Home Counties North Regional Group Newsletter

Issue No. 18 - June 2022

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CHAIR'S BIMONTHLY REPORT JUNE 2022

John Wong FGS
HCNRG Chair

I hope everyone is well and enjoy returning to more normality at work and at outings.

We are still being advised, especially in crowded supermarkets, that face covering is not a legal requirement but a personal choice for the safety of yourself and for other people.

June 2022 is a milestone in the Home Counties North Regional Group calendar, it is the second anniversary of the launch of the bimonthly newsletters. The bimonthly newsletters are unique amongst the regional groups because no other regional group has them. The number of HCNRG members contributing articles is increasing, the contents of their articles maintain a very high standard and they are geologically informative and educational as well as entertaining to read. Their value is reflected in the fact that some regional groups have asked to receive our bimonthly newsletters for distribution to their members. They are, of course, available on the Geological Society website.

The HCNRG newsletters were initiated soon after the re-forming of the regional group; they were issued annually and only reported the group's lectures and field meetings. Since June 2020, the bimonthly newsletters have become members' newsletters for sharing their geological knowledge and voicing their concerns on different issues, relating to the Geological Society, personal career prospects, and further education issues; the bimonthly newsletters are the means for the Chair/Committee Members to update members on any forthcoming events of the Home Counties North Regional Group, as well as reports of the past lectures.

Some contributors to the newsletters have added their published newsletter articles to their curricula vitae, and have been awarded continuing professional development points towards their applications for chartership, a good indication of their value.

If the Covid 19 pandemic had never occurred, I am sure that there would be no bimonthly newsletters and the continuation of an annual newsletter may have been at risk. If the annual newsletter as it was, is represented as a coin, then reports from the Committee would be on both sides of the coin, with no door open to HCNRG members for their contributions; valuable as it

was in keeping members informed of group activities, it was a one-way dialogue and there was no regular two-way communication.

I regret to inform you the June Geology Quiz in High Wycombe has had to be cancelled; Mick McCullough, the HCNRG Treasurer, who organises the geology quizzes is concerned about the major engineering works and a Harry Styles concert at Wembley on Sunday 19th June. There are no trains to and from Amersham from Marylebone in London, and only a limited service to High Wycombe. The tube trains from Baker Street only run every 50 minutes. My apologies to the members for having to disappoint you. Nevertheless, Mick has pencilled in a new date of Sunday 31st July, for the Geology Quiz afternoon event, also in High Wycombe, he will inform you of the details in a flyer in due course.

On Saturday 30th July, I will lead a building stone walk in Ware town in the afternoon, follow by a group visit to the Ware Museum for a guided tour with their curator, after the museum closes at 4 p.m. Refreshments will be available. The flyer with full details will be sent to you shortly.

I am in the process of finalising a full-day field meeting at the Trent Country Park in Cockfosters in north London, it will include some simple field work. This could take place in mid-July at the earliest. I plan to organise a post-field meeting workshop for those of you who are unable to attend this field meeting.

We have always organised field meetings at weekends, except when visits to working quarries or museum or geology institutions need to be held on weekdays. Recently, it has been drawn to my attention that some members keen on attending field trips work at weekends; I will, therefore, arrange a pilot weekday field trip see if it is as appealing as weekend field trips.

Burlington House is currently open Tuesday to Thursday, hopefully I can book a room there for the next geology workshop.

I am also in the process of seeking popular speakers and suitable venues in Northamptonshire.

It is a steep challenge for me to put on the Home Counties North Regional Group Newsletter Editor's hat but I will continue to do so until a volunteer emerges from the membership of the group; I hope you all enjoy reading Newsletter issue 18 and please accept my apologies for its slightly delayed issue.

My profound thanks go to everyone who has contributed an article to this newsletter, I am deeply touched by your enthusiasm in writing such high quality and eye-catching articles, you are all shinning stars in my book.

May I ask all of you to join me to thank the Home Counties North Regional Group Committee Members for their extensive contributions to serve you to date.

The closing date to submit articles for Newsletter issue 19 is Sunday 31st July.

Have a good summer 2022 everyone, take care and best wishes,

John Wong FGS HCNRG Chair

HOME COUNTIES NORTH REGIONAL GROUP
NEWSLETTER ARTICLE REVIEWS

John Wong FGS
HCNRG Newsletter Editor

Adrian Marsh FGS wrote a detailed report of the June lecture on zoom which he organised**, 'Lithium in Cornwall: The foundation for a responsible UK battery supply chain' presented by Dr Rebecca Paisley and Hugo Heard**. We hope Adrian's report would benefit the Home Counties North Regional Group members who were unable to attend the lecture, especially to the members who have registered their places but did not log on for whatever reasons. Thank you to Adrian for writing a full and detailed report of the June lecture.

Nigel Rodwell FGS wrote an in-depth and well researched multi-facetted article entitled '**The history and evolution of a sinkhole in Hodgemoor Woods, Seer Green'.** Nigel used LiDAR data combined with the published surface geology information, historical maps, documented census records, archaeological discoveries and field observations to develop a better understanding of the local stratigraphy, to construct and summarise archaeological and historical chronology from the Iron Age to the 20th century, and to describe the development and evolution of a well-known local sinkhole in the Chilterns. An informative article written with passion and founded on extensive local knowledge, where science meets history. Thank you to Nigel for your contribution to this newsletter, much appreciated.

Dr Tom Hose FGS, his article is '**Recycling 'Edwardian' Geological Excursions in Beds, Bucks & Herts.,'** it is an informative and detailed account article which goes down memory lane, describing how past social lifestyle changed public attitude and appreciation towards cycling geotrail excursions from the late 19th century to the present day. Edwardian bicycles and cycling clothing and accessories are also described in detail. The railway network was at its greatest extent during the Edwardian period and was invaluable in getting the public and their bicycles to and from geology/landscape/engineering excursion areas, Dr Tom Hose mentions some interesting home counties local excursions as well as the past and new geotrails, he also tells how the changes in telecommunications and photography enabled the recognition of the value of photographs of geological interest taken during excursions. Thank you so much Tom, for your contribution of such an excellent and interesting article, well researched and well written, which will be a valuable reference for future research.

Adam Dawson FGS wrote an article '**Geological Survey Ireland – a newcomer's perspective'** is an eye-opener to the past and present work of the Geological Survey of Ireland. A comprehensive report on The Geological Survey Ireland "Down to Earth" exhibition in 2020, celebrating the Survey's 175th anniversary. Adam also wrote about his personal encounter with the diversity of geology in Ireland, which is reflected in its impressive landscape and topography. This article is a good read, which encourages readers to follow up and find out more on the geology of Ireland. Thank you very much for writing such a good read article, Adam.

Karoly Pesztranszki FGS went on geological excursions in Hungary in 2021, which he reports in his article '**Geological excursions in the Buda Hills, Hungary'.** He tells of the different types of carbonate rocks of the Eocene, Oligocene, and Pleistocene, formed in marine and freshwater environments. He explains the nature and origin of 'peastones' and 'cave flowers'.

A good, concise article for readers to appreciate the geology of Hungary and treasure as a useful pictorial guide for future excursions in the Buda Hills area. Thank you Karoly for sharing your field trip experience, you have indeed put Buda Hills on the geology excursion map.

Doris Southam FGS who is a keen photographer, contributes her third article for the bimonthly newsletter, '**First trip out of Lockdown, or (after Lockdown), the Lake District field trip in pictures, September 2021'.** Her article is packed full of many postcard-quality pictures that show the interesting geology of the Lake District, all taken by her on the field trip in 2021. Locations include Borrowdale, Skiddaw, Eyecott Hill Nature Reserve, Ingleton, Cowraik quarry and Shap granite quarry. A picture speaks a thousand words, Doris' Lake District pictures bring back my happy memories of the university field trips. Thank you Doris.

For your information, I have included in this newsletter, The Geological Society Early Career Award 2022 Home Counties North Regional Group wildcard entry abstract by Hannah Ritchie **'Sand dam contributions to water security in Kenya monitored through hand pump abstraction'.**

I also included the abstract of the forthcoming in-person lecture '**The "real" value of microfossils'**, to be presented by Dr Haydon Bailey on Tuesday 12th July at Arup's office in London. Please book your places in advance to homecountiesnorthregionalgroup@gmail.com. The Committee members and I look forward to seeing you there on the day. My thank you to Haydon for present his talk on microfossils to the Home Counties North Regional Group in a few weeks' time.

Report on lecture by Dr Rebecca Paisley and Hugo Heard on 'Lithium in Cornwall: The foundation for a responsible UK battery supply chain' Excursions. held on Zoom on Wednesday 1st June 2022

Adrian Marsh FGS, June 2022
HCNRG

Dr Rebecca Paisley, Lead Geochemist, and Hugo Heard, Generative Geologist, are employed at Cornish Lithium Limited, one of a number of organisations developing plans to start new mineral extraction projects along England's SW peninsula. The region contains significant deposits of minerals bearing elements such as lithium, rubidium and tungsten, together with tin and copper that have been mined historically for thousands of years. The renewed interest in this region's resources is being driven by a variety of factors including global warming, geopolitical supply chain security, sustainability 'ESG' considerations and traditional commercial drivers.

Globally, lithium in particular is experiencing a steep rise in demand for battery production for electric vehicles. These batteries typically have a nickel or cobalt cathode, graphite anode and lithium salt electrolyte, and whilst battery technology is evolving fast in pursuit of better performance and weight reduction, the likelihood is that lithium will remain a key component. In post-Brexit UK, a unique economic driver relates to the Rules of Origin regulations that form

an integral part of the UK/EU trade agreement. They are the criteria used to define where component products are 'made' and have important implications for the import and export of goods into the EU and whether products can be exported to the EU tariff- and quota-free. The UK is still in a transition period on these tariffs that expires in 2027 by which time it is critical for the automotive industry to have a local source of lithium in the UK.

At present, lithium is produced around the world from spodumene mines in regions such as South America and Australia, but most of the ore is processed in China before onward shipment to battery production sites worldwide. Typically, this can involve very high 'mineral miles' of around 50,000 km from mine to car factory. Lithium won from Cornwall, processed locally, moved by train to Britishvolt's gigawatt battery factory in Northumberland and then used say in a Nissan car built in Sunderland will have experienced less than 1,000 km 'mineral miles'.

Cornish Lithium Limited was formed in 2016 and now has mineral exploration rights over some 1,000 km^2 in the region. The current programme of exploration is centred on developing two different forms of extraction, being from hard rock and geothermal waters. So why Cornwall? The last deep mine in the region, South Crofty, closed in 1998 and whilst china clay production, based in the area around St Austell, is continuing volumes have been in decline for some time. These resources are derived from the massive granite batholith intrusion that underlies the region stretching from the Scilly Isles to Dartmoor, which is one of only five globally to consist of lithium-enriched granite. The region still has considerable reserves of other elements including tin, copper, and tungsten. The granite also has an elevated geothermal gradient, despite forming over 300 Ma, and is naturally faulted and fractured giving it permeability for hot waters, which now have naturally elevated concentrations of lithium and other elements. Studies have indicated that these waters are derived from old rainwater circulating at depth which have taken various metal salts into solution.

These characteristics have helped shape the exploration programme, which has included an in-depth archive study of public and private records, together with analysis of satellite imagery, and associated digitisation of thousands of old mine records and other sources to produce a detailed 3D digital elevation model (DEM) of the granite's structure including faults and previously mined veins. This data has been supplemented by field mapping mainly of coastal cliffs and other exposures, together with geochemical soil and water sampling and analysis. In parallel with the geological exploration, the team has been assessing existing infrastructure and human resources and developing its community engagement. Many people associated with mining still live in the area, including alumni of the Camborne School of Mines. The china clay industry has created vast swaths of 'brownfield' land on which new industries can locate. Workers seek well paid permanent employment to counterbalance the often poorly paid highly seasonal tourist economy. In short, many factors are combining to create local community support for new mining ventures.

Cornish Lithium's first project, scheduled to come into production by 2026, is the 'hard rock' Trelavour open cast mine. This will be developed within an existing area of former china clay workings and will eventually be taken to 140m below ground level. The reserve is estimated to be 51.7 Mn tonnes at an average of 0.11% lithium yielding 302,700 tonnes of lithium carbonate equivalent (LCE) over its 15 to 20 year expected lifespan. A key factor in this project is that the lithium is contained within the micas rather than in spodumene (a pyroxene mineral consisting of lithium aluminium inosilicate). Spodumene requires processing at over 1000^{o}C, whereas micas can be crushed, and the lithium leached out and concentrated (under Lepidico's process

license for clean-tech L-Max ® process technology that extracts lithium and recovers valuable by-products).

The geothermal project intends to set up a series of deep wells intersecting existing mineralised fault zones to extract both lithium and heat. Borehole investigations are in progress with two completed to 800 metres and 1,000 metres depth so far and a third borehole in progress to potentially 2,500 metres. At these depths groundwater is in the range 65^{o} to 85^{o}C and contains minimal deleterious other minerals. By locating these wells close to existing industries and urban areas heat exchanges will feed district heating schemes and energy-intensive industries such as brewing. The lithium will be extracted from the waters by processes of filtration, reverse osmosis, sorption, evaporation, etc., which are still under options appraisal and pilot plant trialling at present, before the water is reinjected.

In drawing their lecture to a close, Rebecca and Hugo stressed the importance of responsible development of lithium mining in Cornwall in accordance with the United Nations Sustainable Development Goals. This includes local community involvement, reuse of existing infrastructure and adopting modern technology to drive efficiency and control pollution. Looking ahead, they pointed to the need for a circular economy approach to battery technology to ensure that lithium n batteries can be recycled in future. Finally, the automotive industry needs this home-won lithium to retain its manufacturing and assembly in the UK!

The history and evolution of a sinkhole in Hodgemoor Woods, Seer Green

Nigel Rothwell FGS, May 2022
HCNRG

Summary

Interpretation of high-resolution LiDAR data, together with an understanding of the surface geology, and an analysis of documented history, has provided a plausible integrated geological, archaeological, and historical explanation for the development and evolution of one of the most spectacular sinkholes (dolines or swallow-holes) in the Chilterns.

Introduction

In Newsletter 16, and following a successful field trip to the area in August 2021, Adrian Marsh introduced us to the processes behind the development of sinkholes in the Chilterns, and his favourite sinkhole, at ‘Susie’s Loop’, in Hodgemoor Woods, within the parish of Seer Green. Hodgemoor Woods are owned by the Forestry Commission and are designated by Natural England as ‘Ancient Woodland’ (i.e. woodland that has existed continuously since at least 1600).

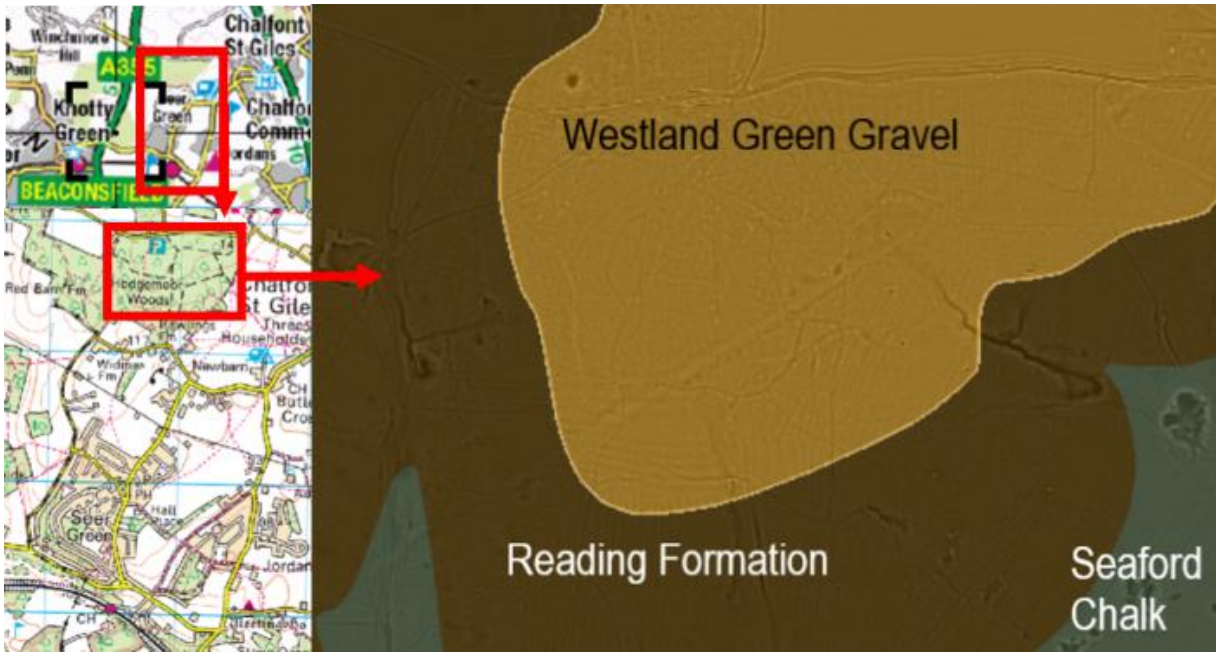


Figure 1: Location map: Hodgemoor Woods, Seer Green, Beaconsfield, Buckinghamshire (© Ordnance Survey). Superficial and Bedrock geology referenced to the LiDAR data, for detail and scale refer to Figure 2 (© BGS and Chilterns Conservation Board)

I have been studying the landscape archaeology and heritage of this region for the past few years: in conjunction with the Chiltern Conservations Board's 'Beacons of the Past' project, in particular interpretation of their high-resolution LiDAR data (see https://chilternsbeacons.org/wp/); and also using GIS software to integrate historical maps and medieval documentary sources, for a local history project (see https://www.ourlivingvillage.org/).

Recently I have been investigating the Lords of the manors of Farnham and Seer Green (for most of its pre-modern history Seer Green was a detached part of the manor of Farnham Royal). Between the Norman Conquest of 1066, when the manor of Farnham (including the land of Hodgemoor) belonged to Countess Goda (daughter of King Ethelred), and the start of the early-modern period when these lands belonged to Elizabeth I, there are some fascinating tales of the roles these nobles played in the development of the Nation.

I have integrated some of the detail from these historical records with the geological understanding, to investigate the evidence for the possible timing and rate of sinkhole development in the Tertiary gravels that overlie the Cretaceous Chalk.

Geology

Adrian introduced us to the geology in the region of Hodgemoor Woods. This is summarised here in Figure 1, which shows the location and illustrates the bedrock and superficial cover. This is taken from the BGS Geology of Britain viewer and overlain on the LiDAR data. Pleistocene Westland Green Gravel (braided fluvial and lacustrine gravel terrace deposits of the paleo-River Thames) overlie the Palaeogene Lambeth Group Reading Formation (fluvial and coastal flood-plain deposits, predominantly of mixed clays and silt with some sands and

gravels). These overlie the Cretaceous Seaford Chalk Formation (thick bedded chalk with nodular flint beds and some marls).

Surface depressions are common on the agricultural and wood lands of the chalk uplands in the Chilterns. These are often recorded as old 'gravel' pits on historical maps, and are sometimes recorded on the geological maps. Some are extraction pits for construction materials: brick-clay, sand, gravel, and some flint; and some are probably chalk pits for crushed chalk / marl used to enrich agricultural pasture.

The Reading Formation has been worked at least since Medieval times for brick clays and sands. The unconformable surface between the Chalk and the Reading Formation is marked across the region by a pronounced but generally concealed karst surface, which, when exposed, exhibits metre scale amplitude profiles. Natural sinkholes or dolines above karst are typically formed through suffusion (creating a subsidence sinkhole or shake hole), rather than collapse, so are the product of a gradual process operating over geological time. However, it can be difficult to determine whether a 'modern' surface depression or pit is the result of an underlying geological process, historical extraction activity, or a combination of both.

The boundary between the Westland Green Gravel with the Reading Formation is often marked by the proximity of ephemeral springs.

LiDAR

This region is not yet covered by Environment Agency LiDAR data, but it is covered by LiDAR acquired by the Chilterns Conservation Board in the winter of 2018/19. The data can be considered high-resolution, having been acquired at an average point density of 16 points per sqm.

Figure 2 shows a Low Relief Model (that is, the data has been processed to effectively remove the trend of larger scale features, in order to show only minor local variations against a 'flattened' model) of the data over Hodgemoor Woods, with Bottrells Lane running E-W (X-X) across the top of the image. The most obvious immediately obvious landscape feature here is the NE-SW trending *agger* of a Roman Road (C-C). Probably contemporaneous with this are a possible Romano-British farmstead (A) and field system (B). Clearly there are a number of extraction features (G, H, I), Adrian's 'perfect' sinkhole (N), and there are the 'tigger stripes' indicative of former Ridge and Furrow ploughing (E, F), as well as numerous tracks and pathways of various vintages. There are also, to the immediate north and south of Bottrells Lane, remnant building platforms from WWII military occupation and their subsequent re-use as a Polish Settlement Camp (M).

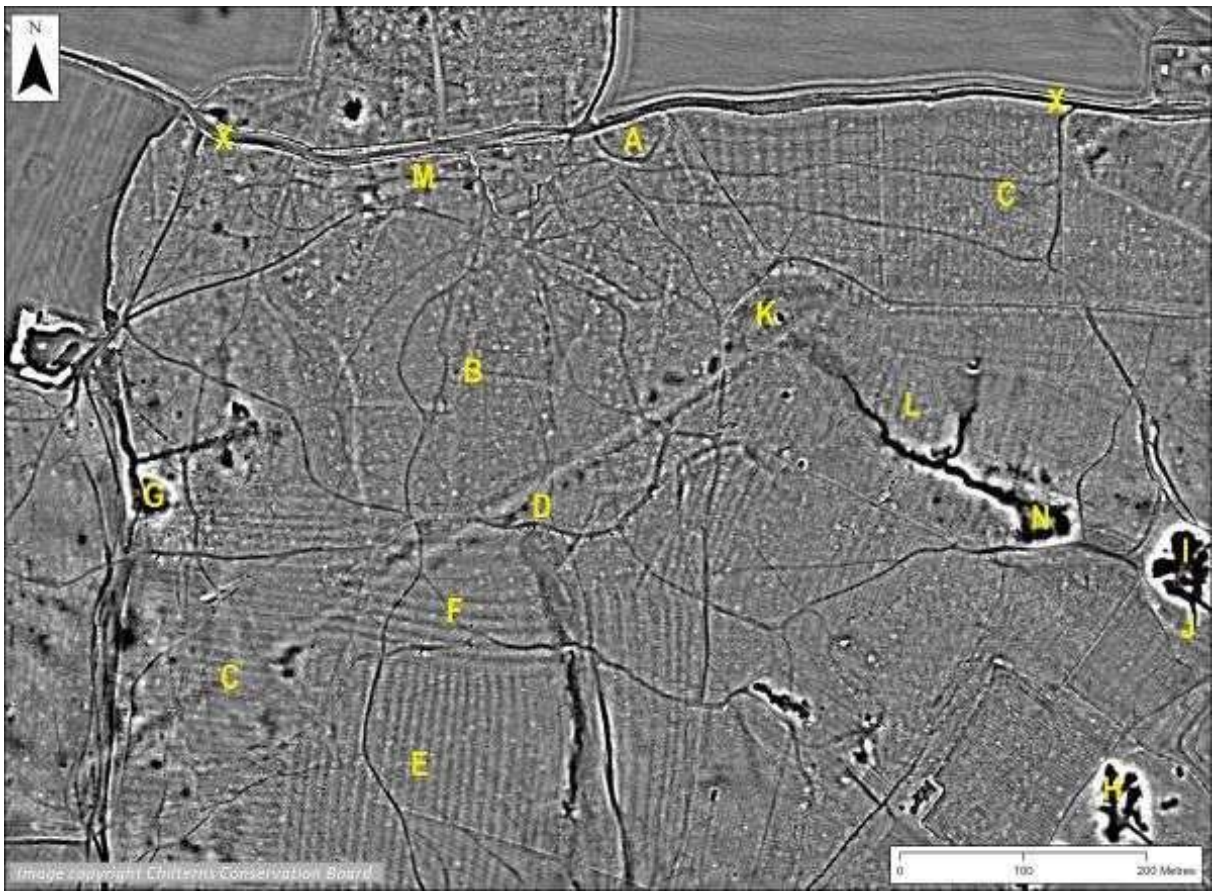


Figure 2: Low Relief Model LiDAR image, Hodgemoor Woods, Seer Green (© Chiltern Conservation Board). Labelled features are explained in the text.

Obviously, we can't precisely date features from the LiDAR data, but we can infer stratigraphic relationships and a chronology.

1st Century AD: The establishment of a transitional Iron Age to Romano-British farm (A) with a small coaxial / aggregational field system (B). This may be pre-Roman Road, but it is difficult to be certain.

c. 60/61: Probably post the Boudican revolt, the Roman Road (C-C) was constructed from *Verulamium* (St Albans) to *Caleva Attrebatum* (Silchester), together with roadside ditches (D) which are present where the road is on top of the Westland Green Gravel. This is the likely date given for the construction of the road out of *Verulamium* (Stead and Rigby, 1989). Note that the spring (K) does not appear to cut the Roman Road.

Post-410: Open field systems with Ridge and Furrow ploughing were established (examples at E, F, L).

Medieval?: Extraction pits were opened up (G, H, I). An ephemeral stream dissected the Ridge and Furrow ploughed fields (L).

19th Century: Probably the peak period for extraction activity. Note the clear access and egress routes from some of the pits (example at J).

20th Century: WWII Camp subsequently used as a Polish Resettlement Camp, established and in occupation up until 1962 (M).

Documentary sources

1086: The manor of Farnham was mentioned in the Domesday Book (1086). We know that pre-Conquest it belonged to Goda, and post-Conquest it was given to Bertram de Verdun.

1232: Seer Green is first mentioned (Cal. Clos., 1232) in historical records as *la Sere* (Anglo-Saxon for dry / barren).

1258: Seer Green is next mentioned (Cal. Chart., 1258), together with Farnham, when the Lord and Tenant-in-Chief was John de Verdun. We can trace John as being the Great-great-great-great-grandson of Bertram, and can infer that Seer Green, as a detached part of Farnham, was almost certainly included in the Farnham holdings described in the Domesday Book.

c. 1275: A Stephano de Hoddesmer' (later corrupted to Hoddsmore and then Hodgemore) was recorded as witnessing a grant of land by Henry, son of Samson de la Stokke to Missenden Abbey (Cart. Miss., 1275).

1541: Henry VIII swapped the manor (and the dissolved Abbey) of Worksop for the manor of Farnham Royal (including the lands of Seer Green).

1550: The lands were bestowed on the future Elizabeth I in Henry VIII's will (Cal. Pat., 1550).

1561: Elizabeth I ordered a 'Court of Survey' to be conducted for the Manor of Farnham Royal (Court Surv., 1561). This survey was a detailed listing of all the demesne lands and their indentured or copyhold tenants, together with the use of the land. Figure 3 is an extract from the survey indenture. It lists Hoddsmore (Hodgemoor) and The Swillie, and indicates the date of the planting of the woods (and therefore the end of open field ploughing) to be the mid-1550s.

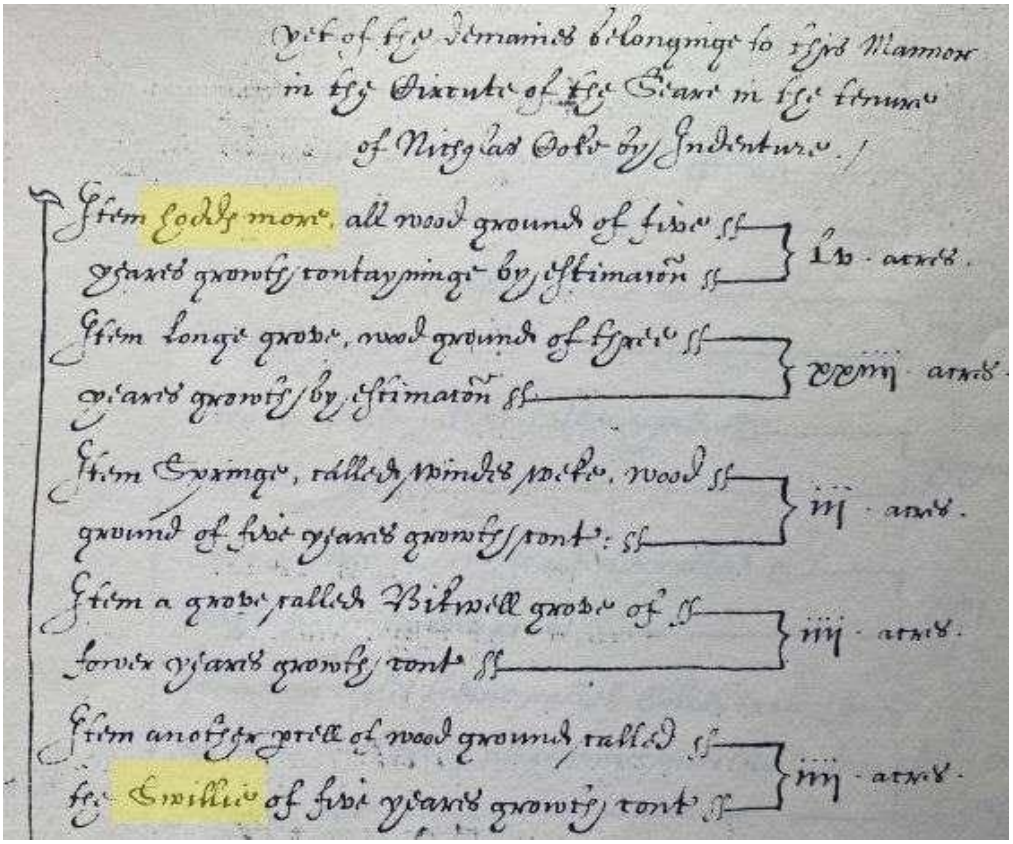


Figure 3: Extract from the Manor of Farnham Royal, Court of Survey, 1561 (Buckinghamshire Archives (Bucks Record Office), D/X 609). Highlighted items read: *Item Hoddsmore, all wood ground of five years growth containing by estimation 55 acres; Item another parcel of wood ground called The Swillie of five years growth containing 4 acres*

1753: Francis Godolphin bought the land of Seer Green from the Earl of Leicester and had an estate map drawn up. Figure 4 is an extract from this map showing the woods and field pattern over our area of interest. The woods and fields are much as we know them today. Notable though is that the northeast part of modern Hodgemoor Woods is called 'Swilly Wood'. The continuity of the field names, from the 1561 survey indentures through to the 1753 estate map, suggests that the open field system was probably being enclosed at around the same time as the woods were being planted. We can be pretty certain that Swilly Wood on the 1753 map was the *parcel of wood ground* called The Swillie in 1561. Two other adjacent fields here are called Hither Brickhill Field and Further Brickhill Field, indicative of brick related activity in the vicinity (however, these fields are not readily identifiable in the 1561 listings).

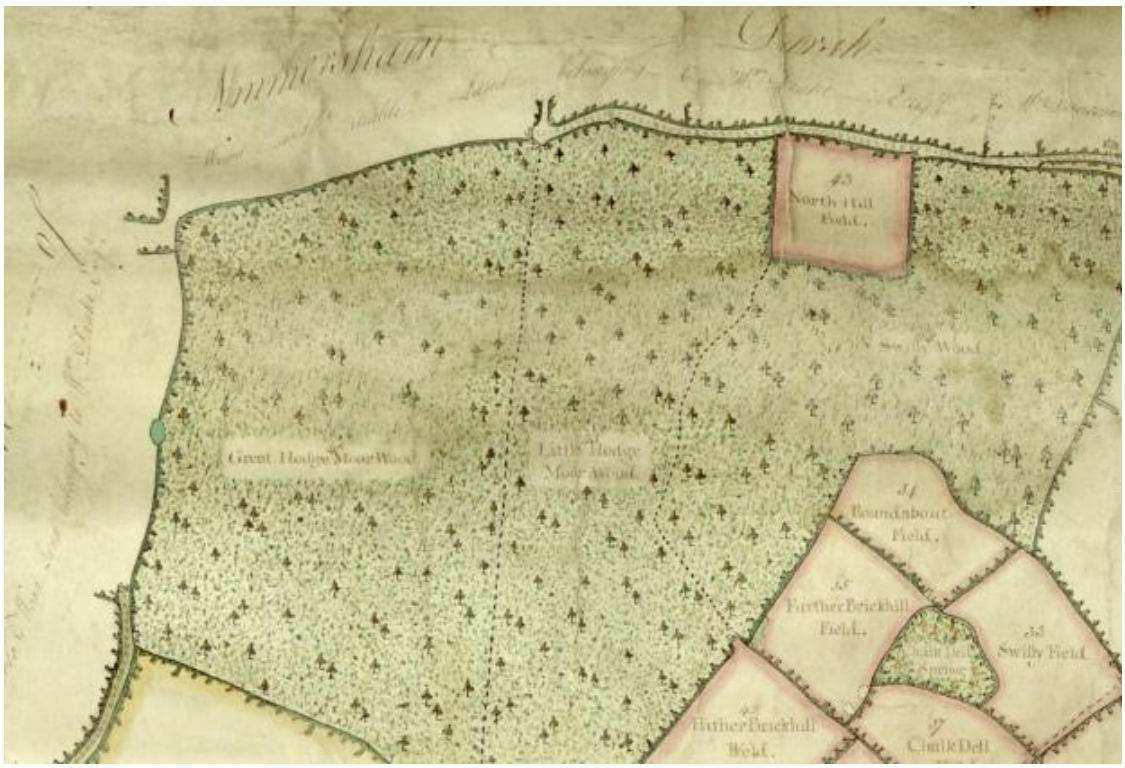


Figure 4: Extract from John Richardson estate map for Francis Godolphin, 1753 (© British Library Board)

1831 / 1841: The next detailed mapping comes with the 1831 Enclosure and 1841 Tithe maps. By this time some of the local names are lost and the woodland area in the northeast is just 'Little Hodgemoor'. Both of these maps show a field pattern more or less identical to the 1753 map, indicating that the enclosure process was completed by the mid-18th century. Although there is clear evidence on the LiDAR for 'old' extraction workings, and some of these are included on the Victorian 1st (1877) and 2nd (1896-1900) Edition Ordnance Survey maps, they have not been included on either the Enclosure or Tithe maps. This suggests that they were not of particular economic importance (and therefore may not have been in operation, or perhaps only intermittently worked) when the area was surveyed – see also Figure 5 for possible corroborative evidence.

19th Century: Census records for Seer Green, between 1841 (the earliest available) and 1911, identify small number of Potters and Brick makers. The *Posse Comitatus* of 1798 (Poss. Com., 1798) lists no persons working in these trades. However, there are no known kilns or brickworks within the village / parish. Farley and Hurman (2015) suggest that these potters were working in Hedgerley Dean (at Andrews Hill, 5km to the south of the village of Seer Green) - both Seer Green and Hedgerley Dean being a part of the civil parish of Farnham Royal until 1901. However, it seems more likely that they would be working in the closer works, in Amersham (Froghall is recorded as having a kiln dating back at least to 1783 and is just 2km to the north) or Beaconsfield (Durrants Heath is recorded as having kilns dating from at least 1805 and is just 2km to the south). Extracted materials from Hodgemoor Woods could possibly have gone to either of these destinations.

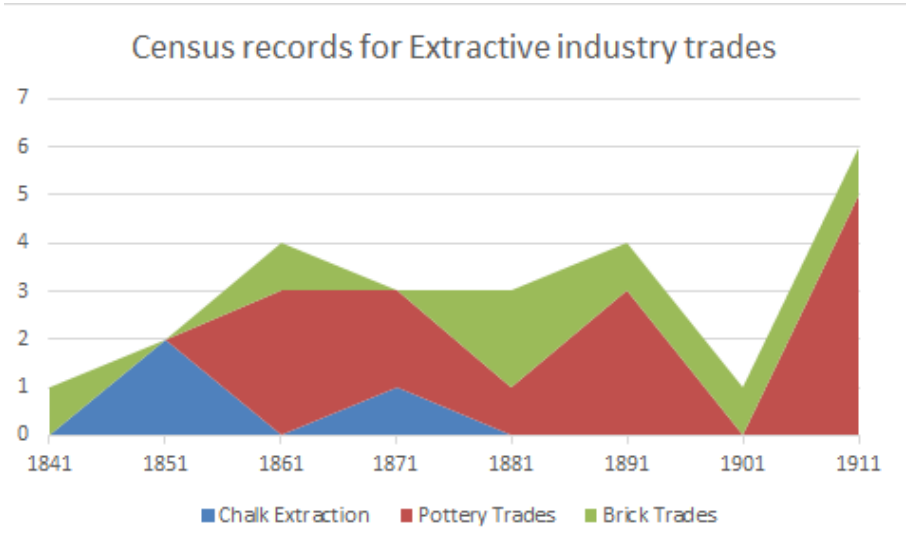


Figure 5: Plot of census records showing numbers of Seer Green residents employed in these extractive and craft industries. These data suggest extractive industries provided very little employment within the village in the early 19th Century and may therefore be inferred to be essentially inactive at that time.

Field observations

20th Century: There is clear evidence of heavy vehicle movement within the woods, presumably as part of the WWII occupation. There are also the remnants of building platforms, evidence for 'modern' enlargement of the spring (K), and some dumping of materials into pits (particularly N). Recent (2022) storm activity has brought down beech trees on the edges of some of the old extraction pits and a crude tree-ring count suggests that these date to around the end of the 19th / start of the 20th century (during their operation, the pits would have been kept clear of encroaching vegetation), effectively dating the end of extraction activity.

Interpretation

The Ridge and Furrow ploughing overlies and post-dates the Roman Road, but other than being Saxon and/or Medieval, it's difficult to date.

Detailed examination of the furrows trending NE-SW across the ephemeral stream that feeds the sinkhole (N) shows that there is probably lineal continuity across the stream, suggesting that the open field was ploughed in continuous strips before the stream developed. Comparison of the LiDAR signature of this indistinct Ridge and Furrow (L), with the much stronger and higher amplitude signature of that at E and F to the southwest (see Figure 2), shows them to be markedly less distinct in the vicinity of the stream. This could suggest that ploughing ceased here well before it ceased in the southwest. The name 'Swillie' / 'Swilly' is suggestive of flowing, eddying, water, and as this name appears on the 1561 indenture it suggests that it must have been a distinctive feature at that time.

There are 16th century brick-built properties in the neighbouring villages of Seer Green and Chalfont St. Giles, so there must have been brick making, and hence clay extraction, in the vicinity at that time. If this sinkhole started as a clay extraction pit, then it would have been a much 'cleaner' feature in its early life and it is easy to imagine water entering it, swirling around and disappearing, as if down a plug-hole! Whilst brick manufacture can tolerate significant

impurities within the raw material, pottery manufacture (for chimney pots, plant pots, domestic ware etc.) requires fairly clean clay. Processing of extracted clay to remove impurities requires large volumes of water. Therefore, it is also plausible that in this upland area, largely devoid of surface water, this water course may have been purposefully exploited, and the extraction may have been seasonal.

An interpretation then is that open field system ploughing was taking place across this area, after the Roman period, probably through Anglo-Saxon and into the high Medieval period. The farmers would have understood the variation in ground conditions and soil types, and recognised that there were clay rich pockets, probably having poor drainage. They may have been prepared to cease the cultivation around these pockets of clay to permit more valuable extraction activity, whilst continuing farming practices across the wider area. Before the formality of the 19th century census', it was quite common for agricultural labour to also be involved in extractive activity.

It is plausible that Reading Formation clay deposits had concentrated here precisely because a long-lived topographic depression existed above a sinkhole in the underlying chalk, perhaps creating a sediment filled 'dissolution pipe' (Maurice *et al*, 2021) which normally would have little surface expression. Suffusion sinkholes can lead to unsupported subsoil subsiding into an underlying cavity. Where the cover material is sandy then associated slumping tends to be gradual, but where it is more cohesive, like clay, then underlying cavities can grow large before sudden collapse.

The presumed extraction of clay from the 'Susie's Loop' sinkhole looks to have created a focus for an ephemeral stream arising at a spring emerging from close to the Westland Green Gravel / Reading Formation boundary. This may then have exacerbated the development of the of the sinkhole.

What we see today, probably had little surface expression until possibly the 13th – 15th centuries. But by the 16th century it was probably a distinctly recognisable landscape feature, deserving of being named, and which continued to develop. Extraction activity appears to have continued in parts of these woods up until about the end of the 19th / early 20th century. And the spring that feeds into the 'Susie's Loop' sinkhole seems to have been enhanced, possibly as part of WWII occupation, which, together with post-war dumping, may have led to acceleration of the erosion of the stream bed but also the 'silting' up of the sinkhole.

Acknowledgements

My thanks to: Adrian Marsh for inspiring this article; Ed Peveler, formerly of the Chilterns Conservation Board, for his guidance on LiDAR interpretation and GIS; and The Seer Green and Jordans Society, and The Chiltern Society, for their support in investigating and documenting the historical maps and the medieval history of Seer Green parish.

References

Cal. Chart., 1258, Calendar of Charter rolls for Henry III, 15th June 1258, Oxford
https://archive.org/details/calendarcharter01cunngoog/page/12/mode/2up

Cal. Close, 1232, Calendar of the Close rolls for Henry III, 28th September 1232, Lambeth
https://archive.org/details/closerollsofreig02grea/page/152/mode/2up

Cal. Pat., 1550, Calendar of Patent Rolls, Edward VI, 17th March 1550
https://babel.hathitrust.org/cgi/pt?id=msu.31293027026396&view=1up&seq=244&skin=2021

Cart. Miss., 1275, Cartulary of Missenden Abbey, Part 2, Entry 329
http://www.bucksrecsoc.org.uk/BRS-VOLUMES/brs-vol-10.pdf

Court Surv., 1561, Court of Survey, held before the Queen's General Surveyor, for the manor of Farnham Royal, 10th March 1561, Buckinghamshire Archives document D/X 609
Domesday Book, 1086 https://hydra.hull.ac.uk/assets/hull:461/content

Farley, M. & B. Hurman, 2015, BUCKINGHAMSHIRE POTS, POTTERS AND POTTERIES, C.1200–1910
http://www.bucksas.org.uk/rob/rob_55_0_161.pdf

Maurice, L., A. R. Farrant, E. Mathewson & T. Atkinson, 2021, Karst hydrogeology of the Chalk and implications for groundwater protection
https://sp.lyellcollection.org/content/early/2021/12/09/SP517-2020-267

Poss. Com., 1798, The Buckinghamshire Posse Commitatus http://www.bucksrecsoc.org.uk/BRS-VOLUMES/brs-vol-22.pdf

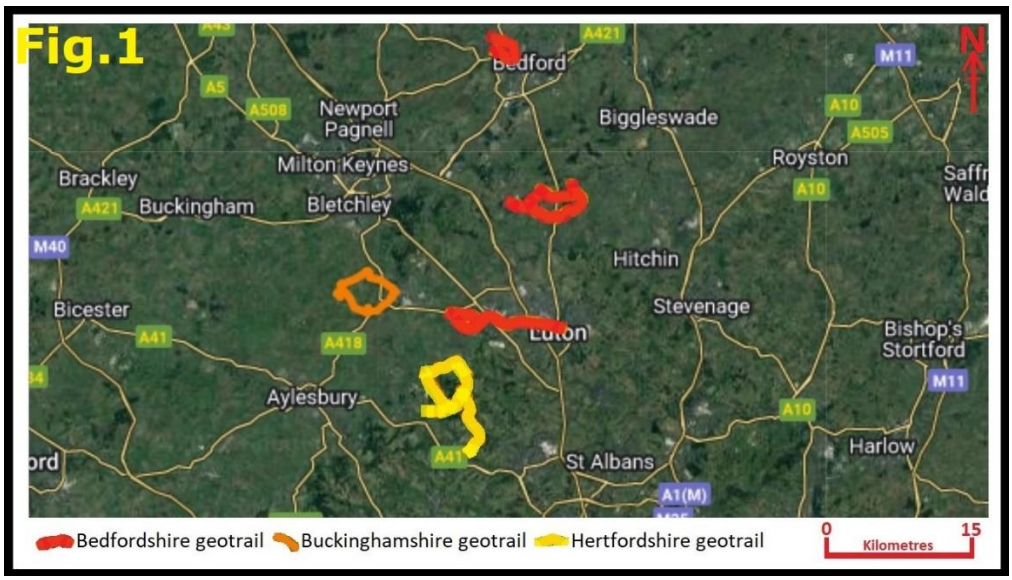
Stead, I.M., and V. Rigby, 1989, *Verulamium*: The King Harry Lane Site, English Heritage, Archaeological Report No. 12

Recycling 'Edwardian' Geological Excursions in Beds, Bucks & Herts.

Dr Tom Hose FGS, May 2022
HCNRG

1. The 'Edwardian period'

For the past five years I have been fortunate to combine my interests in field geology, social and industrial history, railways and cycling in the preparation of cyclists' geotrails based upon past Geologists' Association (GA) excursions for which the literature around some 600 was examined (Hose 2018) and a dozen of their routes explored. The five published (on the 'GeoconservationUK 'website) geotrails [Fig.1] cover the three counties around and readily accessible by bicycle and public transport from my village home just north of Luton.



Because the GA organised a limited programme of (my research has now identified eight with dedicated and another eleven with casual cycling involvement) cycling excursions between 1899 and 1910 the new geotrails' time-frame was established around Edward VII's reign (1901-1910). The 'Edwardian era' strictly applies solely to the years of that king's reign but it can usefully extended to the decades immediately before and afterwards; that 'Edwardian period', from 1890 to 1920, opens in the last decade of Queen Victoria's reign and closes in the immediate aftermath of what contemporary writers dubbed the Great War (1914-1918) in George V's reign (1910-1936).

Within it the first 'bicycle boom', of up to around the early 1900s, was initially embraced by the social elite – Queen Victoria, Edward VII and Sir Arthur Balfour (Prime Minister 1902-1905 and National Cyclists' Union President,) were keen cyclists; thereafter the middle classes up to the Great War were the mainstay of leisure cycling's first heyday. By 1920 bicycles were cheap enough for working class commuting; a middle class minority took up cycle touring.

The three decades of the 'Edwardian period' encompassed major changes in national transport and communication infrastructure together with reforms in politics, education, and welfare; consequently they saw widening book, map, bicycle and camera ownership, much facilitating the exploration and recording of the countryside – particularly around London when coupled with train travel – from which the GA's membership and activities benefited.

2. Excursions and Cycling

The Winchfield to Wokingham excursion (Monckton 1899) of 8thApril, 1899 was the first specifically for cyclists and covered some 15 miles (24.1 km). The distances covered on strictly pedestrian GA excursions, but not travel to and from London, varied between three (4.8 km) and six miles (9.6 km); for distances beyond the latter, typically 15 miles (24.1 km), horse-drawn carriages were taken and commonly referred to, with potential for confusion with mechanical conveyances, as 'drives'. A typical all steel, usually single-geared and 28-inch (71 cm) wheeled, 1890s bicycle weighed a hefty 46 lbs (20.87 kilos); by the late-1900s this had dropped to 28 lbs (12.7 kilos) and three-speed hub gears were common. Modern hybrid bicycles weigh around 25 lbs (11.34 kilos) and typically have 18 gears.

Meanwhile, typical 'Edwardian period' male cyclists' outer clothing [Fig.2A], excepting cycling breeches and knee-length stockings, was similar to that worn by pedestrian excursionists of Norfolk jacket, trousers, and brogues, literally topped off by a cap – sometimes sportingly worn by cyclists with the peak facing backwards. Female cyclists could wear 'rational dress' [Fig.2B] of cycling bloomers and waistcoat. Edwardian clothing manufactured from natural fibres (such as cotton, linen and wool) was heavier and loose-fitted compared with modern lightweight (mainly artificial-fibre) clothing such as fleece and tights with a beanie or helmet.

Cycling enabled distances to be conveniently covered at a cost and time saving unimagined before the 1880s; a fit cyclist could cover much more ground than a horse-carriage that was good for just 15 miles [24.1 km], the distance covered by the 1899 to Winchfield to Wokingham (the GA's first cycling) excursion, and the 1905 Flitwick and Silsoe excursion. For the former *"The route taken and the distance to be traversed will to some extent depend on the state of the roads."* The contemporary roads' state, most rural being gravel and dirt tracks, was weather dependent; the weather was insufficiently inclement to be mentioned in the excursion's report, so it was probably a route assessment that saw only five cyclists taking part. The Excursion Committee Secretary's report for 1899, pasted into the GA Council Minutes book, records the other 1899 cycling excursions were attended by just three and nine members. Having cycled some of the potential new geotrail routes on a single-speed bicycle I can attest to the required fitness of the early cycling excursionists! Cyclists could reduce or augment distances travelled by using trains.

3. Railways and Excursions

During the 'Edwardian period' the railway network was at its greatest extent and the GA's preferred means of getting members (and their bicycles) to and from excursion areas. The GA regularly availed itself of the northbound railway routes from London for excursions into Beds, Bucks, and Herts. As now three mainlines, although some of their branch-lines were torn up in the 1960s, ran across the counties; the: Euston to Birmingham, St. Pancras to Derby, and Kings Cross to Newcastle. The first mainline was ideal for excursions examining the Chalk strata of the Chilterns hills, especially around Tring, the Dunstable Downs, and Totternhoe as well as the Lower Greensand strata around Leighton Buzzard. The second mainline was ideal for excursions to central (Ampthill and Flitwick) and northern Beds (Bedford and Clapham)

examining various Jurassic and Cretaceous (including Lower Greensand) strata. The third mainline was ideal for excursions to eastern Beds examining the Ampthill Clay, Oxford Clay and Lower Greensand strata (particularly around Sandy) and to north Herts (Hitchin, Letchworth, Stevenage and Welwyn) for the Chalk and various Quaternary strata.

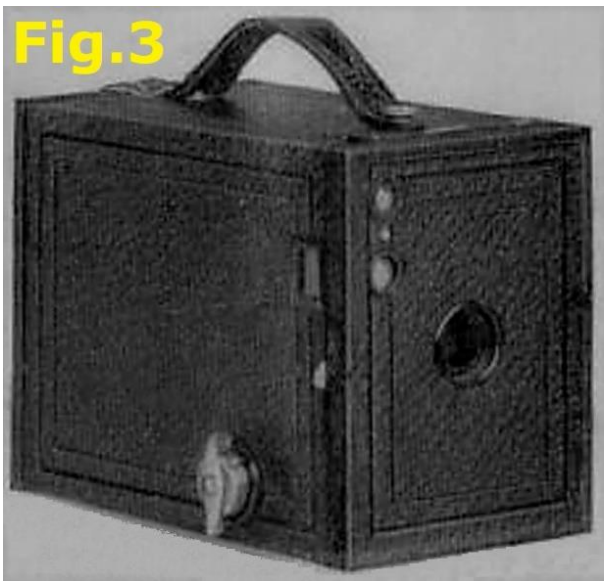
Railway journeys also provided some landscape or civil engineering interest for excursionists; for example, on the 1905 Flitwick and Silsoe excursion's outward journey *"...the whole of the Upper Cretaceous strata...was passed through, and in the cuttings...between Chiltern Green and Charlton the three hard beds in the Chalk...were seen. On the plain beyond, the Gault was traversed, and in approaching Flitwick the outcrop of a formation better withstanding denudation – the Lower Greensand – became evident from the rising ground."* (Hopkinson 1905, 110). Especially favoured were localities near stations around the hills of the Chilterns and the Greensand Ridge and the various clay plains' workings. Indeed, at that time as railway "*...facilities improved the Officers of the Association have been quick to take advantage of them...and nowadays quite a long distance can be traversed to see important sections on a Saturday afternoon or on a public holiday...the Association has held no less than 524 excursions and 241 visits to Museums, the largest number of excursions being 26 in 1900 and 1908, and of visits 14 in 1874."* (Watts 1909, 131). The shift from animal to mechanised horse-power transportation for excursionists testifies to the UK's rapid shift in transport infrastructure over three decades.

4. Excursion Telegraphy and Photography

Similarly, changes in telecommunications and photography occurred. Speedy distant communication depended upon landline-based telegraphy. Initially, excursionists read 'telegrams', teleprinter paper tape text pasted onto a sheet delivered by uniformed telegraph boys by bicycle; for example, the June 1905 Chilterns excursionists were handed at Little Kimble railway station *"...a telegram to say that the Rev. E. C. Spicer, F.G.S. who was to have acted as Director, was unable to come."* (Woodward & Herries 1905, 147).

Telephones, available from the 1880s, were eventually installed in Bedford and Luton in 1896; telephone booths – not the iconic red kiosks – were introduced in the early 1900s and were commonly inside shops and public places (such as railway stations, hotels and inns).

Meantime, after the1880s, fragile glass negatives were replaced by celluloid film spooled onto a paper roll for use in 'box' cameras; epitomised by the [Fig.3] Kodak Brownie No.2 (manufactured 1901-1935), taking eight 2¼ x 3¼ inches (5.7 x 8.25 cm) negatives, they helped photography's mass uptake. The 1899 AGM report recorded that the GA's Council *"...fully recognise the value of photographs of geological interest taken by members during excursions. Such photographs form permanent and unbiased records of geological features which in many cases are liable in the course of time to become altered or obscured."* and one such, now in the Carreck Archive, has been reproduced in the new 'Soulberry, Stewkley & Wing' geotrail guide publication.



5. Excursion Literature

The GA advertised excursions, most of which were of half- or full- day duration on Saturdays, in the *Monthly Circular of the Geologists' Association* (*MCGA*) and published reports on them in the *Proceedings of the Geologists' Association* (*PGA).*

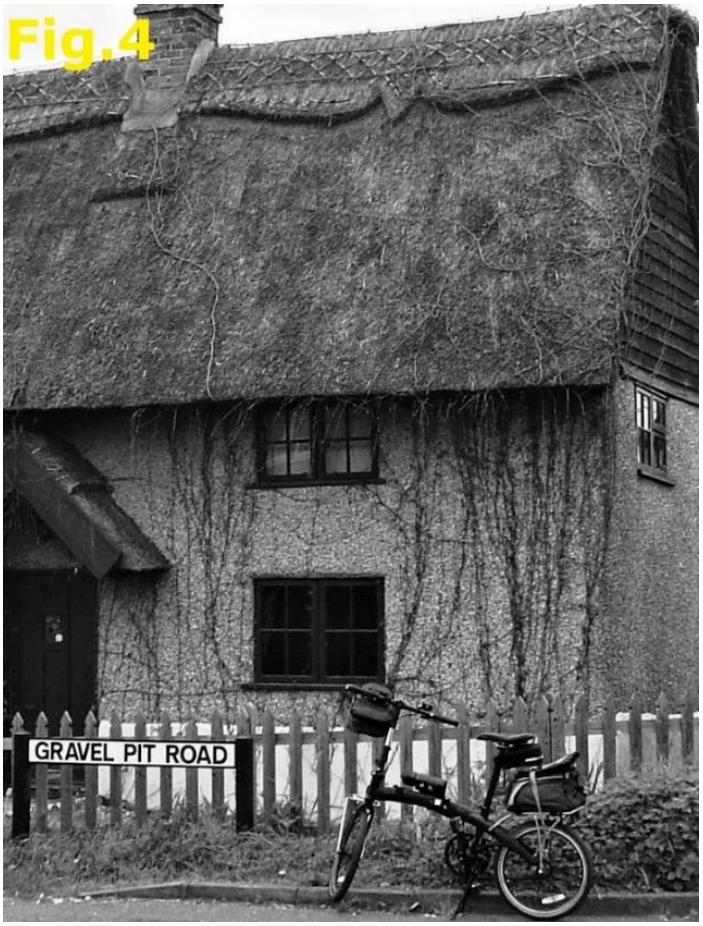
The notices covered transport arrangements (what train(s) to catch and any cheap tickets), refreshment arrangements and a route outline with what might be seen. Whilst most *MCGA* excursion information was textual, including references to be consulted in advance, geological cross-sections (such as for the July 1885 Ampthill and Bedford excursion) and/or stratigraphical columns were sometimes incorporated; likewise, topographical, as for the 1905 Flitwick and Silsoe excursion, and sketch maps were sometimes included.

Sometimes, as for the June 1900 Purley excursion, cyclists are only mentioned in the *MCGA* notice. The reports generally do not indicate how many cyclists joined excursions; for example, the June 1901 Cheam, Ewell and Epsom excursion was *"...augmented by the cycling contingent"* (Stebbing 1901, 167) and the 1904 Farnham excursion members *"...proceeded by carriage, motor, or cycle..."* (Monckton 1904, 409). The reports repeated the *MCGAs* information supplemented with additional illustrations and accounts of the day's observations. They also included any discussion and weather notes. For example, on the 1905 Flitwick and Silsoe excursion *"...the Cycling Director gave some account of this mythical [Pulloxhill gold] mine..."* (Hopkinson 1905, 112) and its weather *"...was perfect, and the country, which in the neighbourhood of Clophill is very pretty, had the freshness of the spring with a foretaste of the leafiness of the summer."* (Hopkinson 1905, 113); its notice gave travel costs as *"Return Tickets, 4s2d [around £22-50p today]; bicycles Is [around £5-00 today] each way, to Flitwick."* and meal costs as *"A meat tea (Is 6d) [around £8-40 today]..."*. Its rail fares, although bicycles are now free, and food prices are relatively close to those paid today.

6. Past and New Geotrails

Significantly for the new geotrails *"...often regarded as ephemeral publications and quickly discarded... [MCGA notices] are a fruitful source of information when planning a field trip...they suggest programmes which can be carried out in a day or a half day...with references to previous work*

on the areas..." (Himus, 1954, 8). Further, they also provide some human interest background information for the new geotrails. During the 'Edwardian Period' *"London geologists then had fine sections at their doors... It would be a long list that would include all..."* (Kennard 1947, 274). Re-examination of excursion publications provides information on historic geosite availability and accessibility, indirectly providing a geoconservation benchmark; for example, 60% of the 1905 Flitwick to Silsoe excursion geosites are extant despite the two named localities and surrounding villages being substantially developed for housing from the 1970s onwards. Their 'Edwardian period' geosites had survived almost unscathed for at least 50 years but were then considered eyesores and ideal landfill sites. Many literally underlie or enfold the urban expansion; just occasionally their locations are recorded in modern street (such as Gravel Pit Road in Flitwick [Fig.4]) and house names. Both extant and lost geosites are included in the new geotrails.



All the published geotrails have a PDF guide publication (downloadable from the 'GeoconservationUK' website); these A4 trifolded double-sided leaflets can be printed and viewed on tablets and smartphones. Individual guide publications display varied content and typography because they were originally designed to assess user attractiveness and communicative efficacy through workshops and user feedback. The first produced, 'Flitwick and Silsoe' geotrail, aided by its report's (Hopkinson 1905) inclusion of a map, almost exactly uses the 1905 cycling excursionists' route. Its guide publication employs a mix of modern photo-images and 1900s-1920s postcard images arranged around a map. The 'Luton to Stanbridgeford' geotrail encompasses the routes (now partly a guided busway and wholly a dedicated cycleway) of the railway that carried the excursionists from Luton to Dunstable and Stanbridgeford, together with parts of the 1881, 1889, 1894 and 1895 pedestrian (none were

ridden by Victorian cyclists) excursion routes. Its guide publication is highly descriptive of its geosites with photo-images (such as of Totternhoe Castle [Fig.5]) that mimic the vibrant style of John Hinde postcards of the 1960s and 1970s.

The 'Bedford to Bromham' geotrail follows the original (Woodward 1905) 27th May, 1905 excursion route which as suggested in its notice could have been cycled, although the excursionists rode in carriages and walked. Its guide publication has, like that for 'Flitwick and Silsoe' a strong social history content asking users to imagine what life and leisure were like in the 'Edwardian period', but modern photo-images illustrate the geosites.

The 'Soulberry, Stewkley & Wing' geotrail recreates a route originally followed by carriages on 11th May, 1901 (Davies 1901). Its guide publication is illustrated by modern and historic photo-images, including one from the Carreck Archive, and a coloured engraving of Stewkley church [Fig.6]; much social and industrial history, especially about brick-making, is included in its text. The 'Tring to Berkhamsted' geotrail mainly follows the route of the 23rd May, 1903 Dunstable Downs dedicated cycling excursion (Hopkinson 1903).

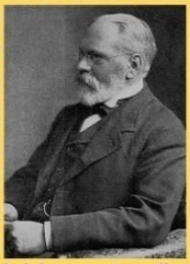
Its guide publication is illustrated with Edwardian and modern sepia and black & white monochrome photo-images – the only coloured illustrations are a map and a stratigraphic column. Its text with contemporary quotes, like the 'Bedford to Bromham' geotrail, describes the route and its geosites; on the first page [Fig.7] is mention of a fatal accident at Tring Station. The inclusion of such local and social history material adds human interest to better engage with general rather than purely geology-focussed cycling users.

Fig.7

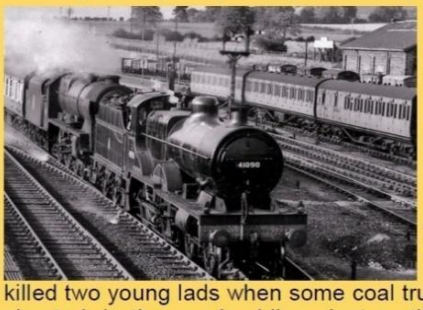
TRING to BERKHAMSTED
Cyclist's GEOTRAIL

RECREATING the DUNSTABLE DOWNS GEOLOGY CYCLING EXCURSION of 23rd MAY, 1903.

WELCOME to this recreation of the route of an Edwardian Geologists' Association geology excursion; one of almost twenty such excursions especially organised between 1899 and 1910 for cyclists. It's mainly presented in the *"words"* of the original published report - updated with background information on the area's geology, railways, and local history - in the *Proceedings of the Geologists' Association*. It was originally led by the eminent Hertfordshire naturalist John Hopkinson (1844-1919), and cycled on a day when *"The weather was perfect, and the route as pretty a one as could well be taken within easy distance of London."* It started from the…



1. Tring (Midland) Railway Station:- When having left London Euston on the 1.45 pm train, the cyclists assembled *"…at 3 o'clock, [in] the party [of 15], which included several members of the Hertfordshire Natural History Society, proceeded (right and, after passing a T-junction on the left, uphill) to the picturesque village of Aldbury… in a pretty valley cut out of the Chalk…"*



Tring Station, on the London to Birmingham - the UK's first ever mainline - railway was opened in 1837; in its first 120 years it only saw *(as seen in the 1950s photo)* steam trains on its tracks. In June 1908 an accident killed two young lads when some coal trucks were being loose shunted, in the goods siding. Just north of the station is the 12-metre deep and 4-kilometre long Tring Cutting – 1.1 million cubic metres of clay and chalk was entirely dug out by hand to create it in the late 1830s.

7. Closing Comments

Limited user feedback across all the geotrail publications has been positive. The attractiveness of some, such as that for the 'Luton to Stanbridgeford' geotrail, is greater than others. Views are mixed on the 'Edwardian period' lifestyle information. It is not yet possible to determine the most communicatively competent approach. Several geotrails – such as for St. Albans, Hitchin and the Kent coalfield – are in preparation. Ideally, especially for areas away from the three counties, some of the new ones will be joint ventures with individuals and local geological/geoconservation groups. Anyway, in this second, almost post-pandemic, cycling heyday why not download and try out the published geotrails? Two of them ('Bedford to Bromham' and 'Luton to Stanbridgeford') could be easily walked in their entirety; the others could be undertaken as pleasant drives. After all, it is to be hoped *"...Geology will never lose its recreative aspect; that it will never cease even to be an interesting hobby to many a toiler in town and country...however humbly it be studied, if it confers one particle of happiness on any individual..."* (Woodward 1894, 249).

References:

Davies, AM (1901) Excursion to Leighton Buzzard, Wing and Stewkley, May 11th 1901. *Proceedings of the Geologists' Association* **17** (3), 139-141.

Himus, GW (1954) The Geologists' Association and its Field Meetings. *Proceedings of the Geologist's Association* **65** (1), 1-10.

Hopkinson, J (1903) Cycling excursion to the Dunstable Downs. *Proceedings of the Geologist's Association* **18**(3), 170-73.

Hopkinson, J (1905) Excursion to Flitwick and Silsoe. *Proceedings of the Geologist's Association* **65** (1), 1-10.

Hose, TA (2018) Awheel in Edwardian Bedfordshire: A 1905 Geologists' Association cycling excursion revisited and contextualised. *Proceedings of the Geologists' Association* **129** (6, 748-769.

Kennard, AS (1947) Fifty and One Years of the Geologists' Association. *Proceedings of the Geologist's Association* **58** (4), 271-293.

Monckton, HW (1899) Cycling excursion from Winchfield to Wokingham. Saturday, April 8th, 1899. *Proceedings of the Geologists' Association* **16** (3), 153-55.

Monckton, HW (1904) Excursions to the Farnham Gravel Pits on April 23rd, and to the brickfields and gravel pits at Dawley, between Hayes and West Drayton on April 30th, 1904. *Proceedings of the Geologists' Association* **18** (8), 409–414.

Stebbing, WPD (1901) Cheam, Ewell and Epsom excursion. *Proceedings of the Geologist's Association* **17** (4), 167-169.

Woodward, HB (1894) Geology in the Field and in the Study. (Being the Presidential Address delivered 2nd February 1894). *Proceedings of the Geologists' Association* **13** (7), 247-273.

Woodward, HB & Herries, RS (1905) Excursion to the Chilterns, Saturday, June 3rd 1905. *Proceedings of the Geologists' Association* **19** (3), 147-149.

Geological Survey Ireland – a newcomer's perspective

Adam Dawson FGS, May 2022
HCNRG

All photos by the author

Figure 1 : The Geological Survey Ireland "Down to Earth" exhibition, celebrating the Survey's 175th anniversary. The displays are fully bilingual - Irish and English

Introduction

Relocating to a new country is undoubtedly challenging and at times sheer hard work. But whatever your reasons for moving, you're presented with the chance to meet new people, visit new places, and learn new things. We've certainly been through all these experiences – and more – since coming to Ireland from the UK last year. Right now we're living just to the north of Dublin and aside from the intrinsic interest of the local geology, being close to the capital means that all the country's main institutions – geological and otherwise – are right on our doorstep.

Ireland does many things well, and its numerous museums and galleries must surely rank among some of the best in Europe. Dublin is, of course, well provided with these institutions and one in particular should catch the eye of any visiting geologist. Out to the west of the City Centre – right opposite the Guinness brewery in fact – is the Collins Barracks building. This magnificent 18th century structure, faced with Wicklow granite and roofed in Welsh slate, was discontinued from military use in 1997 and passed into the keeping of the Office of Public Works. Today it hosts the *National Museum of Ireland – Decorative Arts and History*, which is itself excellent (and free to enter).

Figure 2 : The Collins Barracks, Dublin. Home to the National Museum of Ireland – Decorative Arts and History, and the Geological Survey Ireland exhibition

But why might a geologist be interested in any of this? The reason is simple. From September last year until around the end of 2022, the Barracks is not only hosting the Decorative Arts

museum, but also an exhibition "*Down to Earth - Exploring Ireland's Geology*" laid on by Geological Survey Ireland, which commemorated its 175th anniversary in 2020 (albeit the event was delayed slightly by the pandemic), and the National Museum of Ireland.

The exhibition is interesting – not only to geologists but also more widely – because it offers an insight into the extraordinary diversity of the geology in this small island. But perhaps more than that, it is also a useful reminder that Ireland was in fact one of the first countries in the world to be geologically mapped, and to this day remains one the best studied, with pioneering and world-leading geological survey work going on every day.

History of Geological Survey Ireland

The modern Geological Survey Ireland is a division of the Department of the Environment, Climate and Communications, and has around a hundred staff. But the exhibition explains how its roots lie in the 1820s when the Ordnance Survey started mapping the landscape of Ireland, and then in 1838 when Sir Richard Griffith, a mining engineer and chairman of the Board of Works, published the first geological map. It came just 20 years after the publication of William Smith's geological map of England, Wales and (parts of) Scotland.

Figure 3 : You're greeted by a huge walk-on geological map of Ireland as soon as you enter the exhibition. There well informed and helpful GSI staff on hand, too, to help guide you through the exhibition and answer questions. It's excellently done.

Shortly afterwards, in 1845, the Geological Survey of the United Kingdom was established. As this was almost a century before Irish Independence in 1922, it also had responsibility for Ireland alongside England, Wales and Scotland. The first director of the (UK) Geological Survey was Henry Thomas de la Beche and at the same time Henry James was appointed the Local Superintendent of the Geological Survey of Ireland. The Survey's first task in Ireland was to produce a more detailed six-inch (1:10,560) scale geological map of the whole island

although the process wasn't aided by the Geological Survey Director's refusal to pay for horses "in case the surveyors lost the use of their legs".

Figure 4 One of the first geological maps of Ireland. The early editions were hand-coloured.

The prime purposes of these early geological surveys of Ireland were to establish land valuations for taxation purposes, and to identify potential coal and mineral reserves. But often fossil data, as well as bedrock and drift mapping, was collected to try and establish relative ages of the geology. At the time, these six-inch maps were amongst the most detailed, accurate, and comprehensive in the world which is one of the reasons why Ireland has been able to develop and retain its position as one of the world's best geologically understood regions.

The survey work was completed and consolidated into 205 one-inch (1:63,360) maps which were published in 1890. These original maps really were works of art – printed from blocks of finely grained limestone, etched with mapping detail in negative relief.

Moving towards the modern day, the Geological Survey was established in its own right after Independence and was swift to adopt new technologies as they became available. In the 1980s and 90s, Geological Survey Ireland was one of the first geological institutions in the world to adopt digital mapping, publishing its first digitally-produced map (of North County Mayo) in 1992.

Current priorities

Considering its relatively small size, the Geological Survey Ireland today carries offers a surprisingly wide range of services to the geological and public communities. Aside from describing ongoing activities such as supporting seismic event monitoring (including quarry

blasting) and routine mapping, the exhibition focuses on three areas of their work where the Survey has established a unique or world-leading position.

First is the surveying and monitoring of groundwater. Ireland gets an unusually large proportion – about a third – of its drinking water from groundwater. This water is generally very clean, having been purified through layers of rock. However, because a sizeable proportion of Ireland is covered in karstified limestone, in these areas surface contamination can travel quickly into the groundwater, unfiltered, through this highly permeable rock. Pollution from farms in one county can end up contaminating drinking water two or more counties away – a problem which creates the necessity for careful tracing to understand the systems and enhance groundwater protection.

The second priority is "Tellus" – a massive, detailed project to gather geochemical and geophysical data for the rocks, soils and water of the whole of the island of Ireland (it was in fact started with the Geological Survey of Northern Ireland). A combination of aerial geophysical surveying and ground-based geochemical sampling is being used to compile a database, which is already finding application in mineral exploration, in enhancing agricultural productivity and in environmental management. It's about three-quarters finished and those exploration geologists who have used it attest to the excellence of the data. The Geological Survey Ireland's priority is to secure the resources that will be needed to complete it.

Figure 5 : Tellus - a huge project to map the geochemistry of the whole of Ireland down to an extremely detailed level

And the final big priority is the INFOMAR programme to map the whole of Ireland's seabed as far as the edge of the continental shelf – an area ten times as big as the land of the country of Ireland itself. The programme is jointly managed and run by Geological Survey Ireland and the Marine Institute. The data are some of the most detailed in the world, and are already proving useful in, among other things, the siting of offshore wind farms, and for monitoring the effects of climate change on coasts.

Figure 6 : Guests of all ages enjoy the visit to the virtual cabin of one of the INFOMAR marine survey vessels, impressively mocked-up as part of the exhibition

Less technically-minded visitors to the exhibition will enjoy the displays of some of Ireland's economically important rocks and minerals, and the explanation of how geologically-derived materials make their way into almost every aspect of our day to day lives – from washing powder to mobile phones, from jewellery to foodstuffs. It seems to be a great way to encourage budding Irish geologists to take an interest in their country – and maybe even to consider a geological career one day.

In this context, it seems to come as a bit of a revelation to some visitors to learn that one of Europe's biggest zinc mines is situated just up the road from Dublin – in Navan. In fact, the Boliden Tara mine is so well landscaped that large numbers of the people who live in the nearby town don't even know how big it is – most of the workings, which extend a kilometre underground – are completely invisible from the surface. More recently, a further deposit ("Tara Deep") has been identified at a depth of up to 1,900m, and is slated for future development. An excellent example of mining bringing economic benefit to the country while minimising the environmental impact.

Figure 7 : Daily freight train, passing through Donabate station with zinc ore from the Tara mine at Navan, heading for export via the Alexandra Dock in Dublin

Exploring Ireland's geology

If you live in Ireland, and even if you haven't been to the exhibition, it's actually quite hard not to be impressed by the rich diversity of this country's geological heritage. Taking the east coast near Dublin as an example – to the north, the Fingal group of Lower Carboniferous limestones are well exposed, with fine examples of fossilised coral (*Lithostrotion*) and brachiopods easily visible at low tide in the beds near Malahide. To the south of the capital lie the Wicklow Mountains, shaped by northwest Europe's largest granitic batholith. This has long been a source of building materials – the outcrop at Dalkey being extensively quarried in the past to provide rock for coastal defences and harbour walls around Dublin port, for paving stones, and for the construction of the Basilica in St John's, Newfoundland.

Figure 8 Precariously-perched glacial erratic balanced on the Karst of the Burren limestone

Heading further west, the karstic limestone outcrop in County Clare is world renowned and simply astonishing, as are the Carboniferous sandstones and shales that make up the impressive Cliffs of Moher, a little further south.

But what might actually matter more to Ireland in the longer term could be the mineral assets that lie hidden from sight below ground. Gold, lead, nickel and copper deposits have been identified and further exploration may reveal

commercially viable prospects. Industrial materials including gypsum and fireclays, as well as granites and limestones, are also of interest.

So it seems likely that there is a great potential wealth under Ireland's feet. Perhaps today's visitors to the Down to Earth exhibition may become the geologists of the future who will unlock it, using the world leading tools that the Survey itself has developed over the last one and three-quarter centuries.

Find out more -

Down to Earth – Exploring Ireland's Geology:
https://www.museum.ie/en-IE/Museums/Decorative-Arts-History/Exhibitions/Down-to-Earth

Geological Survey Ireland:
https://www.gsi.ie/en-ie/Pages/default.aspx

Irish Geological Association:
https://geology.ie/

Geological excursions in the Buda Hills, Hungary, July 2021

Karoly Pesztranszki FGS, May 2022
HCNRG

After a long period without being able to take a holiday abroad due to Covid-19, finally I was able to travel to Hungary in July 2021 to visit my family and friends. Whenever I travel to Hungary, I try to seize the opportunity to take part in lectures or geological field trips so that I am able to develop an appreciation for the local geology, and this year was no exception. After a rather long car drive with my family from London to Budapest I joined a geological field trip on 26th July 2021, led by an Associate Professor from the ELTE Department of Geology. The aim of the field trip was to introduce the participants to the geology of Rózsadomb[a] (Rose Hill) and its vicinity.

Rózsadomb is located within the Buda Hills (Figure 1) which in turn is located in the northeastern part of the Transdanubian Range. It is bounded by the Pilisvörösvár Basin to the north, the Zsámbék Basin to the west and the Budaörs Fault to the south. Its eastern boundary is marked by the east-west trending Danube Basin with the Pest Plain beyond. The central massif of the Buda Hills comprises Middle and Upper Triassic dolomites and limestones up to ca. 1500 – 1800m thick[1] (Figure 2).

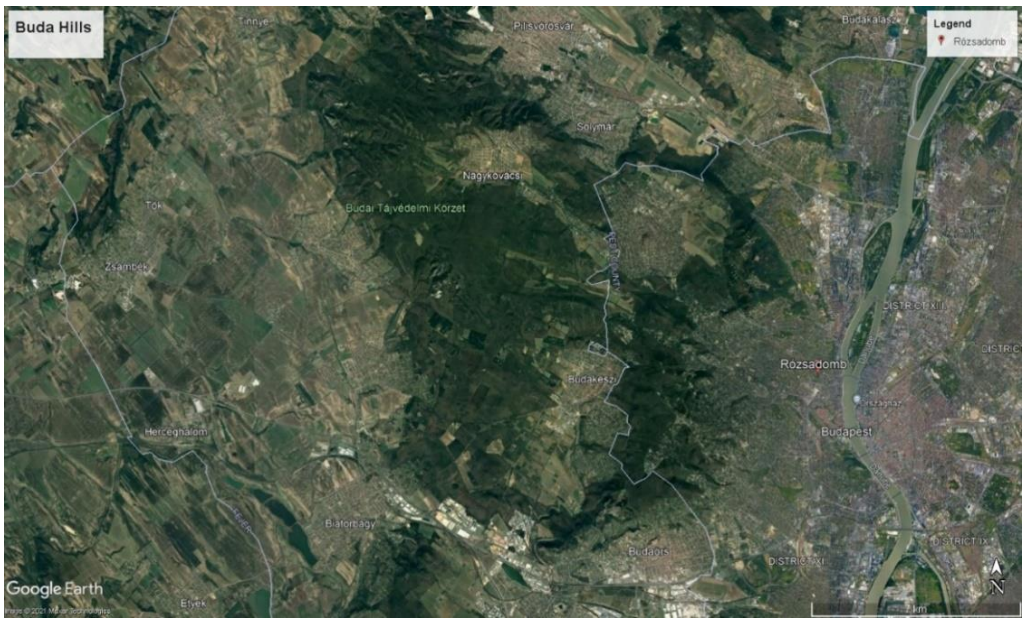


Figure 1. The area of the Buda Hills (west of River Danube) and Rózsadomb (Google Maps 2021)
[a] – Located within the Buda Hills, Rózsadomb is part of the 2nd district of Budapest.

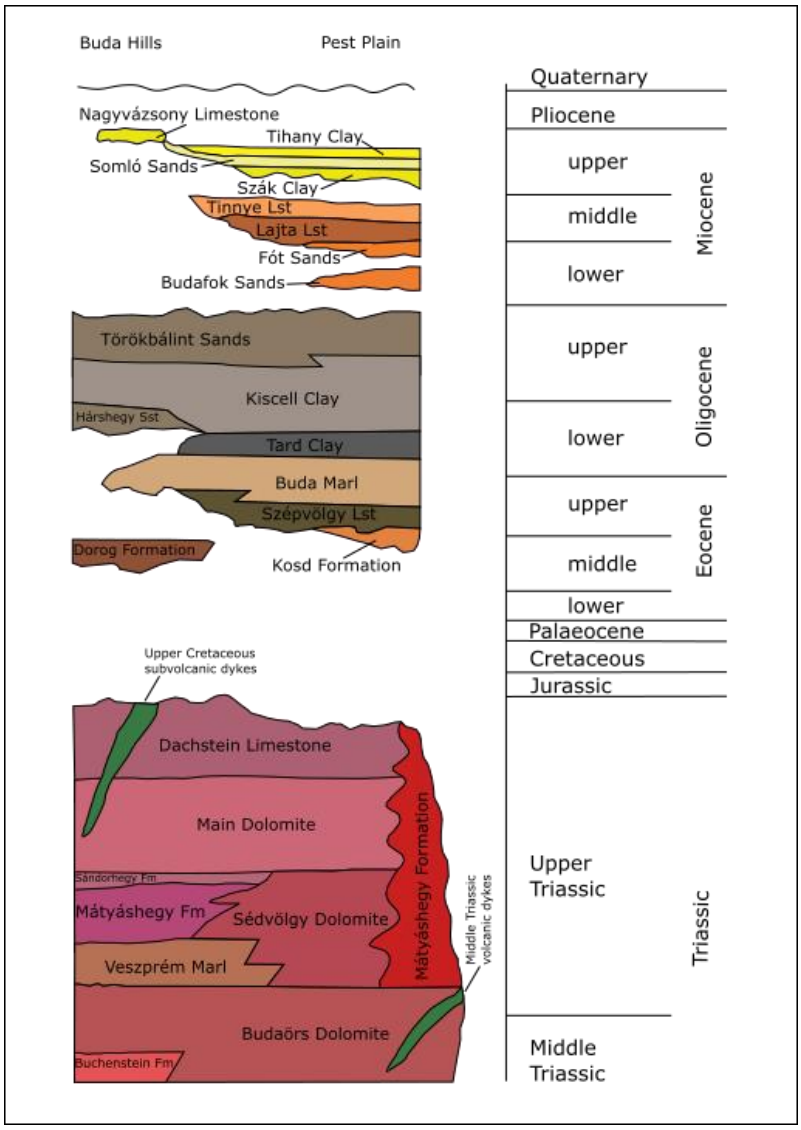


Figure 2. The stratigraphic column of the Buda Hills (after Esteban et al. 2009).

On the day of the field trip the skies were clear with temperatures forecasted to be more than 30 °C and so I decided to carry a rather heavy rucksack packed with bottles of water to try to stay hydrated.

During our first stop we visited an outcrop and type section of the Eocene-Oligocene Buda Marl located on Pusztaszeri Street at the eastern foot of the Szemlő Hill (Photo 1 & 2). During the Mid-Eocene transgression, the successions of the Dorog and then the Kosd Formations were deposited. As the sea-level rose further, at first shallow-marine deposits, such as the Szépvölgy Limestone, were deposited followed by the formation of the Buda Marl in the deeper marine environment with the latter featuring fossil rich (Bryozoans) layers in its basal sections [2].

Photo 1. shows the outcrop of the Buda Marl at 5. Pusztaszeri Street (Photo by K Pesztranszki).

Photo 2. shows the outcrop of the Buda Marl at 5. Pusztaszeri Street (Photo by K Pesztranszki).

Our second stop was at the Szemlő Hill Cave. As the outside temperatures soared above 30 °C, the cooler temperature within the cave combined with some humidity felt quite pleasant after the heat outside. The Szemlő Hill Cave was first discovered in 1930 and then opened to the public in 1986. It welcomes visitors throughout the year and the basic tour takes about 40 minutes to complete.

The Szemlő Hill Cave, which was formed in the Eocene Szépvölgy Limestone, is the result of dissolution along two NE-SW trending tectonic crevices. It is part of the more than 30km long Pál-völgy (Pál Valley) cave system and is dubbed as *'Budapest's underground flower garden'*. It earned its nickname from the numerous calcitic botryoidal stalactites, called either *'peastones'* or in cases where the spherules are not separated and take on a massive form *'cave cauliflower'*[2], that are visible in the sides and roof in the lower parts of the cave (Photo 3 & 4). During our tour we also observed accumulated calcite crystal lamellae, up to a few cm in thickness, called *'cave rafts'.* These formed as the calcite precipitated from the supersaturated waters (due to the degassing of carbon dioxide) of the historic underground lakes (Photo 5). The precipitation process occurred at the surface of the warm water lakes that used to fill the caves. At first, a thin calcareous film forms at the surface which later settles and then accumulates at the bottom. These processes can still be observed in the springs of the Gellért Hill or in the János Molnár Cave [3].

Once the tour is completed, there is a small 3D cinema at the entrance of the Szemlő Hill Cave where the visitors can learn about the history of the Pál-völgy Cave System and the painstaking work that is being undertaken by the cavers and scientists alike to better understand their structure, spatial extent, geology and the processes by which they were formed.

Photo 3. shows the characteristic *'peastone'* stalactites in the Szemlő Hill Cave (Photo by K Pesztranszki).

Photo 4. shows the *'cave cauliflowers'* in the roof and sides of the Szemlő Hill Cave (Photo by K Pesztranszki).

Photo 5. shows the accumulated calcite layers 'cave raft' in the sidewall of the Szemlő Hill Cave (Photo by K Pesztranszki).

After our visit to the Szemlő Hill Cave and a brief lunch, we took another walk to the nearby Small Mátyás Hill where we visited outcrops of the Oligocene Kiscell Clay and the Pleistocene freshwater limestones. The high porosity of the near 500,000 years old limestone is attributed to the carbonates that precipitated around the remains of aquatic plants. As the organic materials decomposed, they left the porous limestone structure behind (Photo 6).

Photo 6. shows the porous structure of the Pleistocene freshwater limestone (Photo taken by K Pesztranszki).

At the end of the day our field trip concluded with visits to the disused eastern and southeastern quarries of the Mátyás Hill (Photo 7) where we observed outcrops of the Mátyáshegy Limestone (cherty limestone) and looked for the fossilised remains of foraminifera, echinoids and bivalves.

Photo 7. shows the disused eastern quarry of the Mátyás Hill.

References:

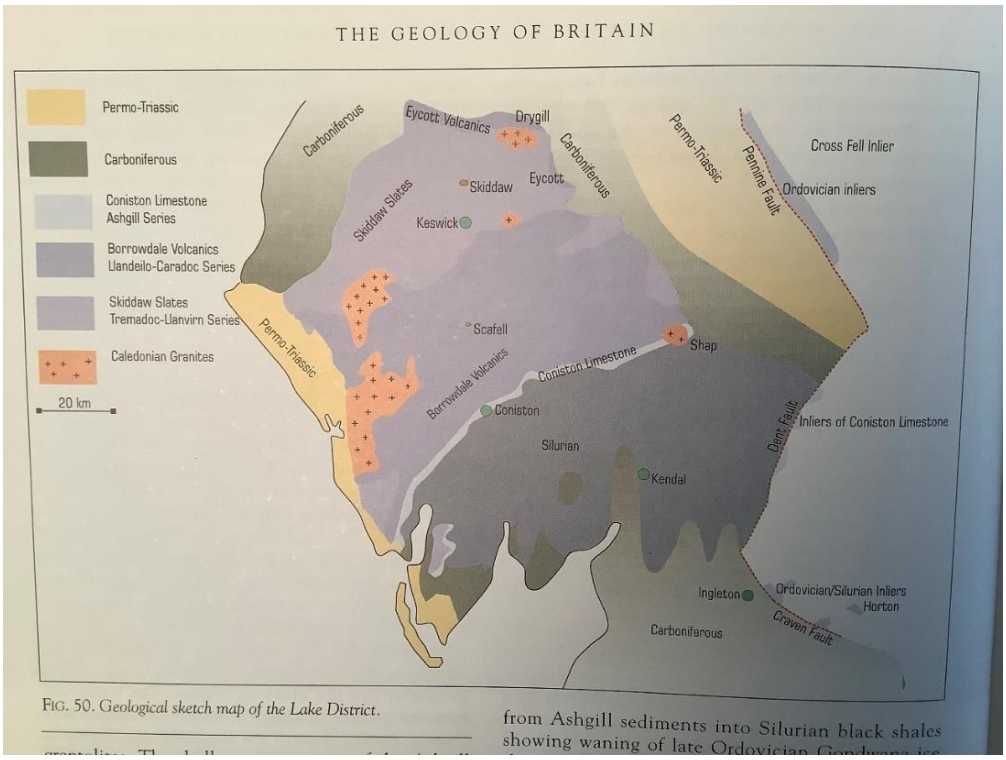
[1] – Esteban M., Budai T., Juhász E., Lapointe P. (2009) Alterations of Triassic carbonates in the Buda Mountains – a hydrothermal model. *Central European Geology*. **52 (1)**, pp. 1-29

[2] – Gyalog L., Maros Gy., Pelikán P. (ed.) (2016) Budapest Geokalauza (Budapest Geoguide), Geological and Geophysical Institute of Hungary

[3] – Leél-Őssy Sz., Virág M. (2018) Developments in the speleology of the Buda Hills in the last two decades (with a special focus on the Rózsadomb and its surroundings) Földtani Közlöny. **184 (1)**, pp. 45-74

First trip out of Lockdown, or (after Lockdown) The Lake District field trip in pictures, September 2021

Doris Southam FGS, May 2022
HCNRG



Map of Lake District, ref: Peter Toghill THE GEOLOGY OF BRITAIN plate. 50, pp58

The Lake District

The first trip after so many lockdowns, restrictions, uncertainties, fears of infection, even possible deaths! A cough or sneeze nearby … conjured up pictures of hospitals, isolation, incubation, induced comas!

I was overwhelmed by being outside in the open, the sky above in this beautiful, bleak countryside. Just to be out, feeling the space above and all around, looking over the countryside, the hills, naked, green occasional trees, but mostly none, stone walls cress crossing the hill sides, at this time of the year empty, partitioned spaces.

It was a wonderful trip, climbing up and sown those hisses, to look at a contact (granite and country slaty regional rock with its altered minerals, or an exposure of those rocks that bring home the notion the earth crust is perhaps like plasticine when pushed and bent by the power of plate tectonics.

I have jotted down many more geological terms and observations for each exposure we visited, you all know the Lake District, and field guides are abundant, the still mysterious provenance of the Borrowdale Volcanics, the jumble of rocks, collapsed craters of different periods remains to be solved.

Nobody will dispute its unique landscape of mountains and lakes of great beauty, I would say its austere beauty.

It was created by the closure of Iapetus, which pushed together several palaeocontinents - Laurentia, Avalonia, Baltica, peri-Gondwana Ganderia and Carolina, called the Iapetus Suture.

This collision history brought various landmass together including the volcanic arcs ocean islands, a disputed theory still not resolved today (Borrowdale Volcanics).

The geological timescale of the Lake District spans the Ordovician (including the Skiddaw Slates, the Borrowdale Volcanics, and the Coniston Limestones) from Tremadoc to Ashgill, into the Silurian.

The Ashgill epoch rocks, followed by dark Silurian shales were deposited during the initial early Silurian transgression that was a result of the melting of the late Ordovician icecap.

Next, the Caledonian and Carboniferous area caused mineralisation: lead, zinc, tungsten veins, and graphite, all mined in the area. The mines are now tourist attractions.

The Shap granite was intruded late in the Caledonian orogeny (about 397 +/- 7 Ma, Devonian, coarse-grained granite with large pink orthoclase feldspar) which is still mined today.

With this rich Earth history and different provenances, this field trip was varied and fascinating after the long dirge of Covid.

Borrowdale - Side Pike

(All photos by the author)

Views from stone wall going up the hill

Parabolic shaped valley (main ice age)

Welded ignimbrite, with flattened pumice, stone is about 80 cm Long

Pepperdine (magma and sediment interaction)

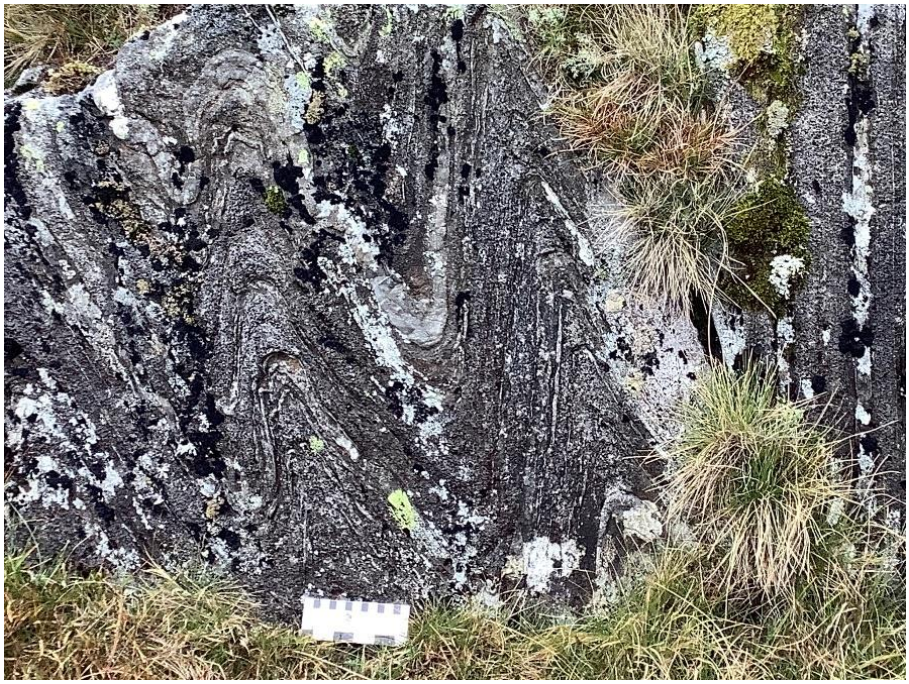
Small lake - pyroclastic currents, saturated ground, streams, steam explosions, small lakes are left behind or formed

Cross bedding rock exposure is about 3 m wide

Toppled rocks from various volcanic eruptions, collapsed craters, into numerous faulting blocks

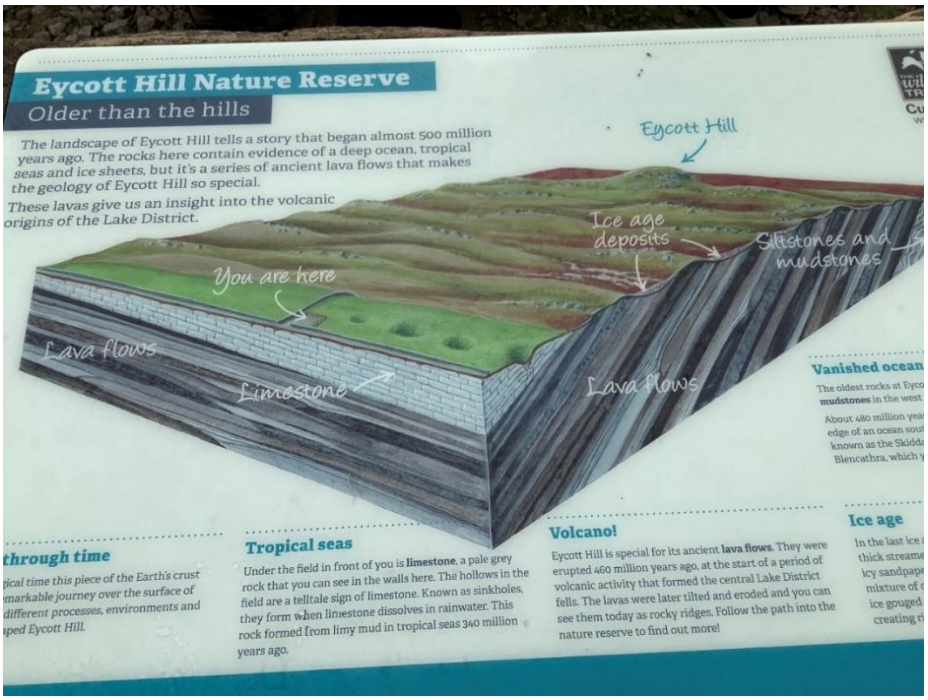
Skiddaw

Waterfall, slaty muddy dark rock, pike fault, north-south, microschist, tectonic cleavage, (sub vertical) , crenulation cleavage, quartz , chlorite, chlorite illite, magnetite, graphite , regional metamorphism



Ductile deformation above the batholith in the metamorphosed turbidities , shear deformation. Regional metamorphism, there is a granitic pluton underneath which uplifted the area.

Eyecott Hill Nature Reserve



The Ingleton Waterfall trail (near Ingleton)

First 1/3 up: limestone, then after Manor Bridge, Ordovician conglomerate (Ingletonian) , at about Raven Ray unconformity (Thornton Force)

Carboniferous above Ingletonian

Ice cream van at top, well positioned!

Views from the top of Ingleton waterfalls trail.

At lower path, (return) quarries, slick and side , carbonates, big fault, breccia

Cowraik quarry

Red sandstone

Shap granite quarry

References:

Wikipedia: Iapetus Suture

Shap Granite age /Virtual microscope – internet

https://webapps bgs.ac.uk

Peter Toghill/The Geology of Britain, An Introduction

The Geological Society Early Career Award 2022
Home Counties North Regional Group wildcard entry abstract
'Sand dam contributions to water security in Kenya monitored through hand pump abstraction'

Hannah Ritchie

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Drylands are home to one third of the world's population but face severe threats to water security (Davies et al. 2016). One such location is Kenya, where groundwater resources are limited, in part due to the nature of the basement rocks (Bloschl et al. 2009). In such environments, sand dams: concrete walls constructed across ephemeral streams, behind which sand builds up, offer opportunities for storing water for use in the dry season (Strohschein 2016). Water from such dams is accessed partly via hand pumps, which, as the dams' only improved method of abstraction, are important for drinking water security.

Sand dams are supposedly built on impermeable bedrock, minimising loss to the underlying aquifer. A growing body of research, however, is considering this to be false (Eisma and Merwade 2021), with the dams potentially acting more as managed aquifer recharge (MAR) structures, therefore reducing the volume of water available for abstraction. There is also contention around the seasonal duration of water availability, with some studies claiming they do not have the capacity to support water needs through the long dry season (Ngugi et al. 2020; Loon and Droogers 2006) and others noting the opposite (Maddrell 2018; Borst and Haas 2006). In response, this study seeks to aid the understanding of the contribution that sand dams make to water security through their interaction with the sub-surface.

The study was based in Makueni County, Southeast Kenya. It focussed on the long dry season (June–September) when water supply from other sources is compromised. Two data sets were used: hourly abstraction data from accelerometers fitted to hand pumps at sand dam sites between April 2019 and October 2021; and interview data collected by Chan (2019) between June and July 2019 to provide insight into the heterogeneity in abstraction observed between sites.

The study found heterogeneity in abstraction patterns and volumes between seasons and wells. Median abstraction was significantly ($p = 2.2e-16$) higher in the long dry season (304 m3/day) compared to the short dry season (15 m3/day), indicating the higher demand after more months of no rain likely due to the drying of other sources. Furthermore, median daily abstraction varied greatly between sites, from 1L to 2070L (Figure 1).

21 wells had water being abstracted in the last full week of September. Median daily abstraction across this week was 291L, indicating provision of water in times of increased need. However, whilst 52.4% (N=11) wells were providing enough water for drinking per person per day (>2.3L) in at least one long dry season, the rest were not (<1.7L) (Figure 2).

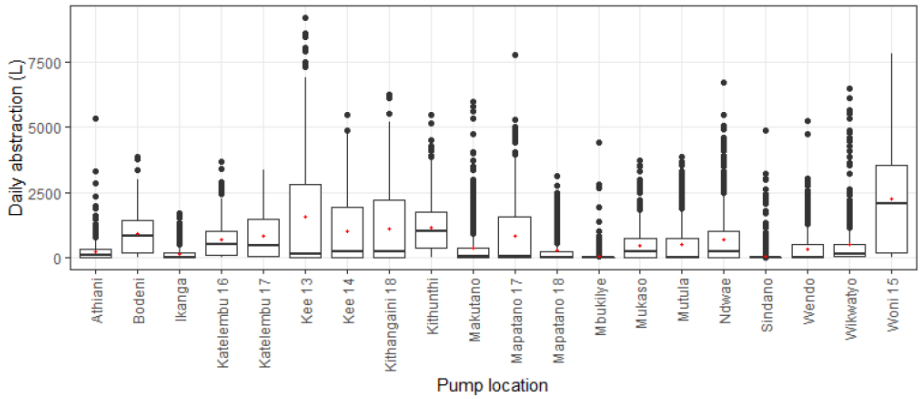

Figure 1: Daily abstraction from the 'smart' hand pump at each sand dam site between April 2019 – October 2021 (red dot shows the mean value as compared to the median line)

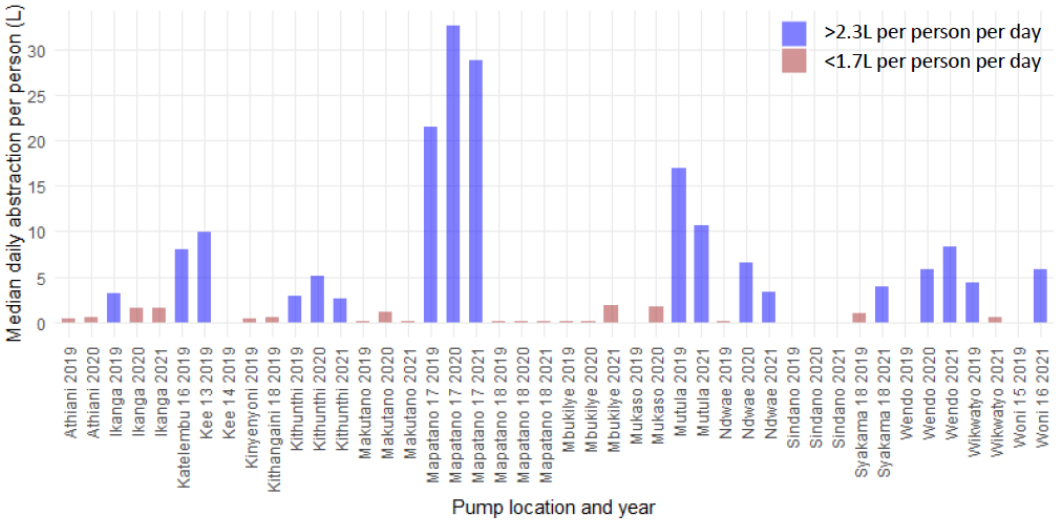

Figure 2: Median daily abstraction per person (L) in the last full week of September from the 'smart' hand pump at each sand dam site between 2019 and 2021, showing only the years from which data is available from each site.

The study highlights the positive contribution that some sand dams make to water security. Better understanding patterns of water use and having a clearer idea of their interaction with the sub-surface will aid water resource management and policy decisions. However, heterogeneity is a reminder that one size does not fit all, with certain sand dams always likely to have higher levels of abstraction than others.

References :

Bloschl, G, D Muralidharan, N Giesen, and F Seyler. 2009. *Improving Integrated Surface and Groundwater Resources Management in a Vulnerable and Changing World*. *IAHS Publication*.

Borst, L., and S.A. de Haas. 2006. "Hydrology of Sand Storage Dams A Case Study in the Kiindu Catchment, Kitui District , Kenya," no. February: 146.

Chan, Joanna. 2019. "Abstraction of Water from Sand Dams in Machakos and Makueni Counties (Kenya) via Handpumps." Cranfield University.

Davies, Editors Jonathan, Stefano Barchiesi, Claire J Ogali, Rebecca Welling, James Dalton, and Peter Laban. 2016. *Water in Drylands : Adapting to Scarcity through Integrated Management*. *IUCN*. Gland, Switzerland. https://doi.org/10.2305/iucn.ch.2016.06.en.

Eisma, J. A., and V. Merwade. 2021. "A Data-Driven Approach to Assessing the Impact of Water Harvesting Structures on Regional Water Storage in East Africa." *Journal of Hydroinformatics* 23 (2): 352–67. https://doi.org/10.2166/HYDRO.2021.115.

Loon, A. van, and P Droogers. 2006. "Water Evaluation And Planning System , Kitui - Kenya WatManSup Project."

Maddrell, Simon. 2018. *Sand Dams : A Practical & Technical Manual*.

Ngugi, K. N.Keziah, C. M.Maina Gichaba, V. M.Vincent Kathumo, and M. W.Maurits Ertsen. 2020. "Back to the Drawing Board: Assessing Siting Guidelines for Sand Dams in Kenya." *Sustainable Water Resources Management* 6 (4): 1–28. https://doi.org/10.1007/s40899-020-00417-4.

Strohschein, Paul M. 2016. "Exploring the Influence of Sand Storage Dams on Hydrology and Water Use."

Home Counties North Regional Group 12th July 2022 lecture abstract

The "real" value of microfossils

Venue: Arup, Emmerson / Shears Meeting Room, 8 Fitzroy Street, London W1T 4BJ

Dr Haydon Bailey FGS
HCNRG

Micropalaeontology or the study of microfossils may initially seem an esoteric subject for a desk bound academic; but if your thinking is along these lines then you couldn't be further from the truth. These microscopic sized fossils can be integral to major engineering projects, can result in helicopter flights to oil rigs around the world and also lead to detailed forensic studies as part of serious criminal investigations or simple art restoration. The information they provide can act as a proxy for past climate change and consequently as an indicator of the changes which may await us in the future.

Microfossils are abundant and diverse in many everyday rock types found worldwide or simply out in the UK countryside; they are attractive, sometimes structurally complex, but rarely dull

and boring. Because they're not the size of a *Diplodocus* they're very easy to carry home in your pocket, but they can still have impact – there would be no pyramids without microfossils.

In industry they are used every day to assist in the enhanced recovery of oil and gas on a global scale, providing massive value added in oil production. Optimal placement and steering of production wells within "sweet spots" in the oil reservoir can enhance recovery by 30%. With oil prices on the rise once again, the micropalaeontologist can have a major impact on hydrocarbon production and consequently, company profits. This paper attempts to put a highly estimated figure onto that added value.

In addition, they were used to define the foundations of the Thames Barrier and to steer the tunnelling machines which cut the Channel Tunnel. How can you put a value on these? Closer to home, they're present in pharmaceuticals, in your breakfast cereals and in your supper drinks. Definitely food for thought!