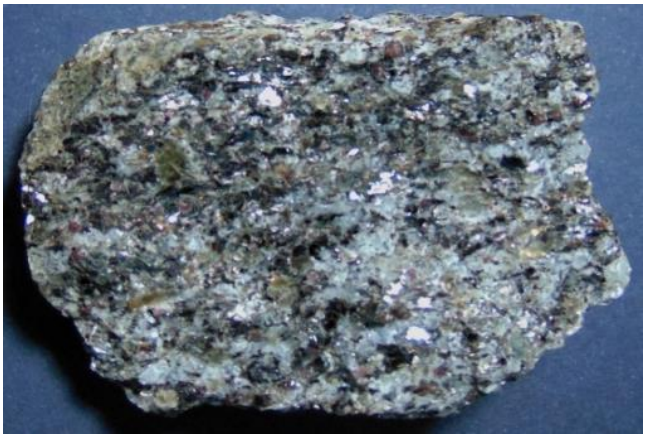
Peridotite. An ultramafic rock containing olivine and pyroxene

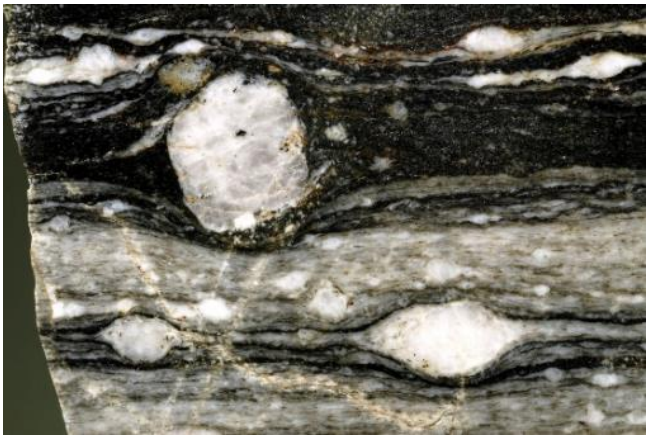
Metamorphic rocks are literally rocks that have 'morphed'. They may form in small amounts by just heat alone (along faults or around magna intrusions). However, most form by building mountains. The metamorphic rocks beneath mountains are called 'regional metamorphic rocks' and form by both heat and pressure.

Any metamorphic rock may have formed from igneous or sedimentary rocks. Limestone morphs to marble, sandstones and granite transform to gneiss, pure sandstone to quartzite and so on.

As the rocks morph they alter their minerals – absorbing the old minerals and forming new, different, ones. Some minerals can only form once a certain temperature or pressure is reached by the rock – garnet is a good example which can only form at high temperatures. Geologists use these key minerals to discover a rock's history. Remarkably, although the minerals change, and the rock totally changes its appearance, the chemistry stays the same.

We all know what slate and marble look like (two good examples of low temperature and low pressure metamorphism). Below are two lovely examples of higher metamorphic grade rocks – schist and gneiss. Note gneiss is formed at such high temperatures it is just one step away from being melted – forming another rock called migmatite.





Two metamorphic rocks

Top: *Schist – a metamorphic rock formed from shale*
Botttom: *Augen gneiss - note the large knots of white feldspar which are growing in the rock*

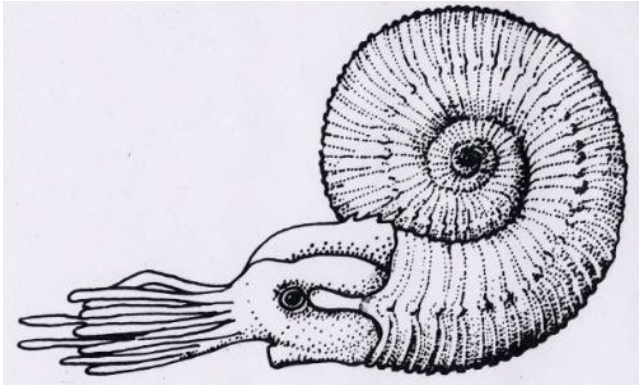
Mike Palmer / Jill Eyers

Ammonites: Evolution, Diversity and Identification, Saturday 15th February 2020

Nine members and guests met at the Museum Resource Centre, Halton for another of Jill Eyers' hands-on geology workshops.

First question, what are ammonites? Jill noted that their fossilised, coiled shells are reminiscent of some modern-day snails, however, while snails and ammonites both belong to the mollusc phylum, they have a totally different internal structure. Jill passed around a cross-section of an ammonite showing how the internal shell was divided into a series of chambers. Snail shells have no internal divisions. Snails belong to a group of molluscs known as the gastropods while ammonites are members of the cephalopods with modern-day members including octopuses, cuttlefish and squid.

The closest living relative to the ammonite are the nautiluses – a small group of marine creatures defined by their coiled, chambered shell and betentacled head. The fossil record (so far) doesn't provide any evidence of ammonites having tentacles but based on modern-day relatives, it is assumed that they did.



Showing the cross-section of an ammonite, Jill explained that the animal lived in the largest and outermost chamber. As the ammonite grew, so the shell extended, sealing of the previous chamber. It was asked if the number of chambers could be used to tell the age of an ammonite. Jill noted that the while the greater the number of chambers, the older the animal, it is unknown at what rate the ammonite produced new chambers and so, impossible to quantify an age this way.

Ammonite cross-section

Looking at the cross-section of a nautilus shell we could see that each chamber was connected to the next by a hole in the middle of the chamber wall. In the living animal this would have been occupied by a tubular structure known as the siphuncle. Similar holes were present in ammonites although these ran though the outer edge of the chamber wall rather than the middle. This interconnection between chambers allowed ammonites to vary the levels of gas and fluid in the chambers and thus, control their buoyancy upwards or downward like a submarine.

Nautilus cross-section

Although ammonites appeared only 200 million years ago (Ma) their ancestors date back to a largely overlooked group of straight-shelled fossils, known as the Bactritina, that lived during the Devonian 415ma. From these came early coiled cephalopods including Goniatites (400 to 250 Ma) and Ceratites (325 to 200 Ma). Ammonites, themselves first appeared 200 Ma, becoming extinct 66 million years ago at same time as the dinosaurs. Jill provided a handout showing how, as these animals evolved over geological time, noting how the suture lines became more complex over geological time.

Orthoceras – an early Palaeozoic form, straight, not coiled.

Goniatite fossils – note curved, looped, sutures

Ammonite showing the much-convoluted suture lines dividing the internal chambers

The similar looking fossil nautiloids date back 500 million years, initially occurring as straight-shelled animals, although becoming coiled over time. While superficially similar to ammonites, nautiloids can be distinguished their simple, near straight suture lines.

A nautiloid, Eutrophoceras sublaevigatum, collected by a member during the 2019 trip to Kensworth Quarry. Note the straighter suture lines

Looking at the selection of ammonites Jill had brought along, two basic forms could be seen: Evolute ammonites, in which all the preserved whorls of the shell were visible, and involute ammonites, where the inner whorls were partly hidden by the outer whorls. Further variation could be seen in the morphology of the shell. Some specimens had pronounced keels running along the outer circumference of the shell, some had ribs running across the whorls (with different patterns discernible), while others had a more knobbly surface. Jill suggested that these could be adaptations to different marine habitats and/or lifestyle. They also provide clues to identification.

Quenstedtoceras lamberti, an involute ammonite

Size could also provide an aid to identification, however, Jill noted a need for caution. Some ammonites of different size have, in the past, been given different names until someone noticed that the two ammonites were consistently found together. It is now understood that a number of species have a smaller-shelled male (the microconch) and a larger-shelled female (the macroconch), an adaptation thought to allow more space for egg production in the female.

In closing, Jill introduced us to the wonderful world of heteromorph ammonites, a number of genera that became more common in the Cretaceous. Heteromorph simply means *'different form'* with species departing from the conventional tight coiled shell to a more free-form approach. Despite their different shape they are still identifiable as ammonites because of the division of their internal shell into a series of chambers

The spiral form of Hypoturrilites tuberculatus

As a brief appendix to the morning, Mike brought out a couple of examples of the large ammonite, *Titanites giganteus*, from the Museum's collection. The largest specimen was 1ft 7 inches (48cm) in diameter. Mike explained how these ammonites were commonly found in former Portland Stone quarries around Aylesbury and mid-vale hills and incorporated into local buildings. Notable examples include the village store in Quainton and the perimeter walls of Hartwell House.

Kelvin with an example of Titanites giganteus. Specimens found in Buckinghamshire walls and buildings vary in size from this to even larger specimens.

Mike Palmer

Field meetings revisited

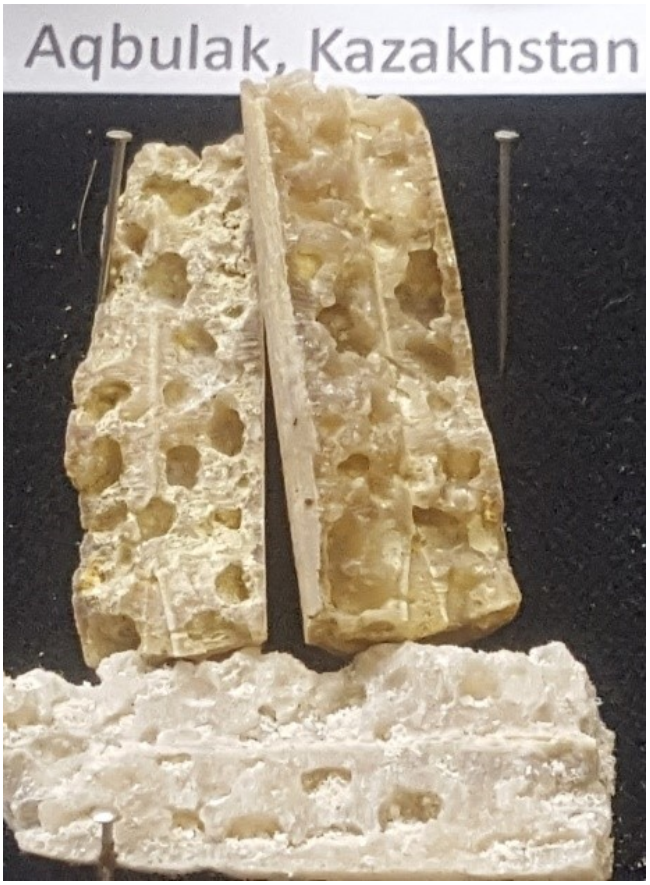
Trace fossil *Entobia* from Kensoworth Quarry, August 2019

Trace fossils record the biological activity of some organism, without necessarily leaving any real clue to the nature of the animal or plant itself that made it. The study of trace fossils is Palaeoichnology, which relies heavily upon Neoichnology in its interpretation. In other words, looking at modern traces to interpret activity in sediment through the fossil record.

Trace fossils have been classified in the same Linnaean, binomial way as living and fossil organisms. On some rare occasions, we might have a trace fossil, e.g. the trackway *Cruziana* and a recognisable fossil trilobite, at its end, actually associated. Clearly, this records the last movements of the trilobite before it died.

Others are more difficult to interpret, but a good example was found on the BGG trip to Kensworth last year (see Newsletter No. 34, March 2020). This is the trace called *Entobia*. It is a network of borings in calcite shell, and the photograph below illustrates this large fragment of the bivalve, *Volviceramus*, which exhibits a series of interconnected crypts. We know from modern examples that *Entobia* is created by a so-called endolithic Clionaid sponge, which bores and breaks up shell material, producing particles from 15-100 microns in size. *Cliona* can be an important carbonate sedimentary particle producer.

Cliona was happy to bore its home into any fairly solid calcite shell.



Two more examples, [Top] *one from Kensworth, in a Brachiopod (Gibbithyris sp) and another* [Bottom] *in belemnites (from late Cretaceous Chalk in Kazakhstan*

When incorporated into a flint nodule, the calcite shell often dissolves, leaving a perfect cast of the delicate tracery of Entobia borings, as exemplified by this fine specimen in the County Museum's collection.

Cliona sp fossil sponge in flint, Chesham, Bucks County Museum

Mick Oates

Geology on your holiday

Have you come across any interesting geological features on recent travels? If so, we'd be interested to hear (and see).

Mike Palmer

Isle of Wight

Graham and a well-preserved bench on the Chale Trail, Isle of Wight

Northumberland holiday snaps 1

Newbiggin by-the-sea is a few miles north of Newcastle. According to the British Geological Survey, the town is largely on the Pennine Middle Coal Measures Formation (Westphalian) and there are handy outcrops at both the north and south end of the adjoining bay. The formation here consists of a dull yellow sandstone which is widely used in buildings in the town.

Pennine Middle Coal Measures Formation outcrop

Incidentally there is a large erratic set in the sandy beach that is familiar enough locally to have been named – the 'Hunkleton Stone', but as it had gradually disappeared from view under the sand it has recently been re-excavated.

Sand-blasted headstone of local sandstone

I can never resist looking at graveyard memorials and noted that all of the (mainly Victorian) memorials in the parish church's graveyard which is on the northern headland of the bay, are in the local sandstone. I don't imagine that future erosion was much considered by families when the memorials were erected, but wind along the coast with the probable addition of sand grains has blasted the majority of them to the extent that the inscriptions are unreadable. However, the erosion has produced quite striking details of current ripples.

Interestingly the fairly erratic patterns that are evident bear little resemblance to any of those on the local foreshore.

Mike Farley

Northumberland Holiday snaps 2

St. James in Morpeth has a series of stone pillars in its entrance portico (Fig. 1) all of which are made from Carboniferous limestone containing numerous well-preserved fossils (Figs 2-3). These appear to be mainly corals. Michael Oates suggests (from photographs) that they might be Carboniferous corals, *Dibunophylum* sp.

Fig 1. St James entrance portico, Morpeth

Fig 2 and 3. Close up of pillar

Mike Farley

Membership Details

The membership year runs from 1st April to 31st March the following year.

Due to the interruption to the Bucks Geology Group's activities membership from 2019 - 2020 the Membership renewal date has been rolled over to April 1st 2021.

Individual membership is £7.50 and Family membership is £12 per annum.

Membership is open to beginners and experts alike.

A copy of the membership form is available on our website under the 'Contact Us' tab. Please complete and return payment to

Membership Secretary, Julia Carey, c/o BMERC, Place Service, 6th Floor, County Hall, Aylesbury, Bucks HP20 1UY (Email: jcarey@buckscc.gov.uk)

Alternatively, you can pay your subscription direct to the Buckinghamshire Geology Group account at: Lloyds TSB (White Hart Street, High Wycombe) Sort code: 30-94-28, Account no 00744003

Further Information

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Buckinghamshire Geology Group – *revised 2020 Programme*

Cost: *Unless otherwise stated, all events are FREE to members and £3 for non-members*

Booking: *Where stated booking is essential to ensure that events are not over-booked and to allow leaders to contact would-be attendees with any last-minute changes*

Clothing: *Some trips, especially quarry visits, may require protective clothing such as helmet and high-vis jackets. Please enquire with the event leader or see event flier nearer the time for details.*

Saturday 19th September 10 am to 12 noon (plus optional lunch) **Geological walk - Ivinghoe Beacon to Incombe Hole.** A walk with beautiful views (weather allowing!) involving geology and archaeology. One mile at slow pace as steep hills involved too. Optional extra is to drive down to Ivinghoe village for a socially distanced lunch at the cafe in Ivinghoe village. Contact Jill (j.eyers@btopenworld.com) for more information and to reserve your place (places strictly limited, booking essential)

Sunday 4th October 10.30 to 12.30 **Geological visit to view and record the section at Stowe Quarry** with Jill Eyers. Jill will provide full guidance on those wanting to learn how to record a geological section, or members may wish to be official photographer, face clearer or other role needed for the valuable work we will be doing.

Optional extra for National Trust members who can get a ticket for entry - lunch at Stowe gardens and a self-led walk around the lovely NT site with hints from Jill on what to look for.

Please note: We are currently waiting for confirmation of permission for the trip to Stowe Quarry as the quarry belongs to the school and COVID instructions and access may change. But those wishing to book a ticket entry to NT Stowe could still undertake that visit even if the school refuse entry after all. Contact Jill (j.eyers@btopenworld.com) for more information and to book a place (booking essential).

Tuesday 13th October 10.30 to 12.30 **Exploring the Jurassic Geology of Great Linford.** A mid-week trip to explore this little gem of a site, not much walking, all on the flat. Strictly restricted to 8 people. Contact Jill (j.eyers@btopenworld.com) for more information and to book a place (booking essential).

Saturday 7th November 2.30 to 3.30 **'Volcanoes - the what, where and why' a Zoom talk by Jill Eyers.** We had planned to offer a workshop on volcanoes on this date, but in the interim we are able to offer a very exciting talk on Zoom. This will be an excellent introduction to this topic before we are allowed to offer the indoor workshop again, hopefully next year. Details on this Zoom talk to follow.

Saturday 21st November **The GA Festival** We will send a link to the interesting virtual events and information that the Geologists' Association are producing this year. We have been busy putting together our contribution called 'The best of Bucks geology'. We can supply you with the link as soon as this is uploaded. I am sure you will enjoy the contributions from many societies and groups around the British Isles.