Dorset GA Group

Newsletter Winter 2021

https://dorsetgeologistsassociation.org/

Contents

Welcome to the Winter Newsletter!

There's a big field trip element to this edition as we've had a full, successful programme, ably organised by Val. I'm pleased to report that Richard Hallett has come forward to fill this important role (see p.16-17). In addition, new member Chris Webb has agreed to be our new Events Officer, another important role that has been vacant for a while. Both posts will need confirming at the A.G.M. We've been less successful in our search for a new Chairperson to replace Alan, our Chairman of long-standing (well, he is quite tall!) We really need someone to come forward to take on this role, ideally at the A.G.M. Please consider applying for this role, to ensure the smooth running of your DGAG. Just let me or another Committee member know if you're interested and want to discuss it. *Kelvin*

Fiona Hyden reports on 'In the Footsteps of William Smith' field trip 25 July 2021 led by Dr Martin Gledhill

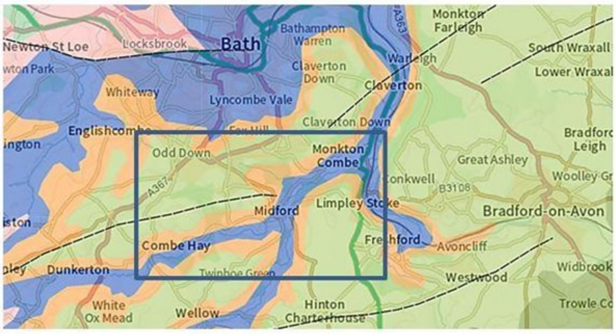
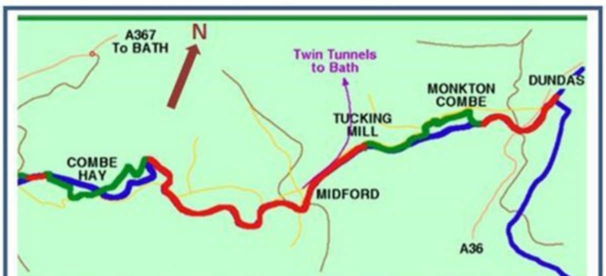


Figure 1: Geology of the area south of Bath (BGS) https://dorsetgeologistsassociation.org/index.php/3d-map/



The canal route is shown in red and blue; walking detours in green
https://coalcanal.org/features/CCWay/Images/CCWmap00.gif

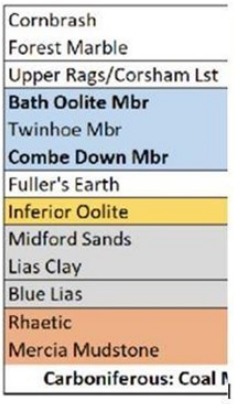
Figure 2: Part of the route of the Somersetshire Coal Canal from Combe Hay to Monkton Combe

Nine DGAG members, very ably led by Dr Martin Gledhill, enjoyed a fascinating walk along part of the Somersetshire Coal Canal which was surveyed by William Smith and constructed in the 1790s. The knowledge gained by Smith during his excavations led him to a realisation of the close links between geological strata and their associated age-specific fauna. Not only did Smith make a significant contribution to our understanding of stratigraphy, but his geological expertise, honed here and further afield, culminated in his famous and truly magnificent geological map of England and Wales published in 1815. It adorns a wall of the Geological Society in London - a fact which is all the more remarkable because Smith was the son of an Oxfordshire blacksmith, and definitely not part of the very elitist establishment of his day, though he did aspire to be accepted in their ranks.

We left some cars in Monkton Combe village, then drove westwards to the Odd Down Park and Ride (OS 772620) to begin our walk, following one of two branches of the Somersetshire Coal Canal which runs 11 miles E-W over surprisingly hilly terrain to the south of Bath (Figures 1 and 2).

We covered the 5-mile section from near Combe Hay to Monkton Combe which runs through strata spanning the early to Mid Jurassic, from the Midford Sands of early Jurassic (Liassic) age (shaded blue in Figure 1), through the Mid Jurassic Inferior Oolite (orange), Fuller's Earth and thence to the Great Oolite (pale green), a freestone from which much of Bath is built (Figure 3).

Walking south-westwards from the Park and Ride towards Combe Hay, we examined samples of the Great Oolite from a wall - a honey-coloured limestone with abundant ooids and worn shelly fragments. We then descended the Great Oolite escarpment, with the Fuller's Earth some 20 m below our feet. Both rock types have been mined since Roman times, mostly accessed via adits and shallow mine shafts. The last Fuller's Earth mine here closed in the 1970s. The combination of alternating permeable limestones and sandstones and intervening, impermeable clays has created water-lubricated surfaces on top of the clays, causing extensive landslips, exacerbated by a honeycomb of mine workings that have created further subsidence. The Fuller's Earth is a particular site of instability. It consists of montmorillonite-rich clays that are derived from the chemical breakdown of submarine-deposited volcanic ash, and it's swelling, thixotropic properties enables significant absorption of water, or, in the case of cleaning or fulling of woollen fleeces, of lipids and lanolin. Under shearing stress, the montmorillonite becomes liquefied.



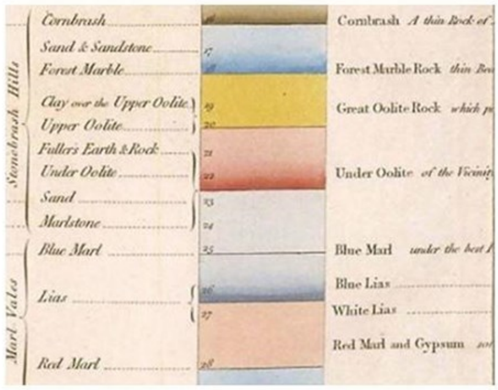


Figure 3A: Stratigraphy of the area around Bath (modified from Tucker 2020; [(PDF) Source of Roman stone for Aquae Sulis (Bath, England): field evidence, facies, pXRF chem-data and a cautionary tale of contamination (researchgate.net)]

Figure 3B. William Smith's stratigraphy (http://www.strata-smith.com/?page_id=312)

William Smith became an assistant surveyor, aged only 18, and 4 years later in 1792, he surveyed an estate near High Littleton SW of Bath that included coal mines. These explorations perhaps triggered his lifelong passion for mapping geological strata. Two years later he was employed to survey the newly proposed coal canal to service the complex folded and faulted coalfield situated between Bath and Wells. The route of the canal is scenic and hilly, and near Caisson House, a flight of 22 locks was built to take the canal down 138 ft. (42 m) to the Cam valley (Figure 4). In addition, three hydrostatic locks (caissons) were planned to reduce the amount of water required for a single canal boat to pass through the locks (https://www.coalcanal.org/features/Caisson/tCD0a.htm), though only one caisson was actually built at Rowley Bottom, near Combe Hay. A demonstration to dignitaries of this invention (essentially a long wooden submarine box which was wound up and down on large screws) had near fatal consequences, and Smith was sacked at this time, though the actual design of the caisson was by Robert Weldon.

Figure 4A: A flight of three of 22 locks near Combe Hay; the width is only 7' (2.14 m). Only some locks have survived https://en.wikipedia.org/wiki/Combe_Hay_Locks#/media/File:Dry_Canal_Locks_at_Combe_Hay.JPG
Figure 4B: Members of DGAG beside one of the Combe Hay locks [Photo: Val Fogarty].

The canal operated until 1899, but the arrival of the Bristol and North Somerset railway in 1881 heralded the steady decline of canal traffic, until its demise and dereliction, though some restoration work is ongoing.

We continued our walk beside the canal (Figure 5A), encountering an accommodation bridge where the packhorse road crosses the canal (Figure 5B); it is one of only 19 such bridges to survive.

Figure 5A: (Left) Bed of the coal canal to the left of the walkers.
Figure 5B: (Right) Accommodation bridge where the packhorse road crosses the canal at Upper Midford). Photos: Fiona Hyden

We passed what is left of the Midford Aqueduct, built in 1802, and at Midford Station (featuring in the 1953 film, the *Titfield Thunderbolt*), the Midford (Bridport) Sands are well exposed. These are pale brown, slightly calcareous and micaceous, very fine, quartz-rich, silty sandstones. Bivalve moulds are common, including those of trigoniids. Further exposures of the Midford Sands can be seen on steep wooded slopes, and in cuttings near the Tucking Mill (railway) Viaduct, the overlying Inferior Oolite is exposed, including the Upper *Trigonia* Grit and Upper Coral Bed. The route then approaches the mile-long Combe Down Tunnel (now a cycle route), but we turned off along a footpath some 110 m above Tucking mill, walking across a 50-yr old mudslide associated with a spring line at the base of the Great Oolite.

The last two stops before we returned to the village of Monkton Combe were to the attractive Tucking Mill property in the parish of South Stoke. William Smith apparently purchased this in 1798 and sold it some 20 years later, necessitated by his parlous finances. A rather impressive plaque was subsequently erected outside this house by the Geological Society of London,

Figure 6A: (Left) Tucking Mill with commemorative plaque to the right of the downstairs' window)
Figure 6B: (right) Tucking Mill House where William Smith actually lived. [Photos: Fiona Hyden]

commemorating William as the 'Father of English Geology' (Figure 6A). However, his actual home was 50 m up the road, just over the parish boundary of Monkton Combe (Figure 6B). It was here that he had purpose-built cabinets made to house his rock and fossil collection - laid out, not only in stratigraphical order, but on shelves built at an angle to simulate the dip of the strata in which they were found.

Whilst living at Tucking Mill House, Smith (despite his precarious finances) opened a quarry at Kingham Field, on the edge of Combe Down, intending to convey the stone by railway to Tucking Mill where it would be sawn into blocks using water power. However, the stone was of poor quality and the opening of the quarry coincided with the Napoleonic wars when the demand for stone was much diminished, and the demand for poor quality stone almost non-existent - so the venture faltered. Martin led us unerringingly through a hedge (!) on Summer Lane to the old adit entrance to the quarry, since walled up (Figure 7).

Figure 7A: (Left) 'entrance' to the old adit through the hedge on Summer Lane. **Figure 7B:** The walled-up entrance to Kingham Field quarry within the Great Oolite. The hole at the top of the wall enabled us to see the stone-faced tunnel by torchlight. [Photos: Fiona Hyden]

Our final stop was the Wheelwright Arms in Monkton Combe……

This account is only a fraction of the historical and geological detail that Martin imparted during our day out. You might like to consult any of the following for further information:
William Smith's Maps - Interactive at http://www.strata-smith.com/
His tramway - Kingham quarry to Tucking mill wharf https://www.youtube.com/watch?v=j2M_TXx0Jo0
The coal canal (Somersetshire Coal Canal Society) https://www.coalcanal.org/

Alan Holiday explains the **Abbotsbury Ironstone Formation**

Fig.1 Specimen of Abbotsbury Ironstone

As a result of an enquiry through the DIGS website from Dr Tom Gernon, a geologist from Southampton University in connection with his research, I have taken a new interest in the Abbotsbury Ironstone. The DIGS group has a Local Geological Site (LGS) (formerly a RIGS) at Red Lane in Abbotsbury. Part of it is accessible to the public as it is used as carpark for some residents. There is a much larger section on private land which can be accessible through the helpful cooperation of the landowner/tenant. The ironstone occurs at the top of the Corallian/base of the Kimmeridge Clay, sometimes called 'passage beds'. The sequence is described in various texts as an 8-metre thick sequence of iron-rich oolitic sandstone and mudstones that were once quarried for their iron content. The ore was worked, one source says in Victorian times, a second says it was the early 20th C. However, the ore, despite having 32-36% iron, proved too siliceous to be economic. In weathered sections such as at Red Lane the exposure is typically red brown in colour due to oxidation to limonite but other locations it is green chamosite. This is a complex...

iron magnesium alumino-silicate. Another source describes it as berthierine which is a variety of chamosite. The exposure in Red Lane shows the dip of the strata to the south and it forms the northern limb of a syncline on the northern limb of the Weymouth Anticline. Apart from Red Lane, the best section and most accessible is reached via Blind Lane, off Back Street just to the east of the village centre. I looked for a reported exposure in Cowards Lane, just west of the village centre off West Street but failed to find it although I did find oolitic sediment on soil. Literature on the ironstone reports a significant fauna of bivalves, brachiopods and the ammonite *Raesenia*. However, in my experience fossils are few and far between and not well preserved! Perhaps they have been collected by previous researchers. The fossils could also have been affected by diagenetic processes following deposition.

Fig. 2 The Blind Lane exposure

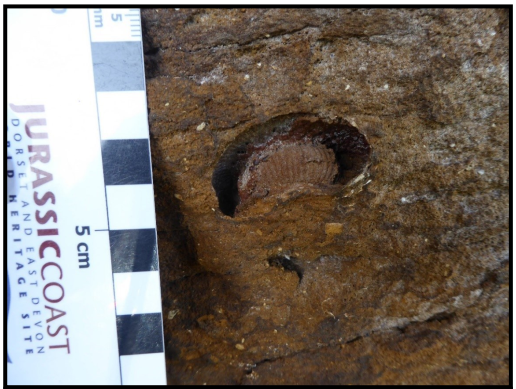


Fig.3 Mould of a bivalve

Dr Gernon's research is looking at cyclicity in sedimentary sequences, possibly linked to Milankovitch Cycles. Using magnetic susceptibility - a measure of the extent to which the rocks become magnetised when exposed to a magnetic field - the team made the discovery that the layered rock archives preserve evidence for orbital cycles. Research at Red Lane involved careful logging of the sequence every few centimetres. I am looking forward to reading about the findings of this research.

References:

1. Dana's Textbook of Mineralogy.
2. Dorset and East Devon Landscape and Geology by Malcolm Hart. Crowood, 2009.
3. Geology of the country around Bridport and Yeovil. Geological Survey of Great Britain. Wilson et al.,1958.
4. Geology of the country around Weymouth, Swanage, Corfe and Lulworth. Geological Survey of Great Britain. W.J. Arkell,1947.
5. Geology of the Dorset Coast. John C.W. Cope. Geologists' Association Guide No. 22.

SHERBORNE QUARRIES, 14^{th} August 2021

Simon Carpenter was our scribe and our thanks go to leaders, Martin Dodge (quarry manager), Bob Chandler and John Whicher for this excursion.

1. Introduction

From medieval times developing conurbations increasingly used stone rather than wood for building. Transport was poor and local sources inevitable used. Sherborne was no exception and local quarries were extensively excavated for building stone. At the height of quarrying (~1812), there were over 1,000 extraction sites, some major but many nothing more than small outcrops excavated to build a single dwelling and outbuildings.

The single most important stone in the Sherborne area, due to its extensive local cover, is Inferior Oolite (IO). It was so-named by Rev. Joseph Townsend in 1813, a collaborator of William Smith, as it lies below the Superior or Great or Main Oolite. It is middle Jurassic in age (~174-164 Ma). At the time of deposition, the area was around 30^0 north of the equator (think Morocco today). Today, IO is exposed from Dorset and Somerset eastwards and northwards through the Midlands and into Yorkshire. Within Dorset, key exposures can also be seen at Horn Park Quarry and at Burton Cliffs.

The Inferior Oolite Formation consists of marine, often condensed limestones. They are cream-orange, bioclastic and nodular, often ferroan, oolitic limestones and micrites, with inter-bedded lime mudstones, ferruginous pelletal beds, oolitic and glauconitic horizons. Deposition is not continuous in any one site. Beds are often thin, representing a geologically short timespan unconformably separated from adjacent beds.

The beds or horizons within them are of geologically instant age but the time gaps between beds are often long and of unknown duration. The formation is richly fossiliferous, most notably with ammonites. Fossils provide an ideal method of assessing the relative age of different strata and for comparing the age of geographically separated strata. Some 13 ammonite zones have been discriminated in the IO, giving good resolution of depositional ages.

2. Frogden Quarry (ST 648 183)

Frogden Quarry, situated on the north-eastern side of Sherborne, owned by the castle estates, was one of the largest and remains the only active quarry in the locality. The quarry is situated adjacent to a key SSSI of the Middle Jurassic succession. Its citation reads:

'Frogden Quarry is an internationally important geological locality demonstrating features of very considerable stratigraphical significance. This is the only site in Southern England where rocks of the Humphriesianum and Subfurcatum zones of the Bajocian (Middle Jurassic) are exposed in any thickness as a complete succession. The site has produced most of the type fossils (in this case ammonites) from which the Humphriesianum and Subfurcatum zones were defined. Elsewhere the time intervals represented by these zones are normally missing or occur in attenuated form. The Frogden section is therefore of particular importance as an international reference site and as a source of type fossils.'

Besides the SSSI there is also a working quarry, extracting stone for local builds and repair/ renovations whilst avoiding the protected face. The stone of significance in this quarry is, of course, Inferior Oolite with a quarry face approaching 30 m in height.

The local geology reflects that this part of Sherborne lies at the very western edge of the Wessex basin, subsidence of which produced accommodation space which encouraged sedimentation. On a larger scale the geology is quite detailed. The stone in the quarry was formed within a graben or half graben. The area is faulted, with subsidence and later reactivation of older Palaeozoic structures. The bigger picture can only be grasped by combining data from many local investigations. Even within the bounds of Frogden, the strata can vary significantly in thickness across the length of the quarry. Data from this quarry, and the area generally, was obtained by several notable investigators, most particularly, Sydney Savory Buckman of Bradford Abbas (19th C), of which more later, with further refinement by Wilfred Hudleston and Linsdall Richardson (on a geological epic across England in the early 20th century) to name but two.

The limestone is oolitic in the lower part and rich in fossils making it less suitable for building. The oolites are iron hydroxide structures often as wackestones with a micritic matrix. They are of a biological origin and developed by fine concentric layers growing by accretion, often around a nannofossil. These are interpreted as small onkolites and their depth of formation is considered to be below the influence of strong currents. This is in contrast to Bahamian-type ooliths which grow by aragonite accretion at a shallower depth in wave-washed, richly carbonated waters. The main unit of exploitation at Frogden is the Sherborne Building Stone Member. This is relatively free of macrofossils apart from gigantic nautiloids. It is a yellow massive stone commonly used for high quality building in the area. Of note in the Sherborne Limestone are *Thalassinoide*s burrows. The active burrows were regularly inundated, probably by turbidites flowing into the sinking graben subsuming the most recent burrows and their inhabitants. A new generation would then establish a new set of burrows, until likewise, they too were overwhelmed. *Thalassinoides* are found not infrequently in sedimentary rocks and the burrowing organism usually remains unknown. Fortuitously at Frogden, the burrowers have been identified from fossil evidence (see later). These are Jurassic lobsters, *Glyphea regleyana*, *Eryma compressum* and occasional *Eogastrodorus granulatus*. The fact that fine detail of these organisms has been preserved within fossils suggests that they have not been rolled around on the seabed, indicating a depth of formation of below the storm wave base for the majority of time, in keeping with a likely depth of ooid formation.

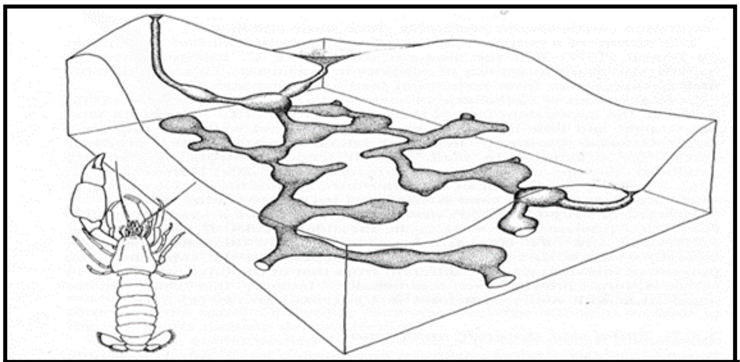


Fig 1. *Thalassinoides* burrows, a branched, 3-dimensional network of cylindrical burrows

The burrows are noted within the rock by their lighter colour, reflecting a higher carbonate content indicative of past organic activity within the burrows. As lithification occurred, the calcium rich burrows attracted addition calcium from surrounding sediment layers giving them a horizontally elongated appearance when viewed in vertical section. The IO presents several beds. Each is wackestone (a mud-supported carbonate rock) and each presents an erosion plane or bedding surface. There is evidence of horizons with broken shells though their significance has not been resolved. Condensing of the beds is established, each probably geologically instantaneous- perhaps representing a duration of around 100K years. Walking down the face, the presence of specific fossils, so called guide fossils, allow the age of each bed to be determined.

Fig.2 The preserved face of Frogden Quarry

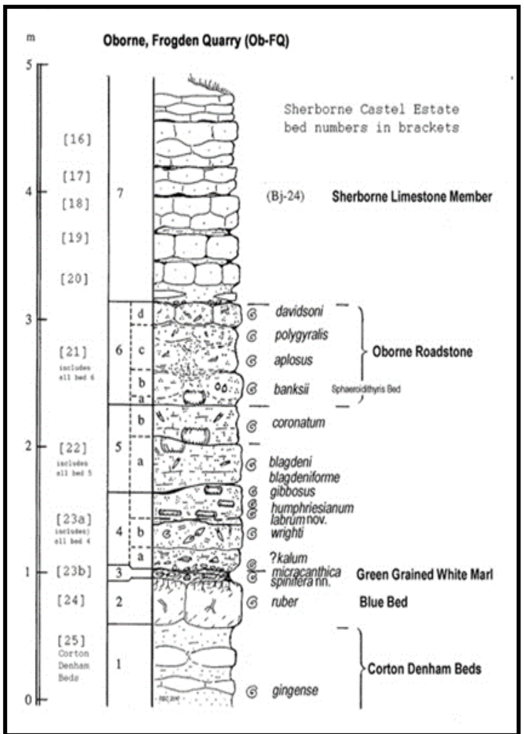


Fig.3 Stratigraphic column - Frogden Quarry

There are several lines of deposition between the main blocks which, when they become wet, have a paste-like consistency giving them the unofficial name of 'toothpaste layers'. A suggestion here is that this could be bentonite derived from pyroclastic flows issuing from distant volcanoes. If true, these layers, containing igneous particles, can be radiometrically dated which would also allow the exact period of deposition of each IO strata between the toothpaste layers, to be determined. There are also phases of limy, sandy deposition within the IO. Again, their origin is uncertain; they could be discrete deposits reflecting a different depositional environment. Alternatively, they could have been layers denuded of calcium carbonate by pressure solution during lithification, leaving only sand. Rock quarried at Frogden is transferred to the mason's yard of Sherborne Stone, adjacent to, and once the stables for, the castle. Quarried rock could be more closely examined. Martin had prepared many sections of rock for inspection, his skilled eye as a quarryman and keen interest in rocks and fossils, allowing him to select some very educational items.

Fig.4 The working quarry, Martin, quarry manager, in blue, with yet to be extracted Sherborne Building Stone behind (with thanks to Mimi Spencer). Below the Sherborne Building Stone lie the richly fossiliferous beds containing ammonites indicating that at least most of the Sherborne Building Stone is within one ammonite Zone.

Fig.5 Frogden is rich in fossils, including ammonites. These examples are mostly from the lower part of the succession (by Mimi Spencer). Also, fossilised wood is in evidence as seen on the left.

3. Sherborne Stone Mason's Yard

Rock quarried at Frogden is transferred to the mason's yard of Sherborne Stone, adjacent to, and once the stables for, the castle. Quarried rock could be more closely examined. Martin had prepared many sections of rock for inspection, his skilled eye as a quarryman and keen interest

in rocks and fossils, allowing him to select some very educational items. Also, Martin and his staff had collected a range of fossils for display, extracting them from rough rock before being lost in processing. Sectional views of Sherborne Building Stone were of particular interest.

In Fig.6 below, the *Thalassinoides* burrows are clearly seen, more calcified than the surrounding rock, and often harder with a tendency to stand proud of the surrounding rocks. Care must be taken cutting through the building stone, the relative hardness of the two areas can cause tools to drift and straight lines are challenging to achieve. Above the burrows, are small, oblong grey areas, thought to represent semi-consolidated mud that has been incorporated into the rock. Below the burrows distorted sedimentary layers are obvious, due to pressurised ground water disturbing lithographic layers prior to lithification.

Fig.6 Vertical section- Sherborne Building Stone

As noted above, Frogden in one of the few places where the burrowers, creating *Thalassinoides*, can be found. Few fossils are found in Sherborne Building Stone, probably because of a decalcification process during lithification destroyed putative fossils, Occasionally, a fossil is found. (Fig.7)

Fig.7 Clear evidence of lobsters found within *Thalassinoides* with individual anatomical parts identifiable.

Such fossils, when they do occur, can protect other adjacent fossils from dissolution and bivalves (internal mould variety) can frequently be found with an enduring larger fossil.

Fig.8 Vertical section- Nautilus fossil

Below the Sherborne Building Stone, lies the fossil bed (Fig.9), which itself sits on a bed of Marl. Interestingly, the middle section contains glauconite, possibly derived from fish faeces, which sometimes permits radioactive dating for an exact age of deposition. Below the Sherborne building stones lies Green Grained White marl, the greenish tinge, most apparent when freshly cut, is due to the presence of the mineral glauconite. The marl is packed with fossils; gastropods, ammonites (often fragmented) and belemnites can be readily seen. Fig.10 shows an extensive range of fossils in the Green Grained White Marl Bed, above the Blue Bed and directly below the main fossil beds (see Fig.3 for relative positions of strata).

Fig. 9 Sections of the fossil bed, unsurprisingly, packed with fossils.

4. Louse (Lows) Hill Quarry (ST 611 162)

The next site of interest was Louse (Lows) Quarry found just off the A30 Sherborne to Yeovil Road. Once used as a gun flint works, it is now a very rural site, a curving outcrop, 150m or so in length and some 2-3m in height. It is gently elevated above the surrounding grasslands and made an ideal spot for lunch. Like Frogden, it is one of the few quarries now in existence for inspection. It is an SSSI because it contains the only accessible section of the Bradford Abbas Fossil Bed.

Fig.10 The Marl Bed

Removal of fossils from the face is not permitted, though fallen fossils can be collected of which many ammonites of the genus *Graphoceras* were noted below the face.

Paleontologically, the quarry exposes the Bradford Abbas Fossil bed with an abundance of *Graphoceras* and *Euhoploceras* ammonites. Geologically, its interest is that it lies at the very edge of the Wessex Basin where only slight subsidence of the basin would have occurred allowing little accommodation space for deposition. In consequence, strata which are substantial at Frogden are now, at Louse, only a few miles away, much thinner. For example, the thin Irony bed at Louse (a few centimetres thick) is all that remains of the Frogden fossil beds. Similarly, the *Astarte obliqua* bed at Louse represents all of the Sherborne Limestone and Coombe Limestone members, that is the entire *Garantiana* zone and *Acris* subzone. Sydney Buckman, of which more later, wrote his first scientific paper, aged 16, on bivalves from this quarry.

Fig.11 Bob Chandler examines the condensed *Astarte obliqua* and Irony beds. The face at Louse exposes the *Muchisonae* to *Parkinsoni* zones

5. Holloway (ST 578 155)

Fig.12 The Holloway- looking east

The section exposed in the Holloway is the Bridport Sand Formation, Toarcian age (183-174Ma) of the Lower Jurassic and lying below the IO. Typical Toarcian ammonites are *P. aalensis* but here the development is a little older. The Holloway, probably the main route east from Yeovil before the construction of the A30, was formed by the continuing wearing down by animal hooves and cart wheels on a soft, unprotected track surface. Geologists have benefited from the travels of itinerant merchants and locals-on-the-move with excellent sections of 6-8 metres in height available for inspection (see Fig.12). Such Holloways are very common in the Bridport Sands, most noticeable in the Ham Hill area of Somerset where Bridport Sands lie beneath the more resistant Ham stone. Roads off the hill frequently form holloways. The structural delicacy of these lanes is indicated by the recent closure of the Odcombe-East Chinnock hollow way road due to erosion and sidewall collapse.

Close examination of the section shows a high concentration of immature, angular, fine sand, some feldspars and lignite, material which is thought to have an origin in Cornubia (Cornwall) and was deposited as a migrating sand bar moving north to south. A number of features of interest are found in the section. Current structures, including cross bedding, suggesting a high energy environment, are evident (see Fig.13) and certain layers within the sands are more prominent reflecting a greater resistance to erosion than the surround sands.

Fig. 13 Flow features evident in the afternoon sunshine

These features, standing proud of the section (see Fig.14), are known as 'doggers' and represent early diagenetic structures resulting from calcium carbonate rich material gathering at certain points. The top of the sand is *Dumorteria moorei* in age, on the coast it passes into the Lower Aalenian. Taking the section into a wider geographical context, Bridport Sands is a geographically extensive deposit with local names in different localities. It is diachronous (i.e. the same deposition but deposited in different regions at different times). The age of the top of the unit decreases as it is followed south from Cheltenham (known as Cotswold Sands), through Bath (ka Midford Sands) to South Somerset (ka Yeovil Sands). A few miles to the west, the Yeovil Sands merge with the Ham Stone of Ham Hill which is a local accumulation of cemented shell debris and sand.

Fig.14 One of many 'doggers' standing proud in the sidewall of the Holloway

The type locality of the Bradford Abbas Fossil Bed is in the nearby railway cutting (ST 592 145), but obviously inaccessible to the public. Equivalent strata were inspected at Louse Hill Quarry. The cutting is an SSSI and constitutes a reference section for parts of the Bajocian Stage for these internationally applicable time units.

6. Bradford Abbas (ST 587 144)

Notable contributions to a better understanding of the IO were made by father and son members of the Buckman family of Bradford Abbas. James, Buckman senior (1814-1884), was professor of Botany and Geology at the Royal College of Agriculture at Cirencester. A major success at Cirencester was the 'student' cultivar of parsnip developing a substantial agricultural vegetable from its wild, spindly ancestor. After a falling out with his bosses in support of Darwin's evolutionary theory, he resigned from the college and moved to Coombe in 1863, a large house in Bradford Abbas, most recently in the hands of the Haynes (Motor Museum) family. The house was blessed with an adjacent quarry (East Hill Quarry) which included the complete section seen in the railway cutting and at Louse Hill. He continued his interest in agriculture, botany and geology and branched out to mastering local archaeology. He was a founder member of Dorset Natural History Field Club. He died in 1863 and his grave and commemorative stone can be found at St Mary's Churchyard in Bradford Abbas.

Although James was a prolific author and collector, the important descriptive work was carried out by son, Sydney (1860-1929) one of James' five children, often relying on his father's extensive fossil collections. Sydney attended Sherborne School and wrote his first scientific paper at the age of 16 years on Astarte bivalves of Louse Hill quarry, a paper which bravely contradicted some of his father's earlier conclusions. He was similarly blessed with a lively mind and explored geologically further afield, most noticeably into Gloucestershire and later, world-wide. Like his father, he was somewhat of a polymath. His interests were extensive. One of his notable projects, having a keen interest in powered flight, was working with Lord Baden-Powell to develop a workable flying machine. With his wife, Maud, he was active in the early days of the feminist movement. Sydney was also an author of novels (pen name 'James Corin', derived from the Roman for Cirencester). He remarked on village life and matters of rural clothing. Under his own name he wrote on the subject of the riding of bicycles by women during the Victorian era and the development of language. Following his death, his ashes were cast from Golden Cap, a tradition later followed for the late John Callomon.

Fig.15 Bradford Abbas- St Mary's Church and James Buckman's final resting place

Sydney recognised the potential of fossils, particularly ammonites, to provide high resolution expression of depositions by using them as guide fossils for subdividing Jurassic strata. He could recognise fine stratigraphical divisions based on the sequence of ammonite faunas, each differing by small evolutionary changes. The time equivalents of these horizons, he termed 'hemerae'.

Being well known as a fossil expert, he is considered to have overreached himself. Fossils were sent to him from around the world, most particularly from America. He attempted to fit these into his 'Hemeral' classification system, one that unnecessarily split (he became infamous as a 'splitter') new species into others which, as later shown, were non-relevant distinctions. His work was further affected by not knowing about (it hadn't been discovered at the time) plate tectonics which is fundamental to better understanding the distribution of ammonite species. His most notable works are '*Monograph of IO Ammonites'* (1887-1907), *'Type Ammonites of the IO'* (1909-1930) and a paper on Sherborne (1893), a classic of geological literature on the area. The monograph was originally planned for the Palaeontological Society. It grew somewhat from its original concept into a very substantial volume and incorporated many drawings that had been made by various accomplished artists.

This publication, originally envisaged as a rather shorter contribution for the Palaeontographical Society, considerably outgrew its planned remit in both time and detail and somewhat estranged him from the Society, most particularly its President, Horace Woodward.

His work, whilst ground-breaking at the time, was also controversial. In the 1980's, his work has been reinterpreted and resurrected as 'faunal horizons' (biohorizons) by, amongst others, Colin Parsons, John Callomon and Robert Chandler. Resolution analysis at the level of faunal horizons suggests the geological record in largely incomplete due to erosion and non-deposition.

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The Northern Malverns: Friday 3rd September, Leader: Peter Bridges, Malvern u3a group

Noel Donnelly, whose report follows, organised this trip for members on their way to the Black Country. Into the heart of an ancient subduction zone! Where else in England can you see this!

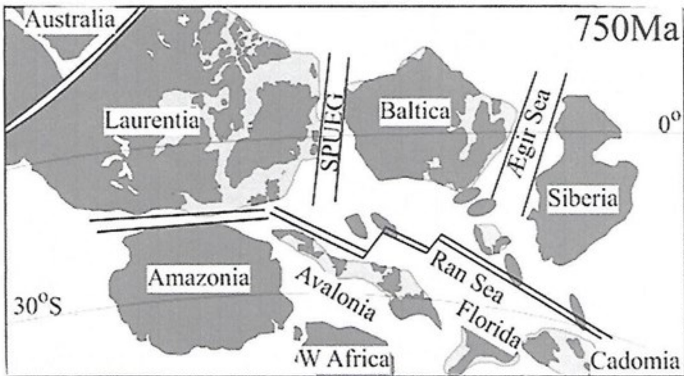

Fig.1 Neoproterozoic paleogeography

During the Neoproterozoic, eastern Avalonia was situated on the north-east margin of Gondwana, on the southern margins of the Ran Sea. Subduction developed, producing magmatism and an arc basin. With progressive subduction, arc magmatism was replaced by a regime dominated by large-scale transform faulting and thrusting as Avalonia collided with Gondwana.

(abstract from The Geological Society, 2006)

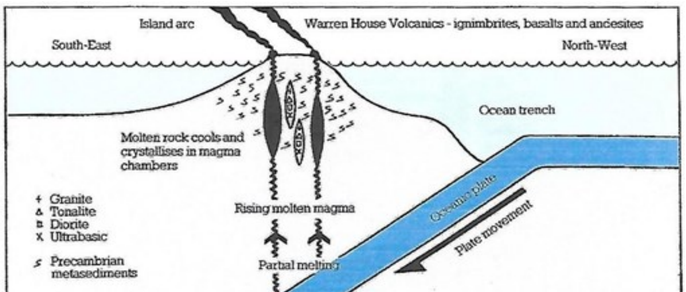

Fig. 2 Speculative section through the Malvern Island Arc in Precambrian times, 680 Ma. © attributed to Bullard, from 'Malvern Hills: a student's guide'.

Peter Bridges, our guide, took us into two quarries at the northern end of the Malvern ridge, North Quarry and Tank Quarry. These were worked for road stone up to the 1970s. They are now well-vegetated and safety considerations restrict access to the faces, but he was still able to show us features of a subduction and plate contact zone. In North Quarry the screes provided specimens of mafic diorite and hornblende amphibolites with crystals up to 2cm long. These represent the base of intrusions rising off a subduction zone, produced by gravity settling.

U-Pb zircon ages of 677+- 2Ma have been established. In places they are cut by granitic/pegmatitic intrusions (with no chilled margins). In Tank Quarry there were specimens of C-M–F diorites, light and dark in colour. These were identified as representing the upper parts of the intrusions. They were also cut by granitic dykes.

Between North and Tank quarries Peter showed us several high angle thrust faults, trending approx. N-S, displaying wide brecciation zones. (see Fig.3)

Fig.3 Fault breccia

Rocky Valley, between the two quarries, has developed along a major high-angle reverse fault line which has brought the lower and upper parts of the diorite intrusion into juxtaposition by major uplift of the eastern side. In Waterworks Quarry, we saw a 2m wide zone of brecciation.

Also we saw diorite thrust over granite, illustrating that these faults were post-granitic intrusion.

Some of the diorites show foliation (but not as strong as we saw in Gullet Quarry a few years ago).

The interpretation is that the diorites were formed in the high temperature low pressure sector of the subduction zone, differentiating as they formed. The whole suite of rocks was then subjected to higher pressures and fracturing as the continental masses collided, generating granitic magmas that intruded the altered diorites. The pegmatites do not show the same degree of alteration, and thrust faulting (Fig.4) and shearing occurred, pushing rock masses together and uplifting them from depth. There are also later faults cutting both the diorites and granites as one might expect in the later stage of collision.

Fig.4 Thrust fault plane

Evidence of a later phase of retrograde metamorphism was provided by the existence of epidote and chlorite in some exposures.

During the late Carboniferous, thrusting from the south-east pushed the whole complex upwards on reverse thrusts from depth to form the ridge we see today. Subsequent crustal stretching produced a large normal fault along the eastern edge of the Malverns. We looked eastward over the Vale of Severn where Triassic marls and sandstone accumulated in this subsiding graben basin. We saw evidence, in fault planes in the Malvernian, of iron oxide deposits and barite carried down by percolating waters in the Triassic.

One can only look on, full of admiration for the geologists who studied this area in the 1970s and unravelled the very complex sequence of events that are illustrated by the rocks in these quarries. This is something that earlier workers could not do until plate tectonics was more fully understood. Many thanks to Peter Bridges for showing us the exposures and explaining their significance.

Black Country Geopark Residential Visit 3rd- 6th September 2021

Val Fogarty writes: This residential trip was planned to take place in May 2020 and then postponed until September 2021 due to all the Covid restrictions. We had been keen to go back to this area after visiting the Wren's Nest in 2018 and meeting the inspirational Graham Worton. With his help and Andrew Harrison, Noel Donnelly and I planned an interesting itinerary which worked out very well indeed. Graham, the Keeper of Geology at the Archives and Local History Centre in Dudley, has been instrumental in creating the Black Country UNESCO Global Geopark. He took us to several geo-sites on Saturday including the Geopark Headquarters, Castle Hill, the Singing Cavern and Dudley Canal Tunnel, the Rowley Hills, Blue Rock Quarry and Bumble Hole. Andrew Harrison, the field officer for the Black Country Geological Society, took us to the Dudley Volcano, Red House Glass Cone and Saltwells Nature Reserve on Sunday.

Geosite 1: Dudley Museum at the Archives, the Geopark Headquarters

The museum has three geological galleries displaying the finest fossils found in the local rocks. The museum has exhibitions and events and runs geological education sessions and a rock and fossil identification service, as well as advice on geological heritage related to engineering…..

..and planning matters. When we went to the museum it was not open to the public and had been closed for 18 months.
Graham met us and took us on a fascinating tour. One of the first exhibits was a first edition book about the Silurian System that was written by Murchison in 1839. This original Siluria encompasses a period of Earth's history from 544 - 410 Ma., which later became split into the Cambrian, Ordovician and Devonian periods. The book is 767 pages long with 48 chapters illustrating some 656 fossils with beautiful sketches. The volume explores the Silurian through careful study of the rocks of South Wales, Worcestershire, Herefordshire, Gloucestershire and Ludlow. It details evidence of the Carboniferous through the Upper Coal Measures and Old Red Sandstone of the Devonian period. (Fig.2)

Fig. 1 Dudley Museum at the Archives

Fig.2 Murchison's book on the Silurian

We walked through the geological galleries which moved us through geological periods of time. We saw amazing fossils that had been found locally, including the 'Dudley Bug' which was a trilobite 425Ma and a good example of a crinoid. (Fig.3) In the Carboniferous section there were fossils of millipedes and spiders that I have never come across before. The final section did contain a T.Rex. They had called it Stan, which had come from Colorado and was killed by a female T.Rex since there are holes on the side of its skull. (Fig.4).

Fig.3 Silurian crinoid

Fig. 4 Graham Worton with Stan, the T.Rex

While we were there Graham also gave an introduction into the geology of the Black Country. The rocks held vast quantities of easily-worked minerals that powered industry. It seems the Black Country was so called because it was black by day as it had 1500 mines, 10,000 iron works and many coalfields. Black smoke and soot filled the air and blackened the streets and houses. It was red by night as and their furnaces glowed fiery red. The lush landscape was destroyed as mining churned up the land and factories piled slag heaps everywhere. No wonder that Tolkien based Mordor, from his book Lord of the Rings on this area. Over time, digging into the ground led to discoveries of fossils and an advancement in geological understanding. The oldest rock layers of the Black Country are limestones and shales full of shelly fossils including coral reefs which lived and died here. They are 428 Ma., at a time when all this area was under a shallow sea. The layers lying above these are grey, muddy rocks that contain seams of ironstone, fireclay and coal formed in the Carboniferous Period, when the Black Country was covered in huge, steamy rainforests. Above this sedimentary rock are reddish, sandy rocks - due to sand dunes and pebbly river beds. This tells us that the landscape dried out to become a scorching hot desert 250 Ma. in the Triassic period. The final chapter in the making of the landscape happened in the Ice Age, which spanned 2.6 Ma when vast ice sheets scraped across the surface of this area, leaving hills and valleys. DGAG readers should notice that there are no Jurassic or Cretaceous rocks in the Black Country.

Geo-site 17 Castle Hill

We walked to the nearby Castle Hill, which is a faulted anticline of the Silurian Elton Formation, Much Wenlock Limestone Formation and Coalbrookdale Formation strata which is folded and uplifted and then overstepped by Carboniferous Pennine Lower and Middle Coal Measures.

Fig. 5 Graham explaining the geology at Castle Hill

Great earth movements lifted the hill and it became land. Rivers then flowed across the area and laid down layers of sand and mud allowing great steamy swamp forests to spread across the Black Country. When these forests died and were buried by more layers they turned into coal seams. There is a major unconformity due to the eroded palaeo-landscape. It is a faulted anticline. This is the site of the world's first true stratigraphical map published in 1665. It was of major economic importance and heavily mined and quarried during the Industrial Revolution. Castle Hill has a cratered surface because of centuries of limestone mining and it has a huge network of tunnels. At the northern end of Castle Hill Basin is an exceptionally fine reef which is highly fossiliferous.

People starting using coal in 1550. The whole area has been greatly quarried and mined. The Worcestershire Cricket Pitch disappeared as it dropped into a huge hole. Many houses are built over coal mines and subsidence is quite common. The Canal Trust are building an Innovation Centre nearby and as they dug the foundations, came across lots of fossils which Graham has been collecting and taking to the Archives. He was pleased to find 2 graptolites, which are very unusual finds in this area.

Castle Hill is now covered in an urban woodland and is full of wildlife. There are Living History Museums, accessible mines and canal tunnels nearby.

Alan Driscole's report on the next Geosites (39 & 23) visited by the group follows.

The Rowley Hills and Blue Rock Quarry

In the afternoon we headed south-east to the Rowley Hills and then on to the disused Blue Rock Quarry. Turner's Hill, being the highest point in the West Midlands at 269 m (883 ft) provides an excellent location from which to view and discuss the geology and structure of the Black Country.


Fig.1 Turner's Hill viewpoint , looking north-west towards Brierley Hill

To the west, at Brierley Hill (Figure 1), the thickest seam in the area, the main South Staffordshire Thick Coal Seam reaches 9 m. The presence of an abundance of coal which, at least initially was relatively easy to mine, was a major reason why the Black Country became the cradle of the Industrial Revolution. During the late Carboniferous (Westphalian) the area lay close to the southern margin of a large area of low-lying swamp, the Pennine Basin, which stretches north to the Southern Uplands of Scotland. To the north the Main Coal splits into many thin seams which were much more difficult to work, whilst to the south the seam thins and pinches out onto the upland area of the London-Brabant Massif; towards Pedmore Hill, only 2 km to the south. To the north of our viewpoint, we could see the Silurian inliers of Wren's Nest and Castle Hill and their rich limestone resources that we had visited in the morning.

During the last Ice Age the Rowley Hills formed a buttress to the Devensian ice sheet as it grew from the north and north-west, with ice deflected around the flanks. The hills still separate two major river basins, with waters to the south draining south into the Severn and the Bristol Channel and to the north into the Tame, the Trent and ultimately into the Humber Estuary.

The geology of the Rowley Hills themselves is interesting. In the late Westphalian (c.307 Ma.), during the early phases of the Variscan Orogeny, the southern Pennine Basin became uplifted, and the Coal Measure swamps gave way to a well-drained alluvial plain with red, oxidised clays and isolated sands deposited by river channels (the Etruria Formation).

At the same time the crust became stretched and faulted, leading to a phase of local intrusive and extrusive volcanism. A major intrusion of olivine (iron and magnesium-rich) dolerite and microgabbro, which may reach 100 m thick, underlies the Rowley Hills (Figure 2– see p.15).

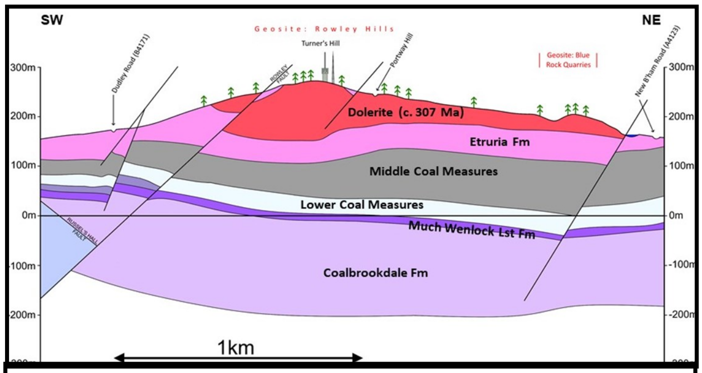

Fig 2. Cross-section of Turner's Hill showing the Rowley Lopolith and Blue Rock Quarry

In the 19th Century this dolerite was thought to be a deep-seated pluton, but a shaft sunk in the 1870s proved the Thick Coal below dolerite at the Lye Cross Colliery. The main dolerite is now known to be a lopolith; a flat-topped intrusion with a depressed base but generally concordant with underlying and overlying strata. No underlying feeder pipe has been found in the underlying mines and the lopolith may have occupied a down-faulted graben, with the magma sourced from the sides.

The dolerite (known as the Rawley Rag) was mined from late 18th Century, with the Blue Rock Quarry closing in 2008. The dolerite was used for kerbstones and, for a time, cobblestones and, more recently as crushed aggregate for roadstone. The Blue Rock Quarry reached a depth of 50 to 100 m, but has now been largely infilled. An exposure preserved towards the top of the old quarry (Figure 3) shows columnar jointing (Figure 4) and strongly weathered dolerite with "onion skin" weathering (exfoliation) formed during the last Ice Age. The weathered rhyolite also gives a rich soil full of minerals; ideal for wild flowers, although we visited at the wrong time of year! The importance of the quarrying heritage, the geological exposures and wild flower meadows is reflected in plans to enhance the site by the local wildlife trust and the Black Country Geological Society. On the way back to the cars we climbed up from the quarry and saw several smaller-scale workings, exploiting thinner dolerite sills within the upper part of the Etruria Marls, overlying the main intrusion.

Fig.3 Graham in full flow! (Exposure of Rawley Rag behind)

Fig.4. Columnar Jointing at the Blue Rock Quarry exposure

The group then moved on to Geosite No.5: Barrow Hill aka the Dudley Volcano. The visit is described here by *Martin Gledhill*

Our guide was Andrew Harrison, a professional engineering geologist, who is also Vice-Chair and Field Trip Secretary of the Black Country Geological Society. He led us 150m up Barrow Hill, an intrusion of dolerite and basalt which once formed the magma chamber of the Dudley Volcano. The volcano was active 307 million years ago during the Variscan Orogeny. The hill is capped by a large cross, from which we could see other dolerite intrusions such as Rowley Hill to the East. The dolerite was intruded into the country rock which is called Etruria Marl – a late Carboniferous clay which is widely used in the manufacture of Staffordshire blue bricks. In the 18th and 19th centuries, the dolerite was quarried for roadstone. We visited East Quarry and saw the columnar structure of the dolerite on the north face. On the south face we could see the point of contact between the black dolerite and the country rock. In places the Etruria Marl had been baked to give it a terracotta appearance.

Fig.1 East Quarry – dolerite intrusion from inside the magma chamber

Fig.2 Dolerite on left with baked Etruria marl

"Barrow Hill and Tansey Green Local Nature Reserve is important nationally and internationally as the only known occurrence of volcanic ashes in the whole of the Black Country. Some of the rocks here contain rare preserved fossil conifers, indicating that a surface volcano erupted here 307 million years ago" Quote from the field guide

Green ash deposits from the Dudley Volcano have been found in the nearby Tansey Green claypit. We were not able to visit the claypit, but Andrew showed us fossils of plants preserved in the ash, including a silicified twig of a conifer, which he described as the world's oldest Christmas tree!

Fig.3 Val holds a fossilised horsetail cone preserved in the Coal Measures

Editors note: An account of the last Geosite visited (Saltwells) will appear in the next Newsletter, along with one on the Singing Cavern and Dudley Canal Tunnel Geosite.

Holiday Rocks 23rd October

It was good to see over 20 members, including some new ones, attend an indoor meeting, the first in quite a while. DGAG Chairman Alan Holiday started proceedings with a well-illustrated talk on his journey to Northumberland, by way of Scarborough and Whitby. The talk covered rocks from the Carboniferous to the Pleistocene, the Variscan Orogeny, intrusive features such as the Whin Sill plus plenty of sedimentary and structural features. Alan also provided us with a taste of the impressive Cragside (NT), a Victorian country house near Rothbury. If anyone knows of a good geology field guide to Northumberland please let Alan know as he couldn't source one before the trip! *(Personally, I think he'd make a pretty good job of writing one himself!)*

After a break for refreshments John Scott showed us some slides featuring his recent geological journeys. We were treated to views of the Jurassic (and Triassic) coast from the sea with classic geological features such as huge landslips and of course the 'Great Unconformity'. John then reported on his trip with the G.A. to the Somerset coast, another coastline with Triassic and Jurassic exposures. John showed us some impressive features, including mud volcanoes, folding and faulting and (new, to me anyway) sedimentary injection dykes. That rounded off a very enjoyable afternoon and my thanks to all who attended, especially both speakers and the refreshment team. *Kelvin Huff*

Field Trip Officer for 2022 by *Richard Hallett*

Following recent requests from Val for a successor as Field Trip Officer, I put my name forward. If no other members step forward, it appears I will be your Field Trip Officer next year, to be confirmed at the AGM in January.

I'm thoroughly looking forward to the 2022 field trips although I'm unlikely to be able to attend all the trips myself, so if there are any other members wishing to take on the role please do step forward before the AGM. Meanwhile, I've written this piece to introduce myself; I have been a DGAG member since 2018, although have only attended one field trip so far which was the memorable and splendid trip to the Undercliff and Goat Island led by Geoff Rowland earlier this year.

Me and my son "following in my footsteps?" about to examine the so-called "Geotimes outcrop" of pillow basalts at Wadi al Jizzi. These are submarine volcanic rocks of the world-class Semail Ophiolite in the mountains of the Sultanate of Oman.

I first studied Dorset rocks in 1982 as a A-level student from Hampshire and later as an undergraduate and postgraduate at Southampton University. Since then I worked in the petroleum industry specialising in stratigraphy, micropalaeontology and palynology and have been lucky to have visited some great rocks in Europe, USA, North Africa, Indonesia and most recently, and most impressively, in the Sultanate of Oman (now that is a field trip!).

Val has given me some fantastic field trip ideas for 2022, thank you to all those involved. So at time of writing (early November) we already have a rough idea of activities for next year. I hope to be able to start publishing details at, or soon after, the AGM.

Recent Field Trips

The records show we have arranged 5 to10 field trips annually over the last few years with a residential trip every year. Interesting to see some nice cultural geology trips as well as plenty of Jurassic and Lower Cretaceous sedimentary geology trips.

2021	2019	2018	2017
Wimborne Minster	Lyme Regis, Pinhay Bay	Peveril Point & Swanage Bay	Durlston Bay
Fleet Lagoon	Vale of Glamorgan (Residential)	Charterhouse, Mendips	Ebbor Gorge & Wells Cathedral
Black Country (Residential)	Ringstead Bay	Worbarrow Bay	Lulworth & Mupe Rocks
Inferior Oolite Quarries, Sherborne	Purbeck	Portland	Ham Hill
In the footsteps of William Smith	Kimmeridge	Shropshire and the Black Country (Weekend Residential)	Inferior Oolite, West Dorset
Goat Island & Undercliff		Highcliffe, Barton-on-sea, Milford-on-sea	Forest of Dean & Malverns (Residential)
Portishead		Salisbury Cathedral	Beaminster & Broadwindsor
Vale of Wardour		Fleet	
Dartmoor			
Urban Geology Weymouth			

Special Requests

If members have any favourite locations or recommendations for an interesting and informative day trip or feel there are some aspects of our local geology that are not so well known please let me know. In both cases, I shall endeavour to find a suitable group leader.

Leaders

Lastly, of course, if anyone would like an opportunity to lead or co-lead a field trip please contact me.

Thank you,
Richard Hallett
richard.rh.hallett@outlook.com

Richard has also suggested a regular Newsletter item "Where am I?" and supplied the 1st picture, as shown here. Equally, it could be a "What am I?" image of a rock, fossil, mineral, etc. We often get this type of question through our website, which I generally forward to someone who's likely to know the answer! Please send your images to me (with an answer, to be revealed in the next edition). Thanks, *Kelvin*

DGAG Field Trips and allied events 2021-22

N.B. All events and field trips are subject to current Covid rules and restrictions

As temporary Events Officer I have booked Broadmayne Village Hall for the following events:

Saturday December 11th: Winter Workshop
Please let me know if you are attending and/or need a table for displays. Likewise, please let me know if you require lunch or can contribute to it!

Saturday January 8th 2022: A.G.M. Post-A.G.M. talk by Bob Chandler

Please note that the above meetings may be by Zoom or as physical events. Members will be informed by email nearer the time. (Kelvin)

https://dorsetgeologistsassociation.org/
https://dorsetrigs.org/
https://dorsetbuildingstone.org

The first publication by the Dorset Building Stone Group, authored by Pete Bath **"The Beauty of Kingston Lacy Stone"** will be available soon, price £6 plus P&P. Orders can be placed with me (Kelvin) or by email at: dorsetbs.publications@gmail.com
I'll also bring some to the Workshop.

DIGS **(Dorset's Important Geological Sites)**

The group welcomes anyone wishing to help with conservation work on Local Geological Sites. Please contact Alan Holiday if you are interested. Working parties go out on both weekdays and weekends.

alanholiday@btinternet.com

Wessex OUGS events have resumed

Jan 14th Talk - The Winchcombe meteorite - fall, recovery and initial analysis. Zoom - Online. Leader: Dr Ashley King. A topical talk about a recent arrival near the Wessex region. It will begin at 7 pm. Contact: Colin Morley, wessex@ougs.org, 01980 846 781

Saturday 22nd January - A.G.M plus a talk.

Fieldtrips: Please contact Jeremy Cranmer on: wessexdaytrips@ougs.org or 'phone 01305 267133 to book a place.
£2.50 day trip charge.

Can we help answer your geological questions?

Either post them on our website's contact form or send them, maybe including photos, to me at the email below.
Kelvin

Reminders: Contributors' deadline for the Spring Newsletter is: **Monday, February 14th, 2022.**

Committee news:

We need a Chairperson. *Kelvin*

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