Links


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NEWCOMEN 2012
CELEBRATING POWER AND ENERGY

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The Front Cover

The large size necessitated the demolition of part of the Henley's Telegraph Company factory wall when it came to loading the spiders for delivery to Rugby Wireless Station. Image: © Porthcurno Telegraph Museum.

Writing for Links

Relevant articles and items of news may be submitted to be considered for inclusion in 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. They should **not** be embedded in the text of the Word document,
Copyright and reproduction issues on images, including diagrams, must be considered and wherever possible permission for publication granted. It is not possible to receive photographs of images in books.
The copy date for the next issue is 10 August 2012
Please submit articles, information, details of events etc to:
The Editor,
Deborah Jaffé at:
editor.links@newcomen.com

Notes on Contributors

Dr. Michael Bailey is a Newcomen Fellow, who joined the Society in 1973. He has served as Member of Council for several terms, and President between 1995 and 1997. He is an author and lecturer on early railway and locomotive history, and is a consultant and archaeologist for museums and television companies. Michael was also Consultant to UNESCO regarding the Rhaetian Railway's application in Switzerland/ Italy for World Heritage status. He represents the Newcomen Society for the 'International Early Railways' Conference series, and is a co-editor of the Conference publications.
Simon Barley who spoke in February 2012 obtained a PhD in 2008, from the University of Sheffield, for a thesis on Hand Tools Manufacturing in the Industrial Revolution: Saw Making in Sheffield c1750-c1830.
Tim Booth started researching and recording mills in 1969 with a survey of Warwickshire's watermills, published in 1976. Tim is an active member of the Midland Mills Group, having served as its chairman and treasurer. Practical experience includes restoring Wrickton Mill, in Shropshire, and milling at New Hall Mill, Sutton Coldfield.
Dr Robert Carr was at first involved with the physical sciences. He has since become more of a generalist, interested in a wider context and in making connections.
Julia Elton is a Past President of the Newcomen Society . She is an antiquarian bookseller specialising in the history of engineering, has written and lectured widely on this subject and is a musician in her spare time.
Dr. Bill Fawcett is an engineer with a life-long interest in architectural history, engineering and railway history. He taught latterly at the University of York and is the author of about ten books.
Allan Green is research Fellow at Porthcurno Telegraph Museum, Penzance, Cornwall.
Deborah Jaffé is a design historian, author of Ingenious Women and editor of Links.
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.
Dr Alan Levitt, an independent scholar and historical archaeologist, focuses on the social impacts of early American railways, and on the use of printers' trains. He was a founding member of the Advisory Board of the Railroad Archives Collection at the University of Connecticut, and of the New York City Transit Museum Advisory Board.
John Liffen is Curator of Communications at the Science Museum, London.
Professor David Perrett is Professor of BioAnalytical Science, William Harvey Research Institute, Barts & the London School of Medicine & Dentistry, Queen Mary University of London. He is a Fellow of the Royal Society of Chemistry and a Chartered Chemist. He is Immediate Past President of The Newcomen Society, and a member of Council and has served on the Council of the Association for Industrial Archaeology 1986-98. He is actively involved in Industrial Archaeology at local, regional and national levels; lecturing widely and writing on IA, organising regular lecture series, and arranging field visits and conferences.
John Sreeves is an Associate Director with civil engineering consultants Halcrow Group Ltd with over 25 years experience in transport infrastructure. As a volunteer, he helped design some of the WHR replacement bridges and continues to be actively engaged in railway restoration projects.
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.
Malcolm Tucker has a background in civil and structural engineering. With many years' experience of industrial archaeology, he now works freelance as an engineering historian. In 2000 he completed an unpublished study for English Heritage of London's 19th century gasholders and their technology.

From the Society's Interim Executive Group

A meeting of Newcomen Council was held on 9 May 2012. Major items included a decision to establish a working party to review the Memorandum and Articles of Association of the Society with a view to bring proposals to the membership next year. These have been tinkered with intermittently over the years but are now badly in need of a comprehensive review. The budget for the financial year 1 July 2012 to 30 June 2013 was approved. It was decided, according to the financial strategy agreed at the previous Council meeting, to invest the bulk of Dr Ray Smith's very generous legacy to the Society with the investment advisor, Rathbones, with the aim of developing the Society in the long term. There was no escaping the fact that the various events to mark the Newcomen engine tercentenary are not proving as successful as had been hoped. The long term viability of summer meetings as they are currently constituted was discussed and will be further considered at the next meeting. In view of both these issues it was agreed that more thought should be given to publicity both to raise the profile of the Society and as an aid to recruitment. The possibility of taking professional advice was raised and will be considered further. However, Julia Elton, who has been going through the back issues of the newsletter and old membership lists, was able to show that current membership is well above its historic low. Please contact the Executive Secretary in the first instance if you would like further information.

From the Editor

This issue of Links reflects the diverse interests and expertise of members of the Society. It includes articles and reports on: windmills; the Victorian engineer, Thomas Elliot Harrison; the saw trade in Sheffield; Henley's Telegraph Company & the Rugby Wireless Station; the Liquid Natural Gas Terminal at the Isle of Grain and the engineering at the Olympics' site in Stratford. Julia Elton has been reading past issues of the Society's Newsletter/Links and highlights issues that have been of concern and interest to members. Michael Bailey writes about our affiliation with Engineering Heritage Australia. There are news items, books to read, details of events and other snippets. I am grateful to Porthcurno Telegraph Museum for the photograph on the front cover which shows the demolition of part of the factory wall when loading spiders for delivery to Rugby Wireless Station. It illustrates the great problem of creating without assessing an exit strategy. Our 2012 celebration events are now underway and it is not too late to book for some of them. Please see the back cover for details. Speakers are already working on articles and papers for publication. To accommodate their breadth of subject matter and numbers we have decided, where appropriate, to publish them as PDF downloads in the Members' Area of the website. An initial synopsis will appear in Links and on the public pages of the website which will direct the user to the PDF. The first synopses will be published in September Links which will also include an overview of the 2012 events. Please send me any relevant and interesting photographs. Once again, many thanks to everyone who has contributed material to this edition of Links. Do continue to send articles and ideas for areas to cover – you make my role as editor very interesting.

Copy date for the next Links is 10 August

Have a good summer

Deborah Jaffé

Newcomen Matters

Welcome to New Members

Full Members: B Abbott, Mr S Algar, Mr M Anderson, Mr N Arellano, Dr G Armstrong, Mr S Atkinson, J Bates, Dr J Beckerson, Ms E Bruton, Mr J Clayson, S M P Cochrane, B Comfort, A Davenport, L Dybing, Mr J Edgley, R M Ellsworth, Dr D Evans, Mr A Green, Mr J Holt, Prof M Irving, Mr P Johnson, Mr A Letts, Mr K Ludvigsen, Mr G Lynes, Mr D Kmiec, Mr H Masterson, Mr M McCall, Dr M North, Mr. G Orme-Bannister, Mr. C Paine, D Pantalony, Mr K Payne, Mr C Pearce, Prof T B Perera, Prof I Pollock, Mr S Pye, Mr G Robertson, Mr W Shier, Mr J Simpson, Mr R Sykes, Mr A P Tester, Mr N Thompson, Dr J Trinder, Mr R Walker, Mr M Whitley

Affiliate Members: Mr N Picken, Mr. J Douglas Mr A Cline, Mr S Higton

Affiliation between Newcomen & Engineering Heritage Australia

Michael R. Bailey

Members will be aware of the close association that the Society has had with members of Engineering Heritage Australia (EHA). For 10 years or so members of the Newcomen Society have participated in EHA's conferences, that are held every other year in different cities in Australia and New Zealand. They have also attended visits to sites of engineering interest arranged by the Australian hosts. EHA has constituent groups in each of the Australian states, hence Engineering Heritage Victoria (EHV), Engineering Heritage Tasmania (EHT) etc. The EH groups are divisions of the professional Institution of Engineers Australia otherwise shortened to 'Engineers Australia'.

The Society's Council and the EHA's National Board have agreed to build on this close association through affiliation. This will serve to heighten awareness of the respective knowledge and expertise in both groups and offer the memberships the opportunity for dialogue on topics of common interest. Recent papers in Newcomen's International Journal have demonstrated our interest in some aspects of engineering progress in Australia and New Zealand. Electronic copies of Links will be made available to the Editor of the EHA Newsletter and News Bulletin, and articles and news items of interest to Australian members will be extracted and brought to the attention of their members. Likewise, electronic copies of EHA publications will be made available to the Links Editor who will pass on matters of mutual interest to Society members. I was invited to give a talk, including reference to the Newcomen Society, during my recent visit to Australia. Over 50 people attended the talk in Engineering House in Melbourne, and the moves towards strengthening of contacts was well received.

EHA's National Board, notably through the efforts of Owen Peake (Immediate Past-Chairman) and Miles Pierce (Chairman of EHV) are planning a 'summer meeting' for EHA members in Manchester in the summer of 2013. I have left with them suggestions for a programme of visits so that they can test the level of interest. This would include the opportunity for them to meet with Society members, and no doubt renew friendships.

Engineering Heritage Australia: www.engineersaustralia.org.au/engineering-heritage-australia

NEWCOMEN 2012
CELEBRATING POWER AND ENERGY

Dartmouth celebrates Thomas Newcomen

Dartmouth launched its celebrations of the life of Thomas Newcomen on 22 May with two tributes to him. One is an impressive, modern monument situated on a roundabout at the entrance to the town. The other is the refurbished and vastly improved Engine House in Royal Avenue Gardens. The ribbon cutting at the monument and the opening ceremony at the Engine House, were performed by Alvin Smith. He is the inventor of the Searaser Wave Pump and, like Newcomen, a Dartmouth man. A tree, at the back of the Engine House, has been removed to open up the whole area and create a new entrance. The words *Newcomen Engine 1712* are picked out in paviers in the plaza. Judging by the crowds that turned out Thomas Newcomen is recognised as a worthy son of Dartmouth.

Left: Alvin Smith cuts the ribbon at the Thomas Newcomen monument on a roundabout at the entrance to Dartmouth.
Above: The paviers spell out 'Newcomen Engine 1712' in front of the Engine House.

The Way We Were

A Brief History of Links, the Newcomen Society Newsletter

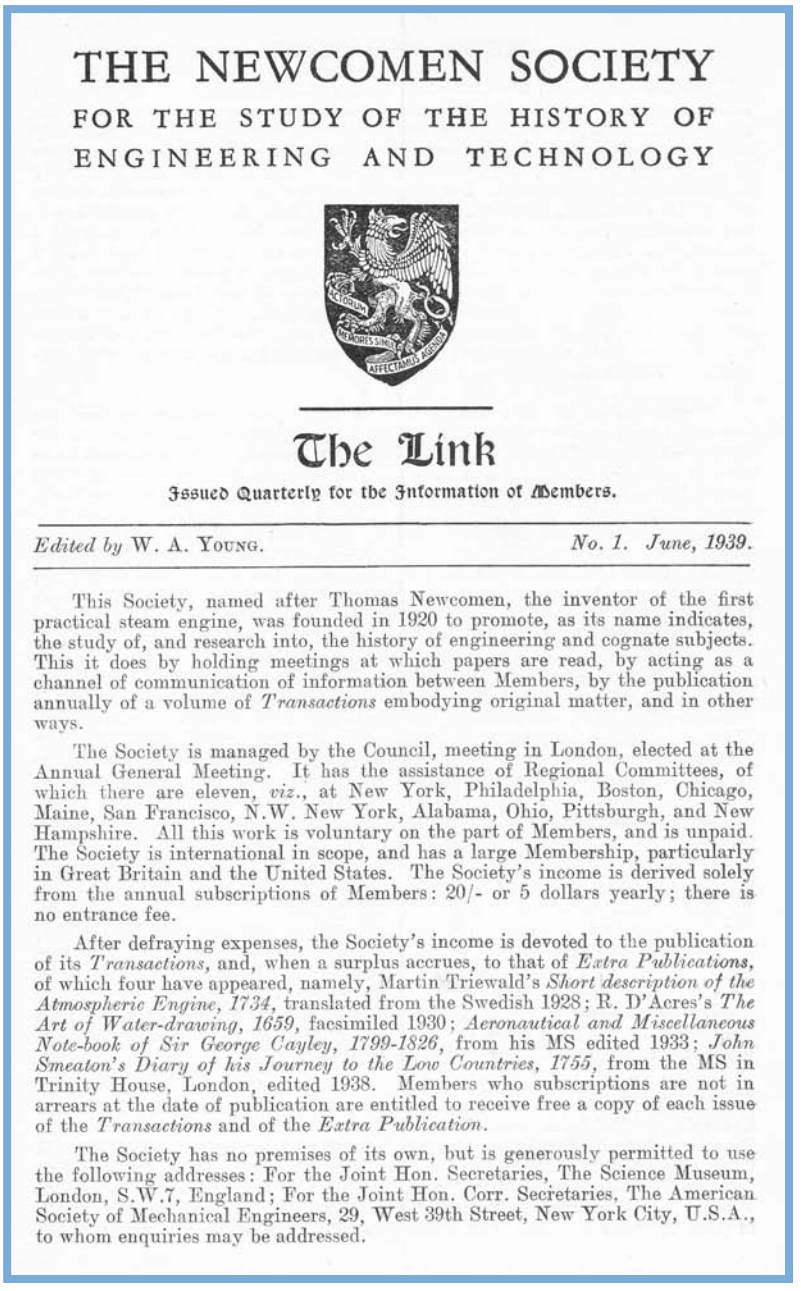
Julia Elton

I am the fortunate owner of a nearly complete set (lacking only 3 issues) of the quarterly newsletter and looking through them the other day I thought it might be amusing for members to look back over past activities, Society concerns, new developments and so on. Actually, it is surprising how little has changed. Notes on anniversaries and lively accounts of meetings and visits rub shoulders with anxieties about membership numbers, efforts to reach an international audience and complaints from members about the subscription. Future issues of Links will contain extracts from past bulletins but first members might be interested in the history of their newsletter.

The first issue appeared in June, 1939, some 20 years after the Society was founded. It was entitled "The Link" and edited by W.A. Young (who continued as editor until issue 9 of July, 1941). Its stated aim was "to link the overseas Members, and particularly those in the United States, with the central organisation more closely and regularly than is possible under the present arrangements. The Transactions have hitherto been that link…but the publication of the Transactions is at best an annual event and, necessarily, always a little belated". This first newsletter was only four pages long.

The second issue appeared in September, 1939 as war broke out, with a new name, "The N.Q.B. (Newcomen Quarterly Bulletin)", with a note to say "The alteration of the title…will hardly cause surprise. These are times in which changes occur with swiftness, and in somewhat less than three months the word that was chosen to suggest a working bond between Members in England and those residing overseas has become an international byword".

In January 1 1942 (issue 10) Eng. Capt. Edgar C. Smith, author of that seminal work, "A short history of naval and marine engineering", took over as editor and continued in the post until May 1950 (issue 32) when he was succeeded by Dr. S.B. Hamilton, a distinguished scholar and research engineer at the Building Research Station who wrote many papers on the history of iron and structural engineering. He continued as editor for nearly 30 years until January 1977 (issue 106) and died in post. Under his long editorship the newsletter once again changed its name to "The Newcomen Bulletin" (April, 1954, issue 43). When Dr. Hamilton died Frank Scowan stepped into the breach for the next 3 issues before John Boyes took over in March 1978 (issue 110). He proved a worthy and long-standing successor to S.B. Hamilton, only handing over the reins to Michael Duffy in December 1994 (issue 140), though he continued to keep members up to date with new publications and periodicals until June 2006. Under Michael Duffy's editorship, the first illustration appeared (issue 164, April 1996). Murdo Macaulay took over in April 2002 (issue 182).



THE NEWCOMEN SOCIETY

FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY

The Link

Issued Quarterly for the Information of Members.

Edited by W. A. Young. *No. 1. June, 1939.*

This Society, named after Thomas Newcomen, the inventor of the first practical steam engine, was founded in 1920 to promote, as its name indicates, the study of, and research into, the history of engineering and cognate subjects. This it does by holding meetings at which papers are read, by acting as a channel of communication of information between Members, by the publication annually of a volume of *Transactions* embodying original matter, and in other ways.

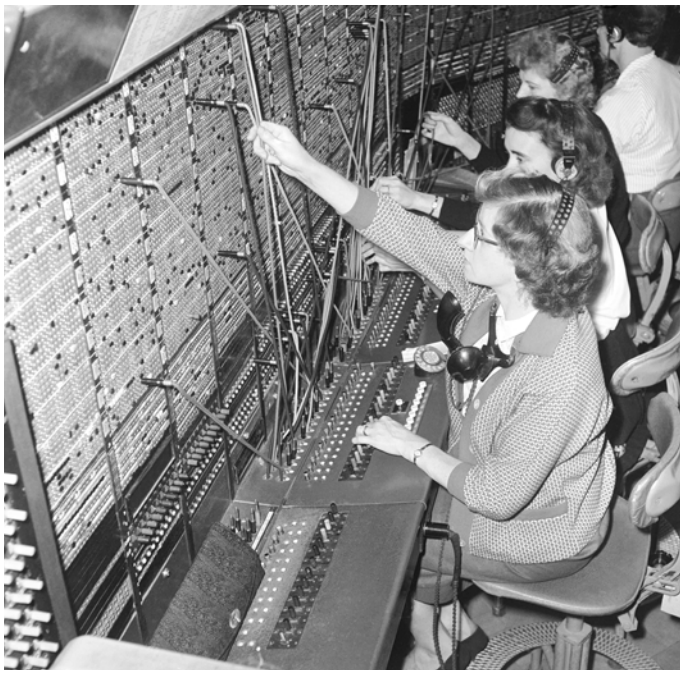
The Society is managed by the Council, meeting in London, elected at the Annual General Meeting. It has the assistance of Regional Committees, of which there are eleven, *viz.*, at New York, Philadelphia, Boston, Chicago, Maine, San Francisco, N.W. New York, Alabama, Ohio, Pittsburgh, and New Hampshire. All this work is voluntary on the part of Members, and is unpaid. The Society is international in scope, and has a large Membership, particularly in Great Britain and the United States. The Society's income is derived solely from the annual subscriptions of Members: 20/- or 5 dollars yearly; there is no entrance fee.

After defraying expenses, the Society's income is devoted to the publication of its *Transactions*, and, when a surplus accrues, to that of *Extra Publications*, of which four have appeared, namely, Martin Triewald's *Short description of the Atmospheric Engine, 1734*, translated from the Swedish 1928; R. D'Acres's *The Art of Water-drawing, 1659*, facsimiled 1930; *Aeronautical and Miscellaneous Note-book of Sir George Cayley, 1799-1826*, from his MS edited 1933; *John Smeaton's Diary of his Journey to the Low Countries, 1755*, from the MS in Trinity House, London, edited 1938. Members who subscriptions are not in arrears at the date of publication are entitled to receive free a copy of each issue of the *Transactions* and of the *Extra Publication*.

The Society has no premises of its own, but is generously permitted to use the following addresses: For the Joint Hon. Secretaries, The Science Museum, London, S.W.7, England; For the Joint Hon. Corr. Secretaries, The American Society of Mechanical Engineers, 29, West 39th Street, New York City, U.S.A., to whom enquiries may be addressed.

The front cover of the first edition of Link, 1 June 1939

Under Neil Cossons' presidency, the Bulletin underwent a dramatic change of format to A4 size and was renamed "Links" (proposed by Frank James), echoing the original short-lived name. This new format allowed for much greater flexibility of layout and illustration and was designed by Keld Fenwick, who took over as editor in December 2002 (issue 184), introducing full colour outer pages in June 2006 (issue 198). He relinquished the post in December 2009 (issue 212) handing over to Peter Whattam for the next 4 issues. Links is now in the capable hands of Deborah Jaffé who has brought her considerable design skills to its appearance as well as coming up with fresh ideas for its content and encouraging far more participation from members.



Operators working at the 'A' switchboard, Enfield telephone exchange, October 1960. Image © Science Museum, London. All Rights Reserved.

Enfield's switchboard comes home

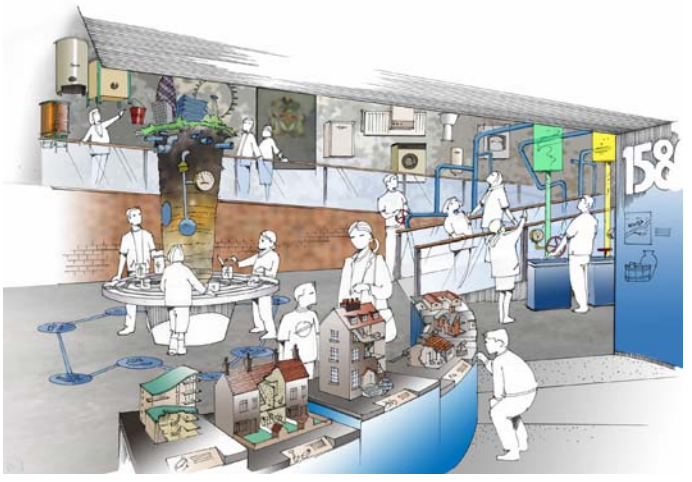
John Liffen

The Science Museum and Enfield Museum Service are jointly mounting a small exhibition at Enfield Museum which will explore the working lives of telephone operators. The centrepiece is a three-position section of Enfield's manual telephone exchange switchboard, preserved when Enfield exchange was converted to automatic switching in October 1960. The exhibition is part of a Science Museum public history project and is funded by the Arts & Humanities Research Council. The exhibition is open Mondays to Saturdays, 9.30 am to 5.00 pm, from 1 June to the end of August at:The Dugdale Centre, Thomas Hardy House, 39 London Road, Enfield, EN2 6DS.
For more information contact John Liffen at:
john.liffen@sciencemuseum.org.uk
or telephone 020 7942 4282.

Heritage Lottery Fund at Ditherington & Kew

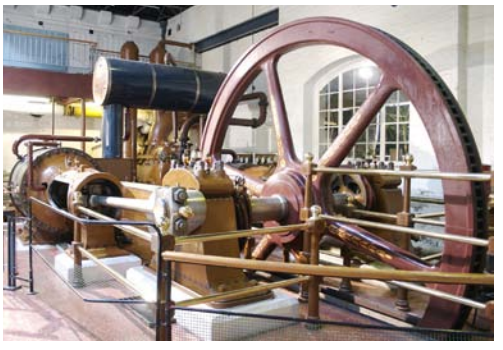
David Perrett

Ditherington Flax Mill Maltings, Shrewsbury, Shropshire, has received initial support from the HLF for a £12.1m bid. This includes £465,300 funding to English Heritage (EH) to develop more detailed regeneration plans. The Ditherington Flax Mill Maltings comprises seven listed buildings, including the 18th century main Mill which is the oldest iron-framed building in the world. As an early prototype for contemporary architecture, the mill was the forerunner of the skyscrapers that are now such a familiar backdrop to city life. This internationally important site reflects a time when Britain led the way in engineering innovation. A partnership including Shropshire Council, EH and the Friends of the Flax Mill Maltings (who also represent the local community) plans to restore and redevelop this conservation area transforming it into a centre for learning, leisure, culture and enterprise.



Above: One of the proposed layouts for Kew.
Below: An existing display

The HLF has a awarded £1.8m grant to Kew Bridge Steam Museum for an exciting restoration project. Project Aquarius will provide new and improved visitor facilities; finish outstanding repairs to the historic buildings; install additional displays, including new outdoor water based interactives; add modern interpretation; and develop new education, outreach and volunteer development programmes. It will also enable the Museum to offer a more exciting, interesting and enjoyable programme every day of the week, as well as greatly enhancing the Museum's contribution to the local community.



Dr. Alphonse le Mire de Normandy 1809 - 1864

Newcomen member, Dr. Jim Birkett, is researching the life of Dr. Alphonse le Mire de Normandy of London who was a highly respected chemist (Fellow of the Chemical Society), inventor and businessman of his period. He founded in the 1850s the "Normandy Patent Marine Aerated Fresh Water Company" which operated in the Victoria Docks section of London from the 1850s until about 1910. The Company manufactured hundreds (perhaps as many as 2,000) sea water distilling units to provide fresh water for boiler make-up, battery topping-up and drinking water purposes. After his early death, it was continued by his sons, Alphonse Louis and Frank Normandy. Please contact Dr Birkett at: westneck@aol.com

Engineering the Olympics

Deborah Jaffé

Sir John Armitt, Chairman of the Olympic Delivery Authority (ODA) gave an illuminating presentation, in London, on the various aspects of delivering the main Olympic site, in east London, in time for the Olympic Games in July. He described the scale of the operation - the initial clearance of the vast area of semi derelict land; issues of sustainability; negotiations with: the four East London local authorities in which the games are situated; local businesses and community groups; government; the London Organising Committee of the Olympic Games and other parties. There was the design and layout of the site and ascertaining exactly what was needed - the main stadium, velodrome, aquatics centre, media centre, athletes' village and landscaping. Then came the briefing of engineers and architects. At the same time the 'legacy' issues had to be considered as well as security, crowd control, queuing and public transport links. All had to be achieved with an absolute deadline in mind which, Sir John remarked, became an excellent focus for decision making. The ODA has published papers on the engineering, development and building of the site. They can be found at: www.london2012.com/about-us/publications

Images – Aerial photographs of the main Olympic Park in east London. Top: The completed main stadium. Middle: The construction of the Olympic Village in 2009, photograph taken by Anthony Charlton. Bottom: The finished site with the stadium and aquatics centre in the distance, athletes' accommodation and basketball hall in the middle left and velodrome bottom left. There are new bridges over and landscaping around the canal.
Images: ©The Olympic Delivery Authority/Getty Images 2012

Henley's Telegraph Company, Digital Radio & the Rugby Wireless Station

Allan Green

Today there is much talk about DAB Digital Radio and the progressive changeover the BBC is making from analogue to digital transmissions. It all sounds rather exotic with everything including speech, music and TV now to be sent as digital signals after being transmitted for the past 80 or more years as AM (amplitude modulated) or FM (frequency modulated) signals.

We are told that the new digital transmissions will provide us with more stations, better quality sound and high definition pictures. We look forward to that but it is perhaps timely to look at what digital radio means and to ask if this is really such a new thing?

By the early 1900s electric telegraph transmission, over wires and submarine cables, had been established for more than 50 years. It was a thriving business, technically and commercially, for companies such as The Eastern Telegraph Company. Messages were coded using dots and dashes which, when put together and decoded, formed the transmitted message. In 1901 Marconi established a radio link from Poldhu in Cornwall across the Atlantic and transmitted the same type of coded telegraph messages which, although technologically quite different from today's DAB transmissions, might still be regarded as the earliest form of digital wire-less transmission.

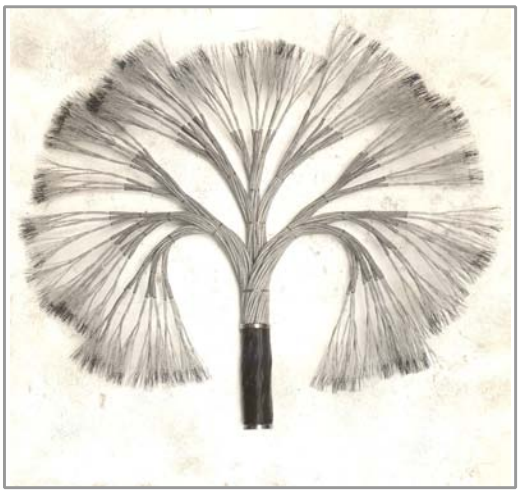
At that time telegraph communication by submarine cable around the world was very profitable for both the telegraph companies and the cable manufacturers. They must have feared dramatic and imminent changes in their fortunes as the new wireless technology became established. Nevertheless, one of the pioneer submarine cable manufacturing companies soon became involved in supplying components for the world's most powerful radio broadcast stations.

That company was W T Henley's Telegraph Works Company (Henleys) in North Woolwich, London. A large archive of Henleys material was rescued from their factory in Gravesend when it closed and was transferred to Porthcurno Telegraph Museum in 2005. It contains a wealth of information including some interesting old photographs. Among other things these show an example of equipment manufactured by the company in the 1920s that was part of the first worldwide broadcast station in the UK. This was the Rugby radio transmitter, originally planned in 1910 as one of the Government's proposed 'imperial chain' of stations connecting the colonies and dominions. Owing to a financial scandal and then World War I it was delayed until 1923 when the Rugby site was purchased and work began. This was a most significant engineering enterprise undertaken by the Post Office with worldwide coverage from the day it opened on 1 January 1926 until 2004 when decommissioning and demolition of facilities began.

Everything about Rugby was on a gigantic scale. It was the most powerful radio transmitter in the world utilising 12 aerial masts each 820ft (250m) tall and weighing 200 tons. The transmitter required a direct current supply of around 18,000 volts. On full power the aerial current was 740 amperes! The transmitter valves had to be water cooled which involved damming a local stream and constructing a cooling pond half a mile away from the station. The transmitted signal originated from a tuning fork oscillating at 1,777 cycles per second the signal of which was then converted to the transmitted frequency of 16000 cycles per second (16 kHz). By today's standards this is a very low radio frequency (VLF). Although such VLF transmissions were very soon replaced by short-wave 'beam stations', for most international traffic the VLF radio transmission remained and remains an invaluable means of communicating with Royal Navy submarines. Such signals are the only ones which are capable of being received by a submerged submarine via a long floating antenna wire. Rugby transmitted coded traffic to British submarines around the world during World War II.

An important part of the Rugby station was the aerial tuning inductance assembly, the part which coupled the powerful transmitter to the aerials which in turn radiated the signals to the world. These were very large coils and were manufactured by Henleys at North Woolwich utilising an extraordinary special cable which was mounted onto wooden frames resembling hexagonal spiders' webs.

The cable had very critical electrical characteristics, necessitating special construction known as Litzendraht and was manufactured using no less than 6561 strands of very fine



The display sample of the cable especially prepared for the Science Museum and donated by W T Henley's Telegraph Works Company Ltd, in 1926. ScM Inv. 1926-585.

wire (0.007in diameter).

An article in The Electrical Journal (1925, Vol 95) described the Litzendraht construction used:

The cable is divided into a number of separate elements or wires, and these wires are plaited or twisted together in such a way that each one over a given length

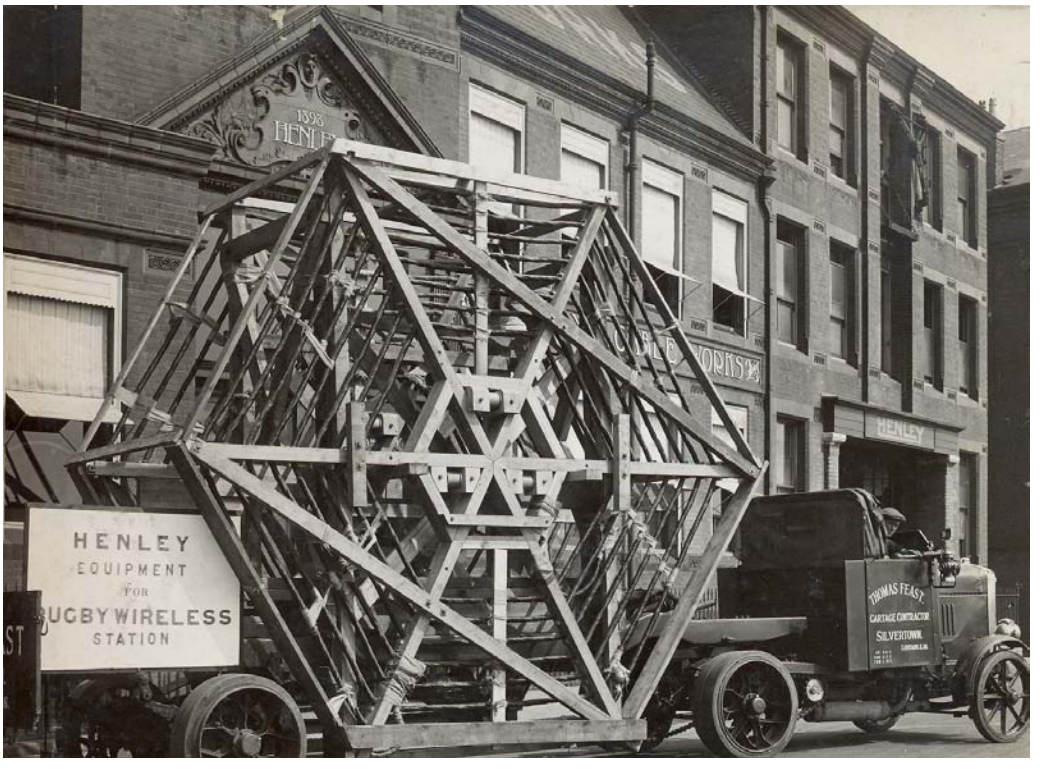
passes through the same phases as all the others with regard to the neutral axis, so that there is no tendency for a greater retardation or impedance due to the high frequency or alternations on any one wire more than another. The wires in an ordinary electric cable, although rotating around the axis always remain at the same radial distance from the axis. In this inductance cable, owing to the different distances from the axis of the various wires from point to point, slight differences of potential are generated.

Each separate wire was insulated with enamel and a wrapping of cotton thread. The insulated strands were then assembled together in threes (3x3x3x3x3x3x3x3= 6561), then all were joined at each end to form a single conductor cable which was given an overall insulating jacket

The transmitter required a number of these coil "spiders" upon which the special cable was wound. Henleys manufactured the entire units in their workshops at North Woolwich. The best insulating material at the time for such aerial coils was specified by the Post Office Engineering Department as "American whitewood" and it was from this material that the giant "spiders" were manufactured. Their very large size necessitated the removal of part of the factory wall when it came to loading the spiders for delivery to Rugby.

The completed Rugby radio station, call-sign GBR, went on the air as the world's most powerful transmitter with world wide coverage on 1 January 1926 transmitting in Morse code only. However, only a few months later Rugby chalked up another first in establishing a two-way radio telephone conversation between England and the USA. Within a further year a commercial radio telephone service to the USA was available via Rugby with calls at £15 for 3 minutes.

The story of the 1926 Henley manufactured tuning coils at Rugby ended unhappily when they were destroyed by fire in 1943. This was not, however due to enemy action but probably as a result of overheating of the heavily utilised transmitter. The coils were replaced soon afterwards but it is not known whether it was Henleys or some other constructor who manufactured the replacements. These 1943 replacement "spiders" have been preserved and are now in store at the Science Museum, London.



Above: The large size necessitated the demolition of part of the factory wall when it came to loading the spiders for delivery to Rugby.
Below: The delivery lorry leaving the Henley works for Rugby.
Images: Credit © Porthcurno Telegraph Museum. All Rights Reserved

Further information about Rugby radio station may be found on-line at: www.subbrit.org.uk/sb-sites/sites/r/rugby_radio/index.shtml

A video clip of the demolition of the last four masts at Rugby can be found on YouTube: www.youtube.com/watch?v=bx21hSUuGqU

A Visit to The Royal Institution

Bryan Lawton

It is about twelve years since the Newcomen Society last visited the Royal Institution on Albemarle Street, and it has been considerably re-vamped in the intervening years. Frank James, Professor of the History of Science at the RI was our guide.

The RI was founded 1799 with the aim of introducing new technologies and science to the general public and is, perhaps, most famous for the annual Christmas Lectures, now televised, that have been running since Faraday founded them in 1825. The RI is equally famous for the quality of its research work and for the distinguished scientists who have worked on the premises, including some fourteen Nobel Prize winners. The RI moved into its current premises almost immediately after its foundation. The imposing Greek façade was added later and the building has been adapted and changed so that only the staircase remains of the original eighteenth century building. At the bottom of the staircase is a very fine 1876 statue of Michael Faraday, in his Oxford gown and holding his induction ring.

Throughout the building there are exhibits of important original scientific apparatus. The theme on the ground floor is "people" and includes: James Dewar, best known for the invention of the Dewar (vacuum) flask; Sir William and Sir Lawrence Bragg, who won the Nobel Prize for their work on X-ray crystallography; and, of course, Michael Faraday, the bookbinder's apprentice who became, after starting work at the RI, a great experimental scientist responsible, amongst many other things, for the discovery of electromagnetic induction (1831). The latter discovery is probably the earliest occasion on which scientific discovery led to the development of a new industry, in this case through the subsequent development of the electric motor, generator, and transformer, although it was some time before scientific theory caught up. I should also mention Sir Humphry Davy, the inventor of the Davy lamp that gave light to miners without the risk of igniting explosive gases and the discoverer, using electrolysis, of sodium, potassium, barium, strontium, and magnesium. In a famous Clerihew, Sir Humphry Davy was said to have "lived in the odium of having discovered sodium".

Above: Kathleen Lonsdale with sample of Benzene isolated by Michael Faraday in 1825 Left: Faraday's experiment in which he discovered the magneto-optical effect in 1845. Credit ©Royal Institution

The first floor is devoted to exhibits illustrating "communication" and it is here that the famous lecture theatre, where many of the world's most famous scientists have taught, is located. Alas, on the day we visited it was occupied, but it can be visited freely at any time it is not in use. However, the most impressive display area is downstairs where the majority of the exhibits are displayed; it is devoted to "experimentation". Here can be found a periodic table where the ten elements discovered at the RI are featured in a game. Amongst the electro-chemical displays is Volta's battery, which was his gift to Faraday, the first cathode ray tube, which was formerly one of the most popular of exhibits but with the advent of digital television, is now almost ignored, and, as you might expect, Faraday's induction ring. A highlight is Faraday's magnetic laboratory, shown as it was in the 1850s, and immediately opposite is a modern, state-of-the-art laboratory devoted to nano-technology. Current research is devoted to nano-magnets.

Two other displays, not previously mentioned, are illustrated. These are Faraday's device with which he discovered the magneto-optical effect in 1845, and Kathleen Lonsdale, the X-ray crystallographer who established the structure of benzene. There are many more discoveries made at or associated with the RI, and this short report recounts only those that struck me as important or interesting as I toured the building. Still further subjects would appeal to other visitors. This is one of the RI's many charms; there is something for everyone, and entry is free.

The Royal Institution of Great Britain, 21 Albemarle Street, London W1S 4BS. 020 7409 2992
www.rigb.org

Sheffield's Saw Trade & its Relations with Birmingham

Simon Barley's lecture to the Midlands Branch

One of the many workers in the Sheffield Saw Trade

Although saws are one of mankind's oldest tools, making them in Britain in large numbers did not take off until the mid 18th century. London smiths had started the trade a century before, followed by Birmingham specialists and then in the 1750s a few prosperous entrepreneurs in Sheffield took advantage of several, favourable factors. Benjamin Huntsman's new crucible steel; the plentiful water power to drive rolling mills, and the metal-working traditions of a large, concentrated labour force were increasing national prosperity and the *can-do* spirit of what became the Industrial Revolution. What Sheffield lacked was specialist saw makers. These were the men who knew how to turn sheet steel into a hardened and tempered form that could be smithed to hold its shape, keep its teeth sharp for prolonged performance and continue to be sharpened and repaired for decades. These skills could be found in the Birmingham area and the West Midlands, and documents exist in the Archives sections of Sheffield City Library and the private records of Joseph Wilson at Sharrow Mills (today still making snuff in a building dating to 1755) which show that men could be brought in to get the industry started. Enticements such as free accommodation for men and their families had to be provided, as well as paying for legal arrangements to release them from their previous employers, and money to continue their sick club payments in Birmingham. Equipment like anvils and bellows were bought by Wilson in Dudley, Wednesbury and in Birmingham itself, where the flourishing firm of Hughes and Sons, saw-handle makers, provided not only their products but, even more importantly, the business contacts and a commercial conduit for transferring money and finding the men.

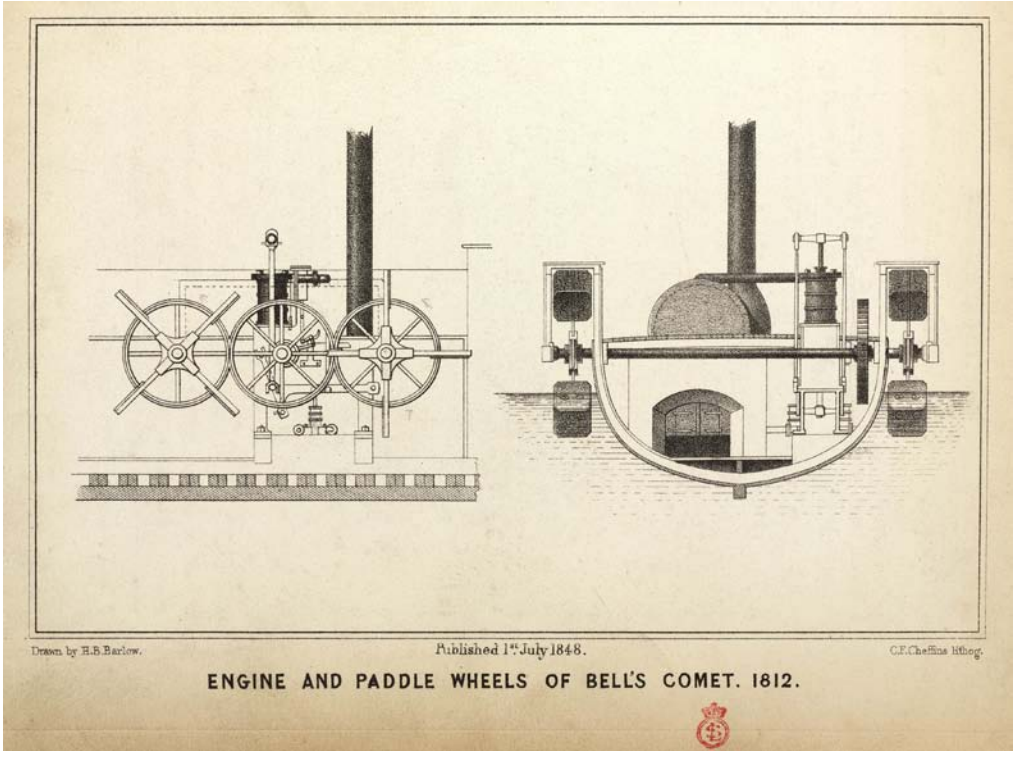
The position was largely reversed 50 years later when Sheffield contained probably two or three times more sawmaking firms than Birmingham. The larger town retained its purely commercial lead, however, and two of its merchants - Americans with linked businesses on the US East coast - were buying and exporting large numbers of saws from at least one Sheffield maker, Jonathan Beardshaw.

One final influence was noted: two of Birmingham's prominent sawmakers who had moved to Sheffield to set up business, were driven out by the over-vigorous activities of the local trades unions. One, Aaron Atkin, began in the 1830s, bought up his main rival in the next decade and continued in business until 1989, probably making more saws than all his local rivals together. Throughout that time, however, he retained the title *Sheffield Works* for his premises.

The Bicentenary of Europe's First Commercial Steam Navigation

Robert Carr

The 200th anniversary of the start of commercial steam navigation in Europe falls on 8 August. In 1812 Henry Bell's paddle steamer, Comet commenced a passenger service on the Clyde from Glasgow to Greenock and Helensburgh three times a week and was the first passenger paddle steamer to operate commercially in Europe. .Within ten years there were nearly 50 steamers on the Clyde. Following rebuilding, the Comet was wrecked in 1820 at Craignish Point, near Oban. The engine was salvaged and is now in the Science Museum, London. For the 150th anniversary in 1962 a full-size replica of the Comet was built by shipyard apprentices and can be seen at Port Glasgow.



Engine and paddle wheel of Bell's 'Comet', 1812.
Lithograph by C F Cheffins after a drawing by H B Barlow, of parts of the steamship designed by Henry Bell (1767-1830). The engine was built by John Robertson (1782-1868), and is now in the Science Museum. The 'Comet' was launched in 1812. She ran aground at Craignish Point, near Fort William, in December 1820. Illustration from 'A sketch of the origin and progress of steam navigation from authentic documents' by Bennet Woodcroft (1803-1879) published in London in 1848. Image No. 10425695. Credit © Science Museum. All rights reserved.

Thomas Elliot Harrison - an exemplary, Victorian, civil engineer

Dr Bill Fawcett spoke about Thomas Elliot Harrison at a joint meeting of the Newcomen Society North East Branch and the Stephenson Locomotive Society at the Discovery Museum, Newcastle upon Tyne

Dr Fawcett, is co-author with John Addyman of 'Thomas Elliot Harrison (1808-1888) Founder and Engineer of the North Eastern Railway'. So, with his extensive research, he was ably qualified to talk about the life of this notable engineer who is largely unrecognised beyond the dedicated historical engineering and industrial archaeology fraternity.

It seems that Harrison's undoubted skill as a civil engineer was overshadowed by the reputation of his engineering contemporary and colleague Robert Stephenson, who himself basked in the reputation of his illustrious father George. Thomas Elliot Harrison was the close assistant to Robert Stephenson on the line from Darlington to Berwick. This became the York, Newcastle & Berwick Railway (YNB), on which he succeeded Stephenson in 1849 as Engineer-in-Chief. Harrison also took on a management role and was instrumental in the 1854 merger which transformed the YNB into the North Eastern (NE) Railway, which became the fourth largest of the major pre-grouping railway companies. Harrison remained engineer-in-chief of the NE Railway until his sudden death in March 1888.

Alongside his achievements for the NER, Harrison also did much work as a consultant for other companies. Sometimes this was on a one-off basis and also for long terms as when he became consulting engineer to the London & South Western Railway (following the death of John Errington) and the Gloucester & Berkeley Canal. He was frequently to be found giving evidence on Parliamentary Bills. This involvement was duly recognised at the time, but has now faded from public awareness.

Although born in Fulham, London, in April 1808, Harrison's interest in and commitment to engineering came as a result of his being brought up in Sunderland where his father and uncle had shipping and coal trade interests. On leaving school, he was articled to the engineer William Chapman. However, after a short spell in a London accountant's office, he found work with Robert Stephenson. Dr Fawcett explained the Harrison family tree in great detail, emphasising the several engineering associations that various members of the family had. The ups and downs of the family financial fortunes (or lack of them!) were also explained.

Harrison's first major work for Stephenson was to survey levels for the Wolverton to Rugby section of the London and Birmingham Railway. He subsequently worked on the construction of the Stanhope & Tyne Railway; his father and uncle being its leading promoters. He was also engineer to the associated Durham Junction Railway. This line was carried over the River Wear on the Victoria Viaduct at Penshaw (1839), which is perhaps the most architecturally significant of Harrison's many civil engineering undertakings. For this he obtained a design from James Walker which he then modified in the light of site conditions.

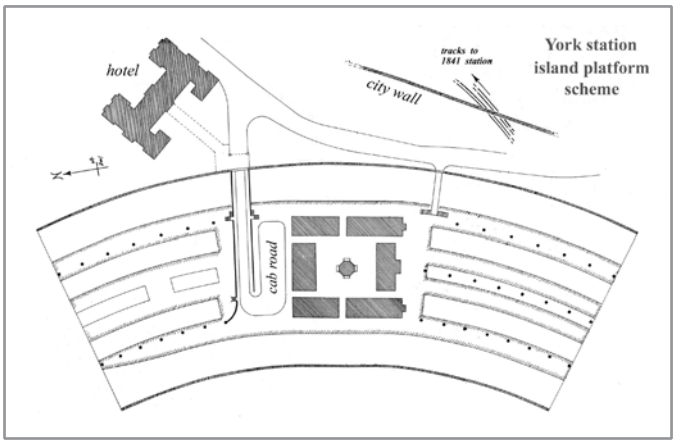
Although known as an outstanding civil engineer, Harrison was also keenly interested in mechanical engineering.

In 1838, he designed the articulated Thunderer locomotive, an ingenious although not very successful concept, to meet Brunel's specification for use on the Great Western Railway.

Dr Fawcett enhanced his lecture with numerous slides illustrating many of Harrison's structures and edifices. Notable among these were bridges and viaducts, including the Newcastle High Level Bridge. Robert Stephenson was responsible for the concept of this North East landmark, but Harrison was master of the fine detailing. He also had an interest in another outstanding railway bridge, the renowned Forth Bridge. The North Eastern Railway was a major investor in the Forth Bridge and Harrison acted as the company's representative by scrutinising and advising on the design. In 1869 Harrison replaced the timber arches of John Green's 1839 Ouseburn and Willington Dene viaducts on Tyneside. He had known Green, and sensitively chose to make the wrought-iron replacement a remarkably close replica of the original, with its distinctive spandrel bracing.

Other bridge illustrations highlighted the grace and functionality of Harrison's designs. His adoption of a semi-elliptical arch rather than the normal regular arc 'roman' arch was commented on. Not content with railway bridge design, Harrison also took an interest in station design and the associated track layout. His single through platform design for Leeds station alleviated the need for a pedestrian bridge for passengers to change platforms. The Forth Goods Yard Station, Newcastle (1870) was a another notable achievement. However, his biggest station scheme was for York, with its distinctly high-Victorian train shed. Harrison's initial concept for York station was a huge island platform with a central court of offices that anticipated the layout adopted at Edinburgh Waverley by 20 years. Although he did the planning for the eventual station at York, Harrison entrusted the detailed design to Thomas Prosser, whom he had recruited as NER architect in 1854. There were also ventures into dock design including at Jarrow and Hartlepool, as well as coal drop schemes and canal works.

Insights into Harrison's working practices reveal he worked for six months from a home in London and six months from his home at Whitburn, in the North East. He maintained extremely good working relationships with most



Left: York station, completed in 1877. Harrison planned the station but entrusted the detailed design to Thomas Prosser, whom he had recruited as NER architect in 1854.
Above: Harrison's first idea for York was this huge island platform with a central court of offices, 20 years before the layout was used at Edinburgh Waverley.
Below: The Ouseburn and Willington Dene viaducts on Tyneside on which Harrison replaced the timber arches of John Green's 1839 construction.

of his engineering contemporaries, except for Board of Trade engineers, whom he seems to have considered over-cautious at times.

In the sharing of his considerable knowledge and copious illustrations, Bill Fawcett, left the audience in no doubt that Thomas Elliot Harrison was a great all-rounder, in the mould of such giants of our Victorian engineering heritage as the Stephensons, the Brunels, et al. A vote of thanks was given by Les Paul, a member of the Stephenson Locomotive Society, which was enthusiastically endorsed by all those present in the usual way.

Thomas Elliot Harrison (1808-1888) Founder and Engineer of the North Eastern Railway. By Bill Fawcett and John Addyman, published by Robert Stephenson Trust

The Reliant's port engine and feathering paddle wheel at Markham. Image © R Carr

The Steam Tug Reliant

Robert Carr

The paddle tug Reliant was originally the Old Trafford, one of six similar vessels of old-fashioned design built 1903-7 in North East England for service on the Manchester Ship Canal where their disconnecting side-lever engines were found to be particularly useful. These engines enabled the paddles to be worked independently, even in opposite directions, giving the tugs great manoeuvrability. Old Trafford worked on the Canal until 1950, was then sold to Newcastle, renamed Reliant and used on the Tyne. She ended her working days at Seaham assisting colliers in and out of the port from 1956 until 30 April 1969, by which time the tug was an extreme rarity.

Reliant was acquired by the National Maritime Museum[1] and was on public display in the Neptune Hall[2], Greenwich, for nearly a quarter of a century. In the mid 1990s it was decided to substantially redevelop much of the Museum. After the tug was offered to other museums, without success, the hull was cut up and the Neptune Hall demolished. What presently remains of the starboard engine is still at the National Maritime Museum Greenwich powered by an electric motor and driving a new reduced-size non-feathering paddle wheel. The port engine was as far as possible restored at the Markham Grange Steam Museum in Yorkshire 2002-6 and now drives the original fully-working complete feathering paddle wheel[3]. This engine and paddle wheel work splendidly at Markham, driven by a discreetly located electric motor. On arrival in Yorkshire in January 2002, so many components were found to be missing that the original intention of restoring the engine to a steamable condition was reluctantly considered to be impracticable.

Feathering paddle wheels are about ten per cent more efficient than the simpler radial paddle wheel. In non-feathering paddle wheels where the blades or floats are fixed, only the float at the bottom exerts an entirely horizontal thrust, all the other immersed floats partly depress or raise the water rather than propel it backwards. This wastes energy. In feathering wheels the angle of the paddle float is continuously adjusted mechanically to a suitable angle.

The Reliant's engines are of the grasshopper type in which the side-levers are pivoted at one end rather than in the centre of the beam or lever. As well as driving the paddle wheels the side levers drive a number of pumps: the air pump for maintaining the vacuum in the condenser, the cooling water pump for circulating cold water through the condenser, the boiler feed pump, and bilge pump.

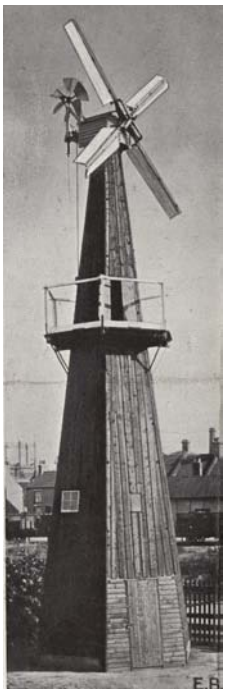
Alley and MacLellan Ltd of Glasgow built Reliant's Sentinel steering engine. This is also at Markham restored to working order. Engines at Markham are generally in steam on Wednesdays but it is advisable to telephone 01302 330430 beforehand to check.

1. Old Order, New Thing by H Campbell McMurray, National Maritime Museum 1972.
2. A former gymnasium of 1873-4 designed by Sir Andrew Clarke RE 1824–1902. Clarke was trained as a Royal Engineer at the Royal Military Academy, Woolwich, where Michael Faraday was one of his teachers. The gymnasium was built for boys being educated in Greenwich at the Royal Hospital Schools for careers in the Royal Navy.
3. Climbing out of the porthole by George Dickinson, Doncaster 2007. The only copy in a library appears to be the one in the J Porter Shaw Library, San Francisco California.

Edward Lancaster Burne's Windmills

Tim Booth's lecture at the Midlands Branch

Edward Lancaster Burne was an engineer with a passion for windmills. His love of mills developed during his boyhood in Sussex in the 1870s when eighty or more windmills were still at work. However, he would have witnessed with regret the rapid decline in their numbers towards the end of that century as steam powered roller mills took over flour production. A trial of annular sailed wind engines at the Royal Agricultural Show in 1903 made Burne acutely aware of the limitations of conventional windmill sails in light winds, another factor affecting their continuing usefulness. He could see a possible further lease of life for windmills as a means of generating electric power, especially if sail performance could be improved, and produced several articles promoting this cause. No doubt establishing his engineering consultancy in London and then the advent of the First World War slowed his progress in developing ideas for a new sail design but he did maintain his interest in traditional windmills, recording and photographing them whenever possible. Burne's interest in the history of engineering meant that he was pleased to become a founder member of the Newcomen Society in 1920. By the early 1920s he had perfected a design which was at least twice as effective as conventional sails and persuaded English Brothers of Wisbech to manufacture a miniature



One of Edward Burne's windmills.

The Welsh Highland Railway

The Beyer-Garrett locomotive built in 1958

John Sreeves' lecture to the Midlands Branch

After closure of the railway in 1937 the rails were removed for the war effort and the trackbed returned to nature. That might have been the end of the line but for a legal quirk of fate in that the trackbed was never "Statutorily Abandoned". Up until takeover by the present administration in 1999, the land had not been sold or redeveloped, thus ensuring the prospect of reopening of the whole route in its entirety. A northern extension into Caernarfon was an aspiration of the old company made possible by use of the ex-BR Afon Wen branch, abandoned in the 1960s, shared with a cycleway.

Progress by the WHR Society established in 1964 was slow with many legal hurdles and three public inquiries. Twice, Secretaries of State for Transport overruled inspectors' recommendations and found in favour of restoration, eventually culminating in the much coveted Transport & Works Act Order being granted in 1999 (SI 1999 No. 2129).

The railway is steeply graded and sharply curved. From the outset it was realised that much larger locomotives would be needed than those used in the 1930s to provide a viable and reliable service. A fleet of redundant 2' gauge Beyer Garratt locomotives was found in South Africa, and these ex-British built locomotives were repatriated for use together with other items of rolling stock and track components. The loading gauge had to be modified to accept their larger outline and this has been done sympathetically while retaining as much of the heritage as possible.

What started out as a volunteer project soon became immense in terms of resources required and would not have been achievable without grant funding first from the Millennium Commission and latterly the European Regional Development Fund. This enabled contractors to be engaged on the ground works such as fencing, drainage and the clearance of 60 years of vegetation growth. Voluntary labour was used primarily for tracklaying, an activity that evokes the greatest amount of interest and enthusiasm.

To deliver a safe railway, all of the old bridges had to be examined and modified, strengthened or replaced. In some cases no work was required at all. The speaker's main involvement in the project was the design of new bridges capable of carrying the heavier loads but similar in outline to those that existed previously. Much of the fabrication work was carried out by Brunswick Ironworks of Caernarfon, having been competitively tendered, thereby maintaining skilled employment in the locality. Particular challenges included difficulty of access to the trackbed and the need to minimise environmental intrusion in the National Park at all times.

One of the most intractable hurdles was the reinstatement of the line though Porthmadog which entailed a unique flat crossing with Network Rail and an interface with their innovative ERTMS signalling system. The final link to the Ffestiniog Railway required an elongated tramway style level crossing over Britannia Bridge that aroused much opposition and controversy.

The construction phase brought significant volumes of work to the local community, and the railway continues to drive regeneration of the economy through both paid employment and spending in the areas by visitors. The culmination of 47 years of effort has resulted in restoration of a spectacular heritage railway, tourist attraction and sustainable transport facility.

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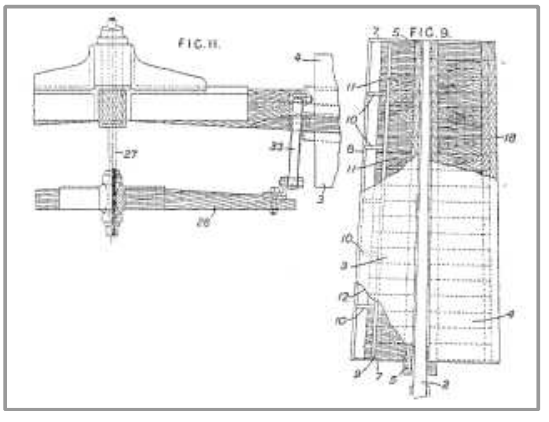
smock mill which would generate sufficient power for the needs of country properties. A cleverly designed switching mechanism, which allowed different cells to be charged in turn, overcame some of the problems of a variable power source and lengthened the lives of both battery and bulbs. However, only a handful of these mills were ever sold and plans for larger more powerful units never came to fruition. Remarkably, one of Burne's mills still stands almost intact after more than fifty years of disuse.

Burne maintained his interest in electrical generation by wind power and was still answering queries on possible applications in the 1940s. He also maintained his passion for traditional windmills and, through his membership of the Newcomen Society, became firm friends with other enthusiasts such as Rex Wailes. He was regarded as a stalwart of the Society and was its president in 1941-2. Burne continued working as a consulting engineer after the World War II but on 12 June, 1946, on his way to a Newcomen Society meeting, he collapsed on the platform of Croydon Station and died shortly afterwards.



Burne took out 8 patents relating to windmills. This diagram is part of patent application GB1921/34273. It states: 'A framed hollow vane for windmills is made with its front surface formed of sheet metal and its rear surface of wood. Fig. 9 shows the construction applied to a vane … the vane is formed of two portions adapted to be folded back by wind pressure against the action of a spring. The leading portion 3 of the vane comprises a longitudinal member 5 hinged to a radial arm 2 of the windmill shaft, boards 7 shaped to the vane-section, a longitudinal strip 9, distance pieces 10, boards 11 forming the rear surfaces of the vane and sheet-metal 12 forming the front surface extending from the member 5 round a rod 8 on the distance-pieces 10 and secured to the boards 11 of the rear surface. The following portion 4 is similarly formed but with a shaped longitudinal member 18 at the edge. The radial arm 2 lies flush with the vane surfaces.' All his patents are listed and can be found at Espacenet – www.espacenet.com. Editor

The National Grid's Liquid Natural Gas Terminal at the Isle of Grain

Report of the Newcomen visit to the Isle of Grain

Fred Starr and Malcolm Tucker

With the continuing fall in output of North Sea Gas, the Isle of Grain Liquefied Natural Gas Terminal is a mainstay of the UK gas supply system. Liquefied Natural Gas (LNG) consists mainly of methane in the liquid form, at -164°C. A cubic metre of LNG contains 600 times as much energy as a cubic metre of gas at ordinary temperatures and pressures.

Our host was Mr Mark Mckenzie, Works Delivery Manager, currently responsible for managing the construction of new tanks and associated equipment on the site. Mark took us round the site, then gave us a talk that was rich in engineering experience. This account is based on what he told us as well as some additional material from the authors.

The Terminal lies at the eastern tip of the Isle of Grain bewteen the estuaries of the Thames and Medway. On the drive to it we could see the coal-fired Kingsnorth Power station and, close to the site, the now defunct oil-fired ex-CEGB power plant. There were also vestiges of the BP refinery complex, but there is no trace of the extremely advanced gasworks which South Eastern Gas built in 1958. The newest power plants are those of the CCGT (combined cycle-gas turbine) variety, one belonging to EON close to the LNG Terminal and the other at Damhead Creek.

North Thames Gas began importing LNG into Britain in 1959 and established a large site at Canvey Island. Subsequently, British Gas built a number of small plants where pipeline gas was liquefied and stored for "peak lopping", as at Glen Mavis in Scotland. The Isle of Grain site was one of the last and built on the gasworks in 1981. However, cryogenic storage is expensive and these units have been decommissioned. In 2005 it was realised that the Grain site was perfect for the import of LNG by tanker. At that time the Terminal could supply 4% of the UK's demand. There has been a progressive expansion of the storage facilities, which have now reached Phase 3. Presently the Terminal can supply nearly 25% of the average UK gas demand.

On our tour of the site we saw, from the road, the four liquid gas tanks of Phase 1, which have metal exteriors with segmental domed tops. These are about 50m diameter and nearly as high. If LNG were to escape, containment is provided by bund walls. Also seen was a spiral-guided low-pressure holder, dating from the time when gas was manufactured on site and now used to store low pressure "boil-off" gas.

After removing anything which could cause a spark, we suited up with flame proof overalls and began our walk around. The Terminal is effectively a warehouse for the storage of gas which comes in by tanker every two days. Although the Terminal has the appearance of a small refinery there was not the usual heat or smell, nor the grubbiness associated with such plants. The absence of heat is not unexpected, but (conversely!) the only units with some ice round them were an LNG vaporiser and an Air Products air separation unit. The latter supplies nitrogen to the gas leaving the site to ensure that an over-rich gas has the right calorific value. Where the gas is lean, propane is used to bring the calorific value up. The calorific value varies partly because of slightly different specifications of LNG from different sources and partly because methane boils off from the LNG at a faster rate than the heavier hydrocarbons.

We got close to one of the three tanks of Phase 2. These are about 90m diameter and 50m high. The outside shell of the tanks acts as the bund containment, and is constructed from slipformed concrete incorporating post-tensioned tendons for strength. Although the gas pressure is only 0.1bar gauge,

Left: Arctic Princess delivers commissioning cargo for Grain LNG's Phase 3
Above right: The tanks at the Isle of Grain LNG from the air.
Images: Credit © National Grid
Below right: The guide for the day, Mark Mckenzie flanked by the Newcomen group

the liquid head corresponds to about 3 bar so the outer shell could be under considerable stress. Insulation is provided by an internal layer of perlite, and is so good that there was no trace of condensation on the tank walls. The LNG is held by a nickel-steel internal vessel. When filling the tanks, LNG is pumped from a ship along a 4.5km twin pipeline system. The pipes are effectively always in use, since when LNG is not being transferred, they are kept at -164°C by recirculating LNG out of the tanks into pipes and then back. Hence when LNG is taken from the ships, there is no danger of flash evaporation, with a big pressure build up, or of massive contraction in pipe length.

Despite the insulation, there is a continual boiling off of gas, which keeps the LNG at -164°C. The daily boil-off corresponds to about 5000 cu. metres of liquid. There was an amusing discussion on what LNG looks like. Because of its inflammability, there are few people who have seen it! The best guess was that it would be a colourless liquid, something like a watery version of paraffin.

When called on to supply gas, the output from the site has reached 600 GWh per day, i.e. over 50 million cubic metres of gas at consumer pressure. First the gas is pumped up to 90 bar pressure using vertically mounted, 9 or 12 stage centrifugal pumps. Each is about the size of a man and is installed underneath the vaporiser banks. The vaporisers consist of large tanks of water, into which a gas burner fires. The warm water then heats tubes carrying the "liquid". Because the pressure is above the critical, no boiling of LNG occurs in the tubes. But a predictive computer program operates via a distributed control system to regulate the flow rate and pressure. During start up it is important not to evaporate too fast, as crash cooling causes contraction stresses in the pipework and pumps. The gas having been heated to 2°C can be put into the pipeline network.

The Phase 3 expansion of 2010-11 cost £395m, with one new tank and a second jetty. There are now 250 berthing slots per year, a total storage of 1 million cubic metres and a delivery capacity of 60 million cubic metres of gas per day. Throughput has increased to 20 billion cubic metres per year. Phase 4 is expected to start construction in 2013 with one new tank, for Russian customers (liquefied in Siberia). There are currently 145 people on site, but the construction workforce peaked at 3000.

The Terminal uses 80 MW of electricity from EON's CCGT plant. In addition a hot water pipeline has been installed, to deliver 227 MW of heat for regasification purposes. A problem is that the Terminal's requirements and times when electricity is being generated do not always coincide. Furthermore heat losses are unexpectedly high and the line is not yet in service.

The only mild disappointment in this visit was that we did not see a tanker at berth or the docking facilities. Nevertheless, it was a great day largely through the expertise and enthusiasm of Mark Mckenzie whose final words to us were, "When you come back I will have a tanker at the jetty for you."

Thomas Davenport's Electric Railway – Part II

Alan M. Levitt follows up his article of Thomas Davenport that appeared in Links 220

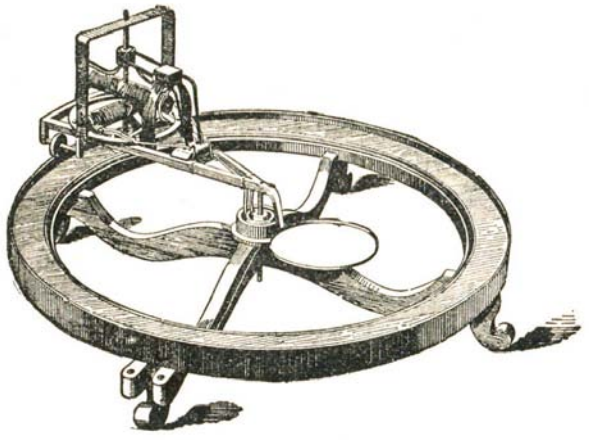
Franklin L. Pope,[1] in a paper read before the American Institute of Electrical Engineers in 1891, remarked that:

In pursuing my investigations into the history of Davenport's work, I was fortunate enough to find that several of his original models were still in existence. One of these models, with a circular railway two feet and a half in diameter with a locomotive traveling on it, similar to the one which we have here to-night, but very much more finely finished, I was able to satisfy myself by contemporaneous evidence was built in 1837. The one which is before you was found in the cabinet of the Female Seminary in Troy [New York], *formerly Miss Willard's. The records of the institution show that it was purchased in 1840, but it evidently must have been built by Davenport himself prior to the more finely finished model of which I have just spoken, which was constructed in 1836-7 with the assistance of Mr. Ransom Cook, of Saratoga* [New York], *a very ingenious person and a finished mechanic. I think there is no doubt that the model before us was built in the early part of 1837 and possibly as early as 1836.*

Pope stated that the model was mounted with the same battery – *a three-cell Grove battery of pint cups* – which he found with it and was set in motion.

The illustration, printed from a wood engraving of Davenport's Electric Railway model built ca. 1836-1837, appeared in The Electrical World in March 1891[2], and in Carl Hering's Recent Progress in Electric Railways. Hering wrote that in December 1835, Davenport '*exhibited in Boston the model of an electric locomotive he had built in Springfield (Massachusetts)*'[3].

Carl Hering cites that Riley Bowers, reminiscing in 1891, stated that Davenport, following the New-York demonstration, '*… took his model to England and set it running. Michael Faraday was well pleased with it …' but '…refused to invest, or recommend it to others*'[4]. Although 'Davenport' appears in Faraday's correspondence, in his letter of 10 May 1856 a 'Davenport' refers to a piece of furniture; another is related to Samuel Thomas Davenport other reference to this demonstration has not been found.



1. Thomas Leonard Pope (1840-1895) was one of the earliest practicing electrical engineers in the United States and made many important inventions in the fields of the printing telegraph, and electric block railway signals. One of the earliest patent solicitors to make electrical inventions a specialty, he was a prominent author, writer, and historian in electrical matters, sometime partner of Thomas Alva Edison, and served as president of the American Institute of Electrical Engineers.

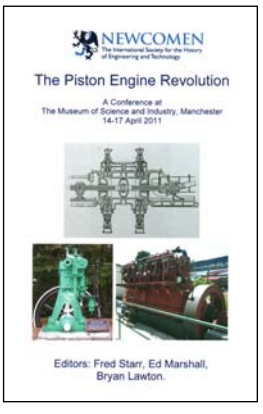
2 . Pope's paper was printed in The Electrical World (Vol. XVII, No. 12) for March 21, 1891.

3. The same engraving appeared in a similar, later, edition [New York: W. J. Johnson Company, 1897, p.12].

4. Carl Hering, Recent Progress in Electric Railways. New York: W. J. Johnston Company, 1897, p.12.

Left: An illustration, printed from a wood engraving of Davenport's Electric Railway model built ca. 1836-1837, appeared in The Electrical World in 1891 .

The Piston Engine Revolution, the conference volume



The Piston Engine Revolution, consists of 22 papers from the conference held in Manchester in 2011. A wide range of internal combustion engines topics is embraced, including early gas engines, early aero- and automotive engines, industrial, rail and marine engines, and sleeve-valve designs. Related topics comprise the manufacture of producer gas, the development and testing of fuels, the progress of exhaust valves, and a short biography of Sir Harry Ricardo. The book has 550 pages and about 300 illustrations.

Price: £35 per copy including p&p (UK and surface mail overseas).
Volumes can be purchased, at a cost of £35.00, from the Society's office.

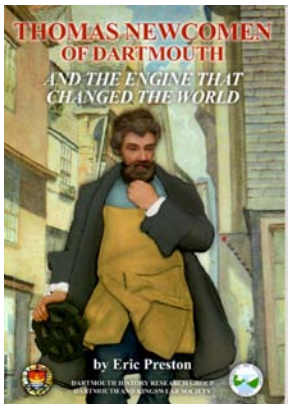
Please send a cheque payable to The Newcomen Society or full card details to:
Roger Cline
The Newcomen Society
The Science Museum,
London SW7 2DD or
atbooksales@newcomen.com

Information Wanted: Indicator Graphs of Newcomen Engines

CDR Matthew Carr of the U.S. Naval Academy and a member of the Society is very interested in obtaining indicator graphs of various Newcomen or Newcomen-type engines. Should any readers possess this information and be willing to share it, CDR Carr would be most grateful if they could forward a scanned image to macarr@usna.edu

Books

Thomas Newcomen of Dartmouth And the Engine that Changed the World



Author: Eric Preston
Published jointly by the Dartmouth Research Group and the Dartmouth and Kingswear Society.
Available from the Dartmouth Community Bookshop, 12 High Street, Dartmouth TQ6 9RB

Eric Preston's book begins with a history of the Newcomen family with a well presented family tree and a map to show the location of the Newcomen workshop in relation to today's road layout with a further map laying out a 'Newcomen Trail' around the town. The description of the engine takes through the well- known steps from Torricelli, Papin and Savery to Newcomen. It then goes on to introduce the work of Watt and, briefly, Richard Trevithick. The struggle to gain recognition for Newcomen in his home town is interesting and well documented. The work of the Newcomen Society features strongly here. There was initial opposition to the Dartmouth Memorial engine. It was described as a 'lump of old iron' and it was recommended that the money should be spent on a swimming pool. However Newcomen won the day and the work of Arthur Pyne is duly recognised. Finally there the Newcomen Eulogy that was presented by L. St. L. Pendred, Newcomen Society President, in July 1929. The booklet is well illustrated, with two letters and an ironmongers bill signed by Newcomen's wife, Hannah, among them. The only disappointment here is the picture of the Memorial Stone in the Royal Avenue Gardens. The front cover will no doubt generate a lot of debate. It shows a portrait of the man himself that has been interpreted from a statuette which is, no doubt, a figment of the imagination. No matter, it is a striking image that sets off this interesting booklet very well.

George Bradshaw's Handbooks

To coincide with Michael Portillo's BBC series, Great British Railway Journeys, two reprints of George Bradshaw's famous Handbooks of the Railways have recently been published. Packed full of details of stations, timetables and even advertisements for hotels, cures and various gadgets for travel so appreciated by Victorian travellers.

Bradshaw's Handbook - A Facsimile of the Famous Guide (1863 edition)

Author: George Bradshaw
512 pages. Hardcover
Publisher: Old House Books; Facsimile edition
ISBN-10: 1908402024

George Bradshaw's 1863 Handbook was published as the British railway network was reaching its zenith, and as tourism by rail became a serious pastime for the better off, it was the first national tourist guide specifically organised around railway journeys, and to this day offers a glimpse through the carriage window at a Britain long past. This facsimile edition of the 1863 guide is published by Old House Books. Bradshaw's Handbook was regularly updated, with the journeys featured, and the remarks made, differing between editions.

Bradshaw's Guide: The 1866 Handbook Reprinted

Author: George Bradshaw
624 pages. Paperback
Publisher: Middleton Press (22 Oct 2011)
ISBN-10: 1908174056

This Handbook covers Great Britain and Ireland. It includes descriptions of the historic buildings of the principle towns; the main inns; locations of the telegraph offices; announcements by the railway companies regarding tours and special arrangements; advertisements by hoteliers; general advertisements for cures, health problems; the newly created kitchen range; improved oil lighting; portmanteaux; many diverse devices including a knife polisher; 14 pages of multiple illustrations and 18 double-page maps.

Industrial Archaeology: A Handbook

Authors: Marilyn Palmer, Michael Nevell and Mark Sissons
Price £20, available from the Council for British Archaeology's www.britarch.ac.uk/books/palmer 2012

For the professional or amateur, this latest assessment of the origins, scope and impact of industrial archaeology is vital reading. From dovecots to tin mines, land drainage to gunpowder production, taking in distilleries and lace industries along the way, the handbook considers all aspects of our industrial heritage. It explores the challenge of industrial archaeology being both an archaeological study of the ways people used to live and work through surviving physical remains and a conservation movement which must protect and interpret those remains.

The Chemistry of Tears

Author: Peter Carey
288 pages. Hardback
Publisher: Faber and Faber
ISBN-10: 057127997X

This is a fascinating piece of fiction. It juxtaposes a Victorian father's visit to Germany to commission the making of an automata for his sick child with the Swinburne Museum curator in 2011. The curator has been given the task of reassembling the automata that, for years, has been lying in pieces in the museum's store behind Olympia. Intriguing diaries are found that reveal more about Vaucusson's automata duck (now in the Bowes Museum), Charles Babbage makes an appearance and there are numerous descriptions of the latest clockwork technologies as well as lots of intrigue.

The Newcomen Diary

NEWCOMEN 2012
CELEBRATING POWER AND ENERGY

The special 2012 events. Please contact the office for further details and to book.

June

26-28 North Western

Conference: The Nuclear Industry; Learning from the Past and Looking to the Future. To be held at MOSI. Booking essential

July

2-6 Ireland

The Summer Meeting: Limerick and Shannon Region. Booking essential

12-13 Dartmouth

Conference: The life and works of Thomas Newcomen. Booking essential

14-15 Midlands

Lecture and Visits: Developments in the Earliest Steam Engines to be held at Black Country Museum and Thinktank, The Birmingham Science Museum. Booking essential

28 Wales

Conference: Power Progressed – The potential of 'strong steam'. To be held at National Waterfront Museum, Swansea.

Institution of Civil Engineers
Thomas Newcomen, Steam Power and the Industrial Revolution

The Annual Smeaton Lecture
17 July 2012
Dr Jim Andrew

Dr Jim Andrew, Newcomen's Midland Branch Secretary, will examine the historical context of the Thomas Newcomen's invention, how the engine's design was evolved by later engineering greats and explain the design's longevity. Celebrating the invention's tri-centenary, Dr Andrew will also cover: Newcomen's bright thought of using pistons, cylinders and beams to increase the relatively small force available from condensing steam to that needed to raise water from a mine; how study of the engines' shortcomings led to James Watt making his significant contribution to steam power; countering some naive stories about how the engine was perfected.

To register and for more information on the Smeaton Lecture Contact:
ICE Events Team
ice.org.uk/newcomen
events@ice.org.uk
020 7665 2226
Free lecture for members, non-members and guests
Tuesday 17 July 2012
18:00 - Registration
18:45 - Lecture
19:50 - Finish

Location: Church House Conference Centre, Dean's Yard, Westminster, London SW1P 3NZ

Visit to the National Gas Museum Leicester with an optional visit to engines in steam at the Abbey Pumping Station, Leicester.
Sunday 9, Monday 10 September 2012

The visit to the National Gas Museum will commence at 1.00 pm on Monday 10 September, but delegates will gather at 12 noon for lunch at a convenient pub before proceeding to the Museum for a private visit. The Curator, Maurice Martin, will give an introductory talk followed by a guided tour lasting about 2½ hours. For anyone prepared to spend a night in the area, the Abbey Pumping Station is holding a steaming event on the previous day (Sunday 9th) when, amongst other things, they will steam at least one of their four restored Woolf compound rotative beam engines. The National Space Centre is also located close to the Abbey Pumping Station.

For more details, accommodation list and a booking form contact Ed Marshall at:
elm.tudor@btopenworld.com
or send a SAE to Ed Marshall, 7 Tudor Way, London W3 9AG.

The BIAS Brunel Prize

Bristol Industrial Archaeology Society has established the Brunel Prize to encourage archeological and other research into, and publication of work on, the industrial archaeology of the Bristol/Bath area. An amount of £150 is made available every two years. Submissions from BIAS members and others with a relevant application should be received by the BIAS Award Panel by 31 August 2012.
Further information about the Prize, submission details etc can be obtained from Mike Chapman, 51 Newton Road, Bath BA2 1RW

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www.newcomen.com