Newsletter No. 265
February 2021

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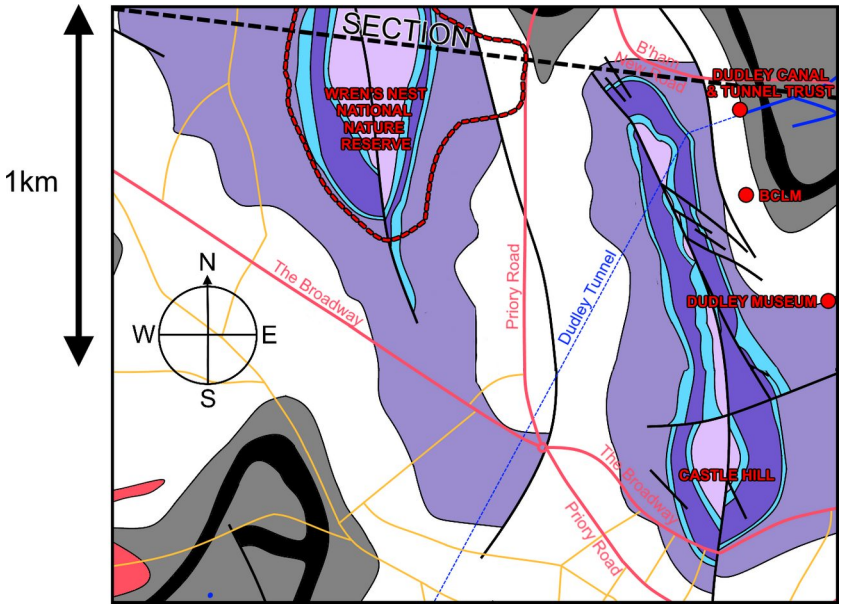
To find out more about this image - read on!



Copy date for the next Newsletter is Thursday 1 April

Position vacant **Honorary Secretary,** secretary@bcgs.info	**Andy Harrison,** **Field Secretary,** ☎ 07973 330706 fieldsecretary@bcgs.info	**Julie Schroder,** **Newsletter Editor,** 42 Billesley Lane, Moseley, Birmingham, B13 9QS. ☎ 0121 449 2407 newsletter@bcgs.info
For enquiries about field and geoconservation meetings please contact the Field Secretary. To submit items for the Newsletter please contact the Newsletter Editor. **For all other business and enquiries please contact the Honorary Secretary.** For further information see our website: bcgs.info, Twitter: @BCGeoSoc and Facebook.		

Future Programme

Indoor meetings are normally held in the Abbey Room at the Dudley Archives, Tipton Road, Dudley, DY1 4SQ, 7.30 for 8.00 o'clock start unless stated otherwise. The same timing applies to the current programme of online 'Zoom' meetings.

Visitors are welcome to attend BCGS events.

Monday 15 February *(Zoom Meeting):* 'Atmospheric Cave Science'. Speaker: Professor Ian Fairchild, School of Geography, Earth and Environmental Sciences, University of Birmingham. Ian's talk will take us from caves and monitoring cave climates over time through the study of stalagmites, to the need for awareness about appropriate room ventilation i.e. CO_2 levels. Recently this issue has been covered in the press with respect to Covid-19, and ventilation on planes and trains, so it is timely and also of interest in relation to underground spaces in the Black Country.

Monday 15 March *(Zoom Meeting, 7.00 for 7.30 start):* AGM followed by 'Silurian Rocks of the Dingle Peninsula'. Speaker: Ken Higgs, Emeritus Professor of Geology, University College Cork. Dudley and the Dingle Peninsula in Eire have much in common, sharing a common Silurian geology. Professor Ken Higgs was not only born in Dudley, but has also undertaken an extensive study of the geology of the Dingle Peninsula recently published as the 'Geology of the Dingle Peninsula' by the Geological Survey of Ireland. His illustrated talk will describe the Dingle Peninsula's dramatic 485 million year history of environmental and climate change.

Covid-19 arrangements for Talks

Keith Elder will send emails to BCGS members enabling registration for our meetings. Julie Schroder will forward invitations to BCGS members for joining meetings that other societies are holding, to which we are invited. Non-members please contact Keith for further information.

Keith Elder, BCGS Meeting Secretary, ☎ 07477075899 keith.elder@hotmail.co.uk

Monday 19 April *(Zoom Meeting):* Speaker: Dr Stephen Knipe in London, Ontario. This talk comes to us live from Canada! Gold has been the lure which has attracted many to North America to prospect for gold. Dr Stephen Knipe will tell us about gold and other metal ore samples which are sent to AMTEL (Advanced Mineral Technology Laboratory) from major mines around the world where they are analysed for the chemical and mechanical processes needed to recover and separate the metals. AMTEL was formed through a multi-million dollar initiative, sponsored by a consortium of eleven mining companies based in Canada and worldwide.

BCGS Committee - vacancy for Honorary Secretary

The Committee meets about 4 times a year to discuss all matters concerning the Society, and particularly to forge together our programme of events. The Society can only thrive with the efforts put in by the Committee behind the scenes, and we are always looking for new ideas.

There is **still** a vacancy for the post of Honorary Secretary, and we urgently need someone to fill this post. If you are interested, or would like more information about the work that this entails please don't be shy to put your name forward!

Please use the email address secretary@bcgs.info if you are interested.

Other Societies and Events

Covid-19 arrangements

Some societies have cancelled their meetings for the foreseeable future. Many are running virtual on-line meetings. Below is a list of the societies whose events we normally promote in this Newsletter. Please check websites for further information.

The Geologists' Association

Geology from your Sofa

The Geologists' Association may not be able to invite you to attend lectures and field trips at the moment, but they are looking at ways for you still to enjoy geology, virtually through online courses, field trips and talks.

See the website for further details: https://geologistsassociation.org.uk/sofageology/

Manchester Geological Association

Wednesday 10 March: 'Minerals in Afghanistan'. Speaker: Robin Grayson.

All Zoom meetings will start at 7.00 with a login time from 6.30. For further information about meetings: http://www.mangeolassoc.org.uk/ Visitors are always welcome.

North Staffordshire Group of the Geologists' Association

Thursday 11 February: 'Delta Tops and Succession Hops: The Clackmannan Group, Midland Valley, Scotland'. Speaker: Andrew Mitten (Keele).

Thursday 11 March: AGM at 7.00 followed by talk **at 7.30: 'The Pleistocene succession in the Middle Trent Basin according to R.M. Deeley (1886) and what we now know from subsequent research'.** Speaker: Peter Jones (Derby and NSGGA Chair).

Meetings are held at 7.30 online via Zoom unless otherwise stated. For enquiries: Steve Alcock, Longfields, Park Lane, Cheddleton, Leek, Staffs, ST13 7JS. Tel: 01538 360431 or 07711 501028. Email: steves261@aol.com More info: https://nsgga.org/

Shropshire Geological Society

Wednesday 10 February: 'Glaciers, Glaciation & the Shaping of the British Landscape'. Speaker: Richard Waller, Keele University.

Wednesday 10 March: 'Iceland and it's Volcanoes'. Speaker: Hazel Rymer, Open University.

Lectures are being held using Zoom and commence at 7.00 for 7.30. Further info: http://www.shropshiregeology.org.uk/SGS/SGSEvents.htm

Mid Wales Geology Club

Wednesday 17 February: 'The Anthropocene: A Unique Geological event and an Age of Collapse'. Speaker: Scott Bennett.

Wednesday 17 March: 'Geothermal Energy'. Speaker: Prof. Ian Stimpson.

Further information: Tony Thorp tel. 01686 624820 and 622517 tonydolfor@gmail.com
Web: http://midwalesgeology.org.uk lectures start at 7.15 via Zoom.

Geological Society, West Midlands Regional Group

Tuesday 9 February: 'The assessment of landslide hazard and risk, using UK and Hong Kong examples'. Speaker: Steve Parry (Parry Engineering Geological Services).

Tuesday 9 March: 'Mercia Mudstone, Salt and Gypsum'. Speaker: Adrian Collings (Arup).

Lectures are being held using Zoom and commence at 6.00 for 6.30. For further details please contact the Group Secretary at: geolsoc_wmrg@live.co.uk Click here for website.

Warwickshire Geological Conservation Group

Wednesday 17 February: 'Geological Time and the Anthropocene'. Speaker: Ian Fairchild, Emeritus Professor, University of Birmingham and Chair, Herefordshire and Worcestershire Earth Heritage Trust.

Wednesday 17 March: 'The Geology of Iceland'. Speaker: Stuart Blake.

WGCG Geology Free Talks: Wednesdays 7.30 via Zoom. For more details visit: https://www.wgcg.co.uk/ or email: warwickshiregcg@gmail.com

Herdman Virtual Symposium: 'Dynamic Earth'

Saturday 20 February 2.00 - 6.00. Speakers: Dr Jacopo Taddeucci, INGV (Italy); Dr David McNamara, University of Liverpool (UK); Prof Sonia Tikoo-Schantz, Stanford University (US).

Sunday 21 February 2.00 - 6.00. Speakers: Prof Christopher Jackson, Imperial College (UK); Prof Christine Janis, University of Bristol (UK); Dr Gillian Apps, University of Texas at Austin (US).

The Zoom events are from 2.00 – 6.00 and are free. Sign up through this Google Forms link.

North West Highlands Geopark

Thursday 25 February at 7.30: 'The dawn of the Cambrian explosion of life: The Scottish fossil evidence'. Speaker: Dr Frankie Dunn (Early Career Research Fellow at the Oxford University Museum of Natural History and Merton College.)

The talk will be hosted on Zoom and is free to attend. Click here to register.

Check websites for the following societies:

Teme Valley Geological Society: http://www.geo-village.eu/
Woolhope Naturalists' Field Club - Geology Section: https://www.woolhopeclub.org.uk/meetings
East Midlands Geological Society: http://www.emgs.org.uk/
Lapworth Lectures: https://www.birmingham.ac.uk/facilities/lapworth-museum/events/lectures.aspx
Abberley & Malvern Hills Geopark: http://geopark.org.uk/
Herefordshire & Worcestershire Earth Heritage Trust: https://www.earthheritagetrust.org/

Subscriptions 2021

Subscriptions were due on **1 January 2021.** If you haven't already paid then please send your cheque to: **Alan Clewlow, 19 Manor Court Road, Bromsgrove, Worcestershire, B60 3NW**
Cheques should be made payable to **'The Black Country Geological Society'**.

Editorial

With no clear end in sight for the Covid restrictions, the Society is continuing with on-line talks at least until the meeting in April. We now have a well-established routine, starting the year with 'Geology in Paradise', a well-attended talk by founder BCGS member Graham Hickman on his experiences of living and working in the Caribbean. If you missed this, or any of our other talks, don't forget that we now have our own YouTube channel. So far, four of our talks are available to watch free of charge. Pete Purewal, our Social Media representative, would like to see more of you subscribing to our channel. It doesn't cost anything, and will help to boost the profile of our fledgling channel.

In this issue I'm pleased to announce the start of an exciting new regular feature: 'Matt's Maps'. Following his talk last December, Matt Sutton has volunteered to do a series of items on some of the main geosites in the Geopark, focussing on geological maps and cross sections. These are sadly lacking at the moment from the site descriptions on both the Geopark and BCGS websites. The idea is that these will appear first in our Newsletter as and when Matt is able to do them, and they will then gradually be added in the relevant places on the BCGS website. Matt gets us off to a fitting start with an item on the Wren's Nest, splendidly illustrated with a map, cross section and stratigraphical column. This initiative provides a very welcome new dimension to the information and interpretation we already have for our local geosites, and we send our thanks to Matt for instigating this project.

We have a further fascinating in-depth instalment of Bob's 'Mini Critters', and an up-date from our ever-busy Poet in Residence, including a poem inspired by Matt's talk in December! We are delighted to welcome two more new members, and we round off with another delightfully light-hearted 'Musing' from Mike.

Don't forget to pay your subs if you haven't already done so! ■

Julie Schroder

Hello from two more new BCGS members

In the last issue, new members Charles Hughes and Alison Delorie shared their profiles, and in this issue I'm delighted to introduce two more new members, Fiona Townley and Stephen Harker. It's encouraging that our outreach is spreading way beyond the Black Country. You don't have to be local to become a member! We'll look forward to welcoming more recruits (and profiles for the Newsletter) in the coming months. Ed.

Profile – Fiona Townley

Hello! I've been meaning to join BCGS for years, having been to a handful of meetings in the old Dudley Museum. By chance I found an old paper membership application form at home around the same time I heard about the recent local nature reserves talk, so that spurred me on to finally join, although I waited until January to avoid confusion with my subs! Black Country (Brierley Hill) born and bred, I've always taken a fascination in my surroundings and in particular the rich industrial heritage of the area and how they're connected. ►

I studied geology A level at Halesowen College, BSc Environmental Geology at the University of Sunderland and MSc Applied Environmental Geology at Cardiff University of Wales, and have spent the last 20 plus years working in geo-environmental consultancy, including an 11 year stint with local stalwart, Johnson Poole & Bloomer. I currently have a technical role with RSK Raw, (remediation and spill response contractors/consultants), primarily dealing with contamination assessments and human health, and controlled waters risk assessments. The huge dumper truck in the photo (I'm 5' 3.5" for scale), is at a quarry during a rock stability assessment I was helping out with some years ago.

I'm so lucky to be able to be applying my studies on a day to day basis. Outside of work I enjoy the great outdoors - a house and garden full of treasures (rocks) is testament to that. Probably my favourite place in the world is Iceland. We've been fortunate to visit many times and love exploring the amazing landscape. I can't wait to rebook last year's trip which never happened! In the meantime, I'm quite content getting my daily exercise allowance around the local canal network and the Buckpool & Fens Pool Nature Reserve. I'm looking forward to more online events and all in good time, meeting in person and perhaps some field trips. ■

Fiona Townley

Profile – Stephen Harker

Over the past 4 years I have been making a gradual shift of gears as I approach retirement very soon. I am not a geologist, but in late 2016 I became a member of the Yorkshire GS and have subsequently joined quite a few other groups around the country. I am trying to understand the geology of the British Isles and joining geology groups is a great way to connect with others who have an interest in rocks. It also provides a fantastic opportunity to learn from knowledgeable and experienced people in different parts of the country. Thank you for having me as a member. ■

Stephen Harker

Mary Anning Statue Appeal

In October we were pleased to pass on details of the Etches Collection appeal, in view of our visit to the Jurassic coast in September 2019. Now we've had a request to promote another project connected with the Jurassic coast: the 'Mary Anning Rocks' appeal. Details are on the project website here: https://www.maryanningrocks.co.uk/

The project started with Evie, an 11 year old fossil-mad school girl (now 13). The plan is to erect a memorial to Mary in her home town of Lyme Regis, and the target is £100k - so they need all the people power they can muster! They have the support of the Geologists Association, Sir David Attenborough, Professor Alice Roberts, NHM, and many more amazing people. Here is the link to the crowdfund page, with a 3 minute film about what they are trying to achieve.

https://www.crowdfunder.co.uk/maryanningrocks

BCGS Poet in Residence

R.M.Francis

I'm remaining as busy as I can, working on my poems, blog posts and essays for this ongoing residency - and despite the current Covid-19 restrictions, I'm making good ground and have exciting plans for the rest of my six months with you all. I'm working with the Scottish Centre for Geopoetry and the Geological Society on a publication to celebrate last year's Geopoetry Day. The collection of essays and poems will be published this year.

Once the lockdown measures are lifted, I'll be running a series of walking geopoetry workshops as part of the legacy events for Wolverhampton Literature Festival. I'll be aiming to do these across some of the geosites in Wolverhampton and it's likely these will take place around Easter time.

Cogs are also in motion for a climax event at the end of my residency in June; I've invited a handful of amazing poets (who also use geography, geology and the earth sciences in their work) to produce a showcase of contemporary poetry. I'll be sharing a stage with Tim Cresswell, Norman Bissell, Alyson Hallet and Harry Gallagher. I'm really excited for this event, which will offer a varied and unique exploration of how these different fields come together in creative ways.

You can catch up on my latest blog entry here: https://rmfrancis.weebly.com/chain-coral-chorus/wings-are-a-constraint-that-makes-it-possible-to-fly This one covers my thoughts on formal verse which I discussed at the Christmas get together.

Speaking of which, it was such a pleasure to meet everyone and to share my ideas and work in December. Thanks so much for tuning in. I was really inspired by Matthew Sutton's keynote talk too, and have penned a couple of poetic responses: *('Ichthyolith' in this issue, 'Coccolithophore' next time, Ed.)* ■

R.M.Francis

Ichthyolith

Bleached lichen webs the blushed sandstone
and mosses crawl and rasp roots roam
and silvered birch mudlarks its leaves
where umber-tan Stour waters weave,

and Matt skulks down the cut's tow path
somnambulist arm becomes a snath,
and scratches nails against the grains,
passing daily, left arm cranes
the Triassic interglacial lodes,
and watch the players get dominoed
and sup in the Royal Exchange:
checks talons gritted in glassmaker range

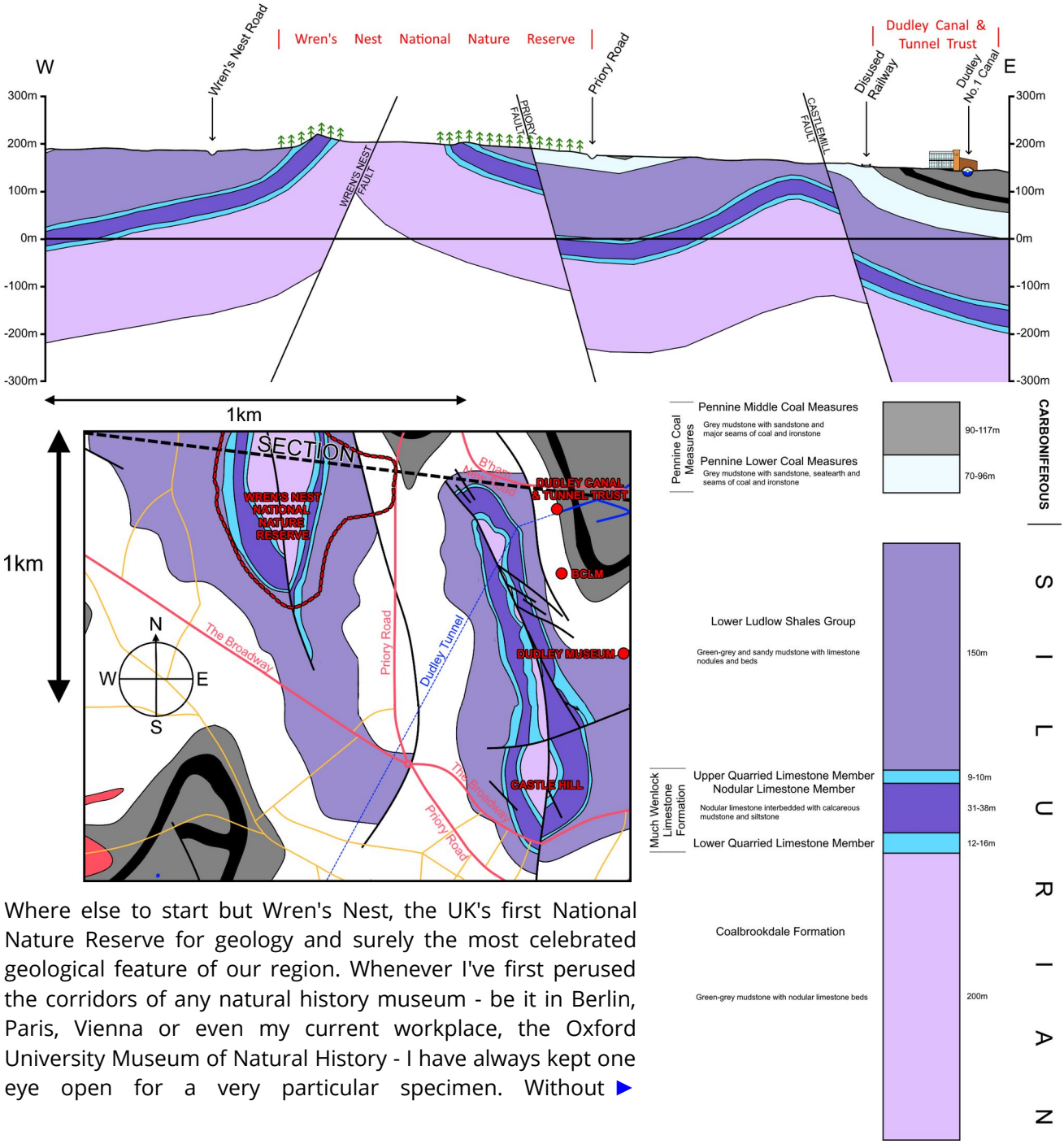
of sediments - dark amber like his ale,
Matt sits and marks his nails,
unaware of dead etiolated teeth
of time clammed ichthyolith.

Fish rock gemmed in keratin
He touches it. It touches him.

Matt's Maps

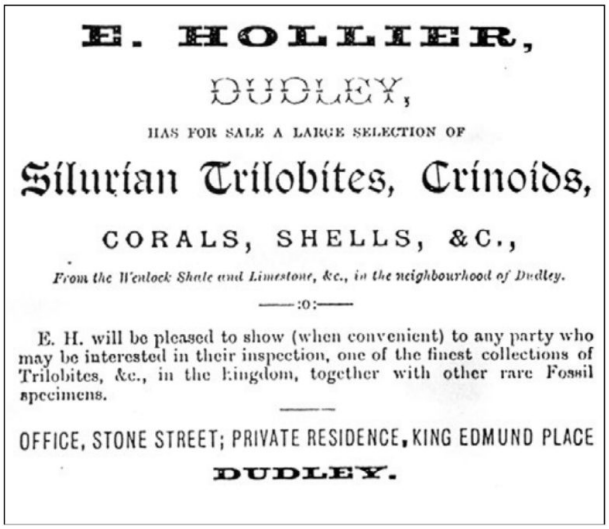
Wren's Nest & Dudley Canal Tunnel Trust

A happy 2021 to you all! To those of you who weren't present for the talk I gave to the BCGS back in December, allow me to introduce myself: I'm a palaeobiology PhD student at the University of Oxford; Black Country Geopark volunteer, and Kingswinford native. Almost two years ago I started the first in a series of geological cross-sections covering the geosites of the then-prospective Geopark. My hope was that these might prove useful as an educational tool illustrating the large-scale structure of all corners of the region and, in doing so, provide an entry point to discuss their long and tumultuous histories. I'm really pleased to give you the first of what will be a series of features for this newsletter.



Where else to start but Wren's Nest, the UK's first National Nature Reserve for geology and surely the most celebrated geological feature of our region. Whenever I've first perused the corridors of any natural history museum - be it in Berlin, Paris, Vienna or even my current workplace, the Oxford University Museum of Natural History - I have always kept one eye open for a very particular specimen. Without ▶

exception, I've found *Calymene blumenbachii* in every one of these museums, and many more besides. The Dudley Bug, and the wider fauna of the Silurian Wenlock Limestone are staples of natural history collections internationally, and it's not difficult to see why.



E. HOLLIER,

DUDLEY,

HAS FOR SALE A LARGE SELECTION OF

Silurian Trilobites, Crinoids,

CORALS, SHELLS, &C.,

From the Wenlock Shale and Limestone, &c., in the neighbourhood of Dudley.

—:o:—

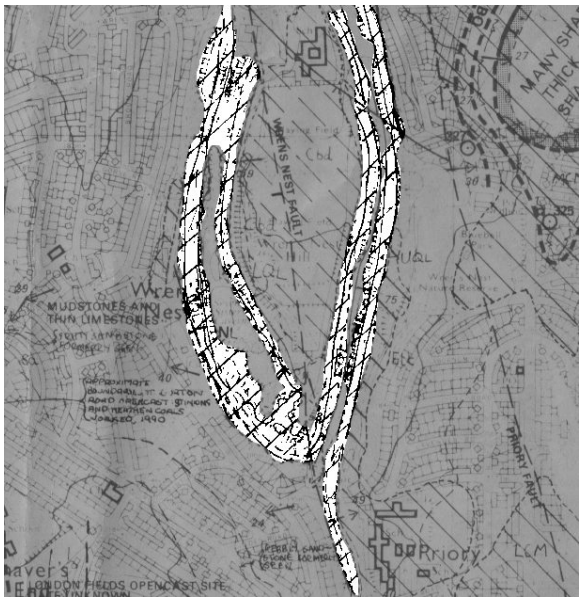
E. H. will be pleased to show (when convenient) to any party who may be interested in their inspection, one of the finest collections of Trilobites, &c., in the Kingdom, together with other rare Fossil specimens.

OFFICE, STONE STREET; PRIVATE RESIDENCE, KING EDMUND PLACE

DUDLEY.

For those miners working on Wren's Nest through the industrial period, rare fossils were not just fascinating, but incredibly lucrative. In 1825, Charles Pye reported that miners in possession of a trilobite specimen had 'been known to refuse its weight in gold'. Fossils were found in such abundance that Wren's Nest supported 3 separate fossil dealerships in Dudley by 1841 (Bentley, 1841, see below).

The hundreds of species found at Wren's Nest are found near the surface thanks to the structural geology of this area. Northern Dudley sits atop a series of folded Palaeozoic rocks. The high ground at Wren's Nest and Castle Hill both sit near the N-S oriented axes of anticlines in this system and host some of the oldest exposed rock in the region. As is often the case, the axes of these folds appear to have acted as structural weak points, and both prominent anticlines are marked by significant faults.

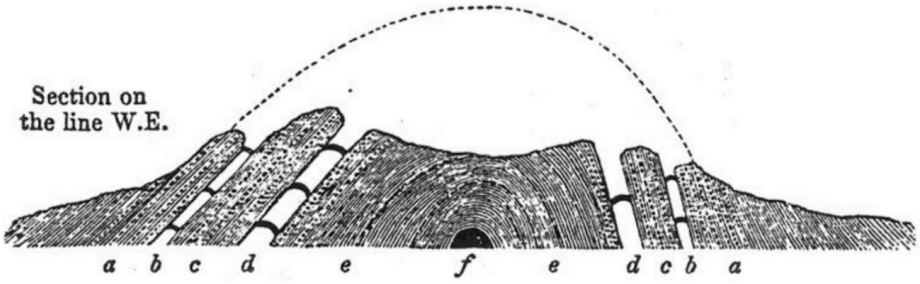


1981 BGS map centred on Wren's Nest, edited to highlight quarried areas. Surface outcrops of the Upper and Lower Quarried Members are visible.

At the core of Wren's Nest is the mid-Silurian Coalbrookdale Formation and sitting stratigraphically above this level is the Much Wenlock Limestone Formation. This horizon, consisting of the Nodular Limestone sandwiched between the Lower and Upper Quarried Members, is the source of those abundant fossils.

In total the formation is only 50-60m thick, but it proved a viable source of limestone for several centuries during industrial times, when the nascent iron industry needed a reliable supply. The scars of surface quarrying are readily visible on local maps of the area - including the 1981 BGS map from which I created this section (above). The boundaries of the Much Wenlock outcrop are clearly defined from the hatched marks showing where extraction has taken place.

Unlike the coal deposits found only a few hundred metres east and west of Wren's Nest, there is little information on underground workings beneath Wren's Nest itself, presumably because so much material was readily available at the surface. This section also covers the Geosite 'Dudley Canal and Tunnel Trust', which sits atop the Middle Coal Measures. On the coalfield, my reconstructions are usually informed by borehole records, as prospectors sought out coal horizons at depth. No such subsurface records are available for the older Silurian units, and so a greater amount of inference is required to reconstruct what is happening at depth. ►



Murchison's 1839 cross section showing the units at Wren's Nest. Units b, c and d make up the Much Wenlock Limestone Formation

In researching this piece, I discovered that Roderick Murchison had drawn a similar section across Wren's Nest almost 200 years before me in his magnum opus, 'The Silurian System'. I think he pips me for artistry, but his lack of a scale bar is truly unforgivable!

Though quarrying has long since stopped at Wren's Nest, its legacy remains in the collections of the world's museums, the landscape of Dudley and the cultural consciousness of the Black Country.

Thank you to Julie for letting me use this newsletter as a means of sharing my maps and sections. I'm also incredibly grateful to Graham for giving me access to his extensive collection of maps, without which these sections could not have been made - see you all next time. ■

Matthew Sutton

References and further reading

British Geological Survey, 1981, 1:10 000 Series SO 99 SE (Dudley)

Bentley, J., 1841, Bentley's history and guide to Dudley, Dudley Castle, and the Castle Hill, and alphabetical and classified directory of the Borough of Dudley: Birmingham, Bull and Turner, 240 p.

Clark, C. F. G., 1881, The curiosities of Dudley and the Black Country from 1800 to 1860: Birmingham, Buckler Brothers, 337 p.

Mikulic, D. G. & Kluessendorf, J., 2007, Legacy of the Locust – Dudley and its Famous Trilobite *Calymene Blumenbachii*, Fabulous Fossils, 300: 141-169 p.

Murchison, R. I., 1839, The Silurian System, founded on geological researches in the counties of Salop, Hereford, Radnor, Montgomery, Caermarthen, Brecon, Pembroke, Monmouth, Gloucester, Worcester and Stafford; with descriptions of the coal-fields and overlying formations: London, John Murray, 768 p.

Pye, C., 1825, The Stranger's Guide to Modern Birmingham, with an Account of its Public Buildings and Institutions, its Show Rooms and Manufactories: Birmingham, Wrightson & Webb, 194 p.

A small selection of the many fossils from Wren's Nest found in the Silurian cabinet at the Oxford University Museum of Natural History

Collecting Mini Critters – Part 2

In this series, Bob gives us an insight into the intensive work involved in collecting and preparing microfossils – the world of micropalaeontology. Whilst this might appear to some as a rather remote and specialised branch of palaeontology, work in this field is actually happening close to home with the on-going efforts of Graham Worton and his Geoteam to unravel the micro-secrets of the Silurian world. This research followed from samples collected before the limestone mines were infilled in 2009, and gives a local context to the methods and processes so clearly explained by Bob in these articles. (See Newsletter 194, April 2009, p.7 for some background information, and Issue 198, December 2009 p.10, for a report on the early micro-fossil discoveries of the Geoteam.) In Part 1 Bob de-mystified the processes involved in the preparation and analysis of micro-fossils, and in this instalment we move on to the task of identification, some practical applications, and a detailed case study. Ed.

In 'Collecting Mini Critters Part 1' *(Newsletter 264, December 2020*) one method for extracting microfossils from a semi-indurated substrate was described with emphasis on ostracods for the purposes of these short articles. Let us now assume that you have managed to isolate a few specimens and are asking: "What next?"

The first thing that becomes obvious is that they are not going to take pride of place in your hand specimen display cabinet for obvious reasons! They do however make good subjects for microphotography, but that is for another article as it is a whole set of 'Dark Arts' in itself. They shall be used to try and identify a specific rock formation based on the information that the microfossils themselves can provide. Of course, if they were collected from outcrop then just say, "thank you British Geological Survey" and go straight to their locality finder and rock lexicon for all the information needed. For the purposes of this exercise, we shall assume that you have been presented with a sample from an unknown Palaeozoic locality and been asked to identify the stratigraphy and possible location based on the ostracod content.

Like any good 'Whodunnit' there are a number of basic pieces of information that you need to know about the main characters, such as what is their name, where did they live and for how long? The first thing to stress is that you don't have to reinvent the wheel.

In the past 40 years or so the science of micropalaeontology has made tremendous advances due to the need for greater knowledge in the field of petroleum geology, where time costs money, a lot of money, so information from test boreholes becomes critical in the decisions relating to where to drill and invest in a potential prospect. Latterly, interest has been increasing in climate change and global warming, where microfossils can be used to provide information on sea temperatures, oxygen and carbon dioxide levels at the time they were living, by using isotope chemistry from their remains to inform about conditions and rates of climate change at that time. This now primarily uses conodonts for Palaeozoic strata, and forams and calcareous nanoplankton for Mesozoic to recent strata. Ostracod use has declined, as their primarily benthic lifestyles are less useful than pelagic life forms, but they are still useful for regional stratigraphy.

What this means in practice (unless you isolate a specimen unknown to science - in which case, well done!), is that somebody has already done the legwork for you and you merely need to consult the literature. There are publications that inform you on how to identify different ostracods down to genus and species level using the morphological characteristics of the carapace such as the size and ►

position of the cusps, crumina, surface spines and ornamentation, if you really want to devote yourself to that level. *(See below: Armstrong and Brasier, pp. 221-225[1], Siveter, D.J., 2009[6]).* This is for the devoted and probably beyond our remit as beginners, so we will go straight to the photo libraries. You are going to look at a book of 'mugshots' so to speak, an identity parade of suspects and pick out your character *(see Fig.1)*. Once you have that, the rest follows automatically. An internet trawl will give you a selection of scientific papers as reference sources that you can use, or books that you can borrow/purchase.

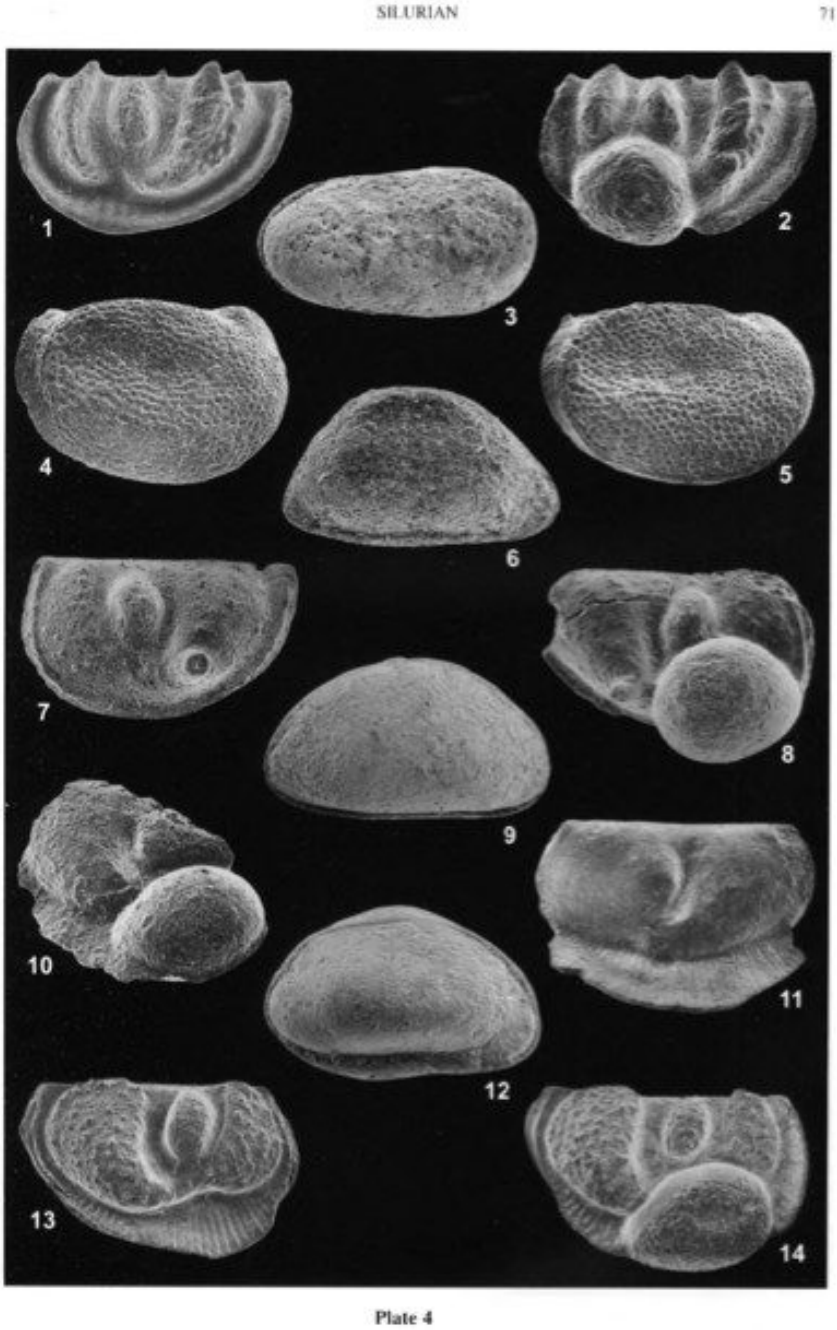


Figure 1: Ostracod photographic plate reproduced from Siveter, 2009[6].

Once upon a time in the Black Country (well, 1946 in Wolverhampton to be precise), were born twins who both went on to study geology. Derek J Siveter went on to become Emeritus Professor of Earth Sciences (Palaeobiology) at the NHM, and David J Siveter became Emeritus Professor of Palaeontology at the University of Leicester. Both studied Palaeozoic fossils and to confuse matters even more, sometimes co-authored papers. I certainly remember being present at a lecture to BCGS members on the soft bodied animals of the Herefordshire Silurian Lagerstatte, a few years ago now. For our particular purposes I will draw your attention to David J. Siveter's work on ostracods.[6,7] He produced a series of publications crammed with photographs of Palaeozoic ostracods, that if consulted will allow you to identify your suspects in the identity parade, the stratigraphical range, and thus allow you to infer the geological formation that you are most likely to be dealing with.

To illustrate this process there follows a very much abridged version of a small research project that was carried out some 10 years ago. This involved using a sample of shale and allocating the likely location of the stratigraphical placement and palaeoenvironment using the microfossil (ostracod) assemblage isolated from the sample. ►

The sample was prepared by the solvent method *(Armstrong and Brasier, 2005, p.274[1])* as outlined in Part 1 *(Newsletter 264)*. Approximately 100g of a dark green/grey soft shale that had been collected in the field from 'Lincoln Hill' was used. Fractions were collected at 1mm, 500µm, 250µm, 125µm and 64µm before being examined under a binocular microscope at 10x magnification. The 64µm fraction was disregarded as it contained only quartz grains and carbonate fragments.

Microfossil assemblage.

The dried fraction samples were then picked for individual microfossils under a binocular microscope at 10x magnification using reflected light. This was a little time-consuming as there was a large amount of shell debris and associated fragments, some of which were well deserving of more attention. The ostracods were present but not in huge numbers. Many individual carapaces were isolated but were covered in granular quartz crystals making identification very difficult.

The 1mm sample contained mainly shell fragments composed of $CaCO_3$ but were too broken and disaggregated to be identified apart from one almost complete example of the brachiopod *Atrypa reticularis*.

The 500µm sample was similar but contained no discrete identifiable macrofossils and was discarded.

Morphotype number	Sieve fraction (µm)	Number of individuals
1	250 - 500	16
2	250 - 500	2
3	250 - 500	3
4	250 - 500	19
5	250 - 500	2
6	125 - 250	38
7	125 - 250	4
8	125 - 250	45
9	125 - 250	7
10	125 - 250	5

Figure 2: Recovered ostracod morphotypes

The 250µm and the 125µm fractions contained broken and disaggregated shell material that also included both incomplete and complete carapaces of ostracods that were separated initially into 10 morphotypes i.e. individual fossils that looked the same *(Fig.2)* for later identification using a binocular light microscope and a scanning electron microscope for selected microfossils.

The initial sample picks were found to have unacceptable levels of the matrix adhering to them and were reprocessed again using the same procedure to remove more sediment. This was limited to 15 minutes to reduce possible degradation of the microfossils but unfortunately this still left sediment adhering to the surfaces.

The smaller individuals in the 125-250µm fraction were mainly members of smaller genera. Both heteromorphs (female) and the tecnomorphs (males and larger juveniles) of all the genera present were also represented and most were as separate carapaces. This was considered to represent a taphocoenosis (allocthonous death assemblage, where individuals have been transported to the site of sedimentation).

Ostracod identification

This was my first immersion into the world of practical microfossil extraction and identification and therefore total accuracy was not guaranteed; this is a skill that is built upon experience! As such any ►

conclusions drawn would have to be tentative. The ostracods were identified by comparing these against photographs of ostracods from known Silurian assemblages depicted in publications by Siveter *(1980[7], 2009[6]).*

The class Ostracoda can be subdivided into two subclasses based upon the number of pairs of limbs arising from the head: the Podocopa (usually 4 pairs) and the Myodocopa (5 pairs), according to Armstrong and Brasier *(2005[1])*. The sub classes are then further divided into the Orders Podocopida, Palaeocopida, Myocopida and Halocyprida.

The 'Lincoln Hill' sample contained ostracods of the Orders Podocopida and Palaeocopida, the latter being easily identified by the straight dorsal hinge line. Within the Palaeocopida were members of the superfamilies Beyrichiacea and Primitiopsacea. The Podocopida were represented by the suborder Metacopina and within this the superfamily Thlipsuracea. Both the heteromorphs (female) and the tecnomorphs (males and juveniles) were present in the sample; most being represented as single carapaces. The picked samples were identified using photographs in publications by Siveter *(1980[7], 2009[6]).* The following morphotypes were identified:

Morphotype 1. *Parasleia angiportuosa* ***(Siveter, 2009, p.71[6]).*** Range: Brinkmarsh Formation. Sheinwoodian Stage, Avon.

Morphotype 2. *Parasleia artemon* ***(Siveter, 2009, p.68[6]).*** Range: Barr Limestone Member, Coalbrookdale Formation. Sheinwoodian Stage, West Midlands.

Morphotype 3. *Undipila subspissa* ***(Siveter, 2009, p.68[6]).*** Range: Apedale Member, Coalbrookdale Formation, Homerian Stage, West Midlands.

Morphotype 4. *Beyrichia clausa* ***(Siveter, 2009, p.74[6]).*** Range: Coalbrookdale Formation, Much Wenlock Limestone and Lower Elton Formations, Homerian and Gorstian Stages, Welsh Borderlands and West Midlands.

Morphotype 5. *Primitiopsacean sp.* ***(Siveter, 2009, p.71[6]).*** Range: Apedale and Farley Members, Coalbrookdale Formation, Much Wenlock Limestone, Homerian Stage, Welsh Borderlands.

Morphotype 6. *Thlipsura martinssoni* ***(Siveter, 2009, p.65[6]).*** Range: Buildwas Formation and Apedale Member, Coalbrookdale Formation, Sheinwoodian Stage, Welsh Borderland.

Morphotype 7. *Dictyotoxotis incuspidata* ***(Siveter, 2009, p.68[6]).*** Range: Buildwas Formation and Apedale Member, Coalbrookdale Formation, Sheinwoodian Stage, Welsh Borderland.

Morphotype 8. *Primitivothlipsurella obtusa* ***(Siveter, 2009, p.70[6]).*** Range: Buildwas Formation and Apedale Member, Sheinwoodian Stage.

Morphotype 9. *Sleia pauperata* ***(Siveter, 2009, p.70[6]).*** Range: Coalbrookdale Formation, Much Wenlock Limestone and Lower Elton Formations, Homerian and Gorstian Stages, Welsh Borderlands and West Midlands.

Morphotype 10. *Wenlockiella phillipsiana* ***(Siveter, 2009, p.72[6]).*** Range: Hughley Shales and Buildwas Formation, Coalbrookdale Formation, Much Wenlock Limestone and Lower Elton Formations, Telychian, Sheinwoodian, Homerian and Gorstian Stages, Welsh Borderlands.

Ostracod Biostratigraphy

Using the occurrence of each species of ostracod initially constrained the upper and lower limits of the stratigraphic sequence to that contained within the Wenlock Series / Lower Ludlow Series, as all microfossils picked have ranges that are within the Telychian, Sheinwoodian, Homerian or Gorstian Stages. These species were used to locate the position of the sample within the stratigraphy of the Welsh Borderland and West Midlands *(Fig.3).* ►

What we were looking for was the best overlap position where all morphotypes could be present at the same time. In an ideal world it would produce one stratigraphic level marker, but rarely is that reality. This is outlined by matching the known range distributions against each other *(Fig.4)* and looking for a best fit line.

Faunal change in both palaeocope and non-palaeocope types *(Siveter, 2009, p.52[6]),* that occurs approximately at the Sheinwoodian-Homerian boundary further refines the position. The first occurrence of individual species such as the Beyrichiacean *Undipila subspissa* is in the upper part of the Coalbrookdale formation (Early Homerian) and as this ostracod is present, the sample should not be older than this. ►

Ludlow Series	Gorstian	Aymestry Limestone	Bringewood Formation	60m
		Lower Ludlow Shales	Elton Formation	120-230m
Wenlock Series	Homerian	Wenlock Limestone	Much Wenlock Limestone Formation	30-140m
		Wenlock Shales	Tickwood Beds (Farley Member)	
	Sheinwoodian		Coalbrookdale Formation (Apedale Member)	300m
			Buildwas Beds	30m
Llandovery Series	Telychian		Purple Shales Formation	76-107m
	Aeronian		Pentamerus Sandstone Formation	0-122m
			Kenley Grit	0-46m
Major unconformity at base of Silurian				

Figure 3: Stratigraphy of the Welsh Borderland area. (Adapted from Toghill. P, 2000[8])

Bringewood Formation	Gorstian										
Elton Formation					■					■	■
Much Wenlock Limestone Formation	Homerian				■	■				■	■
Tickwood Beds (Farley Member)				■	■	■				■	■
Coalbrookdale Formation (Apedale Member)	Sheinwoodian			■	■	■				■	■
		■	■			■	■	■	■	■	■
Buildwas Beds		■					■	■	■	■	■
Purple Shales Formation	Telychian										■
Pentamerus Sandstone Formation	Aeronian										
Kenley Grit											
Morphotypes		1	2	3	4	5	6	7	8	9	10
No. of picked individuals		16	2	3	19	2	38	4	45	7	5

Figure 4: Plotted overlaps of morphotype ranges

This however posed a problem in that some of the ostracods identified in the sample do not range above the *M. riccartonensis* graptolite zone (mid Sheinwoodian stage), whilst others do not first appear until the *C. lundgreni* graptolite zone (top of the Sheinwoodian stage), which leaves a gap of some 3 graptolite biozones. A number of explanations may be responsible for this apparent gap:

- Poor preservation and matrix obscuration of surface features may have led to misidentification of some genera (most probable cause).
- The Silurian succession may be diachronous across the Midland Platform as sea level regression proceeded from east to west, and the accepted range zones for the Welsh Borderland may possibly differ for the 'Lincoln Hill' area.
- There may have been some reworking of early ostracods from erosion and redeposition of earlier sediments.

The biostratigraphical evidence on balance, therefore, points to the sample being stratigraphically located (using the current BGS Rock Lexicon details) somewhere in the uppermost part of the Coalbrookdale Formation (former Wenlock Shale), very close to or just within the overlying Tickwood Member (formerly known as the Farley Member or Tickwood Beds).

The petrology of the sample was that of friable, poorly cemented, grey-olive green shale with significant fine quartz grain and clay mineral content. This possibly places it below the Tickwood Member that contains limestone nodules in some quantity (indicating a shallowing environment), and definitely below the overlying Much Wenlock Limestone Formation that represents a change to a shallower water carbonate based depositional environment.

Ostracod Palaeoecology

Silurian ostracods had adapted to occupy most of the habitats and life styles of the modern ostracods but most were probably benthic *(Siveter, 2009, pp.55-56[6])* living on relatively shallow water shelves or shelf slopes. Most freshwater ostracods have thin, poorly calcified carapaces and spend time swimming several centimetres above the substrate. Marine benthic forms are heavier and tend to be burrowers and crawlers, and thrive best in muddy sands and silts. Those ostracods in relatively near shore, more turbulent environments tend to produce thicker carapaces with marked ribs and reticulations, and sand burrowers tend to have thick but smooth shells *(Armstrong and Brasier, pp. 226-228[1]).* The heavily sculptured nature of many of the forms in the Lincoln Hill sample would therefore seem to confirm a marine benthic lifestyle within a relatively near shore shelf environment.

Siviter *(2009, p.52[6])* refers to a marked faunal change that occurs near to the Sheinwoodian-Homerian Stage boundary in the Upper Coalbrookdale Formation, which lies within the Wenlock Shale. Water depths were at their greatest during the middle and upper part of the Coalbrookdale Formation and this represents a deeper-water fauna. These conditions do not support a high diversity of ostracods. The faunal influx coincides with the major shallowing episode that occurs at the start of the Homerian Stage when a relatively shallow carbonate platform develops.

Climate at this time was probably tropical and palaeomagnetic data from the Late Llandovery lavas at Tortworth in Gloucestershire indicates a paleolatitude of 16ºS *(Cherns et al., 2006[3]).* This is further supported by the existence of reefs in the Wenlock Limestone Formation that overlie the Coalbrookdale Formation. The evolution of the Silurian sequences is also closely related to rises and falls in relative sea levels linked to both eustatic and tectonic movements. ►

Conclusions

The conclusions drawn from this exercise were tentative and somewhat limited in scope. The sample provided was labelled as 'Lincoln Hill' which would initially identify the probable origin as being on the northern side of the River Severn in the Ironbridge area of Shropshire.

The petrology of the sample was that of a grey-olive green friable shale with a significant fine quartz grain content along with associated clay minerals and carbonate shell debris that was well broken. This would indicate an offshore shelf environment in relatively shallow water that was subject to some turbulence and input of shell debris. The depositional environment was probably below fair-weather wave base and probably quiescent for much of the time but was subject to storm disturbance.

The only macrofossil identified was that of *Atrypa reticularis* a common Wenlock Series brachiopod. The ostracod assemblage indicated that the sample was Silurian, and the probable stratigraphic horizon was placed in the Uppermost part of the Coalbrookdale Formation (former Wenlock Shale).

The assemblage was considered to represent a Taphocoenosis (allocthonous death assemblage).

There is still uncertainty as to the exact stratigraphical level as there is an identified Beyricheacean fauna that should not appear until the *C. lundgreni* graptolite biozone. This fauna (if correctly identified) appears earlier at Lincoln Hill, in the *C. rigidus* graptolite biozone and may be linked to early faunal change controlled by a sea level regressive event (Boge P-S Event) that preceded the main Homerian Stage change in Welsh Borderland ostracod assemblages. It is recommended that a much larger sample is processed and picked but additional cleaning of the ostracod carapaces is required to ensure accuracy of identification of the taxa present. Therefore, any conclusion drawn regarding the stratigraphical position of the sample must be at this stage considered as only tentative and subject to further work.

So, there you go then, you have (possibly!) solved the 'Whodunnit' and can tentatively place the rock sample both in place and time based on its microfossil content. The answer will not grace your specimen cabinet, but the process could give you something to focus on in lockdown. Try it out on a local rock sample to keep you occupied until we can all get safely back out into the field.

Professor Siveter informed me that the Wren's Nest contains the most diverse ostracod fauna of any Silurian locality in the UK with perhaps 100 species, so get looking! ■

Bob Bucki

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Mike's Musings No. 31, Getting a Taste for Geology

Many years ago a two-part radio documentary on the origins of oil and gas, ('Crude Facts') began with an imaginative evocation of how depositional basins develop in response to local heating at the base of the Earth's crust (presumably controlled by temperature gradients in the upper mantle). The listener was invited to imagine the effect of a heat source (in this case, a cigarette lighter) placed beneath a horizontally disposed *Mars Bar!* Naturally enough, the basal layer of chocolate begins to melt, followed by a foundering of the fudge layer, leading to the upper toffee and chocolate layers of the confection sagging and stretching, causing the upper chocolate not to melt (insufficient heat transfer) but to break up into small and separated slabs much like crazy paving. These, we are told, are analogous to a series of discrete blocks separating sedimentary basins just waiting to be filled with a fresh supply of sediment (for purposes of the programme, with carbon-rich organic matter that is in due course transformed into the hydrocarbons in question).

Just how realistic this simple analogy is isn't quite the point: it is the image it conveys to an untutored mind that makes it so compelling, and thereby provides a useful, if simplistic, model for the complex process one is trying to explain in manageable terms to an inexperienced audience.

This brings to my mind the numerous occasions I have come across, or used, food-based analogies to better understand, or convey, unfamiliar concepts in both geology and science in general.

I recently attended a workshop on 'Understanding Geological Maps'. One of the first concepts it is useful to explain is the 'principle of superposition' (one of the more fundamental ideas in the whole understanding of geology). An image of a slice of *Bakewell Tart* was projected on to the screen. The basal layer of pastry was successively overlain by layers of jam, frangipane and sugar icing (OK, variations exist, so don't write in to point out your own recipes!): the point here is, that just as the confection is prepared in a specific order, likewise is a stratigraphic sequence built up, ►

Bakewell Tart, Wikimedia Commons

layer upon layer, that maintains an ordered integrity from which one can make reasonable deductions. By using different confections, one can also introduce either igneous intrusion with the help of *Stollen* or tectonic deformation (of a kind!) using, say, a *Swiss Roll* (admittedly not the best example).

Hard boiled egg, Wikimedia Commons

A little later on in the workshop the audience was asked to recognise a domal structure in the outcrop pattern of the Weald: concentric outcrops of strata getting progressively older towards the centre. To imagine how this had taken shape, the audience was invited to consider the progressive slicing through of a *hard boiled egg* resting on its side. The eggshell represents the youngest beds on the 'outside' of the dome, the egg-white the older, intermediate beds, and the yellow yoke the innermost, oldest beds (the Purbeckian inliers?) exposed progressively after initial folding, by uplift, and erosion across a roughly horizontal, plane section.

A different analogy in which I have seen *hard boiled eggs* being used, is to demonstrate differences in the appearance of concretions eroded to differing degrees. A shallow slice through the egg that doesn't get deep enough to expose the yolk is analogous to the more uniform section through the outer part of a concretion. A deeper slice, complete with the yolk, is analogous to a more equatorial section revealing the core of a concretion which may, for instance, reveal the central fossil within (think of the celebrated Dactylioceras concretions from the Yorkshire coast around Whitby).

Dactylioceratidae, Yorkshire, Wikimedia Commons

There are any number of popular confections which may serve to illustrate the different types of sedimentary particle and their lithified counterparts. *Toffee Crisp* centres (made from *Rice Krispies?*) present a good analogy for pisoliths, toffee serving as the cementing matrix. More frequently encountered oolites are less well served by the catering industry (i.e. I'm lost for an exact analogy; perhaps *caviar* will have to do! - after all 'oolith' derives from the Greek 'öon', an egg).

Peanut Brittle Bar, Wikimedia Commons

Peanut Brittle or *Nougat* can be used for breccias and conglomerates; crumbling *Digestive Biscuits* seem to serve the purpose for sand (and grit) grains; *Rich Tea* for siltstone (and, at a push, mudstone too).

The world of volcanic rocks is equally well served, with *Aero* or *Crunchie Bars* mimicking vesicular or scoriaceous textures. *Fruit and Nut* (or any number of healthier (?) nut-based snack bars) would be their amygdaloidal counterparts. The more exotic *chocolate liqueurs*, or, better still, *Meltis 'Newberry Fruits',* can be used to illustrate drusy cavities or geodes, with some of the original mineral-rich fluid still remaining! ►

Aero chocolate bar, Wikimedia Commons

Smarties, Wikimedia Commons

To extend these analogies to what goes on at depth inside a magma chamber, I found it useful to substitute different coloured *Smarties* for different chemical elements sloshing around in a typical magmatic melt. I would add lots of *Mint Imperials* to serve as atoms of oxygen, present in much greater numbers, to accurately reflect the composition of most magmas. *Smarties* conveniently came in eight colours (prior to 2006, when the blue ones with artificial colouring were replaced by white – I bet you didn't expect to learn such useful stuff in a geological article!). This was just the right number to represent the main chemical constituents: red would serve as silica and green as aluminium, both present in most of the common silicate minerals; blue (Ca), violet (Mg) and brown (Fe) - i.e. darker colours for the more 'mafic' constituents; pink (Na), yellow (K) and orange (OH) - i.e. lighter colours for the more 'felsic', or volatile, constituents.

From this, it was easy to 'prepare magmas' with the elements in roughly the correct proportions to represent basic, intermediate or acid melts. This immediately conveyed the accurate notion that nearly all magmas are chiefly composed of oxygen, silicon and aluminium, with just a few further elements, making up around 99% of the mix. Progressive crystallisation along the well known trajectory of Bowen's 'Reaction Series' (for which I refer you back to near the end of Musing No.21, Newsletter No. 255) could then be mimicked, removing, as appropriate and in correct sequence, the 'atoms' required to produce each mineral phase as temperatures cooled. I discovered that this not only helped people to understand more clearly how magmas change (or evolve) as they cool down and crystallise, and how they are proportionately enriched in the more volatile constituents, in particular a more 'watery phase', from which the non-silicate 'ore-minerals are derived, but actually managed to hold their interest in what otherwise seemed a rather challenging subject. I only had to mention *Smarties* at field locations involving igneous petrology and I soon had a rapt and fully engaged audience gathered around me!

This last example is probably as complicated as one would wish a food analogy to become, and with which I leave you to have fun either recalling, or dreaming up new, examples of this marriage of convenience between geology and cookery.

Crème brulée, Wikimedia Commons

P.S.

Lest it be thought that such culinary references only grace the minds of the more simple-minded echelons of the geological fraternity such as myself, I draw further inspiration from references to '*jelly sandwiches, crème brulées and custard pies*' in a highly regarded book dealing with the heady subject of the 'Making of the Himalayas, Karakoram and Tibetan Plateau'. If such food-inspired analogies are suitable for high-minded research of this calibre, they can surely be considered acceptable in any environment! ■

Mike Allen