KENT GEOLOGISTS' GROUP

The Kent Group of the Geologists' Association

KGG

Founded 1990

NEWSLETTER

No.23- December 2014

Website: www.kgg.org.uk

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THE KENT GEOLOGISTS' GROUP IS A LOCAL GROUP OF

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As a local group we receive details of lectures and field trips organised by the GA and other Local Groups and Affiliated Societies. Copies of the GA Magazine and the Circular with these details are on display on the Secretary's Table at all Indoor Meetings.

MEMBERSHIP OF THE KENT GEOLOGISTS' GROUP

Membership is open to all who have an interest in geology, regardless of qualifications and experience. The annual subscription (which runs from January to December) is £7.00. The subscription for each Additional Member living at the same address is £2.00. There will be only one mailing to each address.

Membership application forms may be obtained from the General Secretary or downloaded from the Kent Geologists' Group website:- www.kgg.org.uk via the "How Do I Join" page.

Editorial

In the last newsletter we reported that members had been canvassed for their opinions on frequency and type of field meetings. The returns indicated a preference for one-day meetings in Kent, though there was still strong support for the occasional long weekend excursion, like the trip to Yarwell. We can report that the day trips organised for 2014 by Anne Padfield, Alison Taylor and Norman King all proved to be popular with typically up to a dozen members attending.

After much hard work by Ann Barrett the long awaited return trip to Yarwell went ahead over the weekend of 17th - 20th October 2014 and was also very successful. Reports by Alison Taylor on Wicken Fen, Ann Barrett on Flag Fen, Ely Cathedral by Geoff Downer and Lyddington by John Horder are included in this issue of the newsletter. These personal accounts of the weekend are backed up by a detailed description of the geology by Anne Padfield.

Cover picture: Lyddington church and, to the left, Lyddington Bede House, once a Bishops house before being converted to a Bede house in 1600 by Sir Thomas Cecil, son of Elizabeth I's Chief Minister. The property is now maintained by English Heritage. (See the Yarwell visit by KGG members)

At the kind invitation of Mrs Jean Green, Ann Barrett's mother, the weekend was to be based on her home in Yarwell, there being plenty of space for cars, camper vans, tents etc. The tentative plan for the weekend had been to travel up on Friday, meeting at Wicken Fen at 10.30 am to visit the National Trust nature reserve. After lunch at the reserve the party would travel on to Ely to look at the famous Fenland cathedral before continuing on to Yarwell for an evening meal.

The plan for Saturday was primarily geological with visits to Bullimore's Roadstone and Collyweston Slate Quarry, Duddington to view, and possibly collect from, the Lincolnshire Limestone. The rare gastropod Phyllocheilus *bentleyi* has been be found here. At some time during the day it was hoped to visit the home and workshop of Master Collyweston Slater David Ellis for a talk and demonstration on slate making, looking at samples, building stones and unconfirmed dinosaur footprints.

Other possibilities were a visit to a Colleyweston slate mine. These were typically a hole, about forty feet or so deep, at the bottom of which was the slate working seam usually no more than a hundred yards long. The Collyweston slate is not a true slate (a metamorphosed mudstone) but a very fine sandstone that occurs in shallow layers separated by layers of softer sandstone. The mining process involves digging out the softer sandstone to allow the 'slate' to drop into the hole thus created. The slate is then sorted into slate that will split into thin plates and slate that will not. The former is the now precious commodity, the latter was used to build columns to support the roof. The splittable slate is allowed to 'weather', often for years, before it can be split and shaped into tiles.

For three excellent videos on Collyweston Slate, including an English Heritage video featuring Ann's uncle David Ellis, visit the website http://www.claudesmith.co.uk/video.html

Saturday afternoon was planned as a drive around the beautiful Rutland countryside looking at places of interest including the Welland viaduct. The viaduct, the longest in Great Britain, was built in 1878 by the East Midlands Railway to carry trains across the Welland river valley between Harringworth in Northampton and Seaton in Rutland. It is 1,275 yards long, has 82 arches, each having a span of forty feet. It was constructed using bricks made and fired on site. These have a bright red face but weather badly. Repairs to the viaduct have been made using a stronger, waterproof, blue engineering brick especially good for arches and facing. These repairs give the viaduct its characteristic patchwork appearance that we see today.

Finally, on Sunday, the group visited Flag Fen, a Bronze-age causeway discovered quite by chance in 1982 by Francis Pryor - but you will find more information in the article by Ann Barrett.

The members ended their field trip by returning home on Sunday evening or Monday after what I am sure was a most enjoyable weekend. Moreover, they responded so magnificently to my request for material for the newsletter that I have decided to devote this issue to the Yarwell weekend. My reason has been to show that we have a programme of field meetings covering a wide range of interests that are enjoyed by all of those taking part.

They bring together people with different interests that they are encouraged to share - but I have an ulterior motive!

It was with some sadness that I heard recently that the Ravensbourne Group had closed. I have attended a few of their meetings in South London. They were a very friendly group attracted interesting speakers and always had a large number of nice mineral specimens as prizes in their raffle. At the last meeting I attended, in August, their long-serving committee members expressed their wish to resign but there were no volunteers to take over the roles. The result is that we have lost a very nice group.

Talks and Field Meetings take a lot of effort to plan and we are indebted to those who give up their time to organise events for our pleasure. However, their efforts will fail unless we, the ordinary members take part in the activities planned for us. Good speakers are difficult to get and they will not turn up to talk to a mere handful of members. There may be talks that do not appeal to you; but those that do may not appeal to others. We are a group and will only survive if we work together as a group. If you have preferences, make them known to the committee so that they can plan to meet our preferences.

So may I urge you all to make a New Year resolution to take a more active role Turn up for more indoor meetings, join a few Field Meetings and support the Activities Tables that Adrian Rundle takes to the Rock, Gem 'n' Bead Shows and the GA Festival of Geology. From my own experience I'm sure you will enjoy the experience.

Weekend Visit to Yarwell - 1: Wicken Fen

Alison Taylor

We all arrived at Wicken Fen from different directions just after 10.30 to begin the first day of our weekend field trip. There were only 6 of us today as some people were not able to join the trip until the evening. Wicken Fen was bought by The National Trust from a member of the Rothschild family in 1899 and was the very first piece of land that they took responsibility for. It is the only area of original undrained fen in existence.

The morning was bright and sunny. Having parked in the National Trust car park we walked a short distance down Lode Lane, past 3 or 4 cottages, to the Wicken Fen visitor centre. We enthusiastically scanned a list of birds seen recently on the reserve and then saw another board advertising a boat trip around the Fen. There was also a map showing various walking routes. We decided on a walk first and then the boat trip.

Our route followed a board walk through the swampy ground. We started off with tall reeds on either side and quickly came to a small wooden windmill which has been restored and is fully operational, being used to raise ground water to spread on the fen to keep it from drying out in the Summer. A panel in the side of the mill was open so that we could see the workings. Inside were a large number of ladybirds basking in the sun in this warm and sheltered spot. Two Highland cattle were in a field of tussocky grass and reeds on the other side of the path. Turning in towards the centre of the fen, we passed through an area thick with scrubby trees with their feet in the water. There was willow, alder, hawthorn and guelder rose. Also some trees with black berries which we could not identify but which we later discovered were purging buckthorn, in the past used medicinally and to make a yellow dye. Alongside the path were some seeding hemp agrimony plants, and we heard a green woodpecker.

Coming out of the wooded area we crossed a small ditch where the water was very brown and peaty. Reeds stood tall on either side again. At intervals along the path were wooden benches and also informative plaques telling visitors about different aspects of the fen. On one we learned that reeds had been used by the local families for thatching and burning to heat their homes. Reeds had also been used to fuel the ovens in Cambridge University bake houses.

Returning again to the visitor centre, we were led to a reedy dyke for our boat trip. The boat had an electric motor so was very quiet. We were 10 people on board including the boatman, who gave us lots of information as we nosed our way through the reeds. These waterways cut through the fens are known locally as lodes. He told us that most of them were originally made by the Romans in the 1st to 4th centuries. They used them for transport and communication in this area where road building was impossible. There are 18 miles of lodes in the area to the East of Cambridge, all of which join the River Cam, which joins the Great Ouse to exit into The Wash at Kings Lynn. The Romans brought in goods and personnel from the North Sea in this way. Wicken Lode was a later addition, being cut in the 12th century. The Normans did try to bring the fen people under their rule but gave up in the end because the settlements were so inaccessible. At this time the River Cam was tidal right up to Cambridge, resulting in the water in the system being brackish. However, in the 17th century the Fens were systematically drained and lock gates constructed so that the water levels could be controlled. The boggy, reed covered area had extended for 80 miles to the North of Wicken and for 50 miles to the West and East, but, bit by bit, it was drained and became the agricultural land it is today. The lodes had to be cleared of reeds every year to allow the water to drain away and this was a vital and time consuming job for the fenland farmers. Nowadays the Environment Agency is responsible for keeping the waterways clear. All the agricultural land in the Fens is continuously pumped out to keep it from reverting to its previous watery state. There is a move to allow some areas to reflood, but local opposition to this is strong.

Fig 1. Poodling along the Wicken Lode

All the while we were being regaled with this background information, we were quietly travelling from the initial narrow dyke onto a wider watercourse. One man saw a kingfisher, but there was a surprising absence of the small birds which we had expected to see flitting about. Neither did we see any water-fowl. Our boatman said that these birds favoured the mere in the centre of the reserve. We did see the odd dragon fly hunting along the lode. The vegetation varied as we motored slowly along, areas of wet pasture giving way to dense scrubby woodland and then to reeds.

After 20 minutes we came out under a bridge onto a much larger and wider watercourse which one might have termed a canal. This was Burwell Lode, a major Roman waterway which joins the system to the River Cam, now controlled by lock-gates. Here the scene was very different. Until the 1970's barges used it to service brick and fertiliser companies sited here. Now the banks of the lode are lined with moorings for privately owned motor cruisers. After briefly surveying this scene of human activity, we turned back onto Wicken Lode and the tranquillity of this reedy backwater. As we retraced our steps, our boatman told us about the horses which used to walk along the tow-path (the hailing way here in the fens), pulling the boats from village to village. He pointed out that the previously drained areas were lower than the lode because the peaty ground shrinks as the water drains out, thus necessitating more pumping and higher dykes. In the 17th century when the Fens were first drained it was windmills which provided the power so only a limited amount of water was extracted. The subsequent use of steam powered pumps was much more effective and a greater removal of water resulted in greater shrinkage of the peat.

The boatman told us that in 1947, exceptionally high tides coupled with very heavy and prolonged rainfall had proved too much for the system and that many dykes had been breached causing extensive flooding. We also heard about a floating church which travelled, complete with pastor, around the Fens between 1795 and 1807. It was pulled by a horse and had on board all the trappings of a church: a pulpit and alter, a font and pews for the congregation. During that time 74 weddings and 104 christenings were performed on board as well as normal services.

We passed again the scrubby woodland, noting birch, elder, hawthorn, guelder rose, purging buckthorn and willow. Our boatman told us that the wood is virtually impenetrable and it certainly looked to be so. After this we passed Verral's Fen. This was several feet higher than the other areas as it has never been drained and therefore never shrunk. Konik ponies graze this and other areas to keep the vegetation down and especially to prevent tree growth. As we approached our starting point once more, our boatman told us about Wicken Poor's Fen, which is the fen closest to the visitor centre. It is the common land fen where poor Wicken villagers were allowed to collect reeds and dig peat for their fires.

Fig 2. A traditional fenland cottage

We ended our visit to Wicken Fen by looking around Fen Cottage. This is an original old cottage made of local materials and still lived in by a family during the earlier part of the 20th century. Since the Second World War it had fallen into disrepair but was renovated in 1989 using the traditional fen materials. The out-buildings were very interesting, stacked with a wealth of old tools, eel and fish traps, stilts for getting about in flooded areas and ancient ice-skates to use on the lodes during freezing East coast Winters. The cottage is furnished with household items from 60 or more years ago and we delighted in the patchwork quilts on the beds, oil lamps, old plates and kitchen equipment, a big old mangle, a bar of sunlight soap and an ancient unopened box of washing powder,(Rinso), and many more items remembered from our childhood in our homes or those of our grand-parents. Photographs of the last people to live in the cottage added to the atmosphere. It was very damp despite the fire burning cheerily in the grate and the low ceiling would have made life there uncomfortable for taller people. Fen Cottage really brought to life the times when the people of the village depended almost entirely on their watery surroundings for all their daily needs.

Weekend Visit to Yarwell - 2: Flag Fen Bronze Age Causeway

Ann Barrett

We set off bright and early on Sunday morning to Flag Fen situated at the eastern side of Peterborough on the western edge of the Fens. Nearby, we noticed a huge building which we later discovered to be the aptly named Fengate Power station and which is also used as a landmark on the site to show the direction of the causeway.

It was discovered in 1982 by Francis Pryor MBE during a project to complete a dyke survey for English Heritage. He literally stumbled over a pointed piece of wood in a ditch, which on further inspection, showed clear tool marks.

Fig 1. Roman road, Flag Fen

During Neolithic times, [4,500BC – 2,500 BC] Fengate was a raised area of gravel terraces which was gradually cleared of deciduous woodland by early farming communities. To the east was natural clay 'island' called Northey and in between the two, was an area of low-lying land, called the 'Flag Fen Basin'. Over many centuries, people farmed, fished and hunted in the area.

During the Bronze Age [2,500BC – 700BC] around 1300BC the low lying lands became seasonally inundated and peats began to form. Although the ground was flooded during winter, animals were put out to graze during the summer months on the fertile water meadows and then driven along droveways to higher ground during the wet winter months.

In response to rising water levels and increasingly swampy conditions, farmers gradually moved their fields to higher levels and eventually, work began on the construction of a causeway from Fengate to Northey parallel to one of the main Fengate droveways. This has been partially recreated onsite.

Excavations found a wooden platform and post alignment consisting of 5 rows of 60,000 vertical timber and 250,000 horizontal pieces of wood that stretches for nearly a kilometre across the fen. In the centre is a huge circular platform. The causeway is believed to have been constructed, renewed and enlarged over 3 main phases between 1350BC and 950BC

It is believed to have been originally built as a bridge for ease of movement of people and livestock between the two areas of higher dry ground where it is linked to droveways at either end. Other suggestions have been that it had a defensive use as a boundary and barricade. It appears, eventually, to have become a site of great religious significance.

Within the structure, many hundreds of metal, stone and bone artefacts including weapons and personal ornaments and jewellery have been found (Figure 2). These items have not been lost – they were deliberately placed in the water; some deliberately broken. Many items of leather and wood were kept in excellent condition by the lack of oxygen in the peat, and thus are an important and unique record of Bronze Age life. Furthermore, excavations have uncovered large amounts of animal bone (sheep, cows, pigs) showing signs of butchery which raises the question – was feasting taking place there?

Figure 2. Shears with protective wooden box

England's earliest example of a wheel was also discovered buried amongst the timbers. Many of these objects are well displayed in the museum building alongside helpful, well - designed information boards.

Over the centuries, variations in water level caused deposition of peat and silt which finally covered the timbers leaving a long line of tall posts sticking up from the flooded Fen bed. It is thought that Roman surveyors may have used these to help with alignment during construction of the solid road -the 'Fen

Causeway' - which leads eastwards from the Roman town of Durobrivae, to the west of Peterborough, to Denver, Norfolk. The route of a section of this Roman road is also on site.

At last, even the visible timber posts were gradually obscured and despite later drainage of the fens, waterlogging within the high water table continued their preservation until discovery.

To demonstrate the position of the causeway lying beneath the ground, some wooden posts have been placed in rows. It passes below a preservation hall where a 10m section of the timbers has been exposed and kept within water (see Figure 3 right). These can be viewed from a platform backed by attractive pictures depicting life during the Bronze Age at different times of year. It is vital that the timbers are kept waterlogged or they would crumble if exposed to the air. This is apparently the only place in Europe where such archaeological finds can be viewed in this way.

Figure 3. Vertical causeway posts protected in water

We were impressed by how the site had recreated the fenland of Bronze Age times with meres and dykes. Fenland wildflowers, reeds, willow and alder have been planted to give an idea of the environment and hedges along the droveway have been woven in authentic style. Useful information boards are dotted about the place and Soay sheep and geese lend an authentic air. There was even an interesting Roman herb garden in the grounds.

Figure 4. Reconstructed Round House

Further highlights are reconstructions of Bronze and Iron Age roundhouses - the former of which is being repaired after winter storm damage. The latter contained some interesting artefacts such as wooden furniture, a hearth, tools, cooking items and woven fabrics. It is stressed that these houses, although representative of buildings in the area, are for display only and do not imply that there were settlements on this particular site which would have been too wet in those days.

There was also an archaeological demonstration room which some of our members visited.

Afterwards, we met up for refreshments and packed lunch on the terrace of the attractive architect -designed, visitors' centre which was surrounded by water and reeds.

All in all, we found the site fascinating and really appreciated the efforts by the developers of the centre to show at close hand and recreate aspects of local life in ancient times.

This causeway which has been remarkably preserved due to the waterlogged nature of the fens, is unique and of great national and international significance.

Over the millennia, the Fens have been a changing landscape of dry land, open water, rivers, peat bogs, swamps, silt and islands of clay gravel and sand.

Each generation which has lived in the Flag Fen Basin inhabited this changing and evolving landscape and had to adapt to their environment. We, in the 21st Century, may well also have to learn to adapt to the challenges of climate change.

Weekend Visit to Yarwell - 3: Ely Cathedral

Geoff Downer

Our afternoon visit was to see the splendid cathedral at Ely responsible for its own diocese since peeling away from Lincoln in 1109. Driving toward it we could see why it is known as “the Ship of the Fens”, standing proud of the otherwise flat landscape on a small island of Cretaceous carstone from the Woburn Sands Formation. The presence of a free car park in Ely was a bonus, although this was counteracted by the rather steep entry charges imposed on all cathedral visitors.

Our party split into two, some having already been up to the Octagon Tower on a previous day. Those that did visit the central tower were told how the Norman crossing tower had collapsed in the early 14th century destroying much of the chancel together with the adjoining bays of the nave and transepts. The resulting replacement tower that we see today terminates in a unique glazed lantern tower constructed in wood, built by the master carpenter William Hurley. From the tower there were excellent views in all directions across the surrounding fen country.

The interior of the church, enjoyed by all of the party, possesses a Norman nave with Romanesque architecture up to the clerestory level. Our cathedral guide provided lots of background on the history of the cathedral and pointed out many features we may otherwise have missed. After about an hour he came to a slightly premature halt when the organist commenced making a noise that drowned out all competition.

The early church building was built from Barnack Stone, an extremely durable shelly limestone from the open cast quarries at Barnack. Now known as the “Hills and Holes” (a National Nature Reserve and Site of Special Scientific Interest), these quarries were worked out by the mid-late medieval period. As a consequence all restoration stones have had to use an alternative supply of stone from the Lincolnshire/Northamptonshire Jurassic stone belt. We only had time to examine some of the cathedral walls and in doing so we noted the use of Ketton Stone (a usually white oolitic stone), Clipsham Stone (often blue-hearted i.e. with reduced centres to the blocks, at least in evidence in recent restoration work) and another stone that may have been Weldon Stone. In the west end porch there were several decorative shafts of Devonshire Marble, which may have been replacing their weathered predecessors of Purbeck Marble, which was a common decorative stone used in the Gothic elements of the church interior. At the east end were two chapels with fine carvings constructed from clunch, the local name for stone from the nearby chalk hills. The very local carstone, which formed the bed rock for the church building, was not suitable for ashlar work or for dressings and had been used only as a rubble stone.

From Ely we made our way to Yarwell where we were staying at Ann’s mother’s. We were all extremely grateful for being allowed to stay in such an old and fascinating stone farmhouse, almost as grateful as we were for the chilli-con-carne that Ann had prepared the night before and which was followed by a scrummy apple crumble with custard to round off an enjoyable and informative day.

Fig.1 Ely Cathedral

Fig.2 The lantern viewed from the roof

Some pictures of the cathedral, taken by Geoff Downer, are shown above and on the next page.

Fig.3 The Ceiling of the Lady Chapel

Fig.4 Model of the Octagonal tower

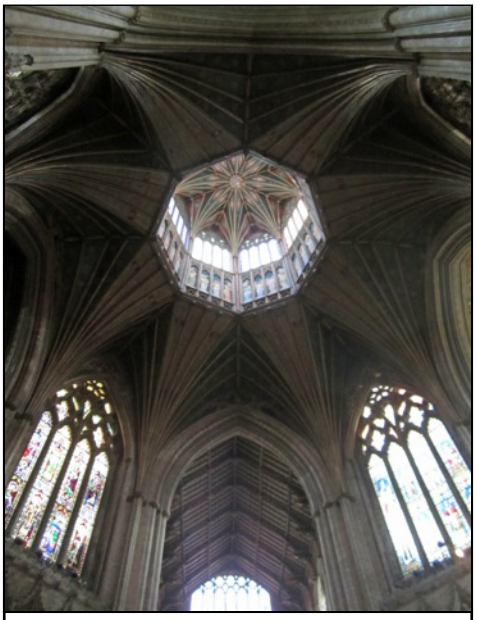

Fig. 5 Looking up into the Octagonal tower and lantern

Fig.6 Giant Organ pipes

Fig.7 View of the fens from the top

Weekend Visit to Yarwell - 4: The Village of Lyddington

John Horder

We left the quarry at mid-day to go a few miles to the village of Lyddington, choosing a route that would afford a view of the Welland railway viaduct. It was an impressive sight from a distance and as we passed under it between the villages of Harrington and Seaton we were able also to appreciate its sheer height. The viaduct was constructed by the Midland Railway company in the period 1876 to 1878 to cross the valley of the River Welland. Its span of 82 arches, constructed from 30 million bricks manufactured on site, stretches over a distance of ¾ mile, and it is claimed to be the longest masonry viaduct crossing a river valley in Britain. Today, it is not only a scheduled monument but still carries a daily service of trains.

Lyddington derives its name from the stream, the Hlyde, which flows through the village and forms a tributary valley of the Welland. The village is a very attractive collection of buildings, all constructed of golden brown sandstone blocks typical of the material we had just seen in the quarry, the centrepiece being the Bede House – formerly a bishop's palace - and the adjacent church of St Andrew.

The symbol on the ordnance survey map depicts the church as one with a spire. The church is striking in having both a spire and a tower with the squat or "broach" spire surmounting the 14th century tower. (Did this present a conundrum for the ordnance survey map maker who chose the symbol depicting a spire?) Inside, the nave is of considerable height, this and other features of the interior reflecting the church's importance during its association with the former Bishops' Palace. There are a number of interesting features including the rood screen and stairs leading to the rood loft, some original 15th century glass showing the heads of a king and bishop, a medieval wall painting uncovered in 1937, and high up on the chancel walls are six acoustic jars – earthenware pots sunk into the walls designed to amplify the voice of the priest. It is not clear whether these are effective, although it appears the overall acoustics of the church are good (whether or not due to the acoustic jars), for it is hosting 8 concerts during 2014.

The adjacent Lyddington Bede House, now an English Heritage property, has had a varied history. It was built as a palace for the Bishops of Lincoln and served both as a residence for the bishops and as an administrative centre for the diocese. The estate included fishponds and a deer park. Following the Reformation when it was seized by the Crown it passed to the Cecils of Burghley in 1600 and the surviving building was converted by Sir Thomas Cecil into an almshouse or Bede House for the accommodation of "twelve poor men, two women and a warden". This function continued until about 1930.

As we toured the building we received an insight into the rooms and living conditions for the pensioners lodging there. Whilst these may seem rather spartan and some of the house rules rather quaint by modern standards, no doubt the accommodation was regarded as very good at the time. On the ground floor are the twelve rooms for the bedesmen each having a fireplace and small window, the latter carefully positioned so that the warden could have a view of the fireplace on his rounds to check on the safety of the occupant and in particular to ensure fires were doused at night. On the first floor are a room for the warden and two rooms for the bedeswomen who served as housekeepers. One room has been furnished to re-create an impression of life in the Bede House.

Fig 1. Exquisitely Carved Ceiling Cornice

The Great Chamber of the former palace retains many of the original features which contributed to its original grandeur – handsome mullioned windows which afford a light and airy appearance to the chamber, an exquisitely carved timber cornice to the ceiling, and the coats of arms of former bishops. Relics from its later more mundane use as the common hall of the Bede House are the oak refectory table and benches, a lectern, chest and a box set into the wall for the receipt of donations from visitors and of fines from residents for misdemeanours and infringements of house rules. The attic, although it does not appear to have had any important use, is nevertheless of considerable interest as here the roof timbers are exposed and it is possible to discern the detail of the roof construction and materials. For example we could see

the Collyweston stone tiles and wooden peg fixings (a good preview for our later visit to the slater's workshop).

Outside, set into the precinct wall at the corner of Main Street and Church Lane is a gazebo – the "bishop's eye"- in the form of a two-storey octagonal tower with a passageway at ground level and a watch tower with windows, now blocked, at the upper level.

After our visit we walked a short distance to the Old White Hart inn for tea and coffee in the garden in the autumn sunshine. Finally, we moved on to the workshop of David Ellis, the Collyweston Master Slater, via the village of Uppingham, where incidentally we glimpsed another octagonal gazebo (is it a feature of the area?) and later had a view of Rutland Water.

Fig 2. Beamed Attic Roof

Weekend Visit to Yarwell - 5: The Collyweston Slate Quarry

Anne Padfield

The highlight for me of the residential field trip to Yarwell, (staying at Ann Barrett's Mum's) was the visit to Bullimore's Collyweston Aggregates Quarry, Duddington, Northamptonshire, where Collyweston Slate and Inferior Oolite may be seen. On arrival at the quarry site office, we were met by Ann Barrett's Uncle, David Ellis, (talk about keep it in the family!), who took us in his very rickety and extremely dirty vehicle to the quarry face. However, this was a journey we were all thankful for as it was a ride of at least ten minutes and walking would have taken considerably longer.

When we arrived at a large pile of boulders, Uncle David, got us all out and told us about the Collyweston Slate. It's not a slate in the real sense, in that it has not been formed by regional tectonic metamorphism, in orogenic mountain fold belts, by combined heat and pressure, but rather, it started as a sedimentary rock, in the bottom part of the Lower Lincolnshire Limestone. However, it has undergone chemical changes and possibly 'low grade' metamorphism, which has altered its original make-up from a typical Lincolnshire Limestone, into a material with different properties.

Lincolnshire limestone is typically oolitic, where dissolved calcium carbonate precipitating in a warm shallow sea, was subject to wave action which rolled the precipitates into 'hard cod roe' like tiny spheres (Hains, B.A. & Horton, A., 1969). Laid down in the Middle Jurassic, Bajocian period, about 165 million years ago, the Lincolnshire Limestone forms part of the edge of The London Platform. With estuarine type beds above and below, it ranges from between about 18m and 40m thick (Hains, B.A. & Horton, A., 1969).

In Bullimore's quarry, the unaltered oolitic limestone is typically a yellow, coarse grained, silty, sandy LIMESTONE, composed of ooids of nominal 0.5mm in size. The latter can be separated from the matrix with a knife, but the rock is fairly well cemented with calcareous cement. Piles of waste rock material dotted about the quarry, tended to be more sandy, fossiliferous and ferruginous. Some of it exhibited decalcification where fossils had been dissolved away, leaving just their moulds behind. Fossils were shelly and appeared to be mostly molluscs, typically bivalves.

A huge rock splitter (Fig 1 below) was situated near to the waste pile, for splitting the rock into masonry blocks. As the oolitic limestone is a 'Freestone', meaning it can be sawn or cut in all directions, it can be fashioned into any shape (Richardson, A. *et al*, 2011, Waltham, T., 2002).

Many houses and cottages in the region are built with this natural building stone, which has a similar appearance to Cotswold stone.

Fig 1 The Rock Splitter

The sandier oolitic limestone would not be strong, durable or frost resistant enough to be used as road aggregate, but would make a suitable fill material. When tested using the 'Strength of Rocks in the Field' test (BS5930:1999 Code of Practice for Site Investigations), it was found to be moderately weak, moderately strong, to strong, therefore ranging from about 12 MN/m^2 to 70 MN/m^2, compared to other more uniformly strong Carboniferous limestone's used for aggregate, with strength values averaging 100 MN/m^2 and up to 150 MN/m^2 (Waltham, T., 2002, BRE, 1997).

The Collyweston Slate Log (the name of these rock slabs) was found to be located in the lower beds of the quarry, nearer to the quarry floor, and where a groundwater sump pool (Fig 3 below) had been excavated it appeared in the beds at the edge of the pool. The slate beds tended to have a blue grey lens (or heart) at the centre, making them easy to distinguish. The engineering properties of this material were substantially different from the sandy limestone. This rock is much harder with ooids appearing to be fused together with a considerably stronger cement, so that they could no longer be prised off with a knife. In fact its appearance had altered from being oolitic to being more akin to a crystalline quartzite. Furthermore, unlike the oolitic limestone, this material has developed a bedding parallel cleavage, allowing slates to be worked by using this fissility. These cleavage planes can be as closely spaced as 5mm apart, allowing thin slates to be made.


Fig 2 Uncle David with Slate Log

The blue heart rock within the slate, may have acquired its different colouration in a number of ways. Firstly, it is apparent from the yellow colouration and ferruginous layers, that oxidised iron is present. At some point in time in the past, either, the centre of these oxidised layers became anaerobic, producing a reducing environment, or the whole layer was originally reduced, but later became oxidised, but not right into the centre or heart. A similar effect can be seen in gleyed clays which are mottled blue and brown by small localised zones of oxidation and reduction. However, this is not a clay with a clay's typical property of very low permeability, or impermeability, this was a silty, sandy oolitic limestone and as such likely to be more permeable, allowing oxygenated water to be mobilised through it (Bell, F.G. 1981). The clue to what might have happened is given by the material itself. This is a much harder, much more cemented rock. In fact it is no longer a limestone, but a quartzite, with a siliceous cement.


Fig 3 A Groundwater Pool

Meteoric water permeating down through the sediments, became heated at depth and together with increased burial pressure from the overlying depth of sediment, dissolved the sand within

the sandy limestone and later precipitated it as the siliceous cement binding all the now pseudomorphed, silicified oolites, together. Furthermore, the replacement of the formerly calcareous ooids with silica, has actually crystallised to fuse their edges together, with interpenetrant crystal growth. The cemented interiors of these beds became impermeable and could not be oxidised, leaving, after the exclusion of oxygen, the interiors reduced. Additionally these meteoric mineral rich hot fluids may have been highly acidic, reducing the now highly impermeable interiors of the beds, before silicification took place, and afterwards preserving them permanently in this condition. The pressure of the overburden layers would have added to this impermeability and explains the phenomenon of the bedding parallel cleavage, where mineral crystals re-align and re-crystallise so that their prism lengths lie perpendicular to the principle stress direction, (in this case 'normal'), producing a cleavage plane.

All the above pre-disposes the idea that the meteoric water became hot enough to dissolve the silica and produce this low grade metamorphism. However, one doesn't have to search far away for the source of this heat. The Mountsorrel batholith is only 25-30 miles away and probably much closer under the ground. Although it intruded 450mya, the granodiorite is a coarsely crystalline igneous intrusive rock, with large crystals, indicating slow cooling and within the last 165my it was probably still hot enough to cause the effects discussed above. For example at Charnwood Forest nearby, over 50 minerals have been deposited just under the Triassic unconformity, by hot mineralised fluids, originating from meteoric water percolating down from above. The bottom of the local Triassic rocks acted as an impermeable barrier, trapping the fluids and proving that these minerals were emplaced after at least the beginning of the Triassic. This is evidence that the batholith was still sufficiently hot to heat water at depth, even in the Triassic. Furthermore, the Duddington Fault, which gave rise to Earthquakes in 1755, 1792, 1813 and 1844, is close to the quarry and may have provided a conduit for these fluids (Hains, B.A. & Horton, A., 1969). At Swithland in Charnwood Forest, near Mountsorrel, the Swithland Slate is a similar roofing material to the Polyester Slate (English Heritage, 2005).

The hardening alteration of the oolite rock here is the reason it can be excavated and utilised for aggregate. With its engineering properties substantially enhanced it meets the criteria required for road stone and Department of Transport Type 1 aggregate and hence becomes commercially viable.

The oolitic limestone rock face is substantially dissected by near vertical jointing and easily fractures with explosives into suitably sized blocks for crushing. Unfortunately, this makes the South face in particular, unstable and liable to toppling failure. (see Fig 4 right). The beds, averagely spaced at about 0.30m apart, dip gently towards the East and there are some features worthy of note visible in the cliff faces, such as cross stratification and small thrusts, trending in a Northerly direction (see Figs 5 to 8 on the next page). In Figure 5, the Ripple cross laminations in both directions probably indicate shallow marine tidal deposition. Note the block has moved probably due to earthquake activity

Fig 4 Toppling Failure is likely

In places there is notable leaching of iron minerals leaving the rock very pale buff in colour. Liesegang rings were also observed. Over the top of the limestone was a 2m layer of very pale cream, fine sand. Above that was glacial till (boulder clay).

Our time having expired, we left the quarry the way we had come, courtesy of Uncle David. It was a very interesting time had by all. Thanks Ann.

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Fig 5 Ripple cross laminations in both directions

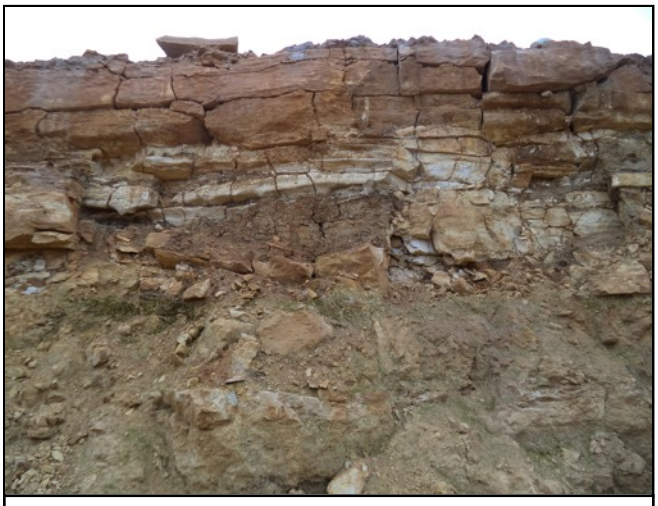

Fig 6 Highly leached and broken beds, with clay between.

Fig 7 Small thrust, possibly associated with earthquake activity?

Fig 8 Sand and till at the eastern end.

Slate Making

Anne Padfield

The Collyweston Slate 'Log', has to be left to mature in the frost and wet for several years and never allowed to dry out. In fact the older the sample the better. Uncle David did his mock demonstration on a piece that he had been storing since the 1960's. The reason for keeping the rocks so long is that the frost can assist in wedging them open, so that they split easily when 'clived'. Uncle David tapped the demonstration sample fairly gently all along the cleavage plane exterior surface. This has the effect of breaking off small clasts of rock, that fall into the cleavage crack and keep it open. Eventually with continued tapping a tabular slab clives off.

A special tool is used for trimming the circumference of the slate, which nips the edges off. In the old days a tool called a 'bill and helvel' was used to make the hole in the slate for pegging it to the roof. This tool looks like a birds beak. Nowadays a modern masonry drilling tool is used. When placed on the roof the slates overlap and some more are put underneath, so that the roof is watertight.

There is a huge range of slate sizes and Uncle David showed us his self-made measuring stick. He then recited all the various sized, local, slate tile names for us. The skill of Collyweston slate working is dying out, but still much in demand for restoration of old buildings. It was interesting to note that, in particular, the roofs of barns and stables where horses are housed, are damaged by ammonia vapours from their pee.

Editor's Comment

Over the years that I have produced the newsletter I have spent much of my effort badgering members to submit articles. If every member that attends the indoor meetings were to write an article, they would only have to do so about once every three years!

I would therefore like to express my thanks to Ann Barrett, Geoff Downer, John Horder, Anne Padfield and Alison Taylor for getting together to flood me with descriptions of the Yarwell weekend. I have never been so indulged. Thank You!

Indoor Meetings Programme, 2015

Ann Barrett

Please bring any interesting material to Indoor Meetings. It does not have to be related to the subject matter of the day's talk. It could include recent finds, specimens for identification and books, maps, photographs, etc. of general interest.

Details of forthcoming field trips will also be announced at Indoor Meetings.

Tea and coffee is available at 20p cup. Non members are always welcomed but are asked to donate £1 to the Group's expenses, unless joining on the night. For any queries concerning this programme, or to suggest speakers or subjects for talks, please contact:-

Indoor Programme Secretary: Ms. Ann Barrett.

Tel. 01233 623126, e-mail annbarrettgeo@gmail.com

20th January 2015	**Tony Mitchell.** The Silk Road
17th February 2015	**Yvonne Cutt** Exploring the Rocks and Seas of Arctic Canada
17th March 2015	**Annual General Meeting** **Jennifer Jackson** Finds Liaison Officer, Heritage Conservation, Kent County Council. Talk and please bring any Kent finds you would like to have recorded in the database.
21st April 2015	**Dr Chris Duffin** Lapis Lazuli
19th May 2015	**Stephen Nye** The Rochester Museum and collection. Talk and display of items.
16th June 2015	**Dr Brian Marker** Talk to be determined
21st July 2015	**Sandy Elsworth** Water for Africa?
18th August 2015	TBA
15th September 2015	**Dr Anne Padfield** The Application of Geology for Engineering
20th October 2015	**Dr Geoff Turner** The Kent Coalfield
17th November 2015	**Ann Barrett** Agate
15th December 2015	**Christmas Evening [3rd Week]** Please bring labelled fossils, minerals and rocks for sale for the benefit of the Group and any other specimens found during the year for display. Members may also care to bring in refreshments