

## **Science & Engineering Events 2022**

### **12/12/22 : Xmas drinks/lunch informal drop in at The Old Spot, Dursley.**

15 members came along to the Old Spot in Dursley for a very informal lunch/drinks prior to Christmas. Lots of chat, nice food and drink, enjoyed by everyone.

### **24/11/22 : Engineering challenges of the Cotswold Canal. A talk by Ken Burgin, Director.**

The Science and Engineering group welcomed local expert Ken Burgin for a talk on the challenges facing the team working on the attempt to re-establish the canal route between the rivers Severn and Thames. Ken has been involved with the project since 1976, was Chief Executive of the Cotswold Canal Trust from 2008 to 2020, and remains a Director of the Company of Proprietors of the Stroudwater Navigation and the Stroud Valleys Canal Company.



The Stroudwater Navigation, one of the country's early canals, was built in the 1770s. In 1789 it became part of a through route to London after linking up with the Thames & Severn Canal. The last use of the full length was in 1911 but parts of the Stroudwater Navigation lingered on until 1954.

The Cotswold Canals Trust has been working to restore these canals since the early 1970s when the M5 motorway construction severed the link between Saul Junction and Stroud. Five miles of canal through Stroud has recently been fully returned to navigation. A second Heritage Fund grant will see the remaining four-mile section of the Stroudwater Navigation restored by 2024 to reconnect with the Gloucester & Sharpness Canal and the rest of the national inland waterway network. Part of this work, the channel through the A38 roundabout at Whitminster, was finished last year. Next up will be to replace the missing mile, cutting a new section to share the existing channel where the River Frome is bridged by the M5, then linking up with the rest of the Navigation at Eastington.

But the biggest challenges lie ahead. These include refurbishing the over two miles long and over 200 feet deep Sapperton Tunnel, opened in 1789 to connect the two canals. Channelled through limestone and Fuller's Earth clay, and only wide enough for narrowboats, which had to be "legged" through. Prone to water leakage in the Fuller's Earth section, the last commercial traffic passed through in 1911 and in 1916 further roof falls occurred. The whole canal was abandoned by 1933. Around 20 miles of the route from the tunnel to the Thames at Lechlade are currently impassable.

The Canal Trust's funding bid rests on the argument that reopening the whole original route from Severn to Thames gives the best value for money solution to a very modern problem: how to meet the increasing demand for water in the South East. Plentiful Welsh water can be transferred via the Severn, the canals and the Thames. Political support will be vital as central Government money will be required, spread over several ministries.

Ken ended his presentation with an interesting hypothesis. Drive between Tetbury and Cirencester and there's a sign directing you to the source of the Thames. It's near the eastern end of the Sapperton Tunnel, close to the route of the canal and, inevitably the Thames Head pub. That part of the canal was notoriously leaky. Does the Thames really rise there, or was there some clever marketing?

Brian Gornall

### 3/10/22 : Woodchester Valley Vineyard.

On the 3rd October 2022, u3a members from the Science and Engineering group visited the vineyard at Woodchester for a video presentation on the history of the vineyard, a tour of the vines and winery and some wine tasting. Woodchester Valley is a Boutique Vineyard that makes wines from grapes it grows itself.

The UK wine industry is booming and has increased fourfold in the last ten years increasing to 178 wineries and 800 vineyards. Woodchester Valley started in 2007 with a trial planting of vines at Culver Hill Amberly. This expanded to the Woodchester site in 2012 and Stonehouse in 2013. It is thought that the Romans may have grown grapes near Amberly and



Woodchester as the slopes are ideal being on limestone, well-draining and south facing. The Stonehouse site is mostly clay so different grapes are grown there. The UK sparkling white wine is so good that the French are now buying up land in the UK to produce it.

Ten grape varieties are grown now at Woodchester Valley to produce a selection of white, rose and red sparkling and still wines from Bacchus, Ortega, Seyval Blanc, Solaris, Pinot Noir, Pinot Blanc, Pinot Meunier, Sauvignon Blanc and Chardonnay grapes. Initially the wine was made

at the Three Choirs Vineyard, but a winery was built at Woodchester Farm in 2016, followed by a tasting room in 2017, a shop on the Bath Road and accommodation in 2018. There are now forty five acres of vines with the newest plantings undertaken in 2019 and 2022. The vines are pruned in the autumn, buds form in spring, fruit forms and the grapes are hand-picked in late summer. The vines are self-pollinating. When the weather is frosty, candles are lit between the vines to keep the air moving and prevent the vines becoming damaged.



The quality of the harvest depends upon the weather. Bunches of grapes must be picked gently, and then crushed in the hopper. To retain the characteristic aromatics of wines produced in a cool climate, the grapes are lightly pressed and fermentation is slow and cool. The pressed remains are sent to a local farmer as cattle feed. Red grape skins colour the red and rose wines. Natural yeasts are not used as the outcome is unpredictable. Fermentation takes about two weeks. Some wines are stored in oak barrels for a couple of years and some are a blend of different grape varieties. A mobile bottling plant comes to the vineyard. After sparkling wines are bottled, a

second fermentation occurs in the bottles. The bottles are turned upside down and turned daily so the sediment collects in the neck. Then the necks are frozen so that the sediment can be easily removed.



Following the tour of some of the vines, and the winery, we returned to the tasting room. There were five wines for tasting, all with about 12% alcohol per volume: two still white wines, Culver Hill and Bacchus; a Pinot Rose; and two white sparkling wines, Cotswold Classic and Reserve Cuvée. Due to limited quantities, the red wine is not including in the tastings, but there were a couple available for those wishing to buy a glass to try.

Sally Beynon



### **25/8/22 : Hinkley Point C**



New build nuclear power stations are back in the news, with Government approval announced for another plant in Suffolk. The design is the same as Hinkley Point C (HPC), now under construction in Somerset, so the recent visit to that site by the Science and Engineering group was well timed. I used to know the area well through my work, but it's over 20 years since I was last in Bridgwater, the nearest town to the site. The area had changed considerably, with new build housing estates, and a new bypass round the town, investment thanks to EDF (Electricite de France) the operator of the UK's remaining nuclear generators, and the developers of HPC.

I don't intend to go into details here about how nuclear power stations work. Suffice to say that HPC is a pressurised water reactor (PWR), extensively used in France and around the world but with only one, Sizewell B, in the UK. EDF developed their own bigger version, producing considerably more power, and HPC is this design,



based on a prototype still under construction in France and operating versions in Finland and China. And HPC has some important safety improvements, insisted on by the UK's nuclear regulators, which are now being back fitted in Europe.

The capital investment required for nuclear stations has always been large, and inevitably bigger stations cost even more. HPC's price tag has now risen to nearly £26 billion. We could see where the money's being spent right from the start of the visit. Our coach dropped us at a park-and-ride



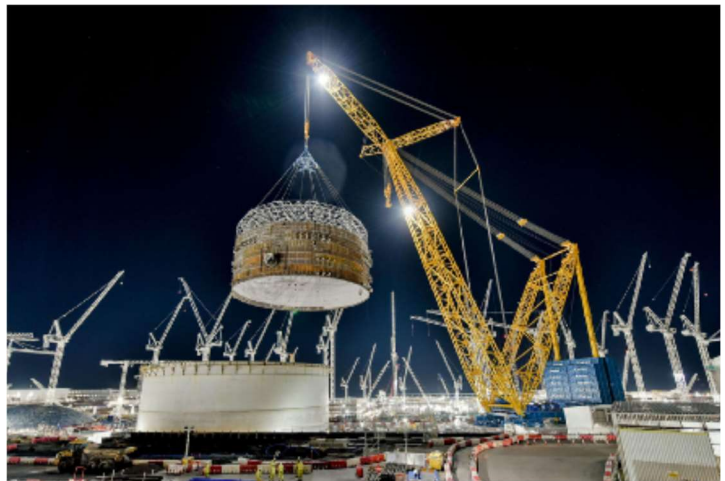
off a new bypass to the village of Cannington, the closest community to the site. After being checked in, photo ID mandatory, there was a safety briefing before a transfer to one of a fleet of buses serving the site. There's no site parking and all workers were required, on pain of the sack, to use the free buses.

But our first stop was in Cannington. Construction and future operating staff are being trained at Canning College. The Visitor Centre is in Cannington Court, which also now houses a conference centre

and 60 room hotel. We watched an immersive video presentation on the build and grabbed a group photo. Once on site, it's strictly no photography and no leaving the tour bus. Thankfully there were lots of photos online.

HPC is about 6 miles from Cannington. En route we could see a power line, with new design towers, to take the output to join the National Grid at Avonmouth. For environmental reasons, part of the line will be underground in a tunnel under the Mendips.

The complex itself is enormous, over 400 acres, and is much more than just a building site. We entered at the southern end through security and drove clockwise along the wide roadways, each junction traffic light controlled. There were offices, training facilities for every aspect of construction and operation, a medical centre, catering, and even accommodation for 510 workers. With the workforce due to peak at about 8,000, there is an off-site facility for another 1000 in Bridgwater.



Everyone was in PPE from top to toe, hard hats, goggles, high-vis waterproof jackets and trousers, safety shoes. No wonder we had to stay on the bus.

Bisecting the site is Green Lane, a retained and enhanced wildlife corridor with an active badger set and rehoused colonies of bats. 65,000 trees and shrubs have been planted to date.

The tour continued past the jetty, where large items arrive by sea,

several concrete making plants, and on past the first of the two reactor pressure vessels. Each ring



of the vessel is assembled on site before being lifted into place by 'Big Carl', the world's largest crane.

This brief account really doesn't do justice to the enormity of the whole project. The pictures from the EDF web site help, but unless you've seen it for yourself it's hard to grasp the sheer engineering achievement. The predicted date for completion is now 2027. The site will generate 3,000 Megawatts of electricity. You can follow electricity demand and production online, and as I write this at the start of October 2022, that would be about 10% of the UK's daily usage. With the prospect of colder winters ahead and world events shaping the price of energy, maybe the HPC project will prove to be a financial success as well as an engineering triumph.

Brian Gornall

### **28/7/22 : Underfall Yard**

The trip in July, organised by Bob Attack, took the group, including your editor, to Bristol and the Underfall Yard, an impressive but little appreciated example of Victorian ingenuity that still keeps the Bristol Docks safely in operation despite the immense tidal variations of the River Avon. The yard is at the mouth of the harbour and what better way to reach it than with a trip from Temple Meads station on a Bristol Ferry. Today, pubs, cafes and floating night clubs now congregate where warehouses and businesses flourished in what was once the country's second biggest port.



Many of us were familiar with the parts of the floating harbour, but only from the ferry was it possible to grasp just how far inland the original moorings stretched. We sailed from Temple Quay past Castle Park and the Old City, past St Mary Redcliffe, the Mathew, SS Great Britain, and on eventually to the Cumberland Basin and the lock at the Hotwells end of the harbour for a view of the Clifton Suspension Bridge.



The Rivers Avon and Frome were first modified for use as docks in the 1240s. They were still tidal and at low tide ships would often run aground. "Shipshape and Bristol fashion" described how vessels and their secured cargo were capable of taking the strain of repeated strandings on the mud. The present harbour, with a dam and locks, was created at the start of the 19th century.

But the harbour kept filling up with silt, and sewage, so it had to be closed periodically, drained, and the obnoxious residues dug out. In the 1830s Isambard Kingdom Brunel was hired to make improvements. He built



under cuts through the dam to scour the silt back into the river. The sluices, later improved, still operate but now they are automated and computer controlled.

The power house at Underfall Yard was built in 1887. The room which is now the visitor centre housed three boilers, which powered steam hydraulic pumps used to power the harbour's hydraulic system of cranes, bridges and locks. There are now three electric pumps in the adjacent room. We saw a demonstrate of how it all worked. In the adjacent tower a 100 ton weight is lifted up above a tank. The weight then slowly falls to pressurise the water in the hydraulic pipes. This accumulator ensures a smooth delivery of pressure, including peak demand, without needing to run the pumps continuously. We visited the maintenance workshops, also from the 1880s. Much of the original machinery survives.

The visit concluded with a walk around the Cumberland Basin to view the locks and the New Cut which takes the Avon out around the Harbour. Then it was back on the ferry to Temple Meads where our party separated for members to do their own thing in Bristol before returning home.



Brian Gornall.

#### **7/6/22 : Incinerator visit no 6**

See report from 2021.



#### **31/5/22 : Incinerator visit no 5**

See report from 2021.



#### **28/4/22 : Museum of Bath at Work, and Herschel Museum of Astronomy, Bath**

Our April visit was to a couple of Bath's lesser known attractions, reports Paul Sheppard. Many tourists from around the world visit the museums in the city centre, unaware of the interesting historical exhibits in the Museum of Bath at Work, situated in Julian Road, halfway down Lansdown Hill.





Established in 1978 in a building dating from 1777 that was once a Real Tennis court, the museum houses a series of authentically reconstructed workplaces, workshops and display galleries.

Stuart the only paid member of staff, showed us a "Bath Chair", a three wheeled carriage invented by James Heath to carry people up and down the steep hills. Our guided tour started with a visit to the extraordinary engineering and soft drinks factory of Victorian businessman J. B. Bowler. Over 50 years ago, the entire contents of the factory in Avon Street was photographed and then transported to the Museum building and re-constructed exactly as it was in its former home. We saw the shop counter, a fully equipped belt driven machine shop and many examples of "one off" items that were made for large companies. There was even a small foundry for casting gears and items related to plumbing.



Bowler's other claim to fame was the production of flavoured and gassed mineral waters. The company perfected a way to produce and store the carbon dioxide and a device to inject the gas into bottles. The first bottles had rounded bases and could only be stored on their sides, thus keeping the corks moist to prevent the gas from escaping. The later version had a loose marble as a stopper. Millions of these bottles, all made by one Yorkshire factory until the patent expired, and fully reusable, with just an occasional replacement of a rubber seal, were used worldwide. Surprisingly, a modern example of a glass marble stoppered bottle is still made in China.



The Museum also has a car manufactured in 1914 by the Horstmann Car Company of Bath. Sidney Horstmann's business operated from 1914 until 1928, making around 2000 cars. One model even had a Dursley made Lister engine. He first made his fortune through inventing a timer to switch street lights on and off. He also made and sold the first illuminated sign, individual one foot high letters made from bent pipe with a series of holes emitting burning town gas, then joined to make a word.



We concluded the morning at the Herschel Museum of Astronomy in New King Street, in the 18th century terrace house where the amateur astronomer William Herschel, using a telescope of his own design, discovered the planet Uranus. His observations doubled the size of the known solar system. Herschel constructed a seven-foot reflector telescope, a modern full-sized replica of which is on display on the Ground Floor. (Your Editor couldn't resist a peek through the lens, and paparazzo Brian Wetton couldn't resist the snap).

The reflector was cast in the basement of the house from an alloy of copper and a high percentage of tin. The mould was made from a mixture of horse manure and plaster. The cast reflector then required weeks of hand polishing. To speed this up, he also invented a polishing machine. On one occasion the molten metal escaped from the forge and caused the flagstone floor to explode. In the attic was a treadle operated lathe used to produce eye pieces.



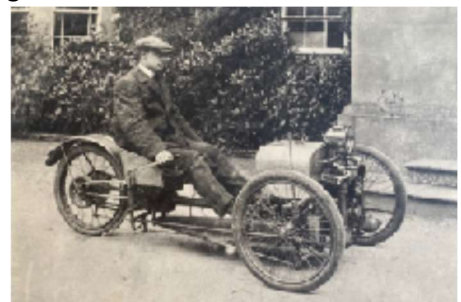
On the 13th March 1781, Herschel, using his telescope in the back garden, discovered the planet we now know as Uranus. He originally named the planet, to the delight of King George III, Georgium Sidus - George's Star. The rest of the world called it Uranus after the Greek deity Ouranus, the sky. Instantly famous, Herschel gave up his career as a musician to become the king's personal astronomer and moved to Slough, nearer Windsor Castle. Here, he built a giant, 40 foot long, telescope. He also discovered infra-red light. While using a glass prism and filters to examine sun spots he noticed that his control thermometer, which was positioned just past the red side of the spectrum, was hotter than any others. From this, he deduced that there must be another form of light beyond the visible spectrum.

Brian Gornall

### **24/3/22 : Morgan Cars.**



Our March trip out was to the Morgan Car Factory, beneath the Malvern Hills. The business is now over 100 years old. Its founder, H.F.S. Morgan, quit the Great Western Railway in 1904 and set up a motor sales and servicing garage in Malvern Link. In 1909 he designed and built a car for his own use, a three wheeler known as a "runabout". The car gained much popularity prompting him to build the Morgan Factory. These iconic three-wheelers were built from 1909-1954. Four-wheeled versions were introduced in 1956. The use of a Rover V8 engine ensured good sales for many years, helped by the fact that, for a while, this was the fastest production car in the world for 0-60 mph. To celebrate the company's centenary they produced a new batch of three wheelers and were so surprised at the success of this model that they continued





production. The motive power for their latest model is a Ford Fiesta engine mated to a Mazda MX5 gearbox.

Our party of 30 was split into two groups for a factory tour with a couple of enthusiastic and informative guides. During the tour we witnessed most aspects of the build, including bending and gluing the ash wood for the frame in the original wooden former, panel beating the aluminium panels and application of veneer to the dashboards. An attempt to import ash from Belgium failed after it was found to contain wartime shrapnel which damaged the cutting tools. Lincolnshire ash is



now used, with enough available for the next 20 years. "Ash dieback" may be a problem in the future. Leather for the upholstery comes from Scotland.

The old ladder frame chassis has been updated to a bonded aluminium platform. This keeps the long standing power to weight ratio in check, ensuring good performance and roadholding. ABS braking is used but not traction control or electronic handbrakes. The ability to perform handbrake turns seems essential for some customers. The record for seriously damaging a

new Morgan is just 600 metres from the factory gate. At one time, there was an eight year waiting list for a new car. Now the wait is five to six months. Paint colour options are in excess of 40,000 and many bespoke build options are available. The worldwide shortage of electronic chips, exacerbated by the war in Ukraine, does have a slight impact on Morgan, but not to the same extent as other manufacturers. Morgan want to use internal combustion engines for as long as possible, but have a secret experimental site for the electric cars of the future.

For most of its history, the company has been owned by the Morgan family, but In 2018 a majority stake was acquired by an Italian investment group Investindustrial, with family members remaining minority shareholders. Most Morgans are exported and 97% of Morgans built are still in existence. I had been to the Morgan factory before and thought I knew what to expect but this visit exceeded my expectations. Morgan Cars have been kept up to date without losing their hand built charm. The production line is the antithesis of the high tech BMW Mini factory in Oxford the u3a visited in 2019. Learning about both cars fully enlightened our brain cells. The only similarity however is that they both use BMW engines.

The tour ended in the recently built "Experience Centre". This houses a museum containing an exact replica of Harry's first "runabout", a shop, cafe and showroom. Driving experiences are available at the Centre, ranging from a half day to as many days as you like, limited only by your bank balance. Many members enjoyed sitting in a Morgan for a while and dreaming. With our age group, however, there were some moans and groans whilst getting in and out.

Paul Sheppard

#### **24/2/22 : John Taylor Bell foundry, Loughborough.**

*February 24th saw a keen coach load of members, including your editor, plus a couple of motorists, head for what turned out to an outstanding day out organised in style by Donald Gibson.*

Our u3a has visited many scientific and engineering businesses, but Taylor Bells of Loughborough might be the first that still uses a century old technology, albeit with one or two modern twists. John Taylor



and Co can trace its lineage back to the 14th century, and the present site, now the largest bell foundry in the world, opened in 1859. They now make single bells, peals, chimes, carillons and even musical handbell sets. The fillings and frameworks are also produced, and there are plans to restore and reuse the original ropewalk. This proud heritage is well represented in the Foundry Museum, run by a charitable trust.



*In the Furnace Gallery, the oldest, and loudest, attraction, was a collection of bells from around the country. Wooden mallets were supplied and the opportunity to clang away was irresistible.*

Bell making was explained on film. Moulds are made using the original loam process. Loam is a mixture of red and black sand, chopped hay, water and horse manure. The final dried, porous, mix allows gases to escape during moulding. The mould is carefully smoothed to the correct shape and size, then decorated and burnished. The casting, using bell metal (77% copper, 23% tin), takes place in the sandy earth of the foundry floor, where the bell cools slowly over two days to give the best sound.

Our visit coincided with the casting of a bell for St John the Baptist Church Eastnor, near Ledbury. We joined their bell ringers on a gallery above the foundry floor to watch. First, the molten bell metal, at a temperature of 1200 degrees, was poured into a large bucket, where willow wood, a natural source of salicylic acid, was incinerated to improve the flux of the pour. Once clean of surface slag, the bucket was carefully swung by crane to the buried mould, where it was gently and slowly poured into the head. Any surplus metal did not go to waste. It was poured into a trench in the sand for cooling before recycling into a future cast. Eddie Hamilton and I grabbed some photos.

It would be a couple of days before the new bell could be freed from the mould, so we next visited the part of the factory where the process would be completed. We were in the large original Victorian structure, bricks once white washed but now a dirty grey. And while the foundry floor was sand, we stood on what looked like stone tiles, but were in fact more forgiving oak blocks, as fitted in the 19th century. Workers have occasionally been known to drop a clanger.







The bell needs to be tuned. The machined metal tuning is by a technique developed by Taylors in 1896, the five-tone principle. The bell tuner uses the five main harmonics, and when the correct frequency is achieved for each, the bell is said to be in-tune with itself. Tuners are trained under an apprenticeship scheme. While digital aids are now available, Taylors rely on tuning forks and a well-trained ear. The factory keeps the tuning forks for all the bells they have ever made, so if a replacement is needed, the tone of the ring will be exactly the same.



Also archived are the dimensions of the circular wooden wheels that carry the bell ropes. The table in the carpentry shop is, again, an original from when the factory opened. Over 25,000 bells have been made in this Loughborough factory. Probably the most famous is

'Great Paul', over 16 tons in weight, cast in 1881, and still hanging in St Paul's Cathedral, London.

*This account can only give a flavour of what was a fascinating day out to both a part of our industrial heritage and a modern successful business. If you're in the East Midlands, make a visit to the museum part of your trip.*

Brian Gornall

**3/2/22 : Incinerator visit no 4**

See report from 2021.