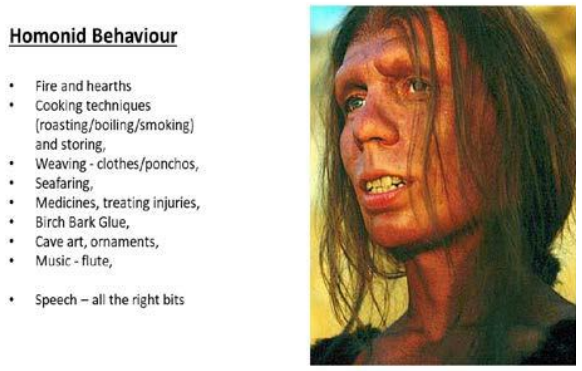
Science & Engineering Events 2020

26/11/2020 Zoom talk by Luke Wilson on "The Denisovens"

The latest Zoom meeting of the Science & Engineering Group on 26th November 2020 was an exciting and informative talk on the Denisovans by Luke Wilson. The meeting was attended by eight people who were eager to learn more about the Denisovans. Presumably more would have attended if they had known who the Denisovans were but of course if you don't come to the meeting you never find out.



They were of course a sub species of hominids (Primitive man) whose remains were discovered in the last few years in a cave in Siberia. They diverged from the rest of humanity about a million years ago and Neanderthals diverged from them about 500k years ago. Detailed examination of the genome has revealed however that they interbred with modern humans and Neanderthals over a long period of prehistory. The most exciting fact of all was something that I certainly did not know was that some humans from Neanderthals and Denisovans inherited a short 50 kb pair segment of DNA, which confers susceptibility to the severe form of Covid disease. Right hand photo shows a Reconstruction of a 15 year old child by Tom Bjorklund.

Alan Keith

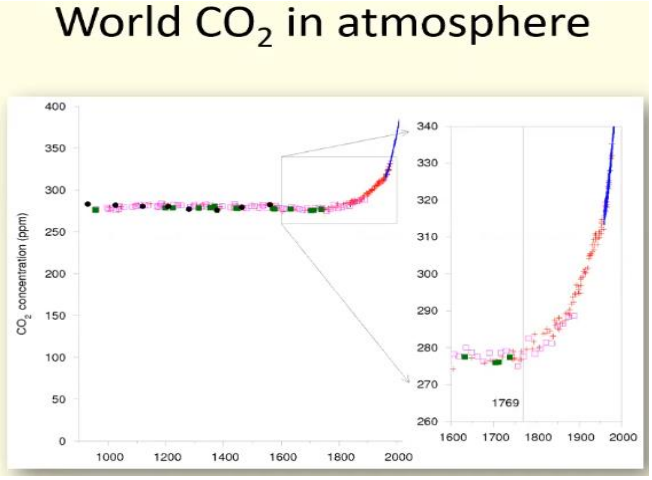
22/10/2020 Zoom talk by Robin Stafford Allen on Sustainable Energy "without the hot Air"

Robin Stafford Allen gave us a very interesting talk previously on "Fusion". He joined in our conversation whilst waiting for others to join this zoom talk. There were several ex CEGB employees present and he recounted how he used to need permission from the CEGB to use large amounts of electricity for small periods of time for his fusion apparatus. He also showed some interest in Barbara's solar panels and Graham's cat Henry.

The lecture started in an unexpected way with slides showing the enormity of horse poo in London during the 1800s. More being deposited than could be removed, with the worry that it would bring London to a standstill. In the late 1800s Mercedes produced a "Horseless Carriage". In 1914, many horses were sent to Europe to support the war, most of them never to return. The point being that through time we often suffer what appear to be unsolvable problems.

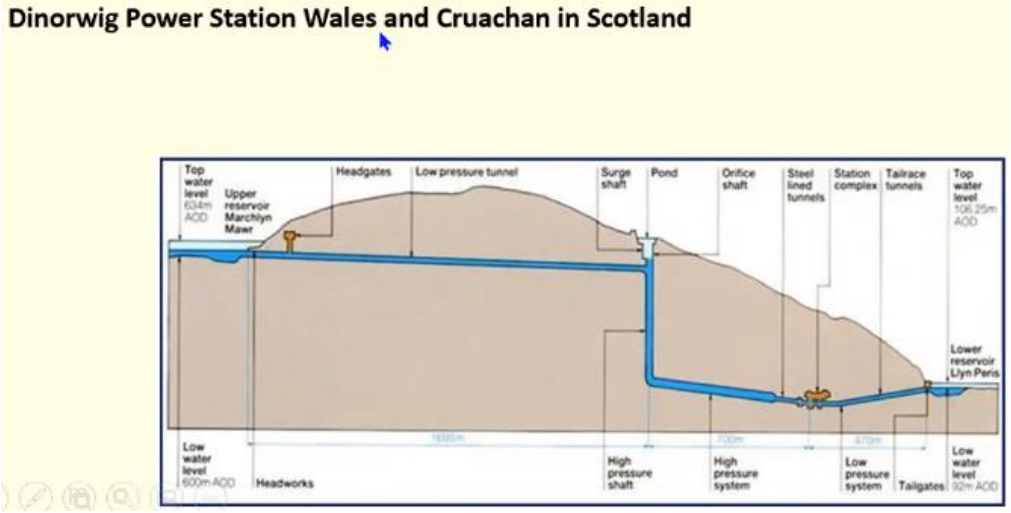
A map of the world detailing human population increase and energy use provided worrying statistics. The developing world is looking forward to enjoying a lifestyle that requires much more electricity, more similar to our own lives. He pointed out that although 1 million people have lost their lives through Covid to date, 1 million new people arrive on the planet each week.

In 1769 Watt's steam engine heralded the exponential rise in CO2 in our atmosphere. This now needs to be reversed and renewables were examined in detail. Currently they are not contributing much to the world's energy production.



Solar energy is beneficial and Robin dismissed those that said the panels cost more to produce than they save. Living so far from the equator as we do, does not allow optimum performance. Even if the whole country were to be covered in solar panels, it would only provide a fraction of our needs and would take up valuable farmland. Similarly, solar thermal (direct heating of homes or water) has limited use at our latitude.

Wind Turbines, although more productive than solar, suffer a similar problem. The off shore wind turbines are more successful. However, a strip 5 miles deep around the UK would still not suffice. Thirty thousand bird deaths per year can be attributed to wind turbines. This seemed alarming until Robin said that bird deaths from cars are about 1 million and from cats even more. At this point Henry pressed paws.



Storage - Dinorwig the hydroelectric station in Snowdonia provides large quantities of electricity with just a few minutes notification. This is ideal to cover sudden losses throughout the National Grid, but only for short periods. The water in the lower lake then has to be pumped back to the upper lake, using electricity.

Another myth was dispelled "leaving a mobile phone on charge all of the time is expensive". Robin said that due to the clever "switch mode" technology within the charger, leaving a mobile on charge for a year is roughly equivalent to 1 second of driving a car. Although he did advise us not to do this.

Tidal - Whilst a Severn Barrage would contribute, the flow through turbines would be limited due to just a 2 metre head of water.

In summary, it seems that solar panels for all are still too expensive at the moment. We can't cover our country in solar panels or wind turbines. Fossil fuels (oil and coal) will become prohibitively expensive as they become harder to reach underground. Renewables are a help but only for part of the day. Electric cars are more efficient but take a long time to recharge. Smart meters do not contribute generally to a reduction in electricity consumption. Their purpose is to educate us with respect to home electricity consumption.

We can help by flying less, driving more efficiently or walking/cycling more. Not upgrading our mobiles and other gadgets each year also helps. Low energy light bulbs help, but take a long time

to pay back. Keep house thermostats to 18°C in the winter and wear a jumper. Avoid excess packaging and eat less meat.

Q & A Session

Alan Keith asked if superconductivity could help, with say direct current (DC) links to Iceland. Robin said that until we can have superconductivity at ambient temperature the answer is no. He highlighted that wind farms already connect with DC.

Barbara asked if batteries could be used to benefit from daytime solar electricity being used at night. Robin said that it might be possible in the future for individual houses. It would be expensive and not likely for the national grid.

Sally asked if renewables destabilise the national grid. Robin said they are useful as small contributors, but sometimes prevent power stations not running to their design loading.

Richard asked if more Dinorwigs could be built. Sally also suggested that the water could be pumped back using solar and wind power. Robin said that available sites are limited and the cost of building would be prohibitive.

Graham asked about the Elon Musk grid batteries that had been installed in Australia. Robin replied that we have one 1st division football club that has batteries which will maintain floodlights for an hour following a grid disconnection.

Tesla Powerpacks used to form the world's largest lithium-ion battery at the Hornsdale wind farm, near Jamestown, South Australia. *Photographer: Carla Gottgens/Bloomberg*

Alan asked if the use of compressed air could be viable as a storage medium. Robin replied that it would not be cost effective. Alan also talked about the possibility of linking the Red Sea with the Dead Sea that is 500 metres lower. Robin said that environmental issues would preclude this. Barbara highlighted that she would no longer be able to float in the less salty water.

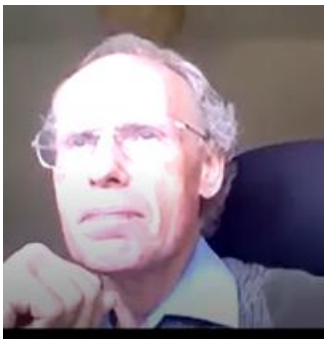
Paul said he had enjoyed Robin's talk on Fusion and that it was often said that Fusion is 25 years away and will always be 25 years away. Robin confirmed that this audience would not be benefiting from electricity from fusion. There is hope for future generations.

Graham thanked Robin for a very interesting lecture and reminded the listeners that they can donate to Robin's suggested charity "Thames Air Ambulance".

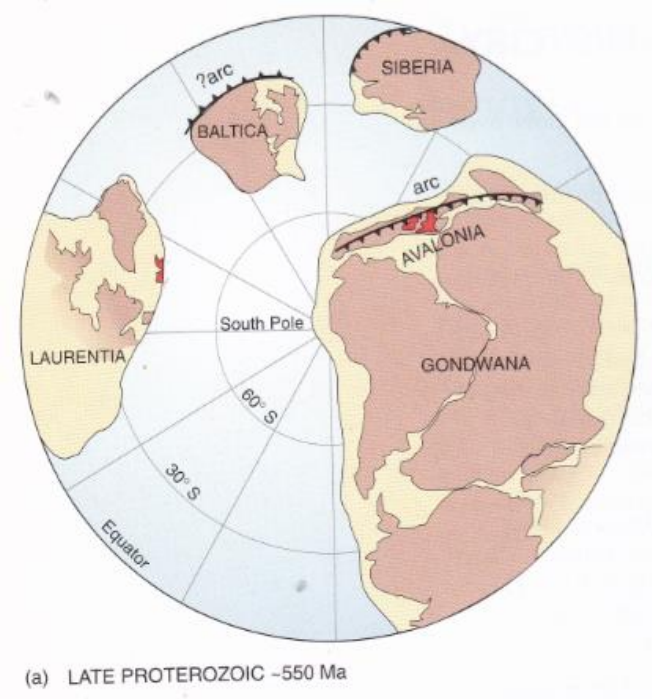
There were rather too many, although interesting, figures to précis. Robin credits much of his lecture to Prof. David Mackay who published a book "Sustainable Energy - without the hot air" should you want to know more.

Paul Sheppard

1/10/2020 Zoom talk by Martin Eales on "The Geology of Britain in the Palaeozoic, the Era of Early Life. A regional look at the history of Britain 540-250 million years ago, how the rocks formed and the evolution of early life"



On 1st October, we welcomed back Martin Eales to give the Science and Engineering and Geology groups another of his excellent lectures by Zoom. Martin began by screening the familiar 12-hour clock representing the history of the Earth from its origins around 4500 Ma (million years ago) to the present day, on which humans appear in the last two seconds. The time he proposed to talk about began with the Cambrian Period, the start of complex life around 540 Ma, and ran through to the "Great Dying" at the end of the Permian, when 95% of all life on Earth became extinct.



(a) LATE PROTEROZOIC ~550 Ma

Fossils tell us that the first animals with backbones, the first fish, appeared in the sea. At that time, southern Britain and southern Ireland were at about 60°S on the edge of Avalonia, a micro-continent on the fringe of Gondwana. Scotland and the northern part of Ireland were some 4000 km away on the other side of an Ocean called the Iapetus. The Earth was in an Ice Age and sea levels were a lot higher than they are now. The first life with shells, living in a warm, shallow sea, produced limestone, as found at Durness in northern Scotland. However, England and Wales were under a cold, deep sea, which resulted in the formation of slate, particularly in Wales.

Martin referred to the dispute between Adam Sedgwick and Sir Roderick Murchison, over the identification of certain rocks in Wales. Sedgwick believed they were Lower Silurian but Murchison was convinced they were Upper Cambrian. This led to a bitter dispute between them and the matter was not decided until after their deaths by Charles Lapworth, who introduced a new Period, the Ordovician. (That and the Silurian were named after early Welsh tribes but were not restricted to Wales). Martin mentioned Dobb's Linn, near Moffatt, as being an example of the Ordovician/Silurian boundary, called "the Golden Peg" and defined by changing graptolites. The Iapetus Ocean was closing and subducting under Canada, Nova Scotia and Greenland on one side and Avalonia on the other, generating volcanics of which Snowdon, the Lake District and the dolerite bluestones of South Wales are examples.

During the Ordovician (505 to 438 Ma), life developed, with graptolites floating near the surface and trilobites inhabiting the seabed, some up to a foot across. This was followed by the Silurian, lasting 30 Ma, during which the Iapetus closed entirely and Scotland collided with England along what is called the Iapetus Suture. As this is a natural boundary, it coincides closely with today's political one, except that Berwick should definitely be on the Scottish side! There is a nice example of ophiolites at Ballantrae, where one side has been thrust up over another, rather than being subducted beneath it. At this stage, the now united land areas were close to the Equator and Africa was at the South Pole. The collision and subsequent mountain building are known as the Caledonian Orogeny. The subduction of the Iapetus Ocean triggered volcanics, resulting in the igneous rocks of the Scottish Highlands (Aberdeen is known as

the granite city). Himalayan-sized mountains were thrust up. This was the time when coral reefs and new types of fish with jaws developed. Also freshwater fish, the first land plants and insects (spiders) appeared.

Next comes the Devonian. The rapid erosion of the mountains produced the Old Red Sandstone, which spread by rivers far to the south. Chester Cathedral is made of it and it can be seen in Ross-on-Wye. It was also used as building stone in Hereford. The Neolithic people of Skara Brae in Orkney built their houses and furniture of it. At this time, some of the fish ventured onto land and the first trees appeared.

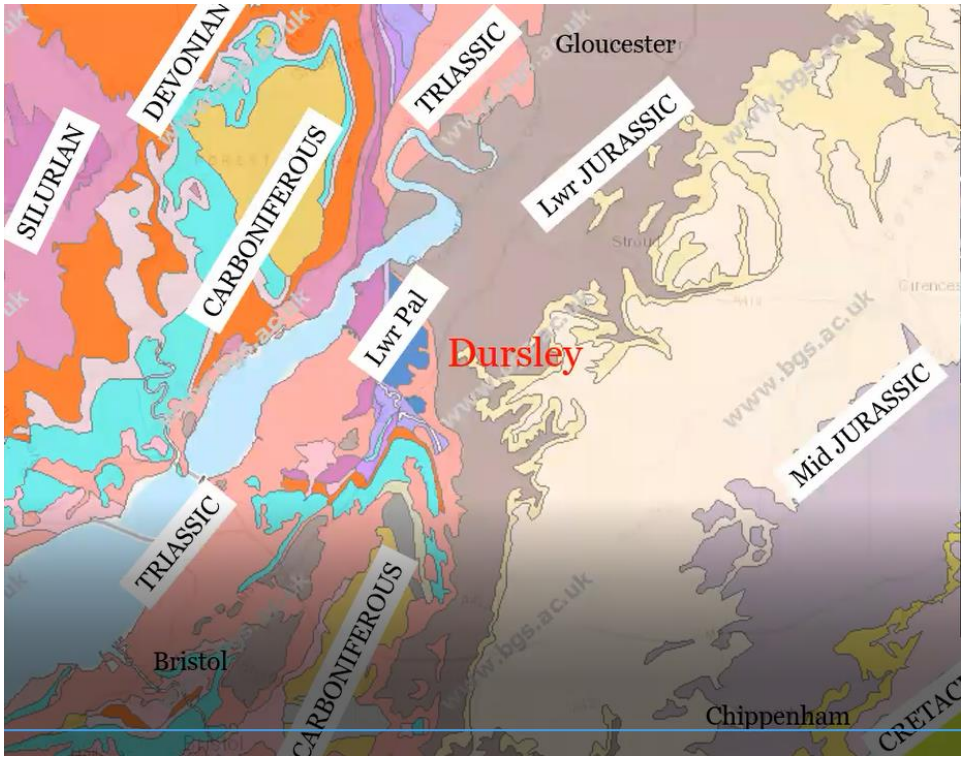
Martin broke off to observe that the study of geology was very much in its infancy when, in 1650, James Ussher, a Protestant Irish prelate working in London, calculated from a literal interpretation of the Book of Genesis that the World was created in 4004 BC! It was also declared that all sedimentary rocks were the result of Noah's Flood in 3290 BC! In 1786, James Hutton, a Scottish farmer and geologist, put forward the proposition that the Earth is not static and has to be extremely old to allow enough time for the formation of the rocks as he observed them. He cited those of Siccar Point, south-east of Edinburgh, where he identified three types of rock lying at different angles, one on top of the other, and but with erosion between the layers, indicating a vast passage of time for this to have taken place (unconformities).

During the Carboniferous Period (360 to 286 Ma), Britain was close to the Equator, when the trees in tropical rain forests (likely lepidodendrons 100 feet high) rotted in braided rivers and swamps, subsequently being buried deep and by high temperature and pressure turned into coal. At this time, reptiles, amphibians and sharks roamed the warm, shallow seas and limestone was laid down, which we see today in the Pennine Hills, Cheddar Gorge and Malham Cove. Beginning in the late Devonian and continuing throughout the Carboniferous, Europe moved northwards and collided with us, triggering the Hercynian (or Variscan) Orogeny, causing massive intrusions in Devon and Cornwall, providing us with tin associated with the granite and another ophiolite on The Lizard.

Lateral oozing of magma produced the Whin Sill, which made a natural site for Hadrian's Wall and is also the basis of Holy Island and Bamburgh Castle. There were more volcanics in Scotland and Edinburgh, Dumbarton and Stirling Castles are all built on granite outcrops.

Finally, Martin came on to the Permian (286 to 248 Ma), at which time Britain had moved north to the same latitude as today's Sahara Desert. It was now part of Pangea, although a north/south marine fairway was forming to the east, similar to today's Mediterranean or Persian Gulf. The limestones from this were used to build York Minster, King's College Cambridge and the Houses of Parliament. The dry Aeolian desert sands solidified into the New Red Sandstone and evaporite salt deposits were formed. These are mined in Cheshire (and in Siberia, Romania and Sicily). The salt is lighter than its sandstone surroundings, so tends to flow upwards like toothpaste, causing anticlinal traps in which rising oil and gas are retained. So formed were our reserves in the North Sea.

Martin completed his most interesting lecture by pointing out that we are, in Dursley, particularly fortunate in that many different rock formations are close at hand in all directions. The Cotswolds were formed in the shallow waters of the Jurassic Period and Salisbury Plain in the younger mid-Jurassic and Cretaceous. The Forest of Dean is largely Devonian and Carboniferous and the latter also extends to the south of us in the Bristol area.



There is a small band of elevated Silurian rocks at Tortworth. Much of Wales was formed in the Palaeozoic — Cambrian, Silurian and Ordovician. The massive extinction at the end of the Permian Period, the "Great Dying", was probably caused by Siberian flood basalts, ash clouds and ignited coal. The oxygen in the atmosphere was very low and sulphur and carbon dioxide levels rose, causing global warming. Both plants and animals died, giving way, when conditions improved, to the Mesozoic, the age of the dinosaurs. Graham Ellis concluded the meeting by expressing our thanks to Martin Eales for a superb informative talk.

John Morton FGS

30/7/2020 Zoom talk by Martin Eales on "The Unification of the British Isles: a Lesson in Geology". How England and Wales collided with Scotland, then Europe with Britain and finally the breakaway of America.

Martin spoke slowly and clearly so that it was easy for the fifteen members watching to follow his talk and spent some time developing the necessary background information. He began by speaking of the political unification between Scotland and England, starting with King James I and VI and the formal union in 1703, in order to emphasise the almost incomprehensible time gone by since the geological union – around a million times the number of years! About 500 Ma (million years ago), England was close to the South Pole about 4000 miles away from Scotland, which lay at around 20°S on the other side of an ocean called the Iapetus. Since then England has moved steadily northwards. The fossils of 500 Ma in the two land areas are quite different from each other. The Iapetus Ocean closed and both areas then show fossils of the same species from about 400 Ma. All the land masses of the Earth joined together to form one continent, Gondwana. From the Carboniferous Period (c.300 Ma) Gondwana began to split up but it was not until the late Cretaceous (65 Ma) that the Atlantic Ocean started to form. Since then it has been widening at about two inches a year (the speed at which your fingernails grow) and continues to do so. I don't think this will substantially affect the air fares between Britain and the U.S. just yet! When Scotland eventually collided with England along what is known as the Iapetus Suture, it threw up huge mountains of Himalayan proportions. These eroded at a very high rate by geological standards and the rock was carried south as the Old Red Sandstone, as far south as Ross-on-Wye, where it can be seen today. It caused volcanic activity in the Lake District and North Wales. The line of collision aligns closely with today's political boundary (as Martin Eales said – most political boundaries are geological ones – and there should be no argument that Berwick is in Scotland!). Some evidence of

the collision is visible in the Ballantrae ophiolite, a part of the edge of the Scottish land mass that was not subducted under England but forced up over the boundary. The Great Glen is an old transverse fault. The northern side can be shown to be sliding north-eastwards because rocks of the same type can be seen on opposite sides of Loch Ness about 40 miles apart. Martin mentioned the Moine Thrust, in which older rocks in northern Scotland have been thrust north-westwards over younger ones, something which perplexed early nineteenth-century geologists. There was also much volcanic activity, evident in the large number of dykes in western Scotland and delightfully visible in the columns on Staffa Island (Fingal's Cave) and the Giants' Causeway in Northern Ireland. Martin answered a small number of questions and Graham Ellis thanked him for a most enlightening lecture.

John Morton, FGS.

16/07/2020 Zoom Presentation by Dr Jane Sellwood on the Virology of Coronavirus.

For anyone wanting a better understanding of all the scientific issues associated with CoVid-19, this was the presentation to watch. In the space of an hour, Dr Jane Sellwood explained the science behind the virus, how the body responds to infection, and the vaccines and other treatments being developed to control the epidemic. Jane Sellwood had worked as a clinical scientist in virology at the Royal Berkshire Hospital in Reading and, although now retired, she was obviously very knowledgeable about the latest scientific developments. She gave a very helpful and informative talk about this complex subject.

We learned that, whereas some viruses contain double-stranded DNA genetic material, CoVid-19 has a single strand of RNA. CoVid-19 is one of the family of coronaviruses which are so-called because of the spikes of protein on the spherical surface. It is these protein spikes that allow the virus to penetrate human cells and replicate rapidly. Fortunately, the human body can develop anti-bodies, which lock onto the protein spikes to disable them, and a second form of defence involves T-cells that can detect and destroy the virus.

There are four strains of coronavirus that cause the common cold, but these infections are not usually too serious and only affect the upper respiratory system. CoVid-19 is more dangerous because it can infect the lower respiratory tract and cause pneumonia. It also has the potential to spread to many other organs in the body causing extensive inflammation or sepsis by over-stimulating the body's immune system. As we all know, such adverse reactions may, sadly, have lethal consequences.

Dr Sellwood explained the current testing techniques; the antigen tests to detect current infection which are not always sufficiently sensitive, and the antibody tests to detect past infection which are not always as specific (and hence reliable) as they should be.

There are four different approaches to producing vaccines that are designed to stimulate the production of antibodies as well as activating the T-cells. Many laboratories worldwide are actively involved in vaccine development as well as investigating antiviral treatments such as dexamethasone, which is already licenced for use and, more recently, interferon which has shown very promising results in trials.

Dr Sellwood concluded her presentation by authoritatively answering questions from the audience.

Tony Wooldridge

From 26/03/2020 Visits and live talks postponed / cancelled due to the Corvid-19 virus self-isolation.

27/02/2020 Visit to the Rolls Royce heritage Centre, Filton.

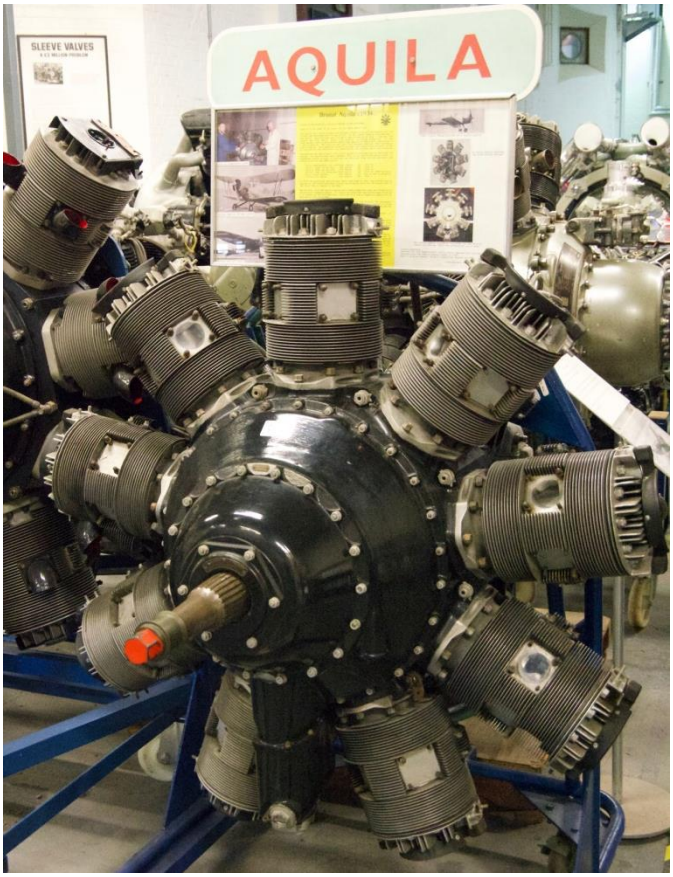
The tour commenced at the security lodge with a 10-minute walk to the museum. On the way, our guide pointed out buildings of interest. In the past 95% of their products were manufactured on site, now most of the parts arrive from all over the world in cardboard boxes. We passed many bright orange boxes known as “module boxes” that contain various engines and components. One was labelled “Bloodhound Engine”. We passed test bed buildings dating back to WW II. These housed dynamometers for a range of engines including turbo props, Olympus, marine Trent, and EJ200 that powers the Eurofighter.

At the lower end of the site, we entered the museum. This contained a collection of hundreds of aircraft engines with a connection to Bristol. Our guide had a thorough knowledge of the history having been employed on the site throughout his working life. He took us through the partnership

Some of the piston engines on view

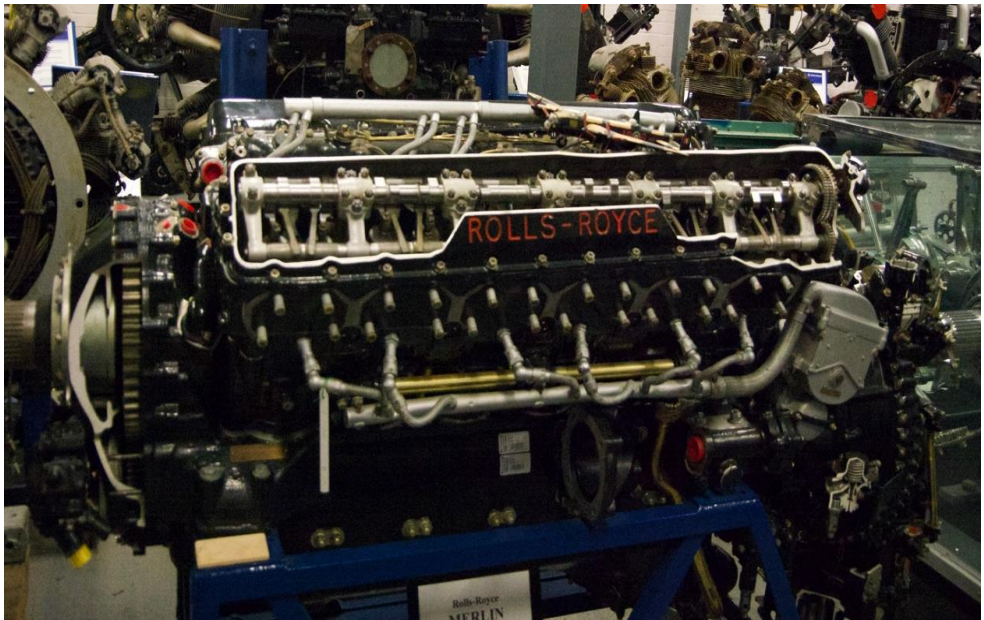
of Mr Rolls and Mr Royce and their association with the factory and regaled us with anecdotes. Mr Rolls was a keen aviator and gas balloonist. It was said that during one of his early gas balloon attempts he had emptied the Monmouth gas main. Armstrong Siddeley, De Havilland and the well-known Bristolian George White had all played a part in progressing the factory. WW 1 raised the game with much focus on producing more engines with greater power output. One of the earliest was the Curtis OX-5, produced in America, but vastly improved in performance and reliability by the

Bristol engineers. We learnt about the first radial engines designed by Fadden. There was no shortage of radial engines to view and discuss. The production of a radial engine having an even number of cylinders had the sceptics saying “I told you it would not run well” proved correct. The introduction of 4 valves per cylinder and a pivoted rocker arm housing, that maintained tappet clearances on hot running air cooled engines, is testimony to the company’s ingenuity. The Jupiter engine enabled the company to stay in business between WW 1 and WW 2. This engine was fitted to over 240 types of different aircraft. Licensing enabled it to be built by other countries, all countries with the exception of one paying royalties. Another first for the company was interchangeability, where, provided components were built to a drawing, they could be fitted to any engine of the same type.



Lord Rothermere privately funded the Blenheim with a Mercury engine. This was developed into the Pegasus a 1,000 HP engine that powered the first aircraft to look down on Everest. A diesel version of this engine was produced. Sleeve valve engines were proven to be very successful. A Merlin engine was on display but was really built by the opposition. The last piston engine - an 18 cylinder, was the Centaurus. A cutaway version, chrome plated, illuminated and rotating was most impressive.

The gas turbine section had examples of an original Whittle engine and a Viper. Through the ages, we had good descriptions of how the jet engine operates, again with working examples. There were tales of Rover and Rolls Royce agreeing to swap factories over a pint of beer, Whittle now working for Rolls Royce. Improvements in materials and counter rotating shafts pushed the boundaries. The Bristol Theseus was a successful turbo prop.



Cutaway Merlin engine used in the Spitfire and Lancaster aircraft

A flying boat had 10 Proteus engines but only 1 ever flew. The Brabazone had 8 Centaur engines. An HMS patrol boat capable of 50 knots due to having 3 Proteus engines impressed many. The Proteus was also used to generate electricity to assist the National Grid at peak times. The Orpheus powered the Bluebird during its attempt on the water speed record. An Olympus 593 removed from a Concorde was on display, and various components from a Harrier, demonstrating how it was able to take off vertically.

Our guide Brian explaining the Ghost engine that powered early versions of the Comet aircraft

I think all would agree that it was a very interesting and successful visit. Our members readily handing over their voluntary contributions before thanking our knowledgeable guides Brian and Robin, then heading to the M5.

Paul Sheppard. Photos by John Hobson

06/02/2020 TALK: John Morton's flying career

On Thursday 6th February, members of the Science & Engineering Group assembled at Dursley Methodist Church for a presentation by prominent U3A member John Morton about his 36-year flying career, which he explained spanned the development of post-war civil aviation.

From gaining his Private Pilots' Licence via a flying scholarship from RAF Air Cadets, at age 18 John was able to fly a plane before he could drive a car! Called up for National Service in 1954, John applied for pilot training, and was subsequently appointed Acting Pilot Officer and posted to RAF Tern Hill to spend 9 months learning to fly the Piston Provost – an overpowered radial-engined basic trainer. After 90 hours on Provosts, John moved on to De Havilland Vampires, an early single-engined jet fighter. On an S&E group visit to the Jet Age Museum near Gloucester a few years ago, John spotted a Vampire that he identified as one he had actually flown.

Having gained his RAF wings in 1956, and completed his National Service, John joined British European Airways, and was posted as second pilot to fly four-engined De Havilland Herons around the Highlands and Island of Scotland, including for the Flying Ambulance service, which averaged one call per day. John gave a detailed and most interesting talk about this last year. After 2 years, John was then posted to London, where he flew 4-engined Vickers Viscounts, which could fly

above the weather at 22,000ft, with its pressurised cabin. Routes were developed over the Mediterranean, and later to Middle East destinations such as Bahrain and Dubai.

Moving on to the 4-jet Comets, which were capable of cruising at 550 mph, John was involved in further developing Mediterranean routes, as well as routes to Scandinavia and Moscow, before taking up his first command in 1967, back on Viscounts, but a more powerful version. A major part of the work was German internal flights – the Russians would not allow Lufthansa to operate in and out of Berlin. There were 96 flights a day from and to Berlin.


De Havilland Comet 4B

In 1969, BEA Airtours was formed; a holiday charter company based at Gatwick. In Command of an Airtours Comet, John flew mostly routes from Balearics and North Africa to Greek Islands and Cyprus in the summer, and ski charters in winter.

1973 saw John flying Airtours' newly acquired Boeing 707s on long-haul flights to Los Angeles via Bangor, and Maine to Bangkok and Hong Kong, while also setting up new routes to places such as Teheran, Delhi, Sana'a, Cairo, and Tripoli.

From 1979, John's last 11 years were on Tristars; powered by three Rolls-Royce RB211 engines, they could carry 393 passengers. He described it as a delightful aircraft, with four separate hydraulic systems, so it was always operable after one or even two hydraulic system failures.


Lockheed L1011 Tristar

John's last flight, accompanied by his wife, was on 30th May 1990 to Abu Dhabi, ending a career totalling 17,600 flying hours "without scratching the paintwork"; a suitable tribute to his motto: SAFETY IS NO ACCIDENT .

Accompanied by tales of many amusing, and some quite tense incidents, this was a thoroughly entertaining and informative presentation. Thank you, John.

Dave Beer