

NEWCOMEN Links



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Writing for Newcomen Links

Relevant articles and items of news may be submitted to be considered for inclusion in Newcomen Links.

Articles should be a maximum of 700 words and sent in Word format by email.

Images should be sent separately by email in jpg (digital) format of 300dpi minimum. They should not be embedded in the text of the Word document.

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The copy date for the next issue is 1 February 2014

Please submit articles, information, details of events etc to:

The Editor,

Deborah Jaffé at:

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07798 603000

Notes on Contributors

Jonathan Ayles is chair of the North Western Branch of the Newcomen Society and co-editor of Ribbon of Fire on the transfer of steel strip rolling technology from the USA to Europe.

Rev Robin Brooks was apprenticed in heavy electrical engineering at ASEA in Walthamstow, London. He joined the London Electricity Board in 1965 as a distribution engineer. Having taken voluntary severance in 1995, he was later ordained as a Methodist Minister, but is still an engineer at heart.

Ian Broom has been an active member of the Western Branch since it was formed in 1998. He was Secretary before becoming Branch Chairman. He is also a long standing member of the Crofton Branch of the Kennet and Avon Canal Trust and has presented two papers to the Society on the history of Crofton.

Elizabeth Duff followed mathematics and linguistics studies at university with an early career in technical publishing, including the sector of marine engineering. She later specialised around writing and editing in the field of international maternal and family health, but maintains a keen interest in broader areas of scientific development, especially those with a longitudinal perspective.

Michael Grace is a chartered town planner and environmental engineer with a life-long interest in the history of technology. He joined Newcomen in 1984 and is currently Vice-President. He is also Vice-President of the Industrial Heritage Association of Ireland.

Henry Gunston is a hydrologist, with a degree in agricultural engineering. His historical interests cover industrial history generally. Special interests are fenland land drainage and river engineering in England, and railway engineering in countries where he has worked overseas, especially East Africa.

Prof Frank James is Professor of the History of Science at the Royal Institution, a Fellow and Treasurer of the Newcomen Society.

Stephen K Jones's career is in industrial development and economic regeneration with particular interest is the study of engineering history, especially relating Brunel. The final volume of the trilogy, Brunel in South Wales, was published in 2009. He is a member of the ICE Panel for Historical Engineering Works (PHEW), sits on the editorial panel for the Engineering History and Heritage journal and is a member of Council.

Nigel Jopson is a Chartered Chemist with 35 years experience in the pulp, paper, converting, printing and packaging industries, from the Americas to Scandinavia. He is also a devotee of all things steam, especially locomotives.

Dr Phil Judkins, PhD MA (Cantab) MSc is Chairman of the Defence Electronics History Society, a lively society devoted to raising awareness of defence electronics of all eras.

Madeleine Kessler, AADipl. MEng (Hons) trained as both a Structural Engineer and an Architect. She was awarded the 2012 KPF Travel Scholarship and currently works as a collaborator at Studio Weave in London, having previously worked in Switzerland and China.

Dr Bryan Lawton was Reader in Thermal Engineering at Cranfield University (Shrivenham) and is now an active member of the Society. He was an organiser of the recent Internal Combustion Engines Conference in Manchester and has written four papers for the Society.

Charles Morris is a Civil Engineer interested in bridges. He worked for Dorman Long & Co Ltd, a company with an international reputation for building bridges. He is Chairman of the Cleveland Industrial Archaeology Society. He has had papers published on: mineral workings, cement manufacture, tunnels, bridges and blast furnaces in the Cleveland area.

Dr Fred Starr is a Metallurgist who has specialised in gas manufacture and electric power generation. He is greatly interested in technical developments in the 20th Century and recently helped set up the Conference on the Piston Engine Revolution. This tied in with his other main interest, the history of aircraft design.

Geoff Wallis is the President of the Newcomen Society. He is founder and former managing director of Dorothea Restorations Ltd and has 30 years of experience as a contractor.

The copy date for the next
issue is
1 February 2014

From the President Geoff Wallis

When does history finish? Our past shapes everything we are and do, so the study of the past gives us wisdom as we gain understanding about our journey thus far and our 'direction of travel' into the future. Surely therefore an important part of the Newcomen Society's role is to study the recent past in the form of modern technical and engineering developments, and to interpret them into the future.

Looking at our Branch winter programmes (see www.newcomen.com) you will see that our historical focus has already widened to include relatively modern engineering and technological developments, and these prove just as popular as the more traditional subjects. For example, in September the North West branch fielded an excellent lecture on 20th century military electronics. This drew an audience of well over a hundred, far more than 'normal' attendance. Past Summer Meetings in Portsmouth and Manchester, which featured visits to research establishments and modern industries, were popular 'sell-outs', and we plan a similarly mixed programme along the M4 corridor in July 2014.

The study of modern technology also widens interest for members and will draw in those less convinced of the value of studying technical history. The study of newer technologies by the Society is to be welcomed and encouraged. Should we perhaps recognise the importance of this and restyle the Newcomen Society: For the study of the development of Engineering and Technology?

What do you think? Please let me know your thoughts on this and any other matter.

Geoff Wallis
president@newcomen.com

From the Editor Deborah Jaffé

Thank you again for the lively range of material that has been submitted and to all those who have ideas for future issues. In many ways this issue shows the relevance of history to engineering developments.

The extensive and in-depth knowledge within the Society's own history is revealed in Jonathan Ayles's report, of Brain Cornfield's talk to the NW Branch, on the Hornblower Family. It references the Society's papers on the Hornblower Family. There are 5 papers in the archive of past papers, the first one dating back to 1929, and all can be downloaded. The Society holds an impressive and invaluable resource for researchers.

Michael Grace's article James Hardress de Warrenne Waller's Ctesiphon System, shows how a technology devised in the 1940s owes its origins to ancient Middle Eastern architecture. The Royal Institution has used the latest technology to transform approaches to archiving manuscripts. The manuscript of The History of the Davy Lamp has been scanned and, with transcripts and notes, been produced as an e-book to be downloaded onto a tablet.

Visits by groups and individuals are covered too. The NE Branch studied the bridges of the Tees estuary. Many thanks to John Liffen and the staff of the Science and Society Picture Library at the Science Museum for supplying a wonderful image of the Stockton & Darlington Railway crossing of the Tees in 1830. A group explored the impact of Brunel in South Wales and there were trips to the Pontypool and Blaenavon Railway, Hereford Waterworks Museum and to the National Stirling Engine Rally. Individuals visited the Museo Galileo in Florence, Scotland and Burma. Engineers Heritage Australia included a report of their visit to the Summer Meeting in their newsletter. We have more news on the proposed visit to Australia to the EHA Summer Conference in 2015.

Reports from the Branches cover meetings on the centenary of stainless steel and the impact of ENIGMA code –breaks on missiles after World War II. As the centenary of the start of World War I approaches we have news of a Newcomen Conference on engineering in that war and aftermath.

The Newcomen Calendar, which was a centre spread pull-out in the September issue, has been updated and appears on p 22-23. Other events are on the back cover.

So, I do hope this issue gives much to read. As usual, please continue to send your contributions. The copy date for the March issue is 1 February 2014.

Best wishes for the holiday season.

Deborah Jaffé
editor.links@newcomen.com

Newcomen Matters

THE SOCIETY'S AGM

FOLLOWED BY
GEOFFREY SMITH'S LECTURE:
THE ORIGIN AND DEVELOPMENT
OF GUNPOWDER

12 FEBRUARY AT 17.45

The Director's Suite
The Science Museum
Exhibition Road
London SW7 2DD

*AGM papers are enclosed with the
mailing of this issue*

Newcomen Summer Meeting

14-18 July 2014

EXPLORING THE M4 CORRIDOR FROM
READING TO BRISTOL

Details on p 24

Supporting the Branches

Now that the finances of the Newcomen Society are back on course to break even this financial year, Council has decided to allocate £5000 towards supporting and developing the branches.

This money could, for example, be used to establish a new branch or to enhance the programme of existing branches, but all proposals should have the aim of increasing membership of the Society.

Proposals, which should not be longer than a single side of A4, with indicative costings should be sent to the Treasurer: fjames@ri.ac.uk

*Geoff Wallis, President
Frank James, Treasurer*

Congratulations

The Society congratulates Richard Hills who has been awarded the Medal of Honour by Manchester University. This is one of the highest awards the university can bestow and is in recognition of his work as Director to launch what became the Museum of Science and Industry (MOSI) in Manchester and for his publications on the history of technology.

New Members

We welcome the following new members:

Mr. Tony Brown, Mr. Alan Clothier,
Mr. John Ditchfield, Dr. Trevor Evans,
Mr. Per Svein Hansen,
Mr. Kieran Keenaghan, Mr. Alan Lundie,
Mr. Patrick Nott, Mr. Brian O'Connor,
Dr. Richard Parry, Mr. Arjan van Rooij,
Dr Thomas Schweizer,
Miss Karyn Stuckey

Membership Matters

Keeping up with what's going on in the area of Membership there are some developments and requests:

LinkedIn Group

An Open Group has been started on the social networking site LinkedIn. Members and non-members have signed up to the group and receive the details posted on the Group and can contribute items of their own. Contributions include Newcomen Society news and details of other "outside" items which would be of interest. This supplements and widens the range of the discussions and news on the Members Area of the web site.

LinkedIn members can look up 'Newcomen Society' in the Groups or follow the link:

www.linkedin.com/groups/Newcomen-Society-4437011?trk=my_groups-b-grp-v

Renewals

A reminder that this is the last issue of Newcomen Links that members who have not yet renewed their subscriptions will receive. I have had comments from some members who have experienced difficulties in using the website.

If anyone has experienced problems in logging in or using the facilities offered please get in touch with me at: membership@newcomen.com or by letter to: D.H.W. Hayton c/o the office.

Email Addresses

Thank you to all of those who let the Society know their current email addresses in response to our last notice. It has, however, come to my notice that some of our members have email addresses that have "expired" by reason of retirement from work or change of employer. It would, perhaps, be more appropriate to use a general email provider such as Gmail.

A Gmail account can be set up at:

<https://accounts.google.com>

If any member is experiencing problems please get in touch with membership@newcomen.com

Dan Hayton, Membership Secretary

*The copy date for the next issue of
Newcomen Links*

is

1 February 2014

*Please send submissions to:
editor.links@newcomen.com*



The Website

The Home Page of the website has been simplified as there was confusion between the 'log in' and the 'sign in' panels. The 'log in' panel, which was midway on the right hand side of the page, has been removed. So, access to the Members' Area, and for new members to join, is by clicking on the 'sign in' panel in the top right of the page.

We need your correct email address!

We need your correct email address so that we can communicate with you more regularly to make you aware of news and events, and for you to be able to access the Members' Area of the website. This is now live and we welcome your ideas for future development. Please email the Membership Secretary, with the email address you wish us to use at: membership@newcomen.com In this way we can make sure our records are up to date.

Please contact the Membership Secretary, not the office, if you have difficulties accessing the Members' Area of the website:
membership@newcomen.com

Seen.....



to be so formed. The company prospered and built a new works in Naylor Street...In 1880 Morton's took over the Windsor Iron Works in Garston, run by Colonel Hamilton... Mortons expanded, increased production, and won orders from all over the world, for their fences, gates, iron schools, churches and railway buildings. One of the first contracts at the new site was for the main girders of the Overhead Railway, work on which started in 1889.

Morton Co Archives: National Museums Merseyside, Business Records Centre SArchives Dept.
www.liverpoolmuseums.org.uk/maritime/archive/

When walking by Loch Ken in Dumfries and Galloway, Elizabeth Duff came across this gate patented by Francis Morton and Co. Ltd. According to records held at the National Museums, Liverpool: *The company goes back to 1766 when John Morton established a Chandler's business in Cable Street, Liverpool. By 1847 the firm was trading as the "Galvanised Iron Merchants", and run by Francis and Henry Morton. In 1858 Henry retired; Francis carried on alone and opened offices at 27 James Street and acquired works premises in Bevington Bush, and in 1863 additional works at Marybone... [when] Francis Morton died,... the business was formed into a limited liability company, under the new Act of 1861, becoming one of the first firms in Liverpool*



In Burma, Madeleine Kessler was intrigued by the number of abandoned railway carriages which people have made their homes. This assortment of carriage homes is in Yangon on the southern slopes of the Himalayas. The Shwedagon Pagoda gleams in the background.



The Refurbished Museo Galileo in Florence

Frank James

At the meeting of the European Society for the History of Science in Florence held at the start of November, I was given the opportunity to visit the newly refurbished Museo Galileo. This is located in one of the oldest surviving buildings in the city and is by the River Arno just around the corner from the Uffizi Gallery. Unlike the Uffizi, however, there are no four hour queues. Until its refurbishment the Museo Galileo was called the Museo di Storia della Scienza and the new name was chosen to emphasise Galileo's central role in Florentine heritage. It is the only museum in the world that possesses objects made for and used by Galileo in the early seventeenth century. These include a number of telescopes as well as the object lens of the first telescope that Galileo used in 1609-10 to observe, among other things, the moons of Jupiter (which he originally named after the Medicis – the Florentine ruling family) and the phases of Venus which provided the first observational evidence of the explanatory superiority of the heliocentric system of the world over the geocentric.

This lens is usually kept in a frame which bears, presumably deliberately, a strong resemblance to a reliquary, but when I was there, the frame had been lent for another exhibition and the lens was exhibited by itself. The quasi-religious devotion to Galileo in Florence is reinforced not only by one of his fingers also being displayed in the Museo, but also by the Tribuna di Galileo in La Specola (next to the Palazzo Pitti) which is a sort of secular chapel built in the 1840s to house Galileo's relics until they were moved to the Museo.

Although the Museo Galileo has all known surviving objects associated with Galileo, they are not especially numerous and only a single room is devoted to him. What the Museo mostly houses are the scientific instrument collections of the Medici family and those of the Lorraine dynasty of the

18th and early 19th century. Here can be seen, amongst much else, the giant lens which Humphry Davy used in 1814 to burn diamond thus showing it was made of carbon and a superb collection of electrical apparatus mostly associated with Leopoldo Nobili. This latter includes a metal frame spelling the word 'DUX' which could be illuminated by electro-statics doubtless much to the pleasure of the Grand Duke of Tuscany.

The permanent display occupies two floors whilst the lower ground floor is devoted to special temporary exhibitions. When I was there this space was filled with bicycles illustrating their history in Italy (this will have closed by the time Newcomen Links is published). Among other things I learned that in the early days of cycling, each bicycle in Italy was taxed and had to display a tax disc, very similar to those that we use on cars in this country.

All told the Museo is well worth visiting by anyone interested in scientific or technological history. Having spent a few days in shirtsleeves (in November) I was sorely tempted to stay on the plane when I got back to a cold, wet and windy Stansted and go back to have another look! It does, though, have an excellent virtual museum on the website.

**Museo Galileo - Istituto e Museo di Storia della Scienza,
Piazza dei Giudici 1, 50122 Florence, Italy
www.museogalileo.it
Tel: +39 055 265 311
E-mail: info@museogalileo.it
E-mail of the library: biblioteca@museogalileo.it**



The Hornblower Family: Steam Engine Builders Extraordinaire, a talk by Brian Corfield to the NW Branch

Jonathan Ayles

Brian Corfield's talk to the North West Branch of the Newcomen Society in September 2013 on "Hornblowers – 18th Century Steam Engine Pioneers" was very much a family affair since the speaker is a direct descendant of Joseph Hornblower who worked with Thomas Newcomen. Society members will be familiar with Brian Corfield's summary of "Thomas Newcomen the Man" in the International Journal for the History of Engineering & Technology issue of summer 2013.

Joseph Hornblower promoted a long tradition of engineering as his sons and his grandson went into the family business of building steam engines. The Hornblowers also drew support from a network of fellow non-conformists. Like Thomas Newcomen, the Hornblowers were staunch Baptists. Excluded from the professions by their religious beliefs, the non-conformists moved into the new fields of engineering and science. These religious ties provided a strong social network linking innovators in the emerging industry of steam power.

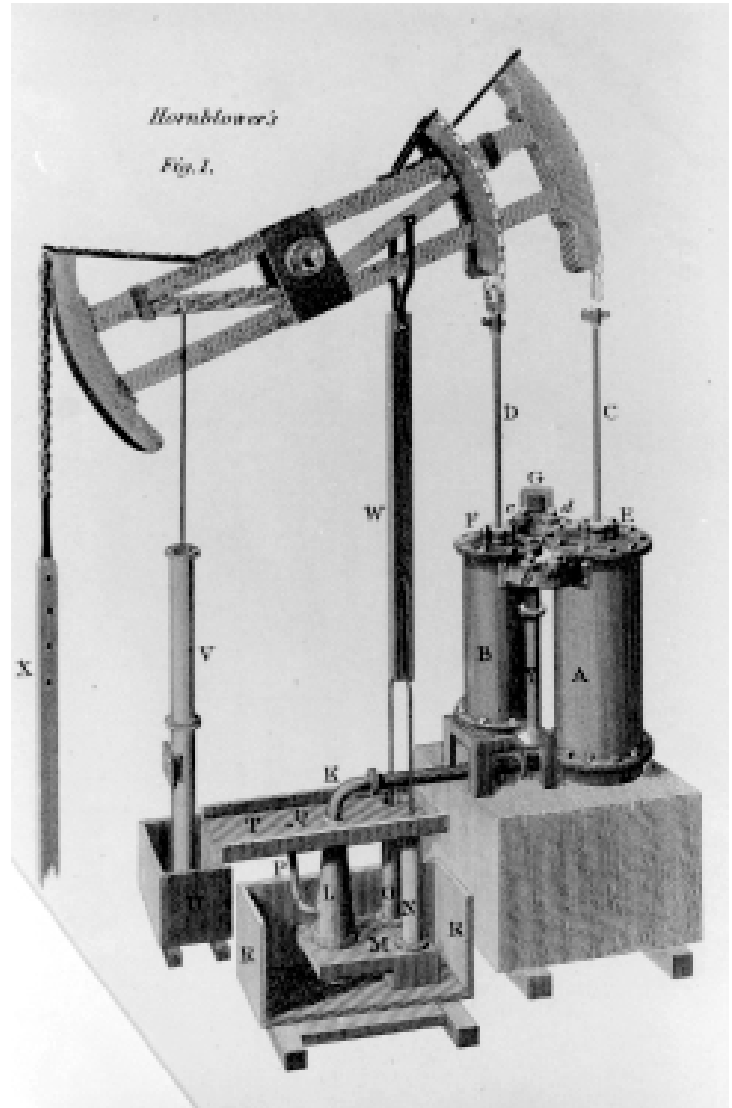
Hornblower was born in 1696 and became an apprentice plumber and brazier, perhaps assisting Thomas Newcomen at Dudley at a young age in 1712. What is clear, is that Joseph Hornblower became active installing Newcomen engines for pumping at Cornish tin mines in the first half of the 18th century, possibly between 1718 and 1741. His son, Jonathan (senior) succeeded him in the business building Newcomen and early Watt engines in Cornwall, North Wales and Bristol. They were the process plant contractors of their day.

The youngest son, Josiah Hornblower, imported the first steam engine in America at a copper mine at Belleville, New Jersey.

He worked in this area from 1753 onwards. Josiah accompanied parts for the first engine out to the North American colony and supervised its construction. Josiah remained in the USA, sided with the colonists and represented New Jersey in the Continental Congress. Josiah built steam engines and ore stamping mills, helping fire up the American industrial revolution.

Joseph's grandson,

Jonathan Hornblower junior, born 1753, is the best documented member of the family in the UK, see for instance the Society's Transactions^{1,2} and is the only member of the family listed in Richard Hills entry in the Biographical Dictionary of the History of Technology edited by Lance Day and Ian McNeil³. He is best known for his early British patent (no. 1,298) of 1781 on compound engines following experiments at Wheal Maid. Some 13 compound engines were built to Jonathan's designs in Bristol and Cornwall.



Jonathan Hornblower's 1781 patent diagram, no1298, The Compound Steam Engine

Notes

1. Jennifer Tann. *Mr Hornblower and His Crew: Watt Engine Pirates at the End of the 18th Century*. Transactions of the Newcomen Society Vol:51 (1979) p95-109
2. There are a number of other Newcomen Society past papers, published in Transactions:
 - A. C. Todd. *Davies Gilbert-Patron of Engineers (1767-1839) & Jonathan Hornblower (1753-1815)*. Vol: 32 (1959) p1-14
 - Rhys Jenkins. *Jonathan Hornblower and the Compound Engine*. Vol:11 (1930) p138-155
 - H. S. Torrens. *Some Newly Discovered Letters from Jonathan Hornblower (1753-1815)*. Vol:54 (1982) p189-200
 - L. F. Loree. *The First Steam Engine of America*. Vol:10 (1929) p015-029
3. Day L., McNeil I.eds. *Biographical Dictionary of the History of Technology*. Routledge 1998



The Ctesiphon store at Locke's Distillery at Kilbeggan, Co. Westmeath in central Ireland

The Ctesiphon System

Michael Grace

James Hardress de Warrenne Waller, to give him his full name, was born in Tasmania in 1884 and received his engineering education at Galway and Cork. In 1913 he established a consultancy business in Dublin in partnership with Alfred Delap. Whilst retaining his interest in the partnership, he joined the Royal Engineers during World War I, serving with distinction. His particular specialism was ferro-concrete and he persuaded the Admiralty to construct a concrete barge, which was launched shortly before the end of the war as a prototype for a battleship. After the war he worked on a variety of schemes in Ireland but following the death of Delap in 1943, he moved to London where he contributed to the Allied war effort through the design of various buildings. Some of them were constructed using his 'Ctesiphon' system which he patented in



*The Great Hall at Ctesiphon.
From 1911 Encyclopædia Britannica.
Wikimedia Commons*

Britain in 1942 and after the war in the US in 1955.

The system was inspired by the ancient arch of Ctesiphon in Iraq, which Waller had seen during a visit in the early 1920s. It exploits the compressive structural shape of an inverted catenary arch to minimise the requirement for reinforcement. A layer of jute or hessian fabric is spread over false-work arches erected at typically 3-foot centres. Cement plaster is then applied to the fabric, both inside and out, forcing the fabric to form the characteristic corrugated or 'jelly mould' surface. The outside is then lightly reinforced and additional plaster applied externally to create a shell about 2.5 inches thick.

The technique was cheap, quick and relatively easy to construct and for a time in the 1940s and '50s proved popular, especially to house aircraft as explained in his patent application.

There is a growing and urgent demand for large span structures of the order of from 100 feet to 500 feet (and possibly more) span for, among other purposes, protecting aircraft, particularly the larger types, from wind and weather conditions.

Very valuable aircraft, owing to lack of the required accommodation, not infrequently have to be parked in the open with all the attendant disadvantages. The erection of wind and weather constructions covering large areas by known methods and the conventional arched or other structural forms present technical problems and has always been very expensive, while with the increasing scarcity and cost of steel and other usual building materials such constructions are becoming prohibitive.

Bridges of the Tees Estuary

Report of the lecture by Charles Morris to the Newcomen Society North East Branch Meeting, held jointly with the Institute of Civil Engineers Heritage Panel, at The Discovery Museum, Newcastle upon Tyne on 27 February 2013

Robin Brooks

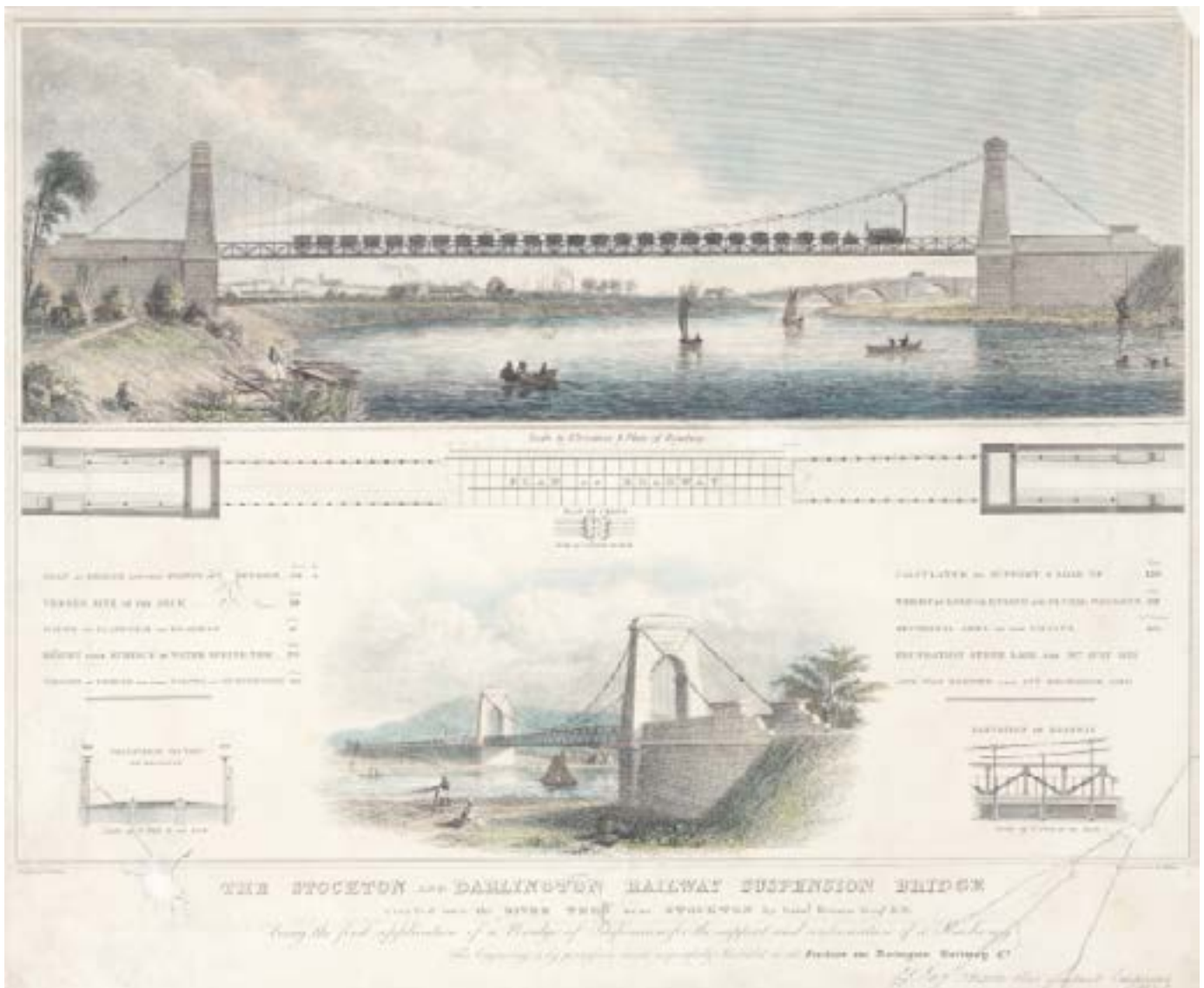
The lecture began with a map of the Tees Estuary area dated 1768. From this it was apparent that the region was then wholly agricultural with no hint of the industrialisation that was to follow in later years. Mr Morris explained that unlike the bridges that were constructed across the River Tees upstream, those near the estuary had to be constructed to accommodate the passage of the tall ships that plied the river. He then continued to describe the bridges that spanned the River Tees from Yarm, down to Middlesbrough, in a nominally chronological order, but with many constructional observations and technical asides.

The earliest bridge in this stretch of river dating from 1400, was the medieval crossing at Yarm built on the orders of the then Bishop of Durham. Two pointed arches of the original medieval stone bridge can still be seen on the upstream side of the bridge. However, the downstream side was widened in

1810 by John Carr thus covering the medieval work on this side. A drawbridge at the northern end, built during the Civil Wars to keep Parliamentarians and Royalists apart, was later removed in 1785 and replaced with an increased width semi circular arch.

In 1769 a five span stone bridge was built at Stockton. Originally a toll bridge, it was made toll free in 1820. This bridge remained until it was replaced by a new iron bridge of three parabolic arches each consisting of eight wrought iron ribs. This was named the Victoria Bridge to commemorate Queen Victoria's Golden Jubilee. Construction was started in 1882 and the bridge opened in 1887.

The railway age brought with it the need for a further crossing over the Tees when powers were obtained by the Stockton & Darlington Railway to build a branch line to Middlesbrough. This site was just upstream from Stockton. This was the world's first railway suspension bridge and was designed and constructed by Sir Samuel Brown at a cost of £2,300 and opened in 1830. It was a single span of 281'-4". Unfortunately, it proved to be unstable in use and oscillating waves were created when trains crossed. A picture of a commemoration medal was shown, which has (in hindsight)



The Stockton & Darlington Railway crossing of the Tees, 1830 (Science & Society Picture Library no. 10419794) ©The Science Museum, All Rights Reserved

proved to be longer lasting than the bridge itself!

Robert Stephenson was commissioned to design a replacement in which he proposed a five span cast iron girder bridge; this was subsequently built and opened in 1844. In order to carry a further two tracks, a riveted wrought iron plate girder bridge was built alongside it in 1882. It is interesting to note that Stephenson's cast iron girder design was also used by him to build the 1846 River Dee crossing which failed spectacularly in 1847, causing the loss of five lives. In 1906 Stephenson's cast iron girders were replaced by mild steel girders supported on the original masonry piers.

In 2009, the 1882 bridge was replaced and in doing so, the foundations of the original suspension bridge were uncovered. The new bridge was designed so that the outer girders matched the appearance of the A66 Surtees Bridge immediately upstream.

The Transporter Bridge which made Middlesbrough world famous, was opened on 17 October 1911. It is now one of just six remaining bridges of this type in the world, from the possible 18 transporter bridges which were constructed between 1893 and 1916. The clear span at Middlesbrough is 174m (571 feet) and clear headroom 48.8m (160 feet). It more than adequately provided the headroom needed for tall sailing vessels, but was totally useless for road traffic. The speaker said it has been described as a "Majestic Dinosaur." Despite this dubious accolade, the Transporter Bridge has become a symbol of the engineering achievements of the area. The bridge was designed by G C Imboul of Cleveland Bridge Engineering Company, Darlington and was built by Sir William Arrol and Company of Glasgow.

Vehicles and foot passengers are carried by means of a gondola suspended from an upper carriage that runs on rails attached to the underside of the cantilevered high level cross members of the bridge. Traction is from ground level electric motors driving a wire rope loop. Apparently, 900 people can be accommodated on the gondola at one time. In 1985 the bridge was given a Grade II* listing and in 2011 the Heritage Lottery Fund awarded its proprietors a £2.6m investment fund. This will ensure its future as a visitor attraction as well as continuing to provide a spectacular river crossing. *See Links 219, p 11*

In 1934 the Newport Vertical Lift Bridge was built by Dorman Long & Co Ltd. The main lifting span provided a road crossing across the river, but either side of the river, two further fixed bridges carried the road over two LNER railway lines. The 2,876 tonne lifting span, was, at the time, the largest vertical lift in the world and provided a headroom of 36.6m (120 feet) and a clear width of 76.2m (250 feet). The last lift of the bridge was in 1990 after which the span was permanently immobilised.

Contemporary with Newport Lift Bridge was the construction of the Billingham Branch Bridge which was built as part of the northern approach to the aforesaid bridge. This bridge's claim to fame is that it is reputed to be the first all-welded portal frame bridge in the world. Like its adjacent sister, the Lift Bridge, it was constructed by Dorman Long & Co Ltd. Electric arc welding used in this manner was in its infancy in 1934 and wasn't in general use for the fabrication of structural members for another 20 years.

The next bridge in this talk which was constructed 41 years after the Newport and Billingham crossings, namely the A19 Tees Viaduct crossing. The viaduct was constructed from 1973 to 1975. It was made of reinforced concrete piers, steel-plate girders and a composite deck. Its overall length is 2.9km (1.8 miles) with approach spans of varying construction.



The Transporter Bridge made Middlesbrough world famous, and was opened 1911

In an attempt to control flooding and prevent the effects of tidal change, the Tees Barrage was completed in 1995. The barrage's concrete piers provide the supports for a bridge built above it, unsurprisingly called the Tees Barrage Bridge. Formed of four arches of 17.5m (57 feet) span, they are augmented by two further similar spans on either side. 350 tonnes of high strength tubular steel together with 280 tonnes of plate and cast steel was used in the fabrication. It was good to be told that northern manufacturers at Wetherby and Guisborough were employed for this work.

Backtracking slightly in time, Mr Morris briefly mentioned the 1992 Princess of Wales Bridge at Stockton built to allow road access to reclaimed land now used for a business park. Reversing chronologically again, the original road bridge which carried the A66 over the Tees built in 1982 was named the Surtees Bridge. It was 125m (410 feet) long of five spans but made of weathering steel which required no painting. This structure was however replaced in 2007 (due to settlement) with a slab and girder design bridge constructed from reinforced concrete and steel plate girders. Mention was also made of the 2002 Jubilee Bridge, a 106m (348 feet) three span balanced cantilever bridge south of Stockton constructed of concrete and steel.

The Teesquay Millennium Footbridge, of a cable-stayed design, like its counterpart in London, has been criticised for wobbling, but nevertheless, it is an example of economic modern bridge design. The steelwork was fabricated in Spain and (as the name implies) was constructed in the year 2000. It lies downstream of the Princess of Wales Bridge.

Finally, the latest bridge across the Tees was illustrated and explained. This was the Infinity Bridge for pedestrians and cycles, opened in 2009. The name is derived from its shape, as, when seen together with its reflected image, this forms the symbol for infinity (∞). The bridge is a dual, tied arch bridge, or bowstring bridge. It has a pair of continuous, differently sized (120m & 60m) structural steel arches with a suspended precast concrete decking and one asymmetrically placed river pier. The bridge was fabricated in the North East by the Cleveland Bridge & Engineering Company. It is fitting that the last bridge to be built across the Tees had such strong local associations. Since its opening, it has received several awards.

Questions from the floor covered many aspects of the bridges described in the lecture. A well deserved vote of thanks was given by Mr Doug Shearer for this most interesting talk about a subject dear to the heart of the students of North East industrial history both past and present.

Brunel in South Wales: a field trip, organised by Stephen K. Jones, starting at Briton Ferry and working its way up the Vale of Neath

Stephen K Jones & Ian Broom

South Wales has a wealth of historic industrial artefacts. Two years ago Steve Jones organised a field trip starting at Chepstow and finishing at Merthyr Tydfil looking at a variety of interesting artefacts. Last September Steve organised a second trip for members of the Western Branch this time



Hydraulic tower at Briton Ferry

access over-bridge of Brunel design to be seen. In its partly overgrown state, it is hard to believe that once a twin track broad gauge railway ran this way.

Our next stop was in Neath. The town of Neath has close connections with Alfred Russel Wallace, but our first port of call was to Alderman Davies Primary School where Rhys Jenkins, a founder member of the Newcomen Society, was educated.² We were able to see the memorial plaque to Rhys Jenkins in the entrance foyer and note that the school presented two Jenkins prizes; Rhys Jenkins for STEM (science, technology, engineering and mathematics) subjects and Katherine Jenkins for music.

Alfred Russel Wallace was a man of many skills, surveyor, architect and botanist. He surveyed the line for the Vale of Neath Railway and designed the new building for the Mechanics Institute, now the West Glamorgan Archive Service's branch office and the headquarters of the Neath Antiquarian Society. Wallace had always had an interest in botany and in 1848 he gave up surveying and architecture and embarked on a botanical expedition to the Amazon. He corresponded with Charles Darwin but Wallace's idea of Natural Selection or the 'Survival of the Fittest' was arrived at independently and both had a hand in the first public presentation of the concept in 1858. Wallace was out of the country when Darwin published his 'Origin of the Species'. We were able to visit Neath Library which had a display about Wallace and also the Mechanics Institute which houses a Wallace archive.

Lunch was taken at the Constitutional Club in Orchard Street, a magnificent building designed by John Norton, the architect who remodelled Tyntesfield House, in Somerset, for the Gibbs family. Before we left Neath we paid a brief visit to the Friends Meeting House graveyard, close to Neath castle and the Neath canal, where members of the Price family of

starting at Briton Ferry and working its way up the Vale of Neath.

The dock at Briton Ferry was designed by I.K. Brunel and opened in August 1861. The entrance was fitted with a single wrought iron buoyant gate, 56 feet long. The remains of the gate can still be seen. Hydraulic power for the coaling appliances alongside the dock was provided by W.G. Armstrong and the hydraulic accumulator tower is still standing. The Brunel Dock Trust was formed in 2005 with the aim of restoring some of the dock and the floating lock gate.¹

From Briton Ferry Dock we moved on to the Ynysmaerdy incline, part of the South Wales Mineral Railway. This was a broad gauge self-acting incline where descending loaded wagons drew up the empties by a wire cable. The 3/4 miles long incline, at a gradient of 1 in 9, is well defined and there is an elegant



Over-bridge on the South Wales Mineral Railway incline

the Neath Abbey Ironworks are buried including Henry Henry Habberley Price. We then made our way up the Vale of Neath to Resolven where we inspected an interesting piece of Brunel's work. This was a cast iron aqueduct with a wooden floor which carried the Clydach or Resolven brook over the Vale of Neath Railway.

The aqueduct was followed by an equally interesting cast iron bridge which used to carry a 4'2" gauge horse-drawn tramroad across the river Cynon between Trecynon and Robertstown. The bridge was built by the Aberdare Canal Co. to link Hirwaun with the canal head at Cwmbach and probably the work of George Overton. Although it pre-dates any of the works of Brunel by some 30 years, a drive through Aberdare would not be complete without a visit to this bridge. Four cast iron arched ribs originally supported a cast iron plate deck, 9ft wide and spans 33ft. This plate deck has been replaced by iron decking with lookalike ridges attached to allow the horse to have sufficient grip when crossing the bridge. It was interesting to note the square holes on the decking, probably easier to either cast or punch out than a round hole? The hand rails have also been replaced but an original cast iron upright has been retained and bears the date 1811. This bridge is not quite the oldest iron bridge in Wales, this distinction goes to Pont y Cafnau, Merthyr Tydfil, which dates from 1791 and which the Newcomen party visited in 2011.

Further up the valley we inspected the 60ft-high Cwm Gwrelych masonry viaduct over the Nant Gwrlych at Pontwalby and dropping down into the Cynon valley walked along part of the Taff Vale Railway's Dare Valley Branch to see the stone pier remains of Brunel's timber Dare viaduct that once crossed overhead. One of two viaducts on the Aman and Dare branch of the Vale of Neath Railway, the Dare and Gamlyn viaducts were not demolished until 1947, and as such, the last complete examples of Brunel's famous timber structures to remain in active use.

From there it was a quick dash down the A 470 and the M4 home to Bristol.

Our thanks to Steve Jones for organising such a fascinating and varied tour.



Brunel's cast iron aqueduct



The field trippers



Robertstown cast iron tramroad bridge

Notes:

1. There is a wealth of background information to many of the sites visited in the three volumes of Brunel in South Wales by Stephen K. Jones

2. Rhys Jenkins by Denis Smith and Stephen K. Jones, TNS vol 79/2 2009

Pontypool and Blaenavon Railway, 30th Anniversary Gala

Nigel Jopson

This event took place on the 14 & 15th September, the author attending on Friday 14th. The Pontypool and Blaenavon line is of more than usual interest from the perspective of industrial history. Firstly, it is contiguous with the Blaenavon World Heritage site. Secondly, it is the last operational section of the London and North Western Railway network in South-East Wales and thirdly, it is redolent of the South Wales valley lines in general, set in a landscape of mountains, spoil heaps (now decently vegetated) and lakes.

The railway was opened as the Brynmawr and Blaenavon Railway for mineral traffic on 1st November 1869 and passengers on 1st January 1870. The original length was 43/4 miles but in 1877 an extension of 33/4 miles was opened southwards to an end-on junction with the GWR at Talywain. The passenger service ceased in 1941 and was latterly provided

The line starts on relatively gentle gradients away from Blaenavon H.L. then steepens as we head north past Forgeside, on the left, where the Blaenavon Iron and Steel works and sidings were located. This site is now occupied by the extensive modern works of Messrs. Doncasters that produce specialty forgings for applications in aerospace, industrial gas turbines, automotive and related sectors. This operation provides an element of continuity with the metallurgical activities of the past. The railway then passes over three iron girder underbridges that formerly bridged the lines serving the iron and steel complex. They now have roads passing beneath them.

The gradient now stiffens as we pass under the girder bridge that carried the connecting line from Big Pit to the washery. The gradient at this point has been variously estimated at 1 in 27 to 1 in 24 and elicits volcanic efforts from the locomotives. The branchline from Big Pit Halt comes in on the left forming two independent lines into Furnace Sidings. This allowed some entertaining parallel running during the Gala. Eventually, the connection from the former washery will be connected to the existing spur forming, in effect, a flying junction into Big Pit over the running lines.

After the more easily graded pitch through the station, the line climbs at a solid 1 in 40 to Garn-yr-Erw. The site of the sidings for Garn-yr-Erw colliery is down on the right at a lower level, the halt itself is on the left and has acquired a beautifully-crafted stone waiting shelter with the image of miners' safety lamp carved thereon. The Furnace Sidings station is a modern creation but the stonework came from Pontypool Crane Street station with the addition of a genuine LNWR footbridge from Hinckley.

The Gala included worthy contributions from two 18" Austerity saddle tanks: Vulcan Foundry 5309 (1945) and Robert Stephenson and Hawthorns 7169 (1944). Appropriately, both served their time in the coal industry. The stars of the show were the two LNWR locomotives, 'Coal Tank' 1054



The picture was taken from the footbridge of Furnace Sidings station, looking south, and illustrates the atmospheric nature of the setting. To the left is the site of the coal washery that served Big Pit and nearby coal workings until 1980. This is now the site of the railway workshops and sidings but the inverted concrete cone of the water clarifier survives (far left). Big Pit lies to the right behind the plume of steam from the Coal Tank.

by the GWR from Pontypool to Blaenavon. The present line extends northward from Blaenavon High Level station, now partly reconstructed, through Furnace Sidings to Garn-yr-Erw halt, handy for the Whistle Inn pub.



The Coal Tank at Big Pit Halt. The colliery headframe is behind the cloud of steam.



The Furnace Sidings station is a modern creation but the stonework came from Pontypool Crane Street station with the addition of a genuine LNWR footbridge from Hinckley.



The double-headed the final train of the day in commemoration of the last passenger train over the Merthyr, Tredegar and Abergavenny line on 5 January 1958

and 'Super D' 485 (as British Railways 49395). These two are the only LNWR locomotives in working order.

They double-headed the final train of the day in commemoration of the last passenger train over the Merthyr, Tredegar and Abergavenny line on 5 January 1958, in which 1054 (as B.R 58926) was pilot engine. The sound effects were truly inspiring!!

The railway is situated just off the B4248 between Blaenavon and Brynmawr.

Further information from:

Pontypool & Blaenavon Railway Co., 33 Broad Street, Blaenavon, Torfaen NP4 9ND

Pontypool & Blaenavon Railway

www.pontypool-and-blaenavon.co.uk

Engineering Heritage Australia

EHA has reported, in its News Bulletin, on the successful trip to the Newcomen Summer Meeting in Manchester:

Newcomen Summer Meeting: UK Trip Success

The trip to the UK was an excellent opportunity for some members of EHA to meet members of the Newcomen Society and see some amazing engineering heritage sites; have a wonderful tour under our tour leader Bill Barksfield and then when all the fun was finished, to go our separate ways through the length and breadth of England (and the continent) to make the most of our opportunity to escape the Australian winter. The hospitality and friendship we received was marvellous and greatly appreciated by us all. Over the coming months I am hoping to see many articles relating to the wonderful things we saw on tour. Owen Peake has written a report of the visit for the EHA News Bulletin 49.

Following this success an EHA Summer Conference is being organised in Australia in December 2015, to which Newcomen members are invited.

Further information on EHA and full report of the Meeting at:

www.engineersaustralia.org.au

AUSTRALIA, DECEMBER 2015

ENGINEERING HERITAGE AUSTRALIA (EHA)

**2015 CONFERENCE
IN NEWCASTLE
NEW SOUTH WALES**

The Newcastle (NSW) Division of Engineers Australia will be hosting the 2015 EHA conference

Newcomen Members are invited to attend

See page 24 for details and booking information

A Visit to Hereford Waterworks Museum.....

Henry Gunston and Bryan Lawton

Hereford Waterworks Museum was established in 1974 on the site of Hereford's Broomy Hill Pumping Station, now Listed Grade II and a Scheduled Monument. Two working steam engines, as originally installed in the buildings, survive in operating condition. A Newcomen party was made very welcome by Dr Noel Meeke, the Museum's Chairman.

Dr Meeke outlined how serious outbreaks of cholera and typhoid fever, especially in overcrowded cities, had led to the exploitation of "clean" water sources for public water supply. These often required pumping, and the Museum had on display a Simpson beam engine, built in 1851 by Harvey of Hayle, which had originally been installed for pumping water at Cardiff. This is now operated by an electric motor. The group then split into two groups, which were led on tours of the exhibits by Derek Duffett and Les Birch

The steam engines originally supplied for work at Broomy Hill were both built by Worth Mackenzie of Stockton on Tees. The large triple expansion engine was installed in



Worth Mackenzie triple expansion engine, inverted, condensing engine, installed 1895

1895 and is the oldest inverted, condensing, triple-expansion steam engine still working in Britain. This engine was in steam, as was a smaller Worth Mackenzie twin engine with pumps, installed in 1906 to lift water to a higher of the two storage levels. Another 'local' engine in operation was a Blackstone EPVS 5-cylinder diesel, originally coupled to Mather and Platt centrifugal MEDIVANE pumps. These were first installed in 1939 at the Rotherwas Munitions Factory, also in Herefordshire,

for fire-fighting purposes. Only the engine is currently operational, and ear-defenders are provided and needed, when



National gas producer plant (gas scrubber and retort). No date but about 1920



A Hayward-Tyler Ltd, 1880 Hot air engine (1 hp)

entering the room where it is now situated. A display, linked to operations at the munitions factory, is housed in the specially built Rotherwas building.

A producer gas engine was also in operation. Made by the National Gas Engine Co., of Ashton under Lyne, in 1912 this producer gas generator was on display outside the museum. A reconstruction of a pumping station building, originally sited at Leominster, houses a Tangye single cylinder semi-diesel of 1932 and a set of Tangye triple throw pumps of the same date. Both were originally installed at Pembroke Dock. Many other engines and pumps were on display, including hydraulic rams, a Climax wind pump, and water turbine driven pump sets. One of these, by Easton, Anderson and Golden, dating from the 1890s, used "dirty" water running in a stream to drive a turbine which operated pumps to move "clean" water from a protected source. A Welsh Water display explained the current passage of water from source to domestic use.

A National Stirling Engine Rally was also held on the same day, organised by the Museum and the Stirling Engine Society of Great Britain. The Museum's two hot air engines, both built by Hayward-Taylor of Luton (1 hp from 1880 and 1/2 hp from the 1890s) were both in operation and there was a wide range of hot-air and Stirling related models and displays.

Hereford Waterworks Museum
www.waterworksmuseum.org.uk

Further information from:
Waterworks Museum - Hereford, Broomy Hill, Hereford, Herefordshire HR4 0LJ
Tel. 01432 267491
info@waterworksmuseum.org.uk

The Stirling Engine Society
www.stirlingengines.org.uk
info@stirlingengines.org

.....& a National Stirling Engine Rally.....

Fred Starr

I had particular interest in attending the 3rd Stirling Engine Rally at Hereford, since along with David Andrews, who was also at the Rally, I got British Gas working on the concept of Domestic Combined Heat and Power, back in the late 80s. The idea was to incorporate a kilowatt output Stirling Engine, driving a generator, as part of an ordinary gas boiler, so that the unit would produce electricity and heat for household needs. Sadly, one of the effects of privatisation, and the huge improvement in efficiency of gas fired power plants, has confined this breakthrough concept to the dustbin of technological history.

The Newcomen Society got to know of the Rally via Derek Duffet, who is on the Waterworks Museum team and had also given a talk on Stirlings at our Conference on the Piston Engine Revolution. The Stirling engine was a rival to the internal combustion engine, and two Ryder pumping engines, which are permanent fixtures at Hereford, date from a time when both technologies were neck and neck. Since then the Stirling has often appeared to be on the brink of success, as new opportunities have opened up. But sadly the field is now left to gifted modellers, of which the crème de la crème were at the Waterworks.

A standard fixture of model engineering exhibitions is the low temperature Stirling, which can run on the heat from a mug of hot water. The Rally had plenty of these, some being sold to the crowd of 200 who were at the event. An attraction of these machines is that the cylinders, which hold the power piston and displacer piston, are made of transparent plastic. People are puzzled by the huge disparity between the diameter of the two cylinders. This results from the low temperature and low pressure changes in the cycle, so that the displacer cylinder must contain a large volume of air.



A Bohm Two Cylinder Stirling. A spirit burner is in the right hand corner

As “buy-as-parts-machines”, I was struck by the really beautiful, but tiny engines, manufactured by Bohm GmbH, a two cylinder example of which had been put together by Mike Crumpton. Although it could have sat in the palm of my hand, these are high temperature engines, being heated by two methylated spirit burners. The engines and burners are in stainless steel, but being CNC machined, cost is not excessive. Mike explained that although his engine would run on one



Austyn Williams stands beside his novel Stirling Engine in which the two displacer cylinders are prominent on the upper part of the machine

burner, the other cylinder then acts like a refrigerator, with what was the heated cylinder becoming ice cold!

The Stirling field is one ripe for ingenuity, as the key point about the practical Stirling engine cycle is the need to have a method by which the working fluid can be moved from the hot to the cold end of the “engine” and then back to the other. This gives the pressure and volume changes that drive the power piston. One on display had a flat heat exchanger, warmed by a high intensity electric lamp. Larger examples of this flat plate type have been advocated for water pumping in the Third World.

In most Stirling engines the displacer is driven by the power piston. This compromises the shape of the Stirling engine pressure-volume diagram, so I was intrigued by a novel “work-in-progress” machine being displayed by Austyn Williams, a retired electronics engineer. His key innovation is to move the displacers (there are two cylinders) using external magnets. This in principle will turn the pressure-volume curve from an ellipse into a distorted rectangle, giving more work and efficiency. I found that Austyn’s expertise gets into the materials field, which caused me some discomfort, as a professional metallurgist! The magnets which he uses are of the neodymium type, the displacers are of calcium silicate refractory, and Austyn uses tungsten disulphide as a high temperature solid lubricant. The engine was working but will need some further refinement, so we look forward to the completed machine, next year.

The Rally provoked the thought that the Stirling engine has had an eventful career in the 20th Century, and what often killed various projects was the engineering rather than the economics. Furthermore, some of our members have had a close association with this type of machine, and in line with the suggestions of Ed Marshall, they might be able to give us some of the background to some Stirling Engine programmes. Tales of hubris to nemesis, indeed!

The Centenary of the Invention of Stainless Steel

*Report of a lecture to the London Branch by Dr David Dulieu
Fred Starr*

Dr David Dulieu achieved perfect balance with his lecture on the Centenary of the Invention of Stainless Steel, by speaking to a mixed audience of engineers, in the form of the Newcomen Society, and metallurgists, as represented by the London Materials Society (LMS). David was sure footed in highlighting the differences between the various forms of stainless steel, martensitic, austenitic and ferritic, and in explaining why people like Faraday had found it impossible to produce corrosion-resistant steels. The big problem was that up to the end of the 19th century, the chromium, needed to make iron 'stainless', was contaminated with significant amounts of carbon.

It was the sales of the stainless steel knife blade, a hard martensitic alloy, which got the stainless steel revolution underway. The alloy had been discovered in 1913 by Harold Brearley of Sheffield, who had learned his trade in the laboratory, melting shop, and forge. He was so experienced and well thought of that he was able to retain part of the rights to his inventions from his employer, Firth Brown. Much of

David's lecture covered the struggle which Brearley had to retain ownership of 'knife blade stainless', as there were continuing attempts to get round the patent, not least by Firth Brown Ltd themselves. More details can be found in David's recent book, *Stay Bright - A History of Stainless Steels in Britain* (see page 21), a copy of which he has donated to the Western Branch Library.

The introduction of stainless steel coincided with the Art Nouveau period, and of the start of modern chemical engineering. Photographs of early examples of stainless design, architecture and chemical plants were shown.

The discussion was genuinely informative. Charles May, Secretary of the LMS, asked about the wastage of stainless when it came to be scrapped. David said that stainless was so easy to pick out of raw scrap that about 70% of it was recycled. Prof Perrett, Council Member, referred to recent work which seemed to be showing that stainless was *friendlier* to bugs rather than the Victorian's usage of copper and brass for medical fittings and door furniture. David suggested that the tests mentioned by Prof Perrett were misleading. The polishing of door handles, etc, using waxy materials, to prevent tarnishing, acted against the biocidal action of copper ions.

But what about Brearley, as a person? This was another query. He seems to have been a really nice man, always encouraging young people to make the best of themselves. In 1941 he founded the Freshgate Trust, which still exists and is intended to expand the horizons of people from a modest background. His character seems to have been in contrast with his successor, WH.Hatfield, who for all his merits as an inventor and publicist for stainless steels, seems to have been somewhat intimidating.

Commemorating the First World War

A NEWCOMEN SOCIETY CONFERENCE ENGINEERING IN THE FIRST WORLD WAR AND AFTER

Many organisations have plans in place to commemorate the events of the First World War. These range from the national bodies like the Imperial War Museum, the BBC, English Heritage and The National Archives to academic departments in universities and specialist societies. If there was one positive gain from the horrors of that war, it was the major stimulus to engineering that it created. During the war new industries came into being, older ones had to replace high-tech imports and others turned over to mass production techniques.

Chemical engineering, fine chemicals, radio-electronics, the aircraft industry, motor manufacture and power generation were all sectors that benefited.

Others, like steel, agriculture, and food production, profited from the introduction of new technologies and techniques.

It is intended to hold a conference in 2015 - Engineering in the First World War and After. Presentations will be welcomed from Newcomen members and others, from enthusiast organisations with an interest in industrial history and wartime technology, as well as those with a professional interest in this subject.

*For further information on the conference, giving a presentation, or attending,
please contact Dr Fred Starr: newcomen.starr@yahoo.com*

Enigma: CRUISE Missiles, Rockets & Superguns

Dr Phil Judkins spoke to the North West Branch in Manchester

ENIGMA, and Bletchley Park code-breaking, are widely-known war stories, but ENIGMA code-breaks also helped defeat cruise missile, rocket and supergun attacks.

Enigma resembles a typewriter, but with a lamp-board, whose lamps illuminate letters; three code-rotors, lettered round their rims; and a plug and socket board. Through code-rotor and plug selection, wiring, and setting-up, a 3-rotor Enigma has 3.3 x 10¹¹ combinations! Even capturing a machine, and a message with its coded equivalent, 100 replica machines, working 24 hours a day with 30 seconds on each combination, could need 6 years to break the cipher. Pre-war work by 3 Poles, Rejewski, Roczyski and Zygaliski, and by the French, using a German traitor, Hans-Thilo Schmidt, reduced those possibilities to 1023. In 1939, Bletchley's first intercepts were



broken by hand; Alan Turing and Gordon Welchman developed machines called 'bombes'. Enigma's Achilles heel is that Enigma can never encrypt a letter as itself, so, guessing at message content, they tested these guesses using the fast electrically-driven 'bombes'.

At the 1919 Peace Treaty of Versailles, the Allies restricted most German weaponry – but not rockets, considered harmless. In 1932, Captain Dornberger recruited Werner von Braun, who in 1934 launched his first significant missile; then at Peenemunde, successively bigger rockets promised a 160 mile range.

By 1942, Hitler's Luftwaffe were mainly engaged on the Eastern Front, so to retaliate against attacks on German cities. new weapons were needed; in October, a rocket flew 120 miles and landed just a mile off-target. Armaments supremo Speer persuaded Hitler to back the Army's rocket. For the Luftwaffe, Fieseler proposed a ramjet powered missile – a cruise missile – of cheap pressed steel for £140 each.

Today we know that the Germans had developed a cruise missile, the V-1, 'doodlebug' or 'buzz-bomb'; a ballistic missile, the V-2; and a long-range 'supergun', the V-3. But in 1942, this was unknown.

British Intelligence bugged two captured German generals discussing a planned rocket attack, but, without knowing there were two weapons, constantly confused the V1 and the V2. British experts, not suspecting liquid fuels, envisaged a cordite-fuelled rocket, which would have been a 90 ton monster. Enigma indicated Peenemunde as important, but reconnaissance photos were indistinct, until in June 1943 a 35' x 5' cylinder was identified. British Ministers, fearing 4,000 casualties per rocket, targeted the Peenemunde Army Research Centre. On 17/8 August, 500 bombers attacked, killing key scientists, and delaying the programme 2-3 months. Raids on Friedrichshafen and Kassel temporarily halted V2 and V1 production. SS General Kammler moved V weapon manufacture underground at Nordhausen, beyond the RAF's ability to interfere; but construction involved further delay.

In London Isaac Lubbock, a liquid oxygen/ petrol fuels engineer, showed British scientists that a rocket without cordite was possible, and near-panic resulted. Jeannie Rousseau, a translator for the Germans – and spy 'Amniarix' -

reported 108, rising to 400, catapult launchers were to be built. From Enigma, Air Intelligence's R.V. Jones produced V1 test results. The first launch site now identified, bombing began on 21 December. Jones predicted that V-1 attack could deliver 320 tons of explosive a day; D-Day planners were advised to look for alternative ports to Southampton and Portsmouth.

By December 1943, photo-interpreter Constance Babington-Smith identified a V1; ENIGMA showed V1 as ready for service, and also that V2 testing had moved to Blizna, south of Warsaw. Polish farmers gathered crashed parts, which revealed liquid oxygen as potential fuel.

The Germans initially wanted bomb-proof launch-sites, such as Wizernes (La Coupole, Northern France). The RAF saturation-bombed the area, making access impossible, and construction was abandoned.

Wachtel, the cruise missile commander, requisitioned railway tunnels as stores and adapted launch sites to take portable prefabricated ramps on concealed footings.

The Allies landed in France on 6 June 1944. On the 10th, a Belgian spy reported 33 rail wagons each carrying 3 missiles; on the 13th, Wachtel managed to use 54 prefabricated sites to attack. Though the first few failed, by the 15th Britain's defences were temporarily overwhelmed; 73 missiles reached London, one killing 121 at the Guards' Chapel, near Whitehall.

London's air defences had been deployed to meet manned bombers; the need now was to move guns and barrage balloons to the coast, and General Pile relocated 800 guns, 23,000 troops and 60,000 tons of ammunition, largely in one weekend! Some V1s were downed by fighters, most pilots preferring to fly alongside, raising their wing underneath the V1s wing to topple it. The double agent 'Zigzag', Eddie Chapman, also transmitted false reports of V1 strikes, misleading the Germans to shorten the range.

Launch sites began to be captured, and Minister Duncan Sandys announced that the threat was over. The next afternoon, the first V2 rocket hit Chiswick, killing 3. As the V2 factory was beyond reach of bombs, mass evacuation was planned; many Londoners left voluntarily. V2s carried on launcher trucks were fired from roadways. It being near-impossible to catch a rocket being launched, Allied Air Forces attacked V-2s being transported by rail.

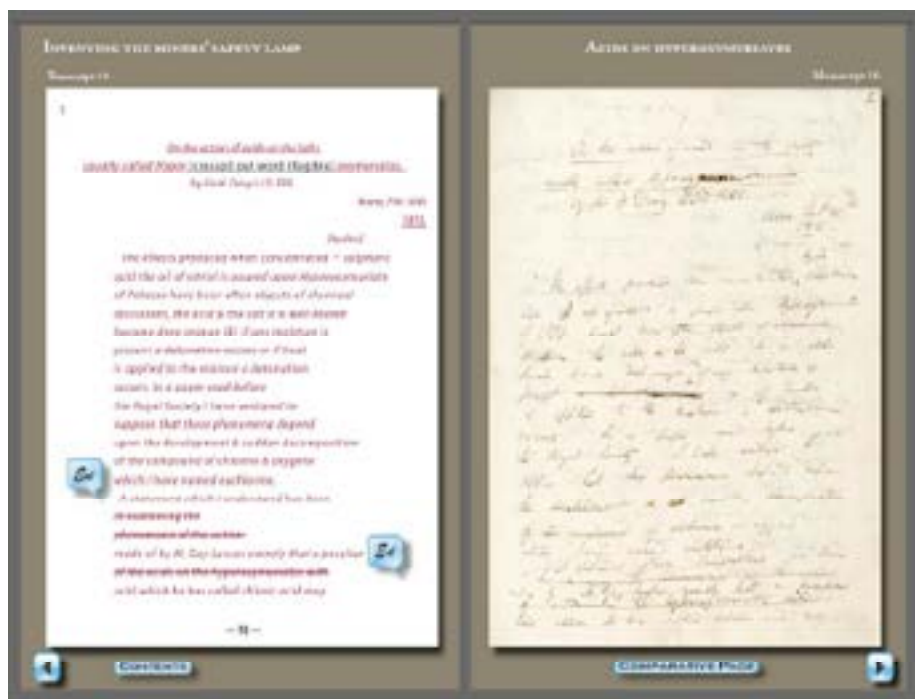
During the V2 campaign, 1,115 reached England, with half reaching London, killing 2,754. In 1945, V1s were carried under bombers and air-launched over the North Sea. On Xmas Eve 1944, the target was Manchester, but only one of 50 launched reached the city. Of 30,000 V-1s built, just 10,500 were launched; defences destroyed 3,957, but 3,531 crossed the coast; 2,420 reached London, killing 6,184.

The V3 supergun comprised 15 barrels, each 150 yards long and dug into the ground at Mimoyecques, Northern France, firing a 12 inch shell. Paired side chambers opened into each barrel, from which propellant would have been fired behind the shell as it moved up the barrel. The RAF bombed Mimoyecques with 6 ton 'tallboy' bombs, wrecking it.

After the war, the Allies found mass production lines for the V1 and V2 at Nordhausen. One blueprint read "Schuttbehälter für K stoff buchsen" ("container for canned nuclear waste") – a dirty bomb; nerve gas and chemical warheads were also planned.



New Technology Transforms Archive Research



A Manuscript, *Inventing the Miners' Safety Lamp*, is held by the Royal Institution. It was written by Davy, copied by Faraday and then amended by Davy, between October and December 1815. The RI in collaboration with Archive Editions has now digitized the manuscript in time in time for the 2015 bicentenary of the invention of the lamp.

The original manuscript includes drafts of the paper on the lamp written by Davy, copied by Faraday and then amended by Davy. These texts track how Davy developed his ideas on safety lamps, culminating in his invention of the gauze lamp. The manuscript has now been digitized so that for the first time anyone in the world will be able to download and read Davy's original manuscripts, as collected by Michael Faraday, containing his scientific notes, workings and diagrams.

The manuscripts are accompanied by a full transcription and expert

THE HISTORY OF THE DAVY LAMP

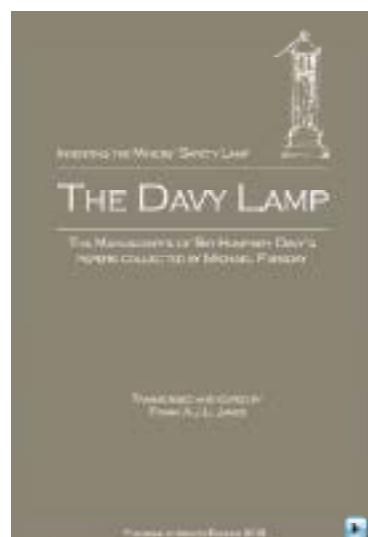
Following a number of serious explosions in North East coal mines due to pockets of flammable gas known as 'firedamp', Humphry Davy was asked by the Rector of Bishopwearmouth (near Newcastle) to find a means of lighting coal mines safely. In an intense period of work from mid-October to December 1815, Davy evolved prototype lamps ending with the iconic lamp.

The lamp was successfully tested in Hebburn colliery in January 1816 and quickly went into production. The effect of the introduction of the lamp immediately increased the amount of coal production (because it permitted deeper coal mining) and, importantly, greatly decreased the number of fatalities per million tons of coal produced. It also made a fundamental contribution to the continuing industrialisation of Britain, and indeed elsewhere, during the 19th century.

commentary from the e-book's editor Frank James, Professor of the History of Science at the RI. Digitization has been a lengthy yet innovative process. Now the entire manuscript can be read in its handwritten form, as a complete transcript or as a handwritten page with the relevant facing page of transcripts. The manuscript is accompanied by a full transcription and expert commentary by the e-book's editor Professor Frank James.

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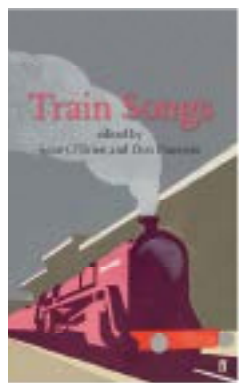


Resources.....

TRAIN SONGS

Edited by Sean O'Brien and Don Paterson
Hardcover: 192 pages. £12.99
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ISBN-13: 978-0571217762

Wordsworth was the first laureate of locomotives: in fact he railed against them, and against the consequent opening up of the Lakes to holiday hordes ('On the Projected Kendal and Windermere Railway'). Yet the train has become part of our psychic landscape: some



of the best-loved English poems - Edward Thomas's 'Adlestrop', or Philip Larkin's 'Whitsun Weddings' - have celebrated carriages, platforms and waiting rooms, while locomotion has inspired some of the most characteristic poetry of Dante Gabriel Rossetti and Stevenson, Hardy and MacNeice, Betjeman and Auden (whose 'Night Mail' was written to accompany a 1930s GPO documentary about the postal express from Euston to Glasgow). Co-edited by two of our most distinguished poets, Train Songs offers a round tour - from Wordsworth to Hugo Williams and beyond - starting from the poetry of departures and brief encounters, but taking in the American Blues, the troop trains of two world wars, and the addiction to speed which characterised the European revolutions. Trains have carried the freight of history from the Industrial Revolution onwards - the Armistice in 1918 was signed in a railway carriage, the death camps were organised around train timetables - and this new anthology shows how the train in all its forms has exercised a unique hold upon our collective unconscious.

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WELSH ACHIEVEMENTS IN SCIENCE TECHNOLOGY AND ENGINEERING

CYMRU'N LLWYDDO MEWN
GWYDDONIAETH, TECHNOLEG A
PHEIRIANNEG

Lywodraeth Cymru
Welsh Government
Paperback, 180 pages
ISBN 978 1 4734 01693
www.cymru.gov.uk
Available on line at: www.businesswales.uberflip.com/i/171252

This book, in both Welsh and English, outlines the contributions of Wales and the Welsh people to the fields of discovery and invention. Working as a directory it lists by subject and short biography how they have underpinned many applications including: the theory of natural selection, the early development of crystallography, the discovery of free radicals and meson decay through to inventions of world wide significance like steam railway locomotives, the fuel cell and microphone and more recent research into embryonic stem cells and the work undertaken by Welsh computer scientists.

THE JOURNAL OF TRANSPORT HISTORY

Manchester University Press
www.manchesteruniversitypress.co.uk/
journals/jth

In existence for over 50 years, The Journal of Transport History publishes the best scholarly articles and research on the history of transport, travel, tourism and mobility, including their relationship with planning and policy. The journal brings together original work by top historians, the best work by academic researchers and transport and mobility enthusiasts, and curators and researchers from the museum world. It also contains special sections with Research Notes, Surveys & Speculations, short essays on related topics, Museum and Exhibition Reviews, as well as an extensive book review section of both English and non-English books. The current issue has a series of papers on the German and Austrian automobile industries and transport policies from the 1920s onwards.

STAY BRIGHT - A HISTORY OF STAINLESS STEELS IN BRITAIN

By David Dulieu
UK £20.00
EU £31.00

Available from British Stainless Steel Association (BSSA)
Tel: +44 114 267 1260
email: admin@bssa.org.uk
www.bssa.org.uk

Stay Bright chronicles the fortunes of the British companies manufacturing stainless steels; it tracks international alliances and rivalries, and charts the history through times of economic boom and recession. It follows the twists of fate of those involved through world war, cold war, nationalisation and the impact of globalised industrial manufacturing. Few materials can claim to have made such an impact on modern life; this is how they did it in Britain.

*The copy date
for the next issue
of
Newcomen Links*

1 February 2014

editor.links@newcomen.com

*Please see submission
details on page 2*

The Newcomen Society Calendar.....

Please check the Events pages on the website for updated information: www.newcomen.com

LONDON

Meetings are held in the Director's Suite, The Science Museum, Exhibition Road, London SW7 2DD.

Time: 17.45. Visitors are welcome, admission is free. Members and guests may go to a nearby restaurant afterwards.

2013

11 December

John Agnew: Daniel Clarke and the 1862 Exhibition

2014

8 January

Jonathan Ayles: Blue Danube – Britain's First Atomic Bomb

12 February

The Society AGM

Geoffrey Smith: The Origin and Development of Gunpowder

12 March

Rob Shorland-Ball: Roller Milling of Flour

9 April

Colin Rynne: Medieval Water Mills in Ireland

14 May

The Dickinson Memorial Lecture

Jennifer Tann: Borrowing Brilliance; Technology Innovation across Sectors in the Early Industrial Revolution

MIDLAND BRANCH

Meetings are held in the Thinktank Theatre, on the middle floor of Thinktank, the Birmingham Science Museum, at Millennium Point, Curzon Street, Birmingham, B4 7XG.

Time: Doors open at 18.30 for the meeting at 19.00. Visitors are welcome, admission is free. There is a pay-bar in the building which may be serving snacks and drinks before the meeting. Parking on-site from Jennens Road is £3 from 6pm or across Jennens Road at £1 from 4.30pm

2013

4 December

Dave Moore: Sandfields Pumping Station

2014

5 February

Professor David Williams: Early Military Gunmaking in Birmingham

5 March

Peter Cross-Rudkin: John Rennie – a life full of employment

2 April

Tony Vernon: Leveson Francis Vernon-Harcourt – Civil Engineer 1839-1907

7 May

Jim Andrew: Housing the Great Exhibition – the Crystal Palace of 1851

NORTH EASTERN BRANCH

Meetings are held in the Discovery Museum, Newcastle upon Tyne NE1 4JA. Please check each event for time and venue. A visit is planned during in the spring to Spadeadam, details tbc

2013

4 December

Ian Whitehead: Ships' Speed Trials Measured Miles Off The North East Coast

Meeting at 14.00

2014

12 February

John Nattrass: Drilling Operations

Meeting at 14.00

9 April

Leslie Shore: Britain's Largest Coal Mine - Powell Duffryn

Meeting at 18.00



THE SOCIETY'S AGM
FOLLOWED BY
GEOFFREY SMITH'S LECTURE:
THE ORIGIN AND DEVELOPMENT OF GUNPOWDER

12 FEBRUARY AT 17.45

The Director's Suite
The Science Museum
Exhibition Road
London SW7 2DD

THE DICKINSON MEMORIAL LECTURE

BY JENNIFER TANN
BORROWING BRILLIANCE;
TECHNOLOGY INNOVATION
ACROSS SECTORS IN
THE EARLY INDUSTRIAL
REVOLUTION

14 May 2014 at 17.45

The Director's Suite
The Science Museum
Exhibition Road
London SW7 2DD

NORTH WEST BRANCH

Meetings are usually held at the Museum of Science and Industry, Liverpool Road, Manchester M3 4FP. Time: 18.30 (usually). Visitors are welcome, admission is free. Members meet at a nearby restaurant from 17.00. Parking is available on site.

2014

28 January

Chris Hodrien: K-class Submarines or History of Babcock Boilers. TBC

25 February

Joint Meeting with the ICE, Manchester Branch, (subject to agreement)

Michael Chrimes, Director, Engineering Policy and Innovation, ICE: Engineers and their books from Grundy to Skempton.

25 March

Dr Richard Brook, Manchester School of Architecture, MMU: Manchester's post war road plans.

SCOTLAND

TBC

SOUTHERN BRANCH

Meetings are held in a lecture room at the University of Portsmouth commencing at 18.30. Some on street parking is available locally but there is a charge for use of the adjacent University car parks.

2013

10 December

John Parker: Medieval Sources of Stone for Winchester Cathedral. Burnaby Building room 2.26

2014

21 January

Neil Linford: Reflections from the Past: Geophysical Techniques for Archaeological Prospection Burnaby Building room 2.26.

18 February

Martin Gregory: A Century of Cleansing Winchester Burnaby Building room 2.26

18 March

Andy Gale: Sources and Usage of Stone in Medieval Southampton Burnaby Building room 2.26

29 April

Stephen K. Jones: Brunel in South Wales. Denis Sciana Building room 2.14

20 May

Tony Cross: The Letter Box - the Development of an English Design Icon. Richmond Building lecture theatre 3

WESTERN BRANCH

Meetings are held in Room 1 Bristol Aeroplane Welfare Association (BAWA), 589 Southmead Road, Filton, BS34 7RG. Time: 7:30-9:00 pm Visitors are welcome, admission is free.

2014

16 January

Joint Meeting with BIAS at BAWA..

20 February

Derek Duffett: Stirling Engines: A Short Review of Loaded Hot Air

20 March

Richard Ellam: Engineering and Astronomy in the 19th Century

17 April

Fred Starr: Lost Opportunities: The Whittle Turbojet Demonstrator of 1929

15 May

Paul Stevens: The Uses of Steam in Bristol

THE SUMMER MEETING

14 – 18 JULY 2014

EXPLORING
THE M4 CORRIDOR
FROM READING TO BRISTOL

details on p 24

SOCIETY VISITS

The Visits Committee is arranging three visits in 2014 which have been agreed in principle but the exact dates have yet to be confirmed. The companies have excellent websites for further information. **Please register your interest by email to:**

western@newcomen.com and we will send you information in due course. The visits are:

RF Giddings, Ringwood Sawmills, Bartley, Southampton. February-March RF Giddings are fifth generation saw millers based at the edge of the New

Forest. Following a fire in 2005 they re-built their plant and installed a state of the art, Swedish, computer controlled, sawmill. They supply sawn timber for building, construction, fencing, and other application.

OCR Robotics, Filton, Bristol.

April-May OCR Robotics was formed in 1997 and manufacture snake-arm robots for work in confined or hazardous locations such as nuclear decommissioning, aerospace, and industrial applications.

Rotron Aero Ltd (Gilo Industries), Semley, Dorset. June-July Rotron manufacture small (297 cm³) Wankel engines for use in UAV's (unmanned aerial vehicles) or drones and supply them to an innovative SDR class aircraft designed by a UK based light aircraft company, e-Go Aeroplanes. Rotron's Wankel engine was first used during Mission Everest, when it powered Gilo Cardozo and TV adventurer Bear Grylls to break all existing paramotor altitude records to look down on the summit of Mount Everest.

NEWCOMEN SUMMER MEETING

NOTE CHANGE OF DATE

14-18 JULY 2014

The Summer Meeting is taking a slightly different direction in 2014. We will be exploring the M4 corridor from Reading to Bristol and, together with the traditional visits to historical sites of engineering interest, we will be including a number of modern production and research sites which we hope will generate interest for members and potential members of the society.

The tour will be based in Swindon with four days of visits ranging through Berkshire, Wiltshire, Gloucestershire & Somerset with the possibility of a trip into Gwent. Amongst the visits the aerospace industry is sure to be represented, we might get to understand something more about earthquakes and we may be able to explore a quarry which makes tarmac under computer control. We hope to get into the Chain Test House at Swindon; a horsehair factory and a silk mill are on the list and we could take a look at how the Thames & Severn Canal is taking a new route through a rubbish tip in Stroud.

For further details as they become available and to register interest please contact

Bill Barksfield at Heritage of Industry:
website: www.heritageofindustry.co.uk
email: info@heritageofindustry.co.uk
write to: Heritage of Industry Ltd, Hunters Moon, Gorelands Lane, Chalfont St Giles, Bucks HP8 4HQ
tel: 01494 873677

AUSTRALIA, DECEMBER 2015

**ENGINEERING HERITAGE AUSTRALIA (EHA)
2015 CONFERENCE
IN NEWCASTLE, NEW SOUTH WALES**

The Newcastle (NSW) Division of Engineers Australia will be hosting the 2015 EHA conference.

We are delighted that at the recent Summer Meeting in Manchester it was agreed that members of Newcomen and EHA will continue to participate in each organisations conferences.

EHA is planning a three day conference on 7, 8 & 9 December 2015 at Newcastle, NSW, with a pre-conference tour commencing on Thursday 3 December. This promises to be a very interesting conference focussing on the areas around Newcastle and the Hunter Valley, with a forward looking theme. There is also the possibility of a 'pre-pre-conference' tour from Canberra through New South Wales to meet up with the official pre-conference tour.

For further details as they become available please contact

Bill Barksfield at Heritage of Industry:
email: info@heritageofindustry.co.uk
write to: Heritage of Industry Ltd, Hunters Moon, Gorelands Lane, Chalfont St Giles, Bucks HP8 4HQ
tel: 01494 873677

Other Events

**INTERNATIONAL EARLY MAIN LINE RAILWAYS
CONFERENCE, CAERNARFON, NORTH WALES
19-22 JUNE 2014**

Building on the success of the International Early Railways Conference series, the organising committee have arranged to accommodate the interests of historians pursuing the origin and development of mainline railways between 1830 and c1870. This reflects the all-important years when railways first developed routes and networks and became major contributors to economic growth around the world. This was made possible by rapid advancements in civil and mechanical engineering techniques. This first conference has attracted papers from authors studying subjects in several parts of the world, in addition to the UK. These are related to economic, political, social and cultural progress in several countries, and business and financial incentive and practice. They also cover developments in surveying, structural, architectural and building practices, as well as mechanical and electrical progress.

For information about the papers and other programme details, and to book your place at the conference, please go to: www.earlymainlinerrailways.org.uk

The conference is promoted by: The Institution of Civil Engineers, Newcomen, The International Society for the History of Engineering and Technology, The Institute of Railway Studies and Transport History, York, The Railway and Canal Historical Society.

**THE VICTORIAN SOCIETY
MASTERPIECES OF ENGINEERING**

LECTURE SERIES JANUARY TO MARCH 2014

This is proving very popular and some events are already sold out, but check with the Victorian Society for availability. The lectures will be held at the Art Workers' Guild, 6 Queen Square, London WC1 and include:

The Thames Tunnel. Tuesday 21 January: 6.30pm to 8pm. A lecture by Julia Elton.

Engineering the Oceans: the SS Great Eastern and HMS Warrior. Wednesday 29 January: 6.30pm to 8pm. A lecture by Andrew Lambert.

The Tube - London's Underground Railways. Wednesday 5 February: 6.30pm to 8pm. A lecture by Mike Chrimes. Lecture: **The North Midland Railway.** Monday 17 February: 6.30pm to 8pm. A lecture by Robert Thorne.

The Eiffel Tower. Tuesday 25 February: 6.30pm to 8pm. A lecture by Andrew Saint.

The Olympic Class liners: Olympic, Titanic and Britannic. Monday 3 March: 6.30pm to 8pm. A lecture by David Livingstone.

Alan Stevenson and the Skerryvore Lighthouse. Monday 10 March: A lecture by Alison Morrison-Low.

For further information and to book:

www.victoriansociety.org.uk
email: admin@victoriansociety.org.uk
tel: 020 8994 1019