Farnham Geological Society

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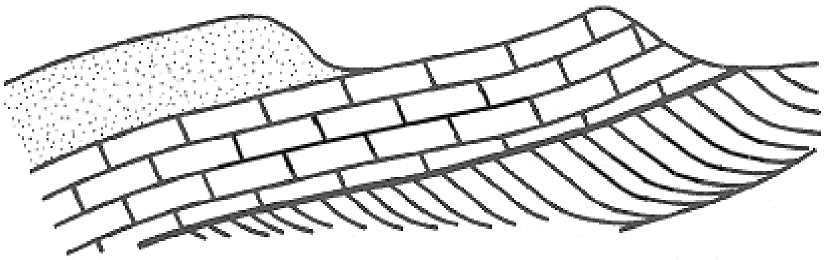

A local group within the GA

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Editorial

This edition of the newsletter includes snippets of geological / astronomical observations gleaned from one of the many scientific journals reaching our members and which they thought might be of interest to other members of the Society. This is considered to be preferable to just producing the summaries of the talks and field trips. I would be glad to get some feedback from members whether you like having these additional snippets.

My personal feeling is that it is important to provide good (even if long) summaries of our talks and field trips for those members who were unable to attend the events and to include plenty of diagrams, photographs etc. to assist in any explanations/enjoyment. I also feel that it is my job to provide a permanent record of what the Society has done as a true reflection of the Society for future reference.

Having said that, I also think it is a very good idea to provide members with additional snippets of relevant interest to most members, so feel free to send me any snippets which you have come across. Please provide me with full details of the origins of the articles and of their authors, so that I can give due recognition to their provenance and expertise.

Liz Aston

Wealden petroleum production: past, present and prospective

Summary of lecture given by prof Richard Selley, Imperial College, London

The surface expression of the Wealden anticline is plain for all to see. It is composed of Cretaceous sediments with Purbeck (Upper Jurassic) sediments cropping out in the core. Seismic imaging of the subsurface, confirmed by boreholes, reveals that the Weald is a biconvex lens of Cretaceous, Jurassic and older sediments. These include the organic-rich shales of the Lias and Kimmeridge Clays. Reconstruction of the evolution of the Weald shows that it was a subsiding basin that was inverted at the end of the Cretaceous Period. Thus the organic rich shales matured to generate petroleum at greater depths and temperatures than they are today.

Oil seeps out of the ground at several locations across the Weald and water wells have been notorious for emissions of ‘foul gas’ (methane) for centuries. In1899, the discovery of methane bubbling in a water well at Heathfield lead to the first commercial production of petroleum in the Weald. Towards the end of the last century 13 oil & gas fields were found in an arc around the feet of the North & South Downs. The petroleum is trapped in faulted anticlines and produced from Jurassic limestones and sand reservoirs.

In recent years there has been much enthusiasm for producing gas and oil from fractured shales. The principal target has been naturally fractured limestones thinly interbedded with the Kimmeridge Clay. At the time of writing no company has requested permission to hydraulically fracture a well in the Weald Basin.

Whether or not recent enthusiasm for exploring for unconventionally trapped petroleum in the Weald is justified, depends on the drilling of several wells, followed by prolonged flow tests, with or without hydraulic fracturing. Meanwhile exploration for conventionally trapped petroleum continues, as at Bury Hill. Some of the vast figures for Wealden petroleum are vastly exaggerated. There is a common misconception in the media and among financiers of the difference between in place resources and economically producible reserves. Opposition to petroleum exploration and production is often based on ignorance coupled with failure to appreciate the imminent energy ‘Trilemma’ facing the UK.

How I ended up as a geologist
Summary of FGS March lecture given by David Walmsey

This article gives a brief look at how I became a geologist and at the variety of work I have done throughout my career, this sort of variety is typical of many professionals – one has to know one’s stuff and learn on the hoof when necessary.

I was born and brought up in a geologically interesting area with quarries and Wolsortian mud mounds to play in and on. Choosing my ‘A’ levels with the intention of becoming a vet, I had a gap in my timetable and took geology as a “fill in” subject. Having an excellent geology teacher in Mr (Jessie) James and an outdoor lifestyle I decided to take a degree in geology at Aberystwyth University. As an undergraduate, I mapped part of the valley above Balachulish which contained some of the more challenging geology of the UK and good training for my later career (Figures 1, 2). Having once helped the vet do a caesarean on cow at my in-laws farm I realised I had made the right decision.

Fig 1: Laroch Valley Sgorr Dhearg and Ballachulish - Thesis Mapping Area 1972.

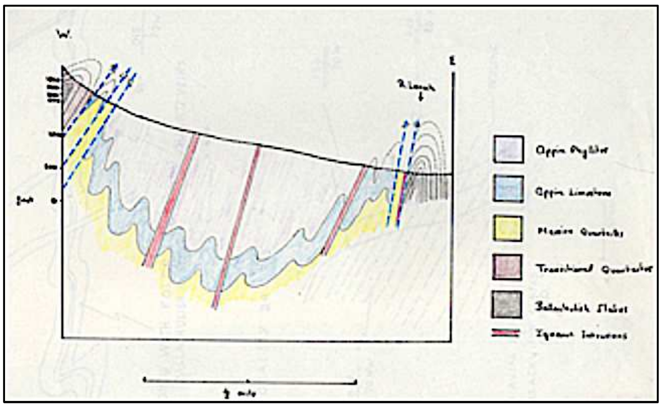

Fig. 2: Allt Sheileach Section.

My first job as a geologist in 1975 was with the South African Geological Survey where I was employed to map the northern part of the Transkei from the Drakensburg Mountains to the Indian Ocean (Figure 3). The geology covered the strata from the Early Permian Dwyka Tillite through the Permian, the Triassic Ecca and Beaufort series to the Jurrasic Drakensberg Volcanics. The geology also featured the massive intrusions of dolerite, a world-renowned area for this event. The area had first been mapped by Dutoit who was an early advocate of continental drift. In one area I was initially fooled by boulders of granite lying on the surface which led me to believe that I was mapping the ancient granites and schists known as the basement. It wasn’t until I realised that it didn’t fit in with the rest of the geology that I established that the boulders were weathered out from the Dwyka Tillite and had originally been brought there by glaciers in late Carboniferous early Permian times.

The Transkei is the home of the Xhosa people and I was able to observe their way of life such as gathering firewood (Figure 4).

Fig. 3: Map of the N part of the Transkei. Early Permian to Jurassic Drakensberg Volcanics.

Fig. 4: Xhosa people gathering firewood, a regular chore

On my return to the UK I joined the National Coal Board (NCB) Opencast Executive and worked on finding and proving coal deposits that could be opencast mined. This involved assessing potential reserves of coal using geological maps where evidence of previous mining was shown, and proving the seams, using drilling techniques (Figures 5, 6, 7 and 8). Increasingly sites were found to be contaminated by previous industrial use and the work had to be designed to protect the workforce from harm, and to restore sites without the contaminants being a risk to the environment.

The amount of coal recoverable from a site depends on the in situ thickness of coal, the percentage of old workings and the standoff and batters required to excavate the overburden.

The St Aidans disaster (Figure 9) occurred in March 1988 when a huge block of land slid into the excavation allowing the adjacent River Aire to flow into the mine and flooding it to a depth of ~61m (200ft). Sometimes events unfold that take people completely by surprise and this was one of them. Fortunately it wasn't my fault although it was foreseeable. No account had been taken of two intersecting faults, that could be seen on the old mine working plans. Additionally the coal seams beneath the river had not been worked but those adjacent had with the effect that subsidence from differential coal mining had occurred, weakening the strata and locally increasing its dip adjacent to the excavation. The site was eventually recovered by moving the river and canal and accessing an extra 5 million tonnes of coal. It is now a country park.

In 1993 the NCB ceased to exist and I was appointed as geotechnical engineer to North Yorkshire County Councils Waste Regulation Dept. to regulate the construction of landfill sites and their monitoring systems for gas and groundwater - a requirement of the EU Landfill Directive (Figure 10).

Fig. 5: Geological Map showing addits and other information.

Fig 6: Coal seams previously mined using bell pits.

A new geological experience for me was the discovery of clay dissolution pipes – these were in a Magnesian Limestone quarry. These are caused by the dissolution of underlying beds of gypsum creating a subterranean cave, the roof of which collapsed creating a cavity which then filled with clay marl from above. The movement of large blocks of limestone even with a shallow dip and no water present, but just a thin clay layer and jointing, was a reminder of how little it takes to create these situations.

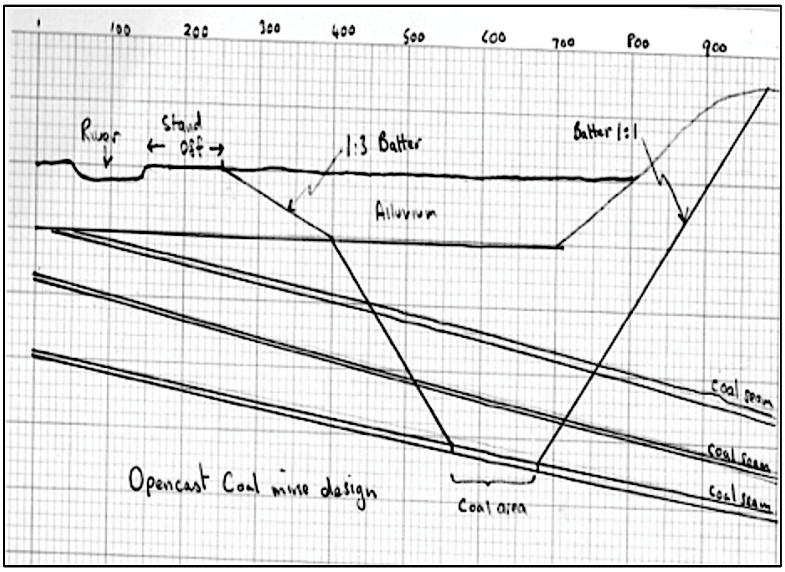

Fig. 7: Opencast Coal Mine Design

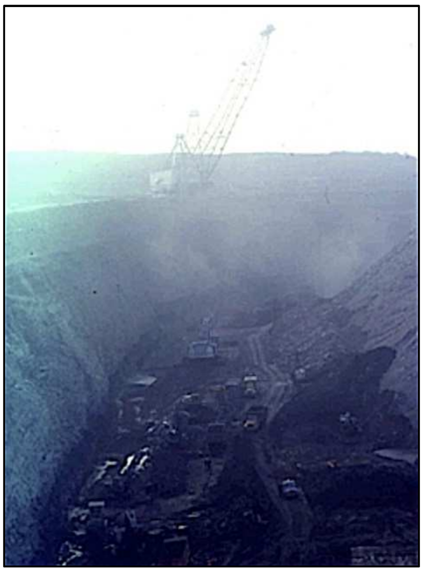

Fig. 8: Opencast coal mine using a dragline

Fig. 9: St Aidans opencast mine now restored with Drax power station in the background

Fig. 10: A modern landfill site with multi-layered barriers to prevent the escape of liquids (leachate) to groundwater and landfill gas (methane) to the surrounding ground. The main liners (upper plastic and clay) performance is monitored by an underlying secondary liner of clay with a drainage layer.

Fig. 11: Dissolution pipe

Fig. 12: Moving block of Magnesian Limestone

Fig. 13: The River Calder

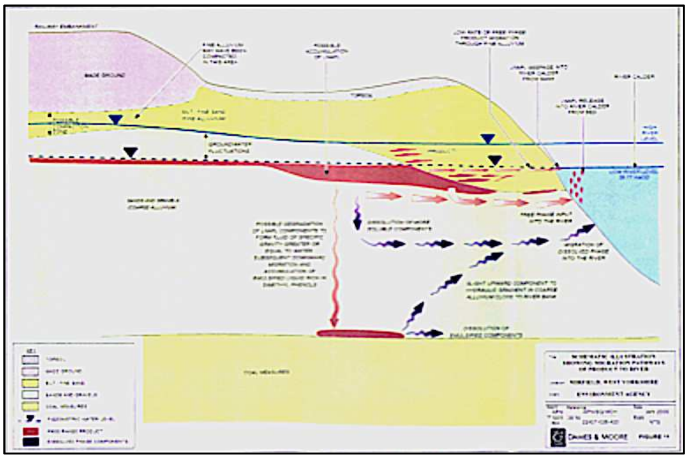

Fig. 14: Model showing the escape of creosote into the River Calder from various directions/sources within the bedrock.

In 2000 a European Directive on contaminated land required the Environment Agency (EA) to regulate and remediate the more difficult Special Sites and I was appointed to carry out that task. The pollution by creosote of the River Calder (Figure 13) had been occurring since the early 1970s. A site investigation was used to model how the creosote was getting into the river (Figure 14), and an appropriate scheme of a sheet pile wall and interception trench was constructed, which has been successful.

The legal justification for this being a Special Site was that the site was situated at a location already licensed by the EA and therefore qualified under the Part IIA regulations enacted by the Environment Protection Act 1990.

Fig. 15: Sheet pile wall and interception trench, constructed to protect Calder River

Hampole Quarry, the tyre dump below (Figure 16) was a Special Site because a fire would have polluted the Magnesian Limestone, a major aquifer listed in the same Regulations. The site was close to the A1M, the E coast main line, and 10,000 people. Previous fires had been contained but a major event was always on the cards. After initially removing tyres it was decided to re-profile the dump and build a containment system of geotextile, shale and limestone.

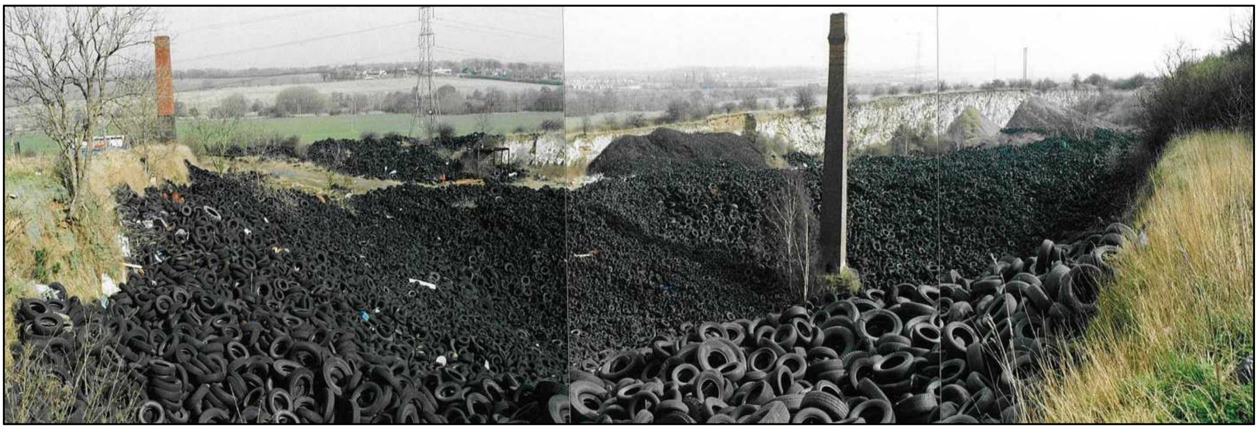

Fig 16- Hampole Quarry – before and after the tyre clearance.

Fig. 17: The last tyre – time to retire.

Fig. 18: Retirement - the Silurian/Carboniferous unconformity in the Yorkshire Dales part of a FGS field trip.

The last tyre!! (Figure 17). I thought this was a fitting tribute to my career as a geologist and decided to retire on a high, leaving me free to accompany FGS on many of their field trips (Figure 18) – better than tyres!!

David Walmsey

Early planet Earth

News snippet from New Scientist 3rd June 2017 page 10

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For a brief time during its infancy Earth was a hot, doughnut-shaped blob called *synestia*. Rocky worlds can be pulverised by collisions with each other, mushrooming into synestia before cooling off and becoming more familiar-looking celestial spheres, a new study says.

Worlds in our universe come in all shapes, from planetesimals to dwarf planets to giants with rings, but we don't fully understand how they changed throughout their lifetimes, says Simon Lock*.

In the early solar system, huge impacts would be common as small bodies smashed together, broke apart and re-formed and smashed again. Previous studies found such impacts could pulverise part of a planet, leaving behind debris that coalesces into a moon or rings such as those that Saturn has.

The most violent collisions can vaporise entire worlds into gas blobs that rotate so fast their edges spin at a higher rate than their inner core.

At a certain point, the planet takes on a new structure: an inner region rotating at a steady rate, loosely connected to a bulbous disc that rotates around it. The disc is not separated like a planet with rings, but sits at the edge of the planet's pull.

It resembles a puffy red blood cell, or a doughnut with a dented middle. A synestia has an exterior region marked by clouds of molten rock and dust, all at a scorching 2000°C or hotter. These conditions only last for a cosmic blink. Earth would have been a synestia for just a century before cooling off enough to condense into a solid object again, says Lock (see further article below on syntestias which includes a figure).

Most planets and even some stars might form synestias at some point in their lives, according to Stewart*. She plans to look for evidence of them around young stars systems, where the outer part of planets are hot and close to their stars. 'That keeps it puffy, and if it is rotating very fast, it could be a synestia,' she says.

**Simon Lock is a graduate student from Harvard University Department of Earth and Planetary Sciences temporarily working with Professor Sarah Stewart at University of California Davis, in the Department of Earth and Planetary Sciences.*

Synestia, a New Type of Planetary Object

News item by Andy Fell on May 22, 2017 in Science & Technology

A new type of planetary object, a donut-shaped body of vaporized and molten rock called a synestia, is being proposed by planetary scientists at University of California Davis (UCD) and Harvard University. Synestias form when planet-sized objects crash into each other with high energy and angular momentum. This new object opens up new ways to think about how the moon formed, and they could be spotted in other solar systems (see Figure 1 by Simon Lock.)

There's something new to look for in the heavens, and it's called a 'synestia,' according to planetary scientists Simon Lock at Harvard University and Sarah Stewart at the University of California, Davis. A synestia, they propose, would be a huge, spinning, donut-shaped mass of hot, vaporized rock, formed as planet-sized objects smash into each other.

At one point early in its history, the Earth itself was probably a synestia, said Stewart, professor in the Department of Earth and Planetary Sciences at UCD. Lock and Stewart describe the new object in a paper published May 22 in the Journal of Geophysical Research: Planets.

Lock, a graduate from Harvard, and Stewart study how planets can form from a series of giant impacts. Current theories of planet formation hold that rocky planets such as the Earth, Mars and Venus formed early in the existence of our solar system as smaller objects collided with each other. These collisions were so violent that the resulting bodies melted and partially vaporized, eventually cooling and solidifying to the (nearly) spherical planets we know today.

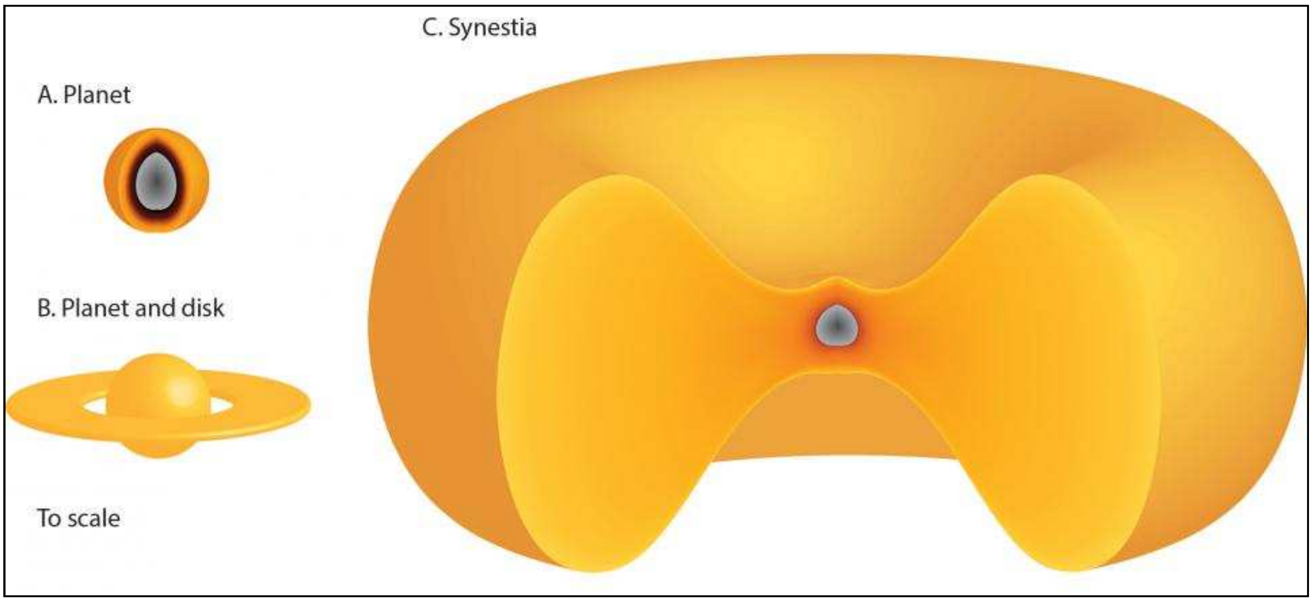

Fig. 1: Image of a new type of structure - a Systestia, a Donut-Shaped Body of Vaporized and Molten Rock.

Lock and Stewart are particularly interested in collisions between spinning objects. A rotating object has an angular momentum, which must be conserved in a collision. Think of a skater spinning on ice: If she extends her arms, she slows her rate of spin, and to spin faster she holds her arms close. Her angular momentum is the same.

Now consider two ice skaters turning on ice: if they catch hold of each other, the angular momentum of each adds together, so their total angular momentum must be the same.

Lock and Stewart modelled what happens when the ‘ice skaters’ are Earth-sized rocky planets colliding with other large objects with both high energy and high angular momentum. ‘We looked at the statistics of giant impacts, and we found that they can form a completely new structure,’ Stewart said.

The researchers found that over a range of high temperatures with high angular momentum, planet-sized bodies could form a new, much larger structure, an indented disk rather like a red blood cell or a donut with the centre filled in. The object is mostly vaporized rock, with no solid or liquid surface.

They have dubbed the new object a ‘synestia,’ from ‘syn-,’ ‘together’ and ‘Hestia,’ Greek goddess of architecture and structures.

The key to synestia formation is that some of the structure’s material actually goes into orbit. In a spinning solid sphere, every point from the core to the surface is rotating at the same rate. But in a giant impact, the material of the planet can become molten or gaseous and expands in volume. If it gets big enough and is moving fast enough, parts of the object pass the velocity needed to keep a satellite in orbit, and that’s when it forms a huge, disk-shaped synestia.

Previous theories had suggested that giant impacts might cause planets to form a disk of solid or molten material surrounding the planet. But for the same mass of planet, a synestia would be much larger than a solid planet with a disk. Most planets likely experience collisions that could form a synestia at some point during formation, Stewart said.

For an object like the Earth, the synestia would not last very long, perhaps a hundred years, before it lost enough heat to condense back into a solid object. But synestias formed from larger or hotter objects such as gas giant planets or stars could potentially last much longer, she said. The synestia structure also suggests new ways to think about lunar formation, Stewart said. Earth’s moon is remarkably similar to Earth in composition, and most current theories about how the moon formed involve a giant impact that threw material into orbit. But such an impact could have instead formed a synestia from which the Earth and moon both condensed.

No one has yet observed a synestia directly, but they might be found in other solar systems once astronomers start looking for them alongside rocky planets and gas giants.

The work was supported by NASA and the U.S. Department of Energy. Contacts for further info:

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The 2nd Farnham Maltings Retirement Fair 27th February 2017

The Fair was on a very unfortunate day as the weather was atrocious. This obviously deterred retirees from venturing out so the attendance was down on last year.

The FGS had the same pitch in the main hall as the previous year and enabled us to have the two tables against an outside wall rather than in the restricted space between the rows of tables. We had access to an electrical source so were able to use spotlights to highlight some of the exhibits on the two tables.

The Society’s display boards were fully used with one section displaying the local rocks and with the other having a local geological map and recent Field Trips run by FGS.

Rocks on display included local examples of the Farnham area, the rock cycle, and some of the more substantial mineral and rock specimens of the FGS collection. Granite was on display indicating the constituent parts and how hydrothermal action breaks it down. The local geological maps were available for inspection and also a display of how the Wey had captured the headwaters of the Blackwater River.

Visitors to the stand were interested in the displays and spent some time talking to the helpers, Janet, Peter, Judith, Sally, Graham and myself (John Williams).

Publicity for the Fair, and specifically the FGS, resulted in articles in two of the local papers, see below, and I subsequently learned that the Fair and the FGS had also been a subject on the local Surrey radio.

It remains to be seen whether our attendance results in an increased membership - however it does put the Society on the map, and provoked discussions with other stall holders.

Fig. 1: FGS Display boards at the Maltings Retirement Fair.

Headlines and comments from the Local Press.

RETIREMENT FESTIVAL A GREAT SUCCESS

… the event again featured a range of clubs societies and organisations for those who are retired or approaching retirement … exhibitors ranged from Farnham Geological Society to …

REFRESHERS' FAIR FOR THE RETIRED

…retirement doesn't have to mean slowing down, it can mean a chance to take up a range of different hobbies, learn something new … visitors can see lots of different special interest groups from Farnham Geological Society to …

John Williams, Member of FGS

The Farnham Quaternary river terraces and their importance within the Thames Palaeolithic record

Summary of April 2017 FGS lecture given by Prof David R Bridgland, Durham University

Modern understanding of the complex climatic record from the latter half of the Quaternary has allowed a meaningful pattern to be recognized within the archive of stone-tool types collected from river terrace deposits in the Thames system. That system benefits from a richness of fossils (especially mammalian and molluscan) within its Pleistocene sediments and the abundance of flint from the Chalk as a high-quality raw material for tool making during the Palaeolithic. Thus the record from the Thames, and especially from its lowermost reach east of London, is second to none in terms of representation of Quaternary palaeo-climate and evidence for early human activity (Figure 1).

The archaeology can be summarized under three broad groups, which correspond with Modes 1, 2 and 3 as defined by the archaeologist Grahame Clark (World Prehistory, 1969):

Mode 1 = the Clactonian industry, comprising cores and flakes, with no core preparation and no formal tools,
Mode 2 = hand axes (= Acheulian) and
Mode 3 = Levallois technology, with core preparation.

It is the hand axes of Mode 2 that were preferentially amassed during the years of extraction of gravel by hand, providing huge collections of such material in museums all over Britain and western Europe. There is considerable variety of hand axe forms, with different classification schemes developed during many years of research, notable amongst which was the definition of six hand axe groups by the Oxford archaeologist Derek Roe, established in the 1960s from exhaustive studies of the museum collections. Roe's groups are summarized in Table 1, which also shows the age to which each group would now be assigned (an interpretation impossible at the time of Roe's research, when the complexity of Quaternary climatic fluctuation was not fully understood).

The Thames sequence, as illustrated in Figure 1, has been important in establishing both the record of Quaternary palaeo-climate and the episodes to which the hand axe groups belong. The groups can thus be plotted onto the terrace sequences in different parts of the Thames valley (see Figures 1 and 2).

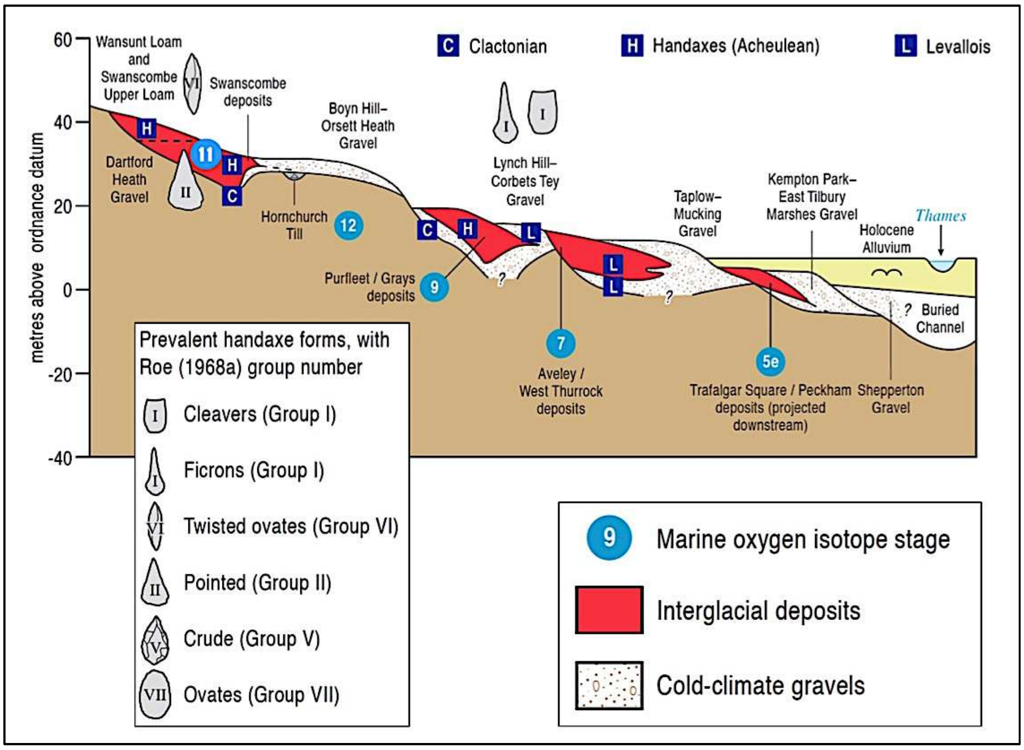

Fig. 1: Idealized cross section through the Pleistocene terraces in the Lower Thames, E of London, showing the occurrence of cold-climate gravels and interglacial sediments, formed in response to the fluctuation between glacial and interglacial climate during the Quaternary. The marine oxygen isotope stages (MIS) to which different parcels of sediment are attributed are shown, ranging from MIS 12, during which the greatest British glaciation occurred (ca. 450Ka) to MIS 5e, the early part of stage 5, which is the youngest of four interglacials represented here (warm periods have odd numbers, the Holocene being MIS 1). Also indicated is the occurrence of different types of archaeology and of particular Derek Roe hand axe groups.

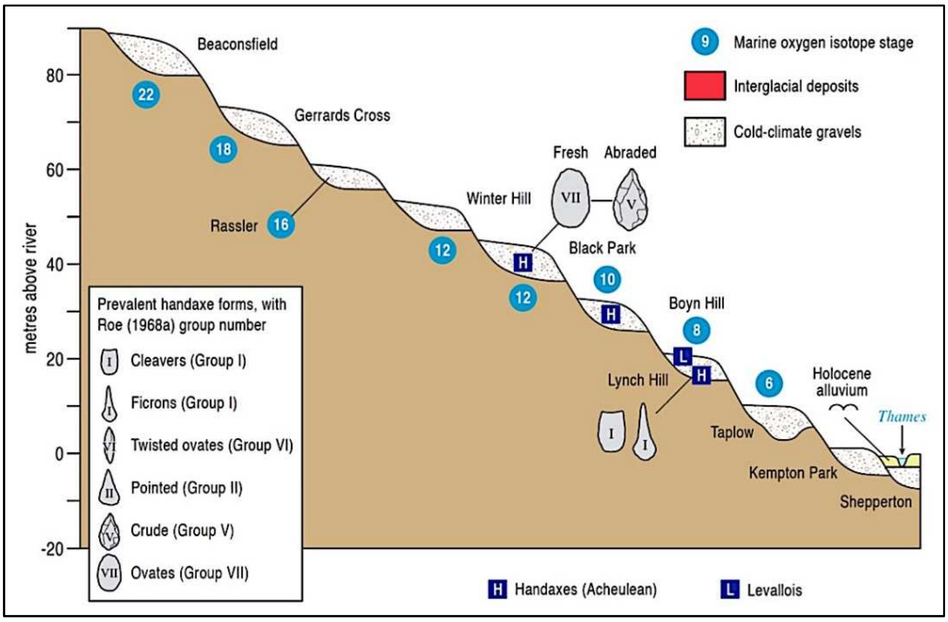

Fig. 2: Similar diagram to Fig. 1, but showing the sequence W of London, where older terraces are preserved. For further explanation, see caption to Fig. 1.

River terraces in the vicinity of Farnham were also rich sources of Palaeolithic material in the early 20th Century, as summarized in publications by Henry Bury and Kenneth Oakley. Derek Roe recognized an assemblage attributable to his Group V (see Table 1) in the highest of the Farnham terraces, designated 'A' (Figure 3). Although no other material from Farnham was considered to represent a high-integrity assemblage, it is apparent that hand axes from the next oldest terrace ('B') resemble those from the Boyn Hill Terrace of the Thames, e.g. at Swanscombe., and those from Terrace 'C' resemble those from the Lynch Hill Terrace of the Thames. Furthermore, Levallois technology appears in the next terrace ('C') and is well developed in the next ('D'), inviting comparison with the Lynch Hill and the Taplow of the Tames, respectively (compare with Figure 1).

←	Pointed tradition	→	←	Ovate tradition	→
Group I (with cleavers)	Group II (with ovates)	Group III (plano-convex)	Group V (crude, narrow)	Group VI (more pointed)	Group VII (less pointed)
MIS 9–8 Furze Platt Bakers Farm Cuxton Stoke Newington 	MIS 11 Swanscombe MG Chadwell St Mary (Hoxne UI) Dovercourt Hitchin (Foxhall Road Red Gravel) 	MIS 9 Wolvercote 	MIS 15–13 Fordwich Farnham terrace A Warren Hill worn (Kents Cavern Breccia) 	MIS 11 Elveden Bowman's Lodge Swanscombe UL (Wansunt) (Foxhall Road Grey Clays) (Hoxne LI) MIS 13–12 Caversham Middle Palaeolithic Shide, Pan Farm Oldbury 	MIS 13 High Lodge Warren Hill fresh Highlands Farm Corfe Mullen (Boxgrove) 

Table 1: Derek Roe's hand axe goups, showing updates based on the work of Mark White (Durham Archaeology).

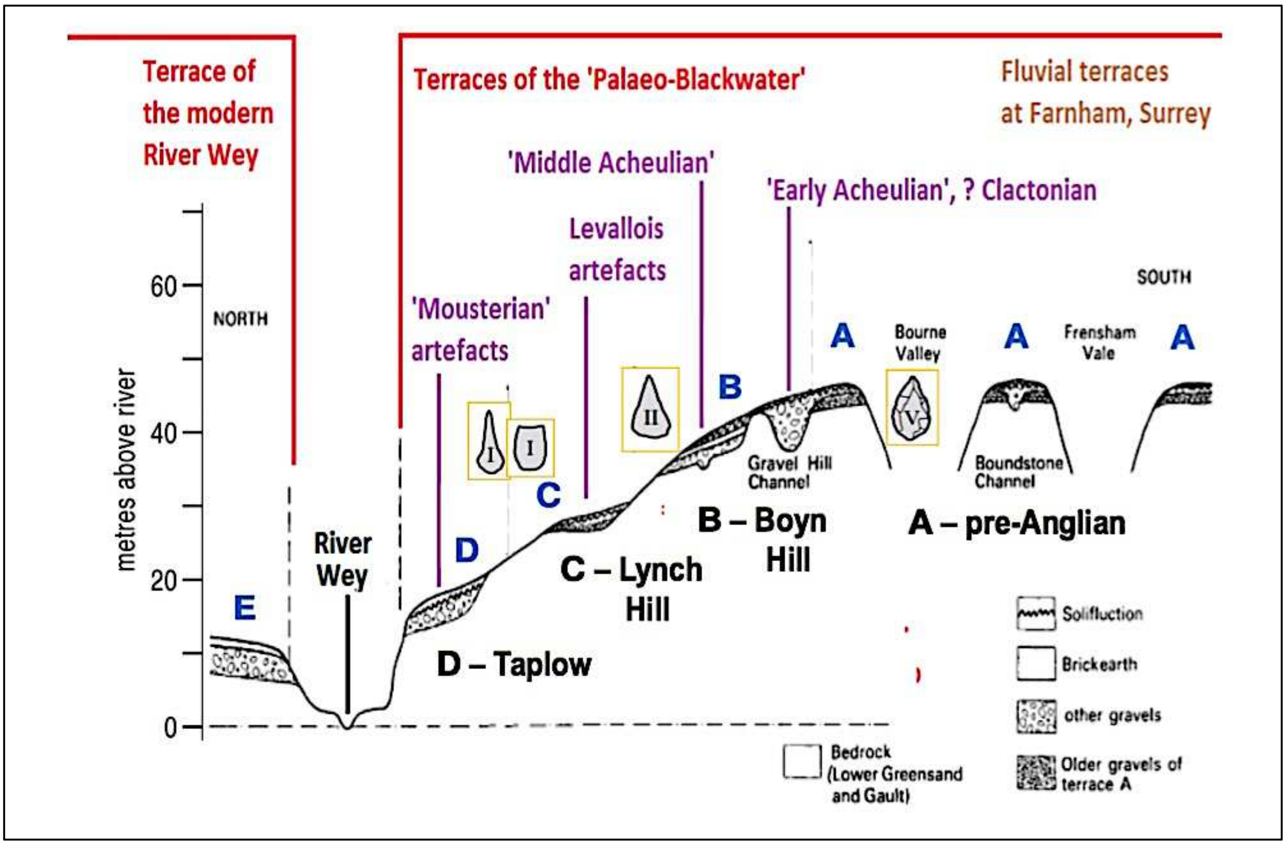

Fig. 3: Cross section through the Blackwater/Wey terraces at Farnham, showing Palaeolithic material that characterizes certain levels (see caption to Figure 1). Updated from John Wymer's 'The lower Palaeolithic Occupation of Britain' (1999).

Thus there is a valuable Palaeolithic record from the Farnham terraces (*see note below*), one that has potential value as a means of correlation with the main River Thames (a correlation that has previously only been attempted by projection of terrace remnants along longitudinal profiles of the river system). A complication here is that when these terraces were formed on the floodplain of the river system at Farnham when this was the headwater stream of the River Blackwater, which is now confined to the area to the north of the Chalk outcrop. It was recognized by Bury (amongst others) that the Farnham stream was 'captured' from the Blackwater by the River Wey (Figure 4), between the formation of Terraces D and E, an interpretation supported by the copious amounts of Lower Greensand clasts within the older terrace deposits of the Blackwater system, clearly derived from the Lower Cretaceous strata of the Farnham area.

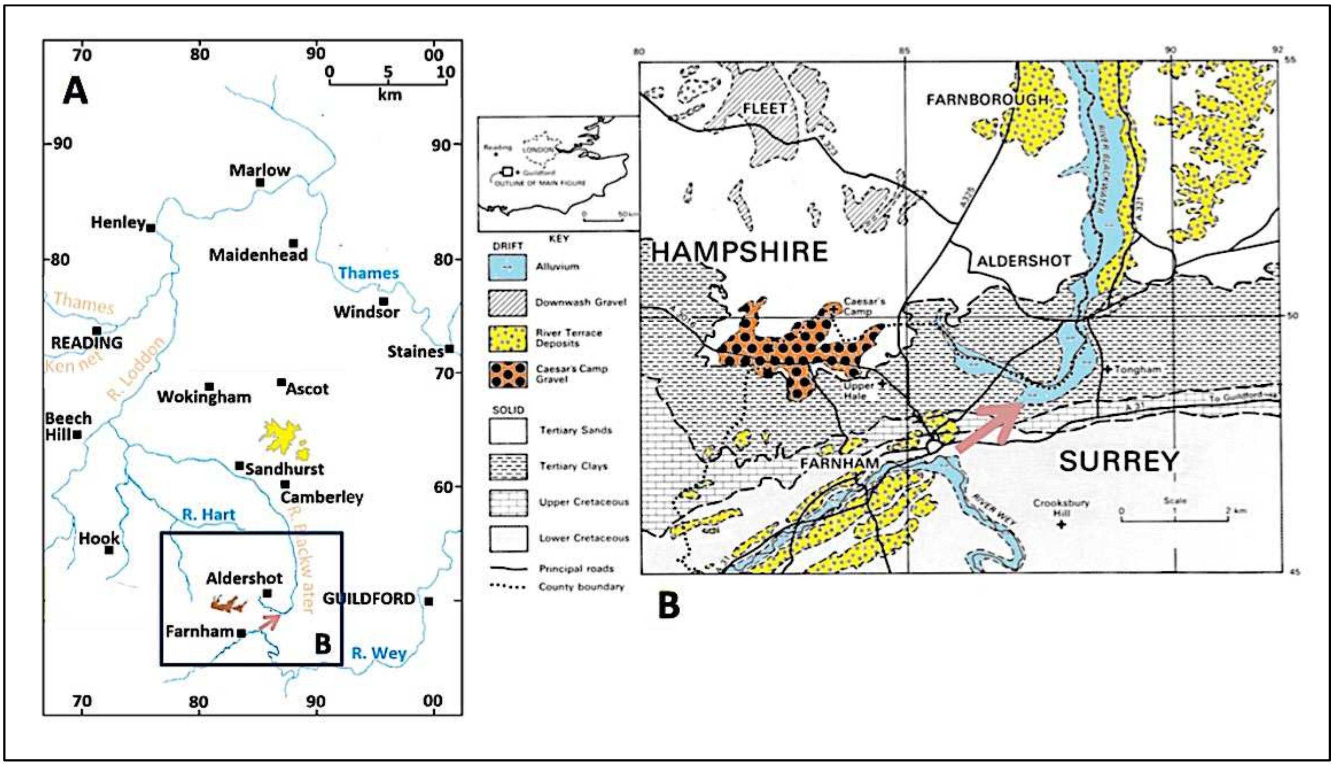

Fig. 4: The Farnham terraces in relation to the Thames drainage system SW of London. The former drainage route of the Farnham Wey into the Blackwater is arrowed. A: drainage in the wider region; B: geology of the Farnham–Aldershot area.

David Bridgland

Post meeting note:

FGS has received a request for help from Professor Bridgland, who is researching the classic Quaternary "staircase" of river terraces along the Blackwater Valley, particularly near Farnham. He writes:

"I need to find out where there might be exposures (or access by digging) on the various terrace outcrops, especially Terraces 1A to D, which were the ones with the most important discoveries of stone tools. On the map, it is the gravel south of the town that is most important, that outcrop representing multiple terrace remnants aligned SW - NE. So it would be good to know from people with local knowledge whether they know of anywhere within that mapped outcrop where gravel can be seen, either in outcrop or as surface debris. Maybe some of the FGS members might even live on the outcrop and might like the soil in their garden turned over?"

Please reply direct to David at: d.r.bridgland@durham.ac.uk