HERTFORDSHIRE GEOLOGICAL SOCIETY NEWSLETTER WINTER 2018

Working Party Field Trip to Little Heath, Potten End Saturday 4th March 2017

By Clive Maton

A bright and fresh day greeted the eight brave HGS members who arrived at the Little Heath SSSI at 10:00. Everyone was suitably dressed in hi-viz [Fig 1] with stout gloves and carrying various gardening tools with the aim of clearing the site of invasive saplings, brambles and other vegetation; and cleaning the exposure.

The Little Heath site was one of the first to be designated a geological SSSI in the early 1950's when the idea of saving our important sites was introduced after WWII. This was based on the work done by Charles Gilbert, an amateur geologist who described the deposit in 1919.[1] It was a pit, like many others in the area, where road stone had been quarried to supply a contract in Hemel Hempstead. The sands may have been used to fill sand bags by The Inns of Court Officer Training Corps associated with the seven miles of trenches they dug on nearby Berkhamsted Common.

Chalk is found at 9m below surface covered by up to 2m of Upnore and Reading Formation,

Fig 1. A big thank you to everyone! [Photo: Chris Green]

but it is the beds above this which are key to this SSSI. The first is up to 6m of lower gravels (the top of which is visible in the exposure). The pebbles are mostly well rounded and sorted in a sandy gravel matrix containing glauconite, and the deposit overall has crude stratification and a lack vertical grading. These have been interpreted as a shallow marine facies possibly grading into a beach.

There is a sharp contact with the stratified sands which are up to 3m thick. These finely laminated sands incorporate clay couplets in the lower part which are not seen higher in the sequence. The beds and dip at 16º towards NNW. An analysis of the heavy minerals of the sand and the matrix of the lower gravel suggest a common origin for the two. The sands have been interpreted as an isolated low energy intertidal environment possibly behind a barrier island, with low energy deposits possibly on a sand bar and higher energy channels without the clay couplets.

It was the top bed of broken rounded flint pebbles in a silty clay matrix which was the target of the road stone one hundred years ago. The thickness under the soil varies from 0.1m to over 3m as seen at this exposure, which is why the whole area is littered with pits where they searched for the stone. These large involutions with the pebbles strongly cryoturbated and frost shattered supports the interpretation of a periglacial solifluction deposit.

The current exposure was made in March 2012 by a team lead by John Catt. The main aim of that excavation was to get samples to date the deposits, but secondly to leave the exposure so it could be seen and studied in the future. The last time it was cleared was in 2015 so it was with the second aim in view that consent was obtained from Natural England (Andrew Hartley) who have control of all SSSIs; and permission to do the work from the land owner, The National Trust Ashridge Estate, (Lead Ranger Lawrence Trowbridge). We had to do the work before the end of March to avoid disturbance during the bird nesting season.

After three hours work the site was transformed - see below [Figs 2 & 3]. All the vegetation was moved off site and deposited in another pit nearby with the agreement of the National Trust. The face of the exposure was cleaned by the removal of no more than one centimetre of material so that the features of the stratified sand could be clearly seen, and the contact with the gravels above and below.

Fig 2. 10:00 - Before the start

Fig 3. 13:00 - Work completed

[Photos: Nick Pierpoint]

Clive Maton then gave a short talk on the history and geology of the site and the findings from the 2012 excavation before we adjourned to the local pub, Martins' Pond in Potten End for a well-earned celebration of all the hard work everyone had done.

[1]GILBERT C.J. (1919) On the occurrence of extensive deposits of high-level sands and gravels resting upon the chalk at Little Heath near Berkhamsted. Quarterly Journal of the Geological Society Volume 75, p 33-43.

Field trip to the Sedgwick Museum, Cambridge
Saturday 25th March 2017

By Lesley Exton

Seventeen HGS members and partners met outside the Sedgewick Museum on a bright sunny Saturday morning [Fig 4]. By the time the museum opened at 10:00 the group had already examined all the blocks of stone to the right of the entrance. The current museum was opened in 1904 and is named after Adam Sedgwick, however, some of the collection is much older. Dr John Woodward (1665-1728) bequeathed some of his collection to the University. Originally the Department of Earth Sciences grew out of the museum, now the museum is embedded within the department.

We started in the basement which houses the building stone gallery and doubles as a common room. The collection of over 2000 samples was put together by John Watson. It contains building stones from quarries all over Britain and the rest of the world. Most are the same size and have a polished, a cut and a rough surface.

Returning to the ground floor we started at the far end of the museum with the Dr Woodward's collection. He collected to learn about the world. When he died he left two of his cases to the museum, they then brought the two remaining cases and had a fifth one made to house the whole collection. As well as collecting, Dr Woodward also brought other collections including that of Scilla. Prof. Sedgwick rapidly expanded this collection so its then premises became inadequate. After his death his many friends and colleagues opened a public subscription to build this museum, as a memorial to him.

Fig 4. Outside the Sedgwick Museum, Cambridge. [Photo: Lesley Exton]

The majority of items on display are fossils arranged in time sequence. We dipped in and out as we moved through the sequence, starting with the Burgess shale, which was a strange ecosystem. Later Henry Wittingham and his PhD students reinterpreted Dr Woodward's materials for this period - three items originally thought to be different organisms turned out to be different parts of a single organism.

We then moved forward to the early tetrapods, before a brief soray into the plant material of Captain Lewis Moysey who was killed at the end of WWI soon after being awarded the Lyle Medal for his work on the Cretaceous for the Geological Society. Next came a display about some of the current research being done, which included a copy of William Smith's map alongside a modern map.

Next came the Jurassic and some items collected by Mary Anning (1799-1847), although the plaque on one of them actually says presented to the museum by Prof. Sedgwick. Correspondence between the two of them held at the museum shows she knew about geology, but wasn't allowed to join the Geological Society as she was a woman.

Cambridge Greensand is the local version of the Upper Greensand and the coprolites (phosphatic nodules) found in it were ground up for fertilizer. The museum also contains some Terasaur remains which look very scrappy, but are the type specimens. The Iguanodon on display near the entrance shows how the interpretation of how it's stance has changed over time, however, the backbone in the display specimen still isn't quite right.

Moving forward into the Pleistocene we saw how the ice age had affected the local area. We examined a skeleton of *Hippopotamus amphibius* found in the Barrington gravels by C.E. Grey. However, it is a composite as one half of the pelvis is male and the other half female.

There have been different pulses of collecting, depending on the interests of the Professors and where the active quarries were at that time.

At the far end of the museum was a display about Charles Darwin, he was first a geologist and had done field work with Prof. Sedgwick in Wales, which had led to his selection for the Beagle. He actually won the Geological Society Medal for his geological theories the year before he published the Origin of Species. However, Prof. Sedgwick couldn't accept the theory of evolution.

After a very interesting tour, the group went their separate ways, either to enjoy the afternoon exploring Cambridge or to head home.

Field trip to the Misbourne Valley - following HS2 route
Saturday 22nd April 2017

By Lesley Exton

After some confusion as to which end of the road the free car park we were due to congregate in was (it turned out there were two car parks). All the group finally met up in Amersham with our leader for the day, Dr Chris Duffin a little later than had been planned. We then left most of the cars there for the day and made our way via car and then by foot to the first stop. Here a little imagination was required as all we could see was two blue posts in a field near the M25 which marked where the entrance to the southern portal would be. HS2 will run northwest from there 10m below the M25 through Tertiary chalk. Turning 180 degrees to face southeast it will run on an embankment cut through the Seaforth formation of the hill in the foreground and then a viaduct through the Colne Valley in the background.

It will only be a two-bore tunnel, rather than a three-bore like the Channel tunnel, so there will have to be ventilation shafts every 1km or so along its 13km length. There will also have to be access for emergency vehicles. It will come back to the surface the other side of Amersham.

We then returned to the cars and moved onto our second stop at Chalfont St Giles. The original plan had been to route HS2 150m north of where we were standing by the River Misbourne [Fig 5]. However, there is an Affinity Water Pumping Station nearby and the drillers log shows 16m of weathered chalk (top most surface of the Lewis chalk) and river gravels of the proto-Thames (Beaconfield gravels). The valley was formed in post-glacial times.

The tunnels will be 19.6m in diameter, however, everything 2m above the top of the tunnel will be loose weathered gravels, so it is a very unstable part of the valley to put a tunnel through. The tunnelling machine will also create bow waves as it progresses, which will cause cracks and could lead to the potential loss of the River Misbourne.

All questions to the engineers get the reply "we will deal with problems as and when they occur" but this means the area could be left with a completely artificial landscape.

Fig 5. Group over the River Misbourne [Photo: Lesley Exton]

We then moved onto stop 3, Shardeloes Lake, a historical clay lined lake [Fig 6]. This is just before the northern end of the tunnel, which will reach the surface again on the far side of the lake. So the roof of the tunnel won't be that much below the bottom of the lake, again tunnelling could impact on the current landscape. If the clay lining is breached the lake will disappear.

Fig 6. Shardeloes Lake [Photo: Lesley Exton]

After a late lunch the final two stops were swapped around. Stop 5, now stop 4, was on a bridge over the A413. The government proposed route alongside the road below us would go down into the water table so would cut through the springs and thus Wendover's water supply. We then looked across at the slope above, which was very hummocky with signs of previous slippage. It looks unstable, which suggests future problems especially if the water is banded up by the proposed cut and cover tunnel. This was the section in the original report where the geology map had been inverted.

Our final stop was Coombe Hill, where we got an over view of the valley below where the north-western end of the tunnel would be. A little more imagination was required to envisage the trains coming out of the tunnel and heading off into the distance.

Here we thanked Clive for a very informative field trip and then after having a look at the war memorial made our way back to Amersham and retrieved our cars.

Field trip to Upware and Wicken, Cambridgeshire
Saturday 20th May 2017

By Clive Maton

The trip took us to the Cambridgeshire countryside half way between Cambridge and Ely. In an area of low lying terrain and fens we were treated to quality exposures exceeding our expectations.

We met up with our leader Dr Simon Kelly, an expert on the Jurassic and Cretaceous palaeo-ecology, at Dimmocks Cote Quarry. This is a working quarry owned by Francis Flower, utilising the late Jurassic Upware Limestone to produce finely milled stone which is sold to be mixed with asphalt for road fill.

The Upware Limestone is present in an area approximately 1km wide running north from the village of Upware for about 5km. It is a member of the West Walton Formation representing a facies change to a fringe reef which formed beside the London-Brabant Massif. The quarry exposes 0.5 km of Upware Limestone, from very near the western edge which displays corals and other fauna of a reef, with the bulk of the quarry representative of a back reef/lagoon facies.

After a safety briefing and complete with protective gear we first had an overview of the quarry and then the pleasure of studying the western edge face which is no longer worked and designated a SSSI [Fig 7]. It is full of bioclastic material and soon we were finding many echinoderms plus broken corals, bivalves and sponges. At the base of the section we could observe the contact with the Dimmock Cote Marl Member and see a host of trace fossils, particularly Thaalassinoides burrows.

Fig 7. Inspecting SSSI face, Dimmocks Cote Quarry [Photo: Clive Maton]

The find of the day also came at this level. Helen Champion spotted a beautifully preserved ammonite and Haydon Bailey managed to remove from the block [Fig 8]. This is *Cardioceras* which was typical of cold Boreal waters. Evidently a much larger ammonite, *Perisphinctes*, is also found at this level which resided in warmer Tethyan waters showing that this area was subject to both bodies of water at the end of the Jurassic. Simon was delighted with the find which will end up in the Sedgwick Museum.

We moved on to explore the working faces of the quarry which are light grey when first uncovered, and then weather to a cream colour. In this area again we found many echinoids, both regular and irregular, but no corals indicating the lagoonal facies.

We had lunch beside the River Cam near Upware at the unusually named pub 'The Five Miles from Anywhere'. Leaving the cars there we walked about half a mile to visit the afternoon locations.

Fig 8. Haydon extracting the Cardioceras [Photo: Clive Maton]

Walking along the field boundary, to the west was a 3m drop to the water level, whilst to the east the field rose gently about a further 5m indicating the underlying ridge of the Upware Limestone. This we learnt was partially covered first by the Amphill Clay Formation and then the Kimmeridge Clay Formation at the end of the Jurrassic; then after an unconformity at the start of the Cretaceous, the Lower Greensand and later the Gault Clay draped onto the limestone ridge.

Our first stop was at a new section which had been dug near the field boundary, orientated west-east which has exposed the Lower Greensand resting on the Upware Limestone. The bedding was clearly visible showing the high concentration of phosphatised pebbles or coprolites. The mining for coprolites from these beds in Cambridgeshire was the basis of a short lived economic boom from about 1860-90. They were dug in large quantities from the local area, washed and then taken away by barge on the fens to a Coprolite Mill, where they were crushed and treated with sulphuric acid to release the phosphate to improve the fertility of the fields. It ended for a variety of reasons, but particularly because of the cheap guano imported from the Americas.

We moved on to a nearby SSSI believed to be a place where the coprolites were collected before being transported by cart to the River Cam. Continuing in the same SSSI we moved down to the water level and the Commissionaires Pit. Here on the bank above the fens the Upware Limestone is exposed, again as a coral rich reef facies with gastropods, bivalves, scallops and echinoderms.

Simon then lead us into the densely vegetated fens and over a waterway which was a canal cut about 100 years ago to transport limestone for conversion to agricultural lime, last used during WWII.

Through the trees we came to the last stop by an area of open water used for fishing where Simon dramatically lay down and plunged his arm deep into water to retrieve the underlying pinkish grey clay. This is the Gault Clay which sits unconformably on the Lower Greensand, so proving that the beds above the Upware Limestone drape onto it.

All in all an excellent day out with really interesting geology and a view of both modern and historical quarrying.

Field trip to the Isle of Sheppey - Eocene fossils in the London Clay Saturday 17th June

By Thomas Fogerty and Nick Pierpoint

On a warm sunny Saturday, an HGS contingent along with the Tertiary Research Group (TRG) assembled at Warden Point car park for a field excursion on the Isle of Sheppey or more precisely 'a fossil hunt' [Fig 9].

The party arrived at much the same time and all found a parking space! The trip leader was David Ward who has considerable experience and knowledge of this basin and the London Clay Formation. The nature of the trip was a walk along the foreshore scouring the area for fossils. The members of the TRG were on hand to assist with identification of finds and tell entertaining 'war stories' during a picnic on the beach.

Fig 9. Warden Point - HGS & TRG Team Photo [Photo: Nick Pierpoint]

The Isle of Sheppey is located off the south shore of the Thames estuary about 70 kilometres east of London. For more than 300 years it has had an international reputation for fossil recovery from the London Clay Formation of the Early Eocene; which is about 54 million years old (Ypresian Stage 55.8-48.6 Ma). The cliff section at Warden Point is about 50m thick, and bore hole data confirms a full section of approximately 150m. The cliffs are pretty unstable and contain a fair amount of human detritus from bricks to spark plugs; it's an Anthropocene veneer.

The London Clay Formation is typically a uniform dark grey silty clay with scattered bands of concretionary nodules. The origin of the clay material is thought to be from the Lias and Jurassic to the south and west. It was formed in an extended North Sea which covered a large part of Southeast England and Northern Europe. The water depth during much of the deposition is considered to be 50m at Sheppey, 100m in the Hampshire basin and up to 1000m in Holland. The Alpine Orogeny caused land to rise in eastern England eroding the London Clay, but leaving deposits in the UK within the London (Berkshire, Essex and Kent) and Wessex basins (East Dorset to West Sussex which also includes the northern half of the Isle of Wight).

Initially it is difficult make sense of this unit and to correlate with exposures of London Clay elsewhere. The current framework, was devised and proposed by Chris King (1981) has 5 subdivisions (A-E) with the clay at the Sheppey exposures being Upper C to E these are further divided into 14 units. Our priorities were finding sharks teeth, or possibility a lobster or a crab within a phosphatic nodule. This can be hard on your back and knees; and requires patience! Typically,

higher up the foreshore in 'pods' of gravel it is possible to find small invertebrates, sharks teeth, and molluscs. Lower down the beach it is muddier with cement-stone crab and larger vertebrates' possible rewards.

As we walked along the beach dozens offshore wind turbines were visible, whereas on the muddy rocky foreshore there were the remains of a rudimentary listening device and pillboxes from WWII. In the estuary, it was possible to make out the offshore forts – also relict defences from WWII.

On the foreshore we noted a large abundance of pyrite, particularly around the pillboxes. David Ward informed us that these accumulations of pyrite were sorted by density; the centre of the accumulations composing of heavy pyrite surrounded by less dense phosphatic nodules. It is in the boundary between these where sharks teeth often accumulate. The pyrite drifts contain plant material including twigs and fragments of wood which have washed out of the clay. Seeds and fruit are not uncommon, particularly Nipa fruits, but unfortunately these are prone to pyrite rot if left untreated and exposed to moisture. Other common pyritised fossils are the internal casts of gastropods and bivalves.

It is unusual in that most of the finds are not *in situ*. The diverse assemblage of well-preserved plant, invertebrate and vertebrate fossils are often found in concretions of pyrite, phosphate or calcite. Whilst the plants had been transported some distance, the animals were relatively local to the shallow water environment.

As we walked West towards Minster continually scanning the ground, the odd shark tooth or fish vertebra were found in the shingle along the upper foreshore, but the most common fossils found were trace fossil lobster burrows. Some members were lucky enough to find a phosphatic nodule containing a crab. These are pale beige in colour, and are identified by the exposure of the black exoskeleton on the side of the nodule. The crabs are prepared using scalpels and dentistry drills, taking many hours of work to reveal. Some of the TRG members pulled out some spectacular examples of 'specimens they found and prepared earlier' over many years of collecting.

It was only when we sat down for lunch that the party started to find shark teeth more frequently. Some members started to get their eye in and managed to find several teeth within a small area. These belong primarily to the sand shark *Striatolamia macrota*. Although mainly a fossil collecting trip, there were also various minerals to be found; a few members picked up crystals of Selenite, which formed in the London Clay from decaying pyrite. Others found specimens of Baryte, which form inside the chambers of septarian nodules that wash onto the beach.

Fig 10. London Clay Sharks Teeth [Photo: Thomas Fogerty]

After lunch, the party gradually made their way back towards Warden Point and the car park. A few members, particularly the veteran TRG, compared finds and thoughts of the locality. Finds throughout the day were variable and we suspect the benefit of repeat visits will be rewarded as experience and 'getting your eye in' is easier. Sheppey is certainly a haven for fossil collectors and will continue to attract attention long into the future.

Once again - thanks to Clive Maton for his logistical skills in arranging this event.

The HGS Summer Event: College Lake, Pitstone, Buckinghamshire Saturday 15th July 2017

By Nick Pierpoint and Chris Green (botanical input)

This years 'Summer Event' adopted the 2016 format - talks in the morning followed by stroll around the College Lake led by Rodney Sims of the Berks, Bucks, Oxon Wildlife Trust (BBOWT) who was to be our host for the day. Having been involved in the restoration work of the quarry and processing site from the very start Rodney's knowledge is un-paralleled. College Lake was formally a chalk quarry of some significance, with associated processing works for cement production. It is situated between Tring and the village of Pitstone at the base of the chalk escarpment on the Herts/Bucks border.

In all we had four presentations - Rodney Sims provided an introduction to the quarrying activities which spanned from 1937 to 1991. The second talk, by Haydon, gave an overview of the chalk at the site, and the contrasting nature of the chalk at quarry pit 3 with that at Pitstone quarry. The latter has a RIG's designation as it has a unique exposure of the Plenus Marl which represents the transition from Lower (Grey) Chalk to the Middle (White) Chalk. Jill Eyres then gave an engaging talk on the features we could see which provided evidence of glacial and interglacial activity over the last 500,000 years. In fact, the fossil finds and periglacial features such as the cryoturbation patterns and ice wedges in quarry pit 3 is an SSSI for its Pleistocene deposits. The final talk of the morning was by Rodney Sims on the work of the volunteers, and latterly the BBOWT, who have transformed the site into a fantastic resource on many levels, from education to recreation, and at the same time providing a wonderfully diverse habitat for flora and fauna.

Quarrying started prior to the second world war (1937) on a temporary emergency extraction licence which was good for 100 years! Towards the end of extraction activities, the quarry was operated by Castle Cement, a division of the Hanson conglomerate. The College Lake pits were worked more intensively from 1967 through to the decommissioning in 1991. The site of 60 hectares is currently managed by the BBOWT and has benefited from Lottery funding to establish a flag ship nature reserve in the county of Buckinghamshire.

Haydon's talk detailed the variations in the chalk between College Lake and Pitstone quarry – unfortunately the chalk is not well preserved at College Lake where it has either been flooded or now covered by vegetation. The Cenomanian - West Melbury Marly Chalk Formation within the Lower (Grey) Chalk is the main unit that has been extracted from College Lake which can contain up to 50% clay. The upper most section of the Lower (Grey) Chalk at this site is the Zig Zag Chalk Formation which sits beneath the Plus Marl Member seen in the exposure in Pitstone quarry. This is quarry across the road from College Lake and partly in Hertfordshire. The Plenus Marl Member is an organically rich clay deposited in anoxic conditions represents the boundary between Middle (White) and Lower (Grey) chalk. This is a RIGS site on the Buckinghamshire list, unfortunately, the site is not freely accessible as the quarry remains a small working concern.

Through time, the open marine environment became richer in CaCO3 and the cleaner younger carbonates had a lower clay content, productivity increased as sea levels and temperatures rose. This is seen in the Middle (White) Chalk sediments. Oldest Chalk with flints in the UK are close to base of this unit.

Jill Eyres focused on the Quaternary the last 2.6 million years to 11,700 years (BP) introducing the notion that geology made the landscape and its breakdown produced the natural habitats – reflected by the acid soils above the sands and gravels, and more alkaline soils on the chalk.

The Quaternary sediments are represented by features formed in periglacial or tundra environments. Although we did not see them in section three channels have been identified with supporting dating evidence (mammal bones) – examples of which are displayed in the visitor's centre. It was suggested one was Ipswichian interglacial c. 120,000 years ago and another by uranium isotope date gave an age range of 150,000-170,000 years.

There are a number short sections on the north-eastern side of the lake where there is evidence of ice wedges and cryoturbation. Both indicative of a tundra environment much of which was partially obscured by vegetation or cliff erosion. We did not see but there are solifluction lobes which are typical of this environment. With an abundance of water and limited plant stabilisation, sitting on top of a permanently frozen interval (which is impermeable) a debris flow of saturated material can be initiated on a slope angle of just 4degrees.

The Nature Reserve may be the 'crown jewel' in the BBOWT portfolio – but the geological aspects warrant attention.

Apparently, mammoth tusks are more value than the teeth in determining the age and health of a specimen. Jill detailed how the mammoth's teeth adapted to change from those living in a temperate climate to a tundra environment. In fact, the mammoth only has 4 teeth at a time which are displaced 5 times during a lifetime, as opposed to 2 sets in humans. The detail from a tusk is useful in determining age. When sliced, a series of rings are revealed much like those with in trees (a form of dendrochronology). The rings are lighter in the winter and darker in the summer – the example found at College Lake was 94 years old!

The concluding talk in the morning was given by Rodney Sims, he described how a small group of highly motived individuals had the vision and energy to set in place the foundations of what we see at College Lake today. Graham Atkins was a driving force and early photos from the 1980's shows the volunteers descending a near vertical cliff face above standing water, of unknown depth, with little more than a washing line tied around their waist. How regard for HSSE has changed over recent years!

The chalk pits have been allowed to fill with ground water to a prognosed datum of 110m above Sea Level (SL). This precise figure proved to be incorrect and subsequently much of the work to prepare gravel islands for ground nesting birds became submerged. BBOWT have worked to create nesting islands based on a more recently defined datum of 117m above SL.

The landowner was granted planning permission for site restoration in 1985, with the stipulation that the pits had to be 'returned to its original land use' which turned out to compromise the work being undertaken by the Trust. In fact, water in the lake was being contaminated by surface run off from heavily fertilised fields. This could not continue. In 1991 Castle Cement had a decommissioning plan formally put in place – not only were the pits being prepared for flooding, and decommissioning of the surface processing equipment which included four 300ft high chimneys. This site used to employ 300 staff – not an insignificant number for a rural community. College Lake became a Nature Reserve

in 2005, and by 2010, with support of Lottery funding is now managed by BBOWT including an impressive Visitor Centre.

We had a picnic lunch – some stayed in the barn (informal classroom) and were entertained by the numerous birds at a feeding station just outside the window. I am not too sure who was watching who!

Fig 11. HGS Group in front of the chalk face [Photo Alison Pierpoint]

The afternoon walk around the perimeter of the lake was in the company of Rodney Sims. We saw sections which included ice wedges and cryoturbation features – the swirling patterns form under freeze-thaw conditions on the tundra. There were pieces of old quarry machinery which included the buckets from the excavator and elements from the conveyor belt system which took the chalk from the working face to the kilns for processing.

Fig 12. Quarrying machinery
[Photo Nick Pierpoint]

Fig 13. Purple Pyramid orchid
[Photo Nick Pierpoint]

We did spot a couple of blocks of sarsen stone and, given the proximity to Hertfordshire, we know what they are called!

College Lake has been set up first and foremost as a nature reserve, and there was plenty to see as we went around the perimeter, though the lesson of all nature reserves was obvious – you need to be a frequent visitor to see all it has to offer. The plants were a case in point, a few species being in full flower while others were over and need a return visit next year. This year has also been exceptionally dry, and the little Adder's Tongue Ferns (*Ophioglossum vulgatum;* a chalk pit specialist) hadn't emerged at all. Beneath the cryoturbation sections on the private path were fine spreads of the yellow pea Dragon's Teeth (*Tetragonabolus maritimum*) in perfect condition. It is a fairly rare non-native plant which doesn't always live beside the sea. Further on we met the faded remains of many orchids, best appreciated in May/June: Twayblades, Pyramidal and Fragrant Orchids. There were probably other species, but it wasn't the time or season to look. College Lake has long had the splendid feature of a Corn Weed field, seeded with the flowers and grasses that farmers hated in their cereal crops before the days of herbicides. The farmers have proved all too successful, and a number of species we saw will have been new to many: much the rarest was Field Cow Wheat (*Melampyrum arvense*), a three-star little plant, resplendent with magenta bracts and yellow/pink flowers; Red Bartsia was common here, and on footpaths; and there was plenty of Corn Cockle, a beauty whose pink flowers were over, and was setting its distasteful/poisonous seeds. Botanists and non-botanists alike may have been surprised by the messiness of the field in high summer, and this is one of the things farmers hated, as the crop became entangled. Near the Corn Weed field some of us were lucky enough to see two males of the Adonis Blue butterfly (*Lysandra bellargus*), the brightest blue of all British species. Chiltern grassland is where it might have been expected in the past, but it almost became extinct and has relied on reserves like College Lake for its survival; it features on the reserve's website. Other species are to be anticipated on warmer days than 15 July. Here and there throughout the reserve the Wayfaring Tree, or Gelder Rose, already had glorious clusters of red berries; a frequent to common chalkland shrub in the south east, but not to be ignored. Most visitors probably come for birds rather than landforms, flowers, or insects, and while our binoculars were trained on the Zigzag Chalk, others could see ducks and geese, and we also saw Greenshank, terns (a good place to watch these), a cormorant and a heron. The reserve is very well provided with hides, some of them luxurious on a summer's day. Finally, the Trust uses cows and Hebridean [black] sheep as its 'smart' lawnmowers.

Unfortunately, the café had closed early but we did see the wonderfully displayed fossils which were found on the site and included mammal teeth and tusks from Woolly Mammoth (*Mammuthus primigenius).* I am confident most of the dozen HGS members who attended this year's summer event will return to College Lake as there is much to absorb and observe in different seasons. Finally, many thanks to Adrian Champion who organised to day and liaised with BBOWT team. It was sad he could not attend but we all appreciated his input into making the day a success.

The Geology of Martley Geovillage & the Malverns, Worcestershire 22nd -24th September 2017

By Lesley Exton

After a leisurely breakfast at the Premier Inn, Worcester and a brief trip out to secure a picnic lunch for the day (the local pub where we were due to stop for lunch having closed down earlier in the week) we drove over to Martley Memorial Hall for 10.00. There over coffee, tea and biscuits and the zuma music blaring out from the class going on next door, the double act of John Nicklin & Ian Pennell gave us a brief introduction of the area, which contains in a very small area a large part of the geological variety of the British Isles. After having a look at the temporary display they had put on for us and helping them dismantle it, John led us through the new housing estate discussing the recent

flooding problems it had experienced, to Martley Rock.

There we were able to examine the Precambrian Malvern Complex which was formed around 700Ma, the Martley Quartzite (530-488Ma), Silurian Raglan mudstones (around 416Ma), Carboniferous Halesowen mudstones, siltstones and sandstones (around 308Ma) and Triassic Bromsgrove sandstones (around 230Ma) all within a single trench. The East Malvern Fault runs through the field adjacent, so to the east are Mesozoic rocks while to the west lie Palaeozoic rocks, the two soils are very different, although difficult to see when there are crops growing. We then walked back down the path and up the side of the field and past where the fault goes through the hedge.

At the top of the ridge we turned right and walked along a path on the other side just below the fault line. To the right in the track bank could be seen a variety of soft sediments, siltstones, clays, mudstones and the occasional lens of harder sandstone, to the left there was was evidence of minor landslips. We then stopped at a viewpoint across the Teme Valley, the hills we could see across the valley were three quarters Raglan capped with nodular limestone. Then in the far distance were the Cleve Hills, Shropshire, a volcanic igneous sill. The river used to go the other way, but this route was blocked by ice during the ice age, so it cut through somewhere else, sound familiar? We continued along, and the soil changed colour again.

After a 360 degree view from the centre of another field we returned to the Triassic at the Nubbins quarries, an outcrop of Bromsgrove sandstone laid down by the Budleighensis river system. There we examined the cross-bedding, after first negotiating the stinging nettles. The same outcrop enclosed the back garden of our lunch stop, Scar Cottage, where Haydon, Liam & Kath joined us.

Fig 14. Looking for crinoids at lower Farm Quarry. [Photo: Lesley Exton]

After lunch we drove a mile or so north to Penny Hill Quarry. The Silurian Much Wenlock Limestone here was quarried extensively during the 20th century, although most of the site is now infilled with landfill waste from which gas is produced to generate electricity. Here we were joined while fossil hunting in the remaining spoil heaps by a friendly four-legged local. Who after sniffing out, nicking

and eating Jan's kit-kat from the bottom of her rucksack, accompanied us on our walk through the woods that skirt the quarry. At the north end is the Canyon, where we looked at cascade folds with bentonite layers, reminding us that Britain was in a tectonically dynamic location during the Silurian period. We had another chance to look for fossils at Lower Farm Quarry, which has specific beds that are very rich in crinoids [Fig 14], although it was a case of 'here's one I found earlier' as there were a number of good examples underneath the display board. Our final stop was another face of Much Wenloch where we looked for the fossils we had seen in the spoil heaps, this time I did find a good example which was left as an example for subsequent groups.

After an excellent day in the field, which had covered some 700 Ma we returned to Worcester and an evening meal by the river.

Saturday morning, we drove south-west to Malvern and met Adrian Wyatt, our guide for the day at the British Camp car park. A vivid imagination was required to start with as the hills were encased in fog, so we could only see a few metres in front of us. The reservoir built in the 1880's magically appeared just after Adrian had finished talking about it, as the the wind slowly dispersed the fog.

Our morning walk took us in a circular route south to Broad Down, onto Hangman's Hill via Shire Ditch, through Silurian Pass and along Swinyard Hill. Then down first into Gullet Quarry (Upper Level) which was fenced off and then Gullet Quarry (Lower Level), back along Swinyard Lane, through Silurian Pass again, up to Clutter's Cave, where we failed to gain access to see the pillow lavas as a Brownie pack had taken up residence around its entrance and were having a rather gruesome sing-song. Finally returning to the car park for lunch.

The Malvern Hills include many different rocks along its 9-mile long range: igneous plutonic (a calc-alkaline magmatic suite, mainly diorite and granite) having crystallized approximately 681Ma that subsequently underwent a regional metamorphic process together with ductile shearing and later brittle deformation; igneous volcanic (basalt and rhyolite) formed about 566Ma; igneous hypabyssal dykes, sills and pegmatites (Precambrian and Ordovician) and mineral veins. The name now used to describe the igneous rocks is the "Malverns Complex", with good reason! By way of marine transgression, sedimentary rocks have been brought into juxtaposition on the flanks of the hills and in places they have been down-faulted to form part of the ridge. These date to Cambrian, Ordovician and Silurian times.

As well as the different rocks we encountered along the route we also examined different features including, within the path banded gniessic rocks produced by local tectonic movements, a microintrusion of fine grained pink rhylolite (Warren House Formation) faulted in, changes in crystal size and xylolites within the granite. At Gullet Quarry we saw evidence of a pebble beach and wave action on the surface of the sedimentary rocks (Wyche Formation). The lower quarry is now filled with water as quarrying finished in the 1970's when the licence ran out. There are now trees growing in the rock face which is typical of the Malverns Complex with sheared diorites and some pegmatic veins [Fig 15]. One unconformity was seen on the walk. Triassic rocks are present on the eastern side of the hills forming the relatively flat Worcestershire basin and this is described as a half-graben structure. The contact with the long established East Malvern Fault is not readily seen but its effect was appreciated.

After a late lunch, with those that hadn't brought a picnic partaking of the fast food on offer from the cafe, Haydon and Adrian discussed the itenary for the afternoon. It was decided to leave out St Ann's Well (which was closed for refurbishment) and Lower Wyche Quarry and end the day at the top of the Worcestershire Beacon. We then drove round to the Wythe Cutting and left the cars in the car park there. Before we made our ascent, we walked back down the road and round to the original cutting, dug on the line of the fault as it crosses the ridge. Here the owner of one of the houses has recently

built a display of Malvern stone into their wall. The rocks are still fresh so the differences in colour could be seen quite clearly. We then headed up the well-worn path to the highest point in Worcestershire, stopping for a rest at a circular directional cairn, known as the Goldmine.

Fig 15. Group photo at Gullet Quarry, Malvern [Photo: Adrian Wyatt]

Walking along the ridge (formed 300 Ma) you can see a marked difference in the landscape either side of the hills. To the east is the flat Severn plain, underlain by 230 Ma Triassic mudstones, with the limestone escarpment of the Cotswold Hills in the distance. To the west you have Silurian ridge (limestone) and vale (shale) topography overlain in parts by the red sandstones and mudstones of Herefordshire. Further ridges projecting through can be seen in the distance, first of limestone, the Ledbury Hills, the Woolhope Dome then the sandstone of the Black Mountains of Wales. At the summit, on a plinth of Aberdeen granite, the toposcope points out all the major land-marks in the surrounding twelve counties, including the Bristol Channel. After identifying as many as we could, we then turned our attention to what was beneath our feet.

There are two small intrusions. One is underneath the south side of the toposcope. Here dolerite is intruded into granite. While the other is on the north side of the cutting, the other side of the toposcope, where fine-grained pink granite is intruded into diorite [Fig 16]. After identifying the position of the now long-gone cafe, which some of us can remember visiting in the 1970's, we made our way back down to the Wyche Cutting. Here we said goodbye to Adrian, after thanking him for a very enjoyable day and returned to Worcester.

Sunday morning saw us back outside Martley Memorial Hall to meet up with Dave Cropp our leader for the morning and say goodbye to John who was leading another walk so couldn't come with us. We left half the cars there and drove over to Shesley Beauchamp. Here we were standing on the Raglan Mudstone, we then looked across the valley. At the top of the vale was St Maughlas old red sandstone with a thin layer of calcite, but that was for later.

Fig 16. Looking at one of the intrusions [Photo: Lesley Exton]

We then entered an old pit surrounded by woodland. Here was what remains of the Brockhill dyke, an intrusive rock with a dolerite/teschenite chemistry which was intruded into the surrounding sandstones and marls in the late Carboniferous (300 Ma) during the Variscan Orogeny. The country rocks were 'baked' by the hot magma, so the sandstones are now hornfels, with conchoidal fracturing. The marls on the other hand were sufficiently plastic to allow the escape of volatile gases, leading to the development of vesicles and tubes which were later lined with calcite, chlorite and analcite. It has been extensively quarried here. The dyke extends east-west for about 1200m, with the river running alongside until it finds a way through.

Those of the party who were not coming on the final trail were dropped off at the bottom of the road up to St Andrew's Church, Shelsley Walsh. The rest of us parked further along the road and walking along a footpath followed a stream uphill, soon entering the woods or dingle. Our climb eventually led to a tufa deposit known as Southstone Rock [Fig 17]. Tufa is formed by the precipitation of water with a high dissolved calcium carbonate content. The calcium carbonate deposits accumulate on the moss growing on the rock, however, the moss continues to grow pushing through the calcium carbonate, this in turn is coated and the process continues. Radiocarbon dating has shown this deposit has gradually accumulated over the last 6700 years. The tufa is filled with many tiny cavities caused by the decay of the moss.

Nearby was a stream formed by a spring emerging from the base of the Bishop's Frome limestone. It would have originally flowed east, however the accumulating tufa deposits forced it to change direction and migrate across to its present position. New tufa can be seen coating some of the pebbles in its bed.

We then followed the tufa cliff round. The cliff is now split into several blocks and in one area the surface of the rock is covered with a smooth hard coating. The calcium carbonate has been deposited

Fig 17. Southstone rick tufa deposit. [Photo: Lesley Exton]

directly onto the tufa forming travertine. Our final stop was the source of the stream we had seen earlier. We began our descent back to the cars, where we said goodbye to Dave and returned to St Andrew's Church. The church is Norman in age and built almost entirely of tufa from Southstone Rock. Tufa can be found in the walls of many churches in the Tene Valley as it is light and easy to carve. We rejoined the rest of our party and had our picnic lunches [Fig 18] before heading home after a very interesting few days.

Fig 18. Group enjoying their picnic [Photo: Lesley Exton]

Chairman's concluding remarks

By Haydon Bailey

I guess the first note I have to record this year is the Society's move from Verulamium to Oaklands

College in the New Year. Personally, I would have loved to have stayed at the Museum, but I'm afraid the economics of it just didn't make sense. When you consider that the cost of the room hire had gone from £44 to £105 per meeting in just over twelve months, it just wasn't sustainable to consider staying in the old room. We have to recognise that it isn't viable to keep increasing annual membership fees in order to placate the whims of St. Albans City council. It will cost us far less per meeting at Oaklands for a room of the same size, so I think we give it a good try and see if it works. If you have any issues with the new location, please don't hesitate to tell me and we'll consider if we have to look again at alternatives.

Having said that, we've had a series of remarkably good meetings at St. Albans over the last year, including Mark Woods from the BGS and of course a fascinating Presidential address from Charlie Bristow. The second half of the year has provided us with lectures on the recognition of the Wallace line (Prof. Robert Hall), seismic events (Rebecca Bell), early land plants (Paul Kenrick) and Mount Erebus (Nial Peters). All of these have been of the highest standard giving us some fantastic insights into areas of geology we rarely get to hear about. On top of these, we are rounding off the year with our Trilobite talk from Prof. Richard Fortey FRS, probably regarded as the world leader in research into these long-gone arthropods. We are very fortunate to have been able to get him to come to visit us in St. Albans.

Through 2017 we've had some fascinating field meetings, ranging from the Sedgwick museum, Cambridge to our long weekend based in Worcestershire. The working party meeting at Little Heath resulted in a very clean set of field sections for a little while at least, celebrated in an article in the GA magazine and a very impressive poster at the Festival of Geology. On a similar theme, our summer meeting at College Lake has also had some follow up with ongoing discussions as to whether we might become involved in a clear up of the Pleistocene glacial features in the south-east corner of the nature reserve. This would be a partnership project with the Buckinghamshire Wildlife Trust and Buckinghamshire Earth Heritage group all overseen by English Nature, as the site is an SSSI. We'll keep you posted if this becomes a reality, as it would be an important project to be involved in.

I've already commented on our trip to Martley and the Malverns in September, but I couldn't miss this opportunity to congratulate all members on the trek through the southern Malverns during the Saturday morning followed by the ascent of Worcestershire Beacon during the afternoon. The view from the latter location was simply amazing, from the Clent Hills to the north to the Bristol Channel in the south. It was a classic way to see the geology of central England and Wales from a single location. Finally, can anyone forget our Cambridgeshire field leader Simon Kelly bog snorkelling into the fen to prove that it was underlain by the Gault Clay?

We're now looking forward to our 2018 programme and I can say with some certainty that we are maintaining the high standard of speakers who are visiting Hertfordshire. I was really pleased to book Ted Nield (Geological Society editor) to come and talk in April about his outstanding book Supercontinent. If you're short of ideas for your Christmas list I thoroughly recommend this as a "good read". We also have Tony Doré talking to us in October about structures associated with the opening of the Atlantic. Tony is a world leader in his field and well worth being in the audience. Given that our autumn field trip is to the west coast of Ireland it seems highly appropriate that we're able to combine the two events.

Finally, 2017 was a memorable year as the Society awarded its first ever Honorary Membership. This was made, following a totally unanimous AGM vote, to Professor John Catt who has done so much for the society. John's leadership of the society is unsurpassed and represents such a consistent level of dedication, capped by the publication of his classic work "Hertfordshire, Geology & Landscape", which is recognised as one of the best publications of its kind. The Society congratulates you John and thanks you for everything you've done.