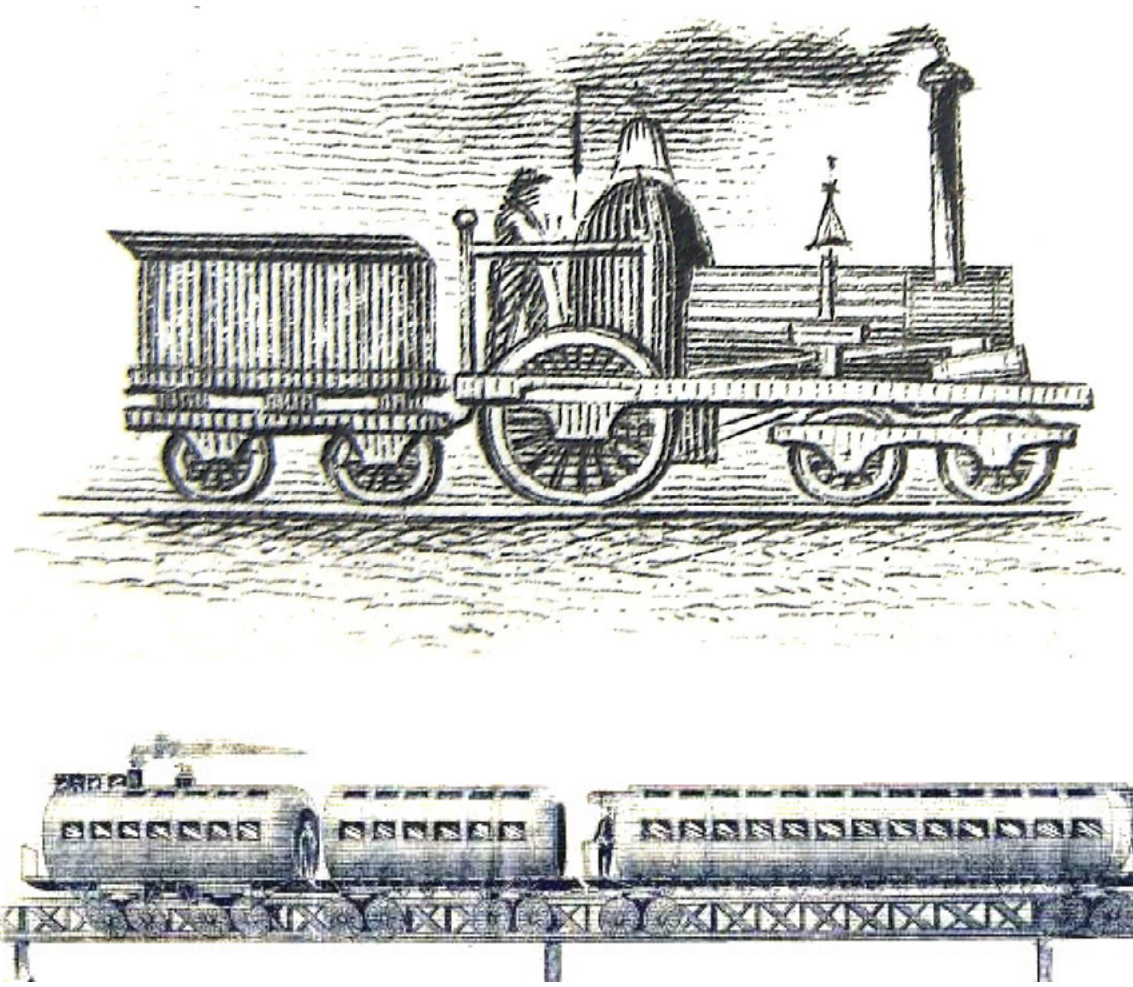
NEWCOMEN Links



Tunnels from the Brunels to Crossrail, Cows in Manhattan, and the Gotthard; Extreme Conservation in Antarctica; Engineering and Design; Images of Engineering; Kelham Island; Trevithick Day; the Napier Lion Aero Engine; anniversaries; symposium, conferences & events; reviews & news....

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NEWCOMEN
The International Society for the History of Engineering and Technology

June2016

NEWCOMEN
The International Society for the History of Engineering and Technology

Patron:
HRH The Duke of Gloucester

The Newcomen Society President:
Michael Grace
Administrator: Sarah-Jane Stagg;
office@newcomen.com;
+44 (0)20 7371 4445
Newcomen Links Editor & Layout Designer:
Deborah Jaffé
editor.links@newcomen.com;
07798 603000
Copy Editor: Elizabeth Duff
Printed by MPC Print Solutions

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The Newcomen Society,
The Science Museum,
London SW7 2DD.
+44 (0)20 7371 4445
www.newcomen.com
email: admin@newcomen.com

@NewcomenSoc
@Newcomen_Mid
@Newcomen_Scot

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Notes on Contributors

Jim Andrew has worked with Birmingham's Science and Industry Collection since 1974 and is now Thinktank's part-time Collections Advisor. For many years he was Hon. Secretary of Newcomen Midlands.
Jonathan Aylen is Chair of Newcomen North-West and a newly elected Vice-President of the Newcomen Society. His interests include the evolution of Cold War technology and the history of rolling mill design.
Robert Carr, a university lecturer, joined the Newcomen Society in 1978. He has served on Newcomen Council and used to organize the London Visits.
Elsa Cox is Senior Curator of Technology at the National Museum of Scotland with particular responsibility for the energy collection. Her research interests include energy technology, politics and sociology of technology and she is leading on a new energy gallery due to open at NMS in 2016. She is a Member of Council and Chair of Newcomen Scotland.
Philip Ingram has been a Newcomen member since the late 1970s. His interests are broad rather than deep. An early graduate of the University of East Anglia, he followed the university motto "Do Different" by using his degree in Biological Sciences to get a job as a Mathematician in a chemical company. After a career in IT with ICI and successors, he has become a member of the North-West group committee.
Deborah Jaffé is the author of Ingenious Women and editor of Newcomen Links.
Frank James, who is Treasurer of the Newcomen Society, is Professor of the History of Science at the Royal Institution and University College London. He is currently researching a book length study of Humphry Davy's practical work.
Stephen K. Jones is a Companion Member of the ICE and has a special interest in Brunel in South Wales, about whom he has published widely.
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.
Alan M Levitt, an independent scholar and historical archaeologist, focuses on the social impacts of early American railways, and 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.

Copy date for the next issue
of
Newcomen Links

1 August 2016

editor.links@newcomen.com
www.newcomen.com

Writing for Newcomen Links

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

Articles should be about 1000 words and sent in Word format by email. Shorter pieces are also welcome.
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. Please, where possible, label each image with its subject rather than by reference number.
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/scans of images in books etc.

The copy date for the next issue is 1 August 2016
Please submit articles, information, details of events etc to:
The Editor,
Deborah Jaffé at: editor.links@newcomen.com
Tel: 07798 603000

The Front Cover

The images on the front cover are from the private collection of Alan M. Levitt. The vastness of this collection never ceases to astound. I am very grateful to Alan for permission to use the images on the front cover. More can be found in his article on p12.

Above, an enlargement of a locomotive and tender printed by the American Bank Note Co.
Below, the Meigs Elevated Railway, which was an experimental steam-powered monorail system invented by Josiah V. Meigs of Lowell, Mass.

From the President, Michael Grace

As I sit to write these words, news is coming through of the opening of one of Europe's newest and greatest engineering achievements, the Gotthard Base Tunnel, which is the world's longest and deepest railway tunnel. Linking Erstfeld and Bosio in Switzerland, the 57 km (35 mile) tunnel will reduce the travel time between Zurich and Milan by an hour but, more importantly, it forms part of a strategy to divert, from road to rail, heavy goods vehicles transiting Switzerland, which, in turn, will have very significant environmental and amenity benefits. The news reports brought to mind the excellent Dickinson Lecture presented to the Society in London last March by Professor Lord Mair on the tunnelling aspects of another of Europe's great engineering projects of the present time – Crossrail. What is striking about both these major tunnelling achievements is the integration of the various fields of engineering in what is sometimes seen as simply a civil engineering project. In both enterprises there was a great deal of geotechnical engineering, whilst the giant tunnel boring machines were products of mechanical engineers and control of the process depended heavily on the work of electronic engineers and computer engineers. Moreover, in both cases, there were many issues that required to be addressed by the various specialist disciplines that now form part of the wider engineering spectrum.

The interaction and interdependence of the various fields of engineering is very evident in almost all large and complex projects. Consider, for example, the range of engineering activities necessary for space travel and the extent of the new sub-disciplines that emerged out of the 'space race'. Modern engineering is highly complex, but it is important to remember that all of its branches share many common techniques and historical backgrounds.

The Newcomen Society, because it embraces the history of all branches of engineering, has an important and unique role to play in demonstrating the interdependence of the various aspects of the discipline and in promoting the unity and integrity of all engineering endeavour. Consequently, we should seek to encourage lectures, papers and articles that deal with, or illustrate, the inter-relationship and connectivity of a range of engineering fields. Can you help in this regard? Over to you!

From the Editor, Deborah Jaffé

Like Michael Grace (above), I was fascinated Professor Lord Mair's lecture, reported here by Jonathan Aylen. He showed how the techinques developed by the Brunels for the Thames Tunnel have influenced the tunnelling machinery used in Crossrail. The three images in this issue illustrate the enormity and scale of Crossrail. Tunnelling has become quite a theme in this issue and includes Alan Levitt's illustration of Manhattan's tunnel for cows. But there are other aspects too. At the end of May I attended a lecture by Nigel Watson of the New Zealand Antarctic Heritage Trust (NZAHT). The NZAHT has spent 10 years renovating Captain Scott's two huts and Shackleton's one in Antarctica. Curators, conservators, technicians and engineers had to work in an extreme and hostile environment. This made me think about the similarities between tunnels and Antarctica; of work in extreme, isolated conditions – beneath ground and in freezing conditions. I am grateful to the NZAHT for permission to reprint some wonderful photographs. As I was putting the magazine together came news of another example of extreme conditions, which Michael has also noted. This is third Gotthard tunnel through the Alps, which is reported on.

Alan Levitt never ceases to amaze me with the number of fascinating images of 'old engineering' he has in his collection. There were many responses to his article in NLinks 237. Now he has written an illustrated article about bank notes and share certificates. Two of the images appear on the front cover.

One of the visions of Prince Albert, Henry Cole and others, when planning the Great Exhibition of 1851, was that the area around Exhibition Road in South Kensington should be a place for the exchange of ideas between those working in the sciences, engineering, arts and design. Hence the establishment of the museums and the colleges. Now, 165 years later, the V&A is holding its first Engineering Season. This includes a major retrospective exhibition on Ove Arup, a structure being made by Kuka robots and other events. This Season is important as it provides long overdue opportunities for important conversations between engineers and designers, which in Britain we have rarely had.

Even though the programme of local lectures for the next season is not yet ready, there other events for members to consider. These include a visit to Catalyst in Widnes, the symposium – Annihilating Space & Time: 150 years of Transatlantic Telecommunications, and an autumn conference - Scotland's Unsung Innovators.

The September issue will include reports of the Summer Meeting in Dublin and the 2016/17 programme of lectures.

I too would like to explore more of the history of engineering and technology in broader contexts and will add the extreme conditions of the deep oceans and space exploration to Michael's suggestions.

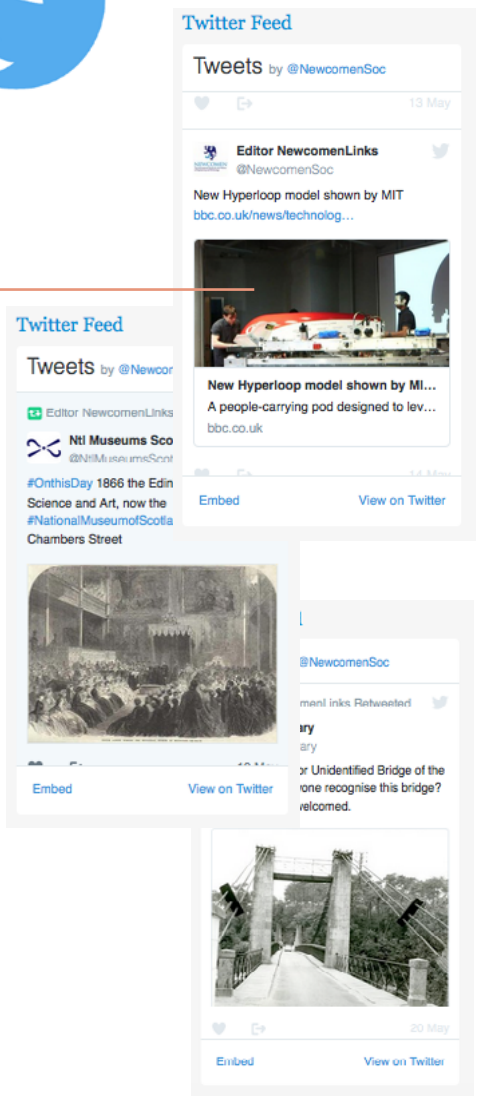
We look forward to your submissions.

Newcomen Matters

Twitter

The Newcomen Society, Newcomen Midlands and Newcomen Scotland now have live Twitter feeds. These are proving to be productive ways of publicising our names, news and events. Jim Ranahan (Midlands) and Elsa Cox (Scotland) are managing their respective accounts and I manage the Society tweets. Other accounts will follow.

The Society's tweets appear on the Home Page of the website, so can be viewed without subscribing to Twitter. Scroll down to see the tweets - they include tweets from other organisations and societies, relevant news items and other information. They might include video clips, links to websites and articles to read or pictures to look at. Examples of the tweets from the Home Page of the website. Please let us have potential tweets - but remember, tweets have to be short, a maximum of 140 characters. Or, join Twitter, it is free, easy to use from a desk top computer, tablet and mobile phone.
Deborah Jaffé



Twitter addresses:
@NewcomenSoc
@Newcomen_Mid
@Newcomen_Scot

Register for Twitter at:
www.twitter.com

The International Journal for the History of Engineering and Technology

Our apologies for the late arrival of the January issue of the International Journal for the History of Engineering and Technology which members received in May. The journal is now in the hands of new publishers with the takeover of Maney by Taylor & Francis. The four month delay in publication is due to a number of causes including floods in Chennai, India where the journal is typeset, the departure of the former production editor, and changes in management at Taylor & Francis. We look forward to getting the publishing schedule back on track.

New Members

We welcome the following new members:
Andy Bowden, David Greenfield,
John Howat, Kim Howells,
John Kanefsky, David Miller,
Maria Monteleone, Michael Morecombe,
Andrew Overy, Thomas Ricketts,
David Waghorn, Michael Webb,
Barry Williams and Paul Wood

Correction

We are grateful to George Charlton for alerting us to the misunderstanding in the report of the James Watt reception in the Scottish Parliament (NLinks 237, March, p 8). We are, of course, aware that James Watt invented the separate condenser and not the condensing steam engine, as the article implied. A correction has been made in the on-line edition. An article to compare Newcomen and Watt's inventions is being prepared and will appear in a future edition of Newcomen Links.



The Piston Engine Revolution

The papers from the Piston Engine Revolution conference are now available to download in the Members' Area of the website. It will migrate to the main site shortly. Arranged by chapter, each one is free to downlad.

The printed version, a book edited by Fred Starr, Ed Marshall and Bryan Lawtonbook is still available to buy.

Congratulations

We are pleased to report that one of our members, Dr. Fred Starr, has been made a *Legacy Member* of the Aircraft Engine History Society/ This Spcoety has over 1000 subscribers, most of whom are in the USA. Fred Starr was accorded this honour, by the President, Kimberly Crutchen.

The citation states: *AEHS Member Dr. Fred Starr has completed his groundbreaking three-part series, "Design and Development of Exhaust Valves from the Perspective of Modern Thinking". These articles have appeared in the Newcomen Society's prestigious International Journal for the History of Engineering & Technology.*

Parts 1 and 2 of Fred's account covered valve development from the earliest days of the internal combustion engine up to 1990, but Part 3 highlighted the differences in thinking about valve design and materials in British and American WWII aircraft engines.

The Newcomen Society congratulates Fred on this prestigious honour.

The Aircraft Engine History Society
www.enginehistory.org

Seen & Heard.....



Conserved & Converted

This telephone box has a new lease of life as a coffee shop in Hampstead High Street, North London. One box has been spotted hosting a bank cash machine in South Kensington. Another is used as part of an art installation for the Lumière events organised by Artichoke Arts. Has anyone else spotted them in new guises?
Ed

There are four of them

Readers may be amused to learn that there is a pop song which explains that there are four eminent Victorians called Steph(v)enson, two spelt with a v and two spelt ph. Moreover there were two Roberts. How confusing! The chorus includes the refrain 'Oh, Mr. Steph(v)enson, Which Mr. Steph(v)enson, Which one are you?'

By the end of the song things are more or less sorted out. The people responsible, a 'steampunk band' from London founded in 2008, have a long-winded name - The Men That Will Not Be Blamed For Nothing. They also have a song about Isambard Kingdom Brunel and one about the Great Stink involving Sir Joseph Bazalgette.

View at: www.youtube.com/watch?v=S87mKwgYR6A

Robert Carr

Copy dates for Newcomen Links

1 August for September
1 November for December
1 February 2017 for March

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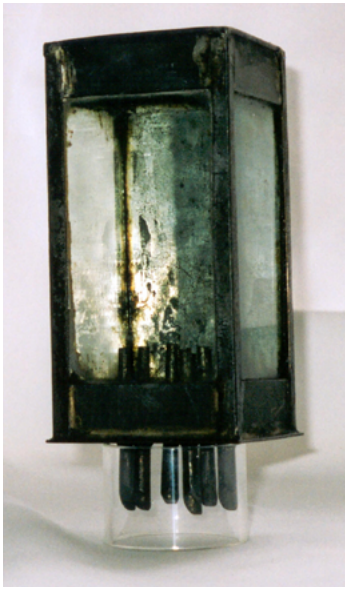
Anniversaries

200

Humphry Davy's Miners' Safety Lamp

Frank James

This year marks the bicentenary of the deployment of the miners' gauze safety lamp invented in December 1815 following two months of concentrated work by Humphry Davy assisted by Michael Faraday in the basement laboratory of the Royal Institution. Davy's lamp was first tested in Hebburn colliery, County Durham, on 9 January 1816 and in the years following it was manufactured in its tens of thousands and widely used throughout the world. The use of the lamp both saved the lives of countless coalminers, but also permitted increased coal production vital to continuing industrialisation.



In the absence of entries in the Royal Institution's laboratory notebook, one of the few sources which sheds light on Davy's path to the successful invention is a manuscript volume held in the archives of the Royal Institution (RI MS HD/11) that contains Davy's drafting and redrafting of his first paper on the miners' safety lamp. Davy's path to this invention in those weeks was a very intense process involving changing his mind rapidly several times about the best form that a safety lamp should take. The unpredictable way in which Davy's thought and work progressed during this period is reflected in this volume. Davy's original paper was copied by Faraday and sent to the Royal Society of London where it was read on 9 November 1815. However, following its reading, Davy developed further ideas and these were reflected in a second copy, also made by Faraday, to which Davy added significantly and moved whole passages around as cross referencing the two versions illustrate. Davy also made many alterations and additions to this text, including removing a less than favourable comment on contemporary chemists. He originally thought that this would be the final text, as evinced by the production of an illustrative plate, which would have cost some money. However, he then found that all he had to do was to enclose flame in metal gauze which absorbed the heat (thus preventing explosion) and allowed light to pass through the holes. This discovery of the properties of gauze necessitated withdrawing the plate (thus making the example in the manuscript the only surviving copy). Faraday then made the final version of the paper for the Royal Society of London for publication the following year.

To mark this key anniversary in coal mining history the Royal Institution is partnering with ArchAlive to publish a unique edition of this manuscript volume. The book, which will be available by subscription only, will be produced to the highest standards by Blissetts, bookbinder to HM The Queen. It will be printed on acid free paper, bound and protected in its own bespoke slip-case. Each subscriber will be listed in the book and will receive access to the searchable e-book of the text and Frank James's Presidential Address to the Newcomen Society detailing the history of the lamp.

This book and manuscript are a unique record of the combined creative work of Humphry Davy, the leading English chemist of the day, and Michael Faraday who would eventually succeed Davy in that role.

Further details can be found at www.archalive.co.uk/

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New Galleries at the National Museum of Scotland mark the anniversary of its opening

Elsa Cox

Ten new galleries are set to open at the National Museum of Scotland on Friday, 8 July 2016. More than 3000 objects are being installed in six galleries of science and technology and four of decorative art, fashion and design.

The science and technology galleries will focus on energy, scientific enquiry, communication, engineering, transport and manufacture and represent the next phase of the £80m masterplan to transform the museum. They will be completed in the 150th anniversary year of the Victorian building, which first opened in 1866. Display space will increase by over 40%, with 75% of the objects on display not having been seen for at least a generation. The new displays will champion excellence and innovation, offering an inspirational experience for the scientists, engineers, artists and designers of tomorrow.

This £14.1 million project is supported by the Heritage Lottery Fund, the Wellcome Trust and the Scottish Government, with £7 million of the costs being raised from Trusts, Foundations and many generous individual donors.



The National Museum of Scotland opened at Chambers Street, Edinburgh in 1866

A full report on the new galleries will be published in the September issue of Newcomen Links.
www.nms.ac.uk

NEWCOMEN
The International Society for the History of Engineering and Technology

Annihilating Space & Time: 150 years of Transatlantic Telecommunication

5th September 2016
at The Royal Institution of Great Britain

The first successful working transatlantic telegraph cable began transmitting 150 years ago on 27th July 1866. The history of this remarkable achievement and the developments which sprang from it are explored in this one-day symposium.

Stewart Ash: The First Steps – Joining the Dots & Dashes.
Nigel Linge: Encircling the globe.
Donard de Cogan: From Mirror Galvanometer to Telex: how they increased the bit rate of telegraph cables.
John Moyle: Looking for a Needle in a Haystack - Locating causes of malfunction in Victorian submarine telegraph cables.
Ron Shearer: An urgent message: North America's obsession with the Atlantic Cable.
Keith Schofield: Submarine cable protection and security in the modern world
Jacob Ward: The Politics of Automating the Telephone Network in Post- WWII Britain
Derek Cassidy: Submarine networks, the next stage in their evolution.

Date & Time: 5th September 2016. Registration opens at 09.15.
Place: The Royal Institution of Great Britain, 21 Albemarle Street, London W1S 4BS
Fee: £65 including coffee and lunch.

To book
Online here: Eventbrite

By cheque: send a cheque for £65 made out to The Newcomen Society with your name, address and a note of the conference title to: The Administrator, The Newcomen Society, The Science Museum, Blythe House, 23 Blythe Road, London ,W14 0QX

Antarctica - Conservation in Extremes



Sir Ernest Shackleton's hut after conservation, at Cape Royds, Antarctica -77°33'10.7"S, 166°10'6.5"E. Image: © NZAHT 2016

Deborah Jaffé

Conservators and technicians of the Antarctic Heritage Trust (NZAHT), based in Christchurch New Zealand, have spent the last ten years working on the restoration and conservation of the huts built and used by Captain Scott and Sir Ernest Shackleton in the Antarctic. Nigel Watson, CEO of the Trust, gave a fascinating overview and convincing argument for its work at a lecture to the World Monuments Fund at the Royal Geographical Society in May. These huts are somewhat mired in the myths of the teams of explorers and the conditions in which they worked. They were built to be robust and (Antarctic) weatherproof. Shackleton's hut at Cape Royds was a timber prefabricated structure made by Humphreys Limited of Knightsbridge in London in 1907. It was first assembled in London and the parts were marked for re-erection on site. For a century these have stood, weathering the extreme elements of the Antarctic weather.

Our images of the interiors are the black and white photographs, usually showing a group of men huddled around a stove to keep warm or planning an expedition. When looking at the robust construction of the most recent British Antarctic Survey buildings one is struck by the flimsy appearance of these huts and astonished that they could have survived for a century battered by extreme snow, ice and winds. But they have and were in need of help.

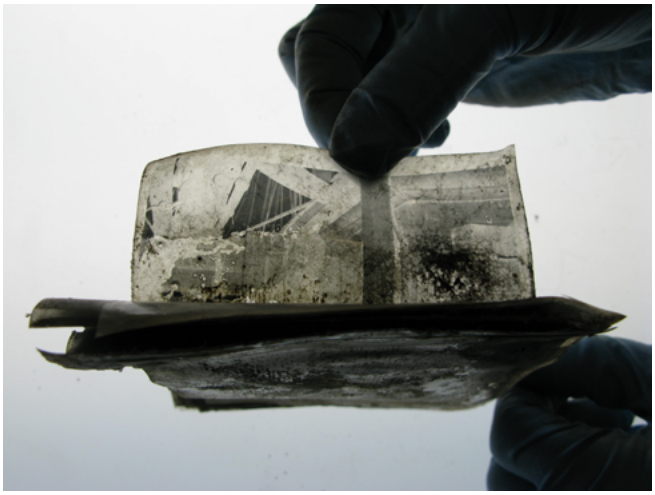
An international team of over 60 curators, conservators, technicians, engineers and support staff, braved the physical conditions to spend 10 years working on Scott's two huts and Shackleton's one. They had to take everything they might need with them as they embarked on a six month stint in the Antarctic.

The fabric of the huts was of immediate concern, the walls and roofs were failing under the weight of tons of snow and ice. When the lino was carefully rolled (to be restored and relaid later), the very damp floor boards were lifted to reveal what looked like white lagging material, but was packs of snow. The interiors of the huts were much as they had been left 100 years ago. But metal objects were rusting and bent and included: the first bicycle in Antarctica; a dismantled heating system; and disjointed bedsteads.

Paper based objects had not fared well with the extreme cold and damp and included: mouldy and encrusted notebooks; diaries and torn packaging. But with the skills of the on-site workshop bedsteads were unbent and treated, the heating system made to work and notebooks revealed plans and observations made.

There were many discoveries. Perhaps the most unusual were a pair of men's evening dress shoes and cuff links. Would, a conservator pondered, they have planned to have a formal dance party here amidst the snow? Another surprise was three crates of Mackinlay's whisky and two crates of brandy encased intact in ice beneath Shackleton's hut, just as they had been when leaving Britian a century ago.

One of the most remarkable discoveries was at Scott's Cape Evans base. Here, a small box of cellulose nitrate negatives all stuck together was found in the darkroom of Herbert Ponting, Scott's expedition photographer at the base. The negatives were taken back to Christchurch where the conservators managed to separate them to reveal 22 photographs from Shackleton's Ross Sea Party (1914-1917). They had spent time living in Scott's hut after being stranded on Ross Island when their ship blew out to sea. Their role was to lay vital depots for



The Ross Sea Party negatives, before conservation. The negatives were removed from Antarctica to undergo detailed conservation treatment back in New Zealand, where the negatives were painstakingly separated to reveal 22 never-before-seen Antarctic images. Image: © NZAHT 2016

Shackleton's expedition. Now, these photographs, undeveloped for a century provide new perspective on that expedition.

Nigel Watson summed it all up when he said:
The story of the exploration of the Antarctic is largely about legends – Shackleton, Scott, Amundsen – larger-than-life characters who endured the most hostile conditions imaginable in their quest for discovery. Our more recent mission has been to safeguard the extraordinary remains of that 'heroic era' of exploration: the slight wooden buildings that were both laboratories and homes to those men and their teams... we have just finished an intensive decade of 'extreme' conservation, and in the process maintained that thirst for knowledge, storytelling and a little of the original pioneers' spirit. This is not just about the past. It is a story about science, research and climate change that is relevant today. Conservation at the edge of the world has a lot to teach us, wherever we happen to live.

The team used established and new conservation techniques combined with improvisation and skill. No doubt what was learned here will have implications for others working in extreme conditions.

The Antarctic Heritage Trust's next project is to embark on Sir Edmund Hillary's hut. Although the huts are open to visit, there are the practicalities of getting there. To over come this the Trust has developed an immersive photographic experience using photographs by Jane Ussher to create STILL LIFE. This visual and sensory experience takes the viewer inside the huts to see the wall-projected images and experience the landscape of Antarctica and the isolation endured by the early explorers, and indeed of the current teams of restorers. It can be viewed on the website.

- **The Antarctic Heritage Trust: www.nzaht.org The NZAHT's website is excellent, with lots of detail including extensive photographs, locations and information on future developments.**
- **Conservation Plans. Antarctic Heritage Trust. The Trust has produced a Conservation Plan for each of the five bases. They detail the history of the site, the buildings and artefacts, conservation and ongoing maintenance. Hard copy NZ$50 + P&P. USB (PDF) $20 + P&P**
- **The NZAHT has partnered with Google and the Polar Geospatial Center for Google's World Wonders Project. Scott's Cape Evans Hut and Shackleton's hut at Cape Royds can be viewed. www.google.com/culturalinstitute**

A print of one of the cellulose nitrate negatives found in Scott's hut, Ross Island, Antarctica. It shows Alexander Stevens, Shackleton's chief scientist and geologist looking south. Hut Point Peninsula is in the background. Image: © NZAHT 2016



Trevithick Day in Camborne

Bryan Lawton

Following an excellent Western Branch talk on "The Oblivion of Richard Trevithick" by Phillip Hoskins, members were invited to Camborne on 30 April. This was to celebrate the annual Trevithick Day and also to attend the dedication, in Camborne Parish Churchyard, of a plaque in memory of Richard Trevithick's parents and the mining engineer, John Budge.



The Revd Canon Olive Stevens, Rector of Camborne, and David Thomas, Camborne Old Cornwall Society, at the dedication in Camborne Parish Churchyard, of the memorial to Richard Trevithick senior, his wife Anne, and engineer John Budge.

The weather was glorious and the dedication was well attended and very moving. The Revd Canon Olive Stevens, Rector of Camborne, performed the dedication and David Thomas, President and Recorder of the Camborne Old Cornwall Society, gave an informative address, which he has very kindly allowed us to reproduce here.

Throughout the day the main streets of Camborne were closed to traffic and bustled with stalls, choirs, bands, dancers, street theatre and exhibitions. After the dedication members were provided with a light lunch, courtesy of The Trevithick Society, and we had an enjoyable afternoon taking in the various entertainments that included fairground rides, displays of steam engines and steam cars and the replica of Trevithick's *Puffing Devil*. Camborne was packed with visitors and looked its very best. The day ended with a grand procession of steam vehicles through the town.



Replica of Trevithick's Puffing Devil built by the Trevithick Society.



The start of the steam parade

The address at the dedication of the memorial tablet to Richard Trevithick senior (1735-1797), Anne Teague, his wife (1736-1810) and the engineer John Budge (1731-1823), Camborne Parish Churchyard.

Given by David Thomas, President and Recorder, Camborne Old Cornwall Society

On the 9th November 1760 a young couple came before the altar of Camborne parish church on their wedding day. He was 25 and she 24 and as they stood there pledging their troth each to other on that most important day of their lives they had no idea that they would be the parents to eight children, not all of whom would live into adulthood and that it would be their fifth child, Richard, who would go on to change the course of recorded world history, following the dramatic events of Christmas 1801 on the streets of the then village of Camborne. I refer of course to Richard Trevithick senior, born in 1735 and his wife Anne Teague, born in 1736. The surname of Trevithick occurs in the Camborne parish registers as far back as the late sixteenth century while the direct antecedents of Richard senior, born in 1735, can be traced back two more generations to a John Trevithick and a Thamasyn Oliver who were married in this church on 24 April 1688, the year of the Glorious Revolution. The month of April features so often in recorded Cornish Trevithick history.

Both Richard Trevithicks, senior and junior, had connections with Dolcoath mine, active in the eighteenth century, the earliest surviving records of which date from the 1730s. In 1765 Richard Trevithick senior supervised the construction of its new deep drainage adit while a decade later we find him re-erecting a second-hand Newcomen atmospheric engine, bought from Carloose mine for £414. He redesigned its boiler and installed self-acting gears and valves, doubling its efficiency but increasing the final bill for the work to £1349. In 1776 Richard Trevithick, as a yeoman farmer, took up a mining sett or licence from the Bassets of Tehidy in property in the North Entral and Roskear tenements of Camborne parish while in the same year he undertook a survey of Baldhu mine in Kea parish on behalf of the executors of Francis Basset, who had died suddenly in 1769. Three years later in 1779 he was listed as one of the adventurers in Wheal Chance mine here in

Camborne. He therefore had extensive mining knowledge and experience and it was into this family setting that the young Richard junior, born in 1771, at the tender age of 15, received his first Dolcoath wage packet of 14 shillings on 19 October 1786. This father and son mining partnership was to last until Richard senior died in 1797, though Dolcoath had closed as a copper mine in the summer of 1788, following extensive competition from the Parys Mountain mines in Anglesey in Wales and was not to re-start until 1799. Young Richard therefore cut his engineering teeth in the shadow of his highly experienced father.

Richard senior's will, proved in 1797, is highly interesting. He is living at Penponds at the time of his death and he leaves the tenement there to his wife Anne with £300, but also has premises and cellars at Hayle, more property here in Camborne Churchtown and at Pencobben which sits astride the boundaries of both Camborne and Gwithian parishes between Fisherman's Cove and Godrevy. His son Richard was to receive the ready money and the residue of all the estate, following the payment of funeral expenses, and was to act as executor. Tradition says that Richard senior was buried on Carn Brea but our parish registers very clearly record his burial in our churchyard. Richard's wife Anne survived him by thirteen years but she too was carried to her grave here in 1810. At the time of their burials the pre-1816 original churchyard was then very small, being the area immediately surrounding the church and somewhere there they lie. No proper plot records were kept in this graveyard before 1875 while the area concerned was landscaped around 1860. In that part of the churchyard too are also buried the couple's children who died young, Prudence in 1775, Mary in 1790, Sarah in 1780, Tamisen in 1773 and Alexander in 1790. We remember them too, the Trevithicks who have vanished from history, the four sisters and one brother of the great inventor.

Also commemorated today is the venerable Cornish engineer John Budge who lived to the age of 93 years. His family origins lie in the parish of Lewannick in east Cornwall, where he was baptized on 28 October 1731, being the son of a John Budge and an Ann Vincent who married there on 31 December 1730 and he is sometimes mentioned in the letters of engineer James Watt as Mr Bouge. The Budges appear to have come from yeoman farming stock in Lewannick. In his early career John Budge worked under George John while by the 1770s we find him in the Camborne area where he erected a 63 inch cylinder atmospheric engine at Dolcoath mine in 1771 and more atmospheric engines at Wheal Chance. In 1778 he was engineer to Wheal Union but declined to superintend the Boulton and Watt engine there. Around 1779 however he did collaborate with them in erecting engines at Wheal Chance, Dolcoath and Pool in Illogan. Owning a brass foundry at Tuckingmill he also produced several inventions and patented a tapered-barrel whim in 1772 with improvements. That he knew the Trevithicks closely, including Richard senior, is undeniable, for among the surviving records of the Pendarves estate there is an agreement dated 19 July 1779 for the building of a new engine house at Wheal Chance mine near Gerry 'to such height after such structure as Mr John Budge of Camborne shall direct and to be conformable in all things to his direction'. On the reverse side of this document are the signature of John Budge engineer, Captain Richard Trevithick (senior) and Captain John Vivian, jointly working together to value the engines and other materials of Wheal Hatchet mine on 10 July 1779. John himself was married to Miss Mary Paull in this church on 28 January 1790. Other members of the Budge family also moved to the area and played prominent business roles as mercers and merchants, including John's brother Peter, who died in 1832, aged 85. They were a long lived family. When John Budge the engineer died in 1823 he too was buried in this churchyard in a spot possibly much closer to where we are standing today as there are 1820s graves near where we gather. In his will made on 17th January 1821 the engineer makes particular mention of his writing books, books of accounts, Great Bible, New Testament and Methodists Magazines.

The book of Ecclesiasticus has a passage which says 'And some there be, which have no memorial'. Conscious of the fact that Richard junior lies in an unmarked grave 25 feet from the wall of the old churchyard of St Edmund King and Martyr at Dartford in Kent, far from his native Cornwall, and that his parents lie in this churchyard along with other notable Cornish engineering acquaintances like John Budge, the Camborne Old Cornwall Society was minded to commemorate his parents and colleague on this memorial. It has been sited here by the grave of Richard Trevithick junior's friend, mentor and business partner Captain Andrew Vivian (1759-1842) along with whom he patented the Locomotive Engine in 1802 and this is particularly appropriate. It is also very apposite that we dedicate it today on that special time in the calendar when both Camborne and Cornwall commemorate one of its greatest sons, who changed the course of world history and revolutionized modes of transport. The April connection once again.

The Camborne Old Cornwall Society would like to thank all those other old Cornwall Societies, individuals and the Federation of Old Cornwall Societies itself who have all so generously contributed towards the cost of the erection of this fine slate memorial. We also pay tribute to the excellent stone mason skills and craftsmanship of Mr Michael Simmons of Illogan, who has both created the tablet and erected it. We also thank the Rector of Camborne, Canon Olive Stevens, for carrying out the dedication and lastly yourselves for your encouraging presence and interest on this unique occasion. Kernow bys vyken (Cornwall for ever). A reading now from Ecclesiasticus chapter 44 before I ask the Rector to dedicate the tablet.

Copy dates
for Newcomen Links

1 August for September
1 November for December
1 February 2017 for March

editor.links@newcomen.com
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NEWCOMEN
The International Society for the History of Engineering and Technology

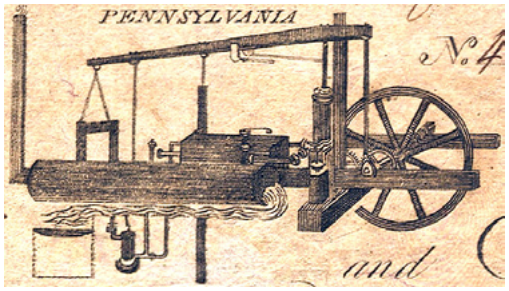
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The Designs of American Bank Notes and Share Certificates

***Alan M. Levitt** wrote about John Ericsson and the images of his inventions on US stamps and share certificates. He also asked for information about a 10$ note of the Farmers and Mechanics Bank. Many readers have responded to his article. Here he reveals more of his extensive collection of these illustrations and questions what they are portraying.*

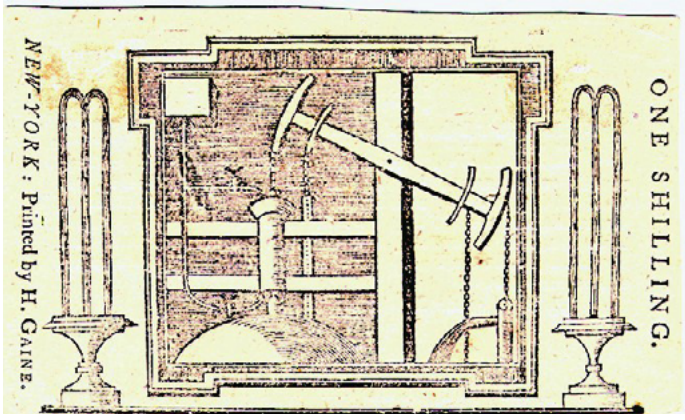
It is a likely and reasonably-held tenet that paper currency and share certificates have (or originally had) some value. But is the technology often pictured on them correctly portrayed?[1] The image may be accurate or inaccurate from a technological perspective. It may be used inappropriately or mistakenly. Or, it may be impossible at any time or place from a technological point-of-view. But was the *innocent* viewer able to distinguish and thus learn?

The vignette on the 1815 Farmers and Mechanics Bank $10 note pictured in NLinks 237, and which several readers kindly identified as Oliver Evan's (1755-1819)



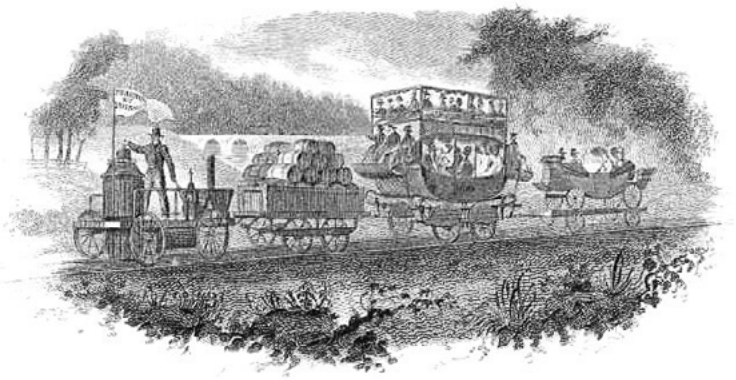
Columbian Engine of 1812, is an example of technology that is likely to have been portrayed accurately. The image was engraved by Charles P. Harrison (1783-1850) who may have actually seen Evan's engine.[2] It is unlikely that many people who saw the Harrison image realized what it represented or cared about it.[3]

Another representation of early technology was Christopher Colles' (1739-1816) Newcomen engine and pump



on the reverse of the New-York Water-Works one, two, four, and eight shillings promissory notes of 1774, 1775, and 1776.[4] It is possibly the only printed image of Colles' engine, but neither the wood-engraver, nor the basis for the engraving have been identified. This image, too, is likely to be quite accurate, although the depiction of the fountains flanking the engine might be questioned. A total of about 44,000 notes were printed at a time when New York had a population of about 23,000.

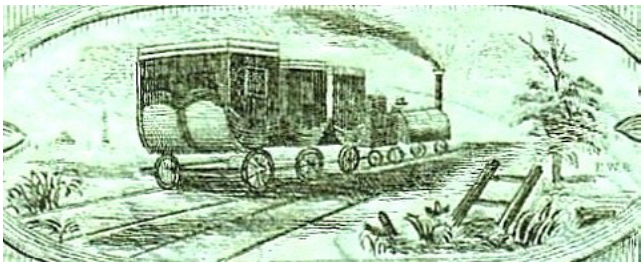
The illustration on the Baltimore & Ohio Rail Road (B&O) share certificates exemplifies a technology that is accurately depicted, but it could not be in the place where shown. Unmistakably, Braithwaite and Ericsson's *Novelty*,



the B&O inferred – by its use – that the image was of Peter Cooper's *Tom Thumb*. Appearing as early as 1835 (in an environment that could be B&O's), the image continued in use, albeit with slight modifications (notably, the text on the pendant), until the B&O's demise in 1987. Just how and why the original engraver or bank note company (both unidentified) came to use *Novelty* is unknown. *Novelty*, unlike Ericsson, never left the Sceptered Isle.

The instances where impossible technology are represented are legion. The images may have stemmed from the bank note engravers, most of whom worked for prominent bank note companies, but who had never seen a train, or had forgotten what one looks like when setting burin-to-plate. Apparently, the issuers did not care what images graced their documents.

A vignette on an 1848 (but probably printed much earlier) *off-the-peg* Promissory Note shows a train and its line-



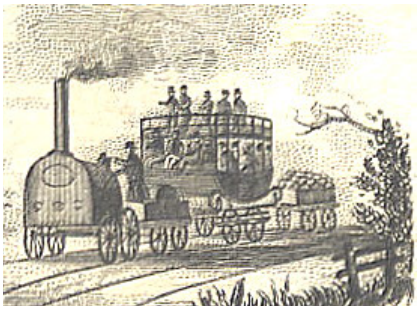
side environment. The three carriages are mounted directly on the rims of the wheels on three axles, but no hint of a frame or other mounting. One can only speculate concerning the significance of the ladder emerging from the ground! The initials "F.W.B." appear beneath the tree branches at the right, and are undoubtedly those of the engraver.[5]



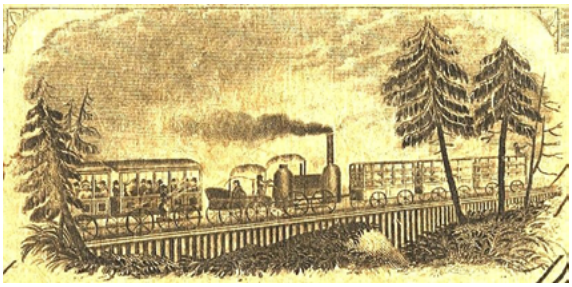
A nearly-identical vignette, probably engraved later, appears on notes issued by several banks in the mid- to late-1830s, and on a Reward of Merit for scholarly achievement. All were printed by the New-England Bank Note Co. In comparison with the Promissory Note, the locomotive is a bit more realistic. A fireman is riding (seated?) on the tender, and two carriage

bodies are supported on single frame. There is a ladder and pole emerging from a hole, and the tree is of a different sort. The initials are absent. At least two steeples and Boston's Old State House dome are visible in the background.

The landsape in the vignette of the train on the New-England Bank Note Co. 'Specimen of Engraving',of 11 February 1833, suggest that the two other train vignettes were produced by New-England Bank Note Co.

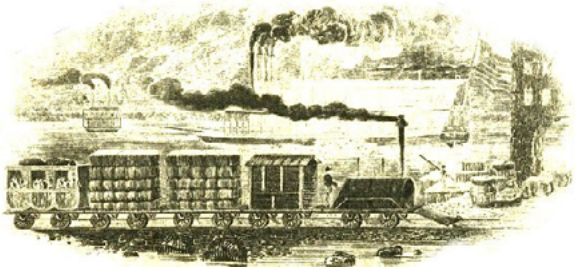


Rather unlikely in the realm of railway technology

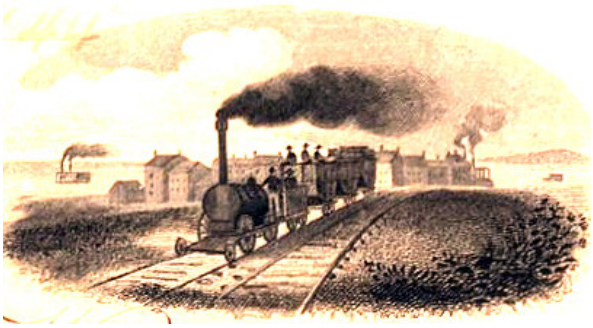


and operations is this train in an early 1830s vignette. The passenger carriages are not coupled to the locomotive, although the locomotive (which has an 'imaginative' boiler and smokebox) has coupled wheels. An individual on the running board of the first roofed carriage is carrying branches (for fuel?). The three goods trucks appear to contain sheep riding on several decks.

Perhaps inspired by an illustration of William Brunton's 'Mechanical Traveller' of 1813, an improbable



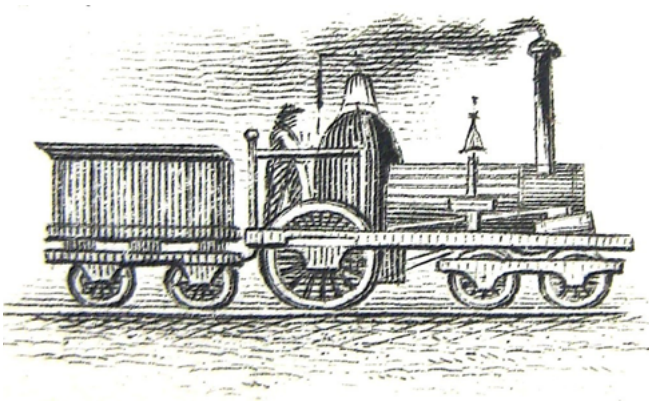
locomotive, and tender appeared in several different vignettes printed in the late 1830s. An innovative leading truck fitted to a



locomotive appears in a post-1840 vignette. The steamboat and sailboat were common features in vignettes.

Engravers could present technology quite accurately! Rather exacting details were incorporated into many intaglio plates. This locomotive and tender – actual size of the image is 5/8 inch (16mm) wide by 5/16 inch (8mm) high –

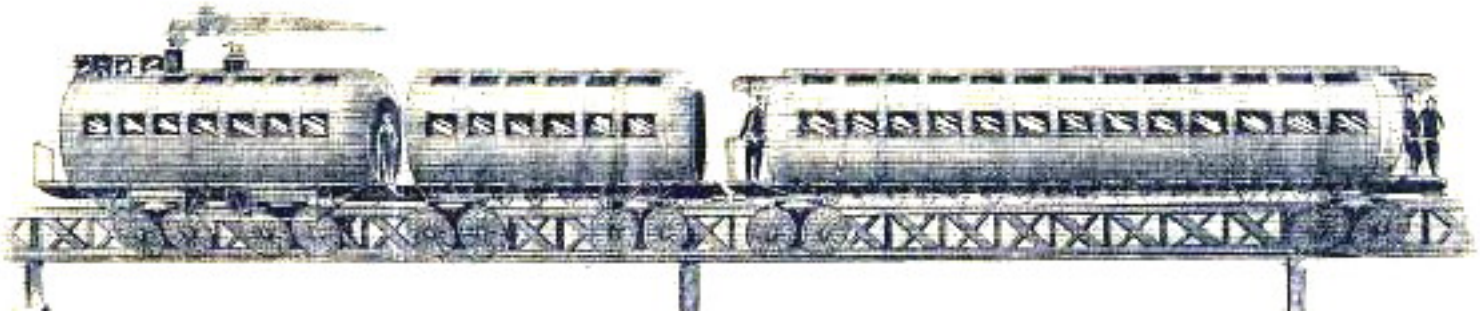




appears on currency, share certificates, and checks that were printed by the American Bank Note Co. An enlargement of the locomotive and tender shows that remarkable details are quite achievable!

Notes:
1. Use of images on United States currency and share certificates dates to Colonial days. They were primarily intended to serve as deterrents against counterfeiting and other fraudulent acts rather than for their aesthetic appeal.
2. An illustration, not engraved by Harrison, in the 1812 'The Emporium of Arts and Sciences, Volume II' differs in the valve gear and other elements and may be over-all more accurate.
3. Ten dollars was then a great deal of money (equal to about $600 or £400 in 2016 money). Because the notes, when negotiated, would have been discounted in amounts related to distance from Pittsburgh, few travelled afield.
4. See author's article in Int. J. for the History of Eng. & Tech., Vol. 79 No. 2, Jul. 2009, 245–279.
5. He or she has not been identified.
6. The seven other vignettes on it are accurate representations.

Although 'pictured technology' does not always denote what existed or operated, let the sceptics beware. The Meigs Elevated Railway was an experimental steam-powered monorail system invented by Josiah V. Meigs of Lowell, Mass. A 227-foot demonstration line in East Cambridge, Mass. Operated from 1886 until 1894. ——The picturing railway technology using metal or wooden types is another area for consideration. But such must wait for another time.



A Visit to Kelham Island in Sheffield



A section of the boiler formerly used to power River Don engine. Image ©Philip Ingram

Philip Ingram

On 7th April, a party of North West group members ventured across the Pennines to Kelham Island Museum in Sheffield and learn about the industrial history of the area. Background to Kelham Island was presented by John Hamshere, the museum's CEO, who explained that his role is almost exclusively to bring in enough money to keep it afloat.

Among the museum's largest exhibits is the *River Don* steam engine which provided the power to roll armour plate for the Royal Navy's battleships at Jutland in 1916. Associated with this, a 1916 exhibition is in preparation. It will look at life in Sheffield in 1916, for example, Zeppelin raids and the role of women in factories. John emphasised the need to interest people in technology as early as possible and proudly showed us the "processing line" in which children can start in the ball-pond (furnace), pass through the Bessemer converter, to strip steel being rolled and sheared.

The rest of the visit was spent in the Hawley Collection at Kelham Island. Ken Hawley was a tool retailer who was fascinated by tools and the skills of those who used and made them.[1] In one obituary there is interesting extended comment from his son.[2] After selling a new piece of equipment, he would look at its predecessor and say "you'll not be needing that now...". He knew that the most interesting old tools would be under the bench or out of the way and could skilfully locate key items. Judith Smith briefly explained the history of the Ken Hawley Collection and give an overview of the Collection *Sheffield built the world*. Barry Chambers then showed us some of the collection of Boxwood rules. We learnt that "rulers" are monarchs and but that for measuring one uses a "rule". Many of the rules were conventional length measures but some were much more subtle. One from the Vanderbilt estate in the USA was used to assess the amount of timber in a tree while standing at a distance. Others would measure a diameter but report the circumference. Because tradesmen carried their rules, they had reference tables stamped on them for locomotive builders, weavers, brewers and almost any other trade imaginable.

From Jim Nicholson we learnt about files and file making. Sheffield had been a key centre for making files: Chesterman alone had made 35,000 a week at one stage. Jim showed us a file cutter's hammer with a wrought iron head faced with crucible steel. A good file cutter could hand-cut 50,000 teeth a day. Files were hardened first in lead and then cooled in brine. The austenitic to martensitic transformation took a significant time, giving a window during which a file could be bent straight. At its peak, there were around 300 firms making files with 6,000 employees. Modern production methods mean that very little "fitting" work is needed, hence





Left: Jim Nicholson demonstrates a Chesterman Height Gauge. Image © Gareth Morgan. Right: Marine armour plate with John Hamshere as scale object. Image ©Philip Ingram.

files are of far less importance. File cutting was monotonous, poorly-paid and unhealthy. Perhaps we should not mourn it too much.

While in the museum restaurant, some of the party examined the photos on the walls, especially one showing a craftsman grinding the flutes on a 1½" drill by eye. Such skill! We returned to The Hawley Collection to learn more about measurement from Jim Nicholson. He had been a long term Chesterman employee. When Chesterman was taken over by Stanley, he closed the factory, rescuing what he could before turning off the power as he left for the last time.

The first Chesterman had come to Sheffield from the London area. He developed rust resistant steel strip for Victorian corsets as supplies of "whalebone" dwindled. He established one of the first, possibly the first, multi-process production line, which made cotton covered buttons. Essentially, strips of cotton and brass entered the equipment and cotton covered buttons emerged at the end. Land chain manufacture was similarly automated: wire was oiled, straightened and formed into eyes in a single machine. Jim showed an Imperial surveyor's chain, noting that despite the complexity of the links, it had to be accurate to 1/8" in 22 yards. A member volunteered to demonstrate how to throw a chain but the challenge of refolding it meant that this offer was declined. The subtleties of making 200ft steel measurement tapes were discussed, together with the processes for checking long vernier tapes against the UK standard.

From large scale measurement we moved via some very large callipers to precision metrology. Ken Hawley had been keen to acquire such equipment from all round the world. Newcomen member David Eaton demonstrated this section to us. A Société Genevoise dividing engine gave the opportunity to discuss the mechanisms used to compensate for imperfections in screw threads in high precision equipment. Ensuring uniform loading on measured objects was demonstrated by a German comparator that used a spring pointer to show the load applied.

We had a fascinating time. Even the best informed in the party felt they had gained new insights. We thank John Hamshere, Judith Smith, Barry Chambers, Jim Nicholson and David Eaton for their time on the day and all their colleagues for the work going on behind the scenes. All our party would like to return to spend more time at Kelham Island and its sister museums, the Abbeydale Industrial Hamlet and the Shepherd Wheel Workshop. We believe that other Newcomen members would find a visit similarly rewarding.

1. See the obituary of Ken Hawley by Sir Neil Cossons in NLinks 232, p23
2. www.toolsforworkingwood.com/store/blog/682/title/Ken+Hawley,+MBE+1927-2014

Kelham Island,
Abbeydale Industrial Hamlet, Abbeydale Road South,
Sheffield S7 2QW
www.simt.co.uk/kelham-island-museum

Hawley Tool Collection www.hawleytoolcollection.com

Steelmaking with children. Image © Philip Ingram





Sydney Opera House under construction, 6 April 1966 © Robert Baudin for Hornibrook Ltd. Courtesy Australian Air Photos. V&A.

Engineering and Design: Ove Arup, Achim Menges, Jan Knippers and the V&A

The first major retrospective exhibition of one of the most influential engineers of the 20th century and a site specific installation inspired by nature and fabricated by robots are highlights of the V&A's first Engineering Season. The season will highlight the importance of engineering and consider the place of engineers in the design process as well as the vital and creative role they play in the creation of everything from small, common objects to the large schemes of the built environment. All of which resonates with the vision of Prince Albert, Henry Cole and those other Victorian idealists when planning South Kensington's 'interdisciplinary campus' as a place for the exchange of ideas.

The main exhibition *Engineering the World: Ove Arup and the Philosophy of Total Design* (18 June – 6 November 2016) will explore the work and legacy of Ove Arup (1895-1988). Ove pioneered a multidisciplinary approach to design that has defined the way engineering is understood and practised today. Spanning 100 years of engineering and architectural design, the exhibition will be guided by Ove's writings about design and include his early projects, such as the Penguin Pool at London Zoo, as well as renowned projects by the firm like Sydney Opera House and the Centre Pompidou in Paris. Arup's collaborations with major architects of the 20th century pioneered new approaches to design and construction. It will also showcase recent work by the Arup company, from major infrastructure projects like Crossrail and novel technologies for acoustics and crowd flow analysis, to engineering solutions for open source housing design.

Through previously unseen prototypes, models, archival materials, drawings, film and photography, as well as a host of new immersive digital displays featuring animations, simulations and virtual reality, the exhibition will uncover the untold design stories behind some of the world's most recognisable buildings and the engineering trends shaping the world we live in.

A digitally engineered garden pavilion has been commissioned for the season. This installation is by architect Achim Menges with Moritz Dörstelmann, structural engineer Jan Knippers and climate engineer Thomas Auer. Their Elytra Filament Pavilion explores the impact of emerging robotic technologies on architectural design and engineering. Inspired by the fibrous structures of the fore-wing shells of flying

beetles known as elytra, the pavilion is an undulating canopy of tightly-woven carbon fibre cells which are created using a novel robotic production process. The pavilion is growing over the course of the season in response to the data on behaviour and patterns of use that are collected by the real-time sensors in its canopy fibres. At select moments, visitors have the opportunity to witness the pavilion's live construction as new cells are fabricated in-situ by a Kuka robot.

Professor Achim Menges is the founding director of the Institute for Computational Design at Stuttgart University. He collaborates with structural engineers, computer scientists, materials scientists and biologists. Together Achim Menges and Jan Knippers are pioneering the integration of biomimicry, robotic fabrication and new materials research in architecture. They have recently completed several innovative projects in Germany. Referencing Paxton's design for the Great Exhibition building based on the structure of a giant lily leaf, they note their aim to challenge established modes of design, engineering and making. The pavilion's intricate, filament canopy is at the same time architectural envelope, load-bearing structure and environmental filter, which will extend and transform over time.

Acknowledging the importance of engineers to design, Martin Roth, Director of the V&A commented that: "....engineers organise the world ...we are reliant on visible and invisible systems conceived, built, run or facilitated by the many disciplines of contemporary engineering. The V&A Engineering Season is a clear statement in our renewed interest in industrial design and the engineer. It builds on our industrial design heritage and reflects the crucial role of engineering in the development of the V&A. ... the season will celebrate the wonder and importance of engineering."

In addition to the main exhibition and the pavilion, there will be a series of engineering projects by British engineering firms such as AKT II, Atelier One, Buro Happold, Expedition Engineering and Jane Wernick Associates. These will be on display in *Mind over Matte*r in the V&A + RIBA Architecture Gallery (from 15 June 2016). Other activities in the Engineering Season will include an Exhibition Road Engineering Residency supported by the National Lottery through the Heritage Lottery Fund; a themed Friday Late; a series of lunchtime and evening lectures; talks and gallery tours, as well as a symposium about biomimicry, design and engineering with a keynote lecture by Achim Menges.



Elytra Filament Pavilion, render, V&A John Madejski Garden 2016 . © ICD/ITKE University of Stuttgart.V&A

V&A Engineering Season:
Elytra Filament Pavilion in The John Madejski Garden, open until 6 November 2016.

Engineering the World: Ove Arup and the Philosophy of Total Design in the Porter Gallery from 18 June – 6 November 2016

Mind over Matter in the V&A + RIBA Architecture Gallery from 15 June 2016.

Victoria and Albert Museum
Cromwell Road
London, SW7 2RL
www.vam.ac.uk

The Dickinson Lecture
The Brunels' Thames Tunnel: a great legacy to modern tunnelling

Jonathan Aylen

Marc Brunel's Thames Tunnel was a great legacy to modern tunnelling, according to Lord Mair's 2016 Dickinson Memorial Lecture.

Speaking at the Science Museum on 9 March, Robert Mair said the genius of Marc Brunel was the fundamental idea of a moveable shield for tunnelling through soft material. The shield was backed up by continuous lining of the circular tunnel as it advanced. These basic ideas of a shield and continuous lining underpinned the subsequent construction of much of the London underground. The same principles are inherent in the modern Howden back-hoe shield with its hydraulic back action. These machines still retain the idea of a circular shield at the front and jacks to shove the machine forward against a ring of precast concrete lining segments. This is still essentially a "Brunel machine" even though it can dig 50 metres per day.

Most of the world's cities are built on soft ground prone to subsidence. They are also criss-crossed by sub-surface tunnelling for subways and sewers. Settlement of soil is a reality. Given these difficult circumstances it is no surprise that a tunnel has been defined as something with "a geologist at one end and a group of lawyers at the other."

London is no exception to this picture of soft ground and multiple uses. The London clay north of the River Thames is strong enough for open face tunnelling with conventional machines. But the sand deposits, found south of the river, are highly permeable and quite unsuitable for open face tunnelling techniques. This helps explain the dearth of tube lines within the sandy soil of south London, its geology made tunnelling too difficult.

Now modern "earth pressure balance tunnelling machines" can operate in these waterlogged circumstances.[1] There is a much better understanding of soil mechanics since the dreadful events at Aberfan in South Wales in 1966 when a coal tip "liquefied" and moved down hill at 30 miles per hour, engulfing the village below. These events gave an impetus to the science of soil and rock mechanics and improved understanding of engineering geology.

The importance of prior ground investigation ahead of modern tunnelling work was stressed. It is crucial to anticipate potential subsidence, which can be modelled and predicted with accuracy. Ground surveys also reveal the presence of sand lenses and geological faults, such as the four major faults found at Farringdon Station during construction of Crossrail.

Platform tunnels at Farringdon Station, July 2015. Image © Crossrail Ltd



Subsidence is no longer acceptable, and Lord Mair outlined the extreme lengths taken to grout the ground under the Palace of Westminster to keep the Houses of Parliament intact and Big Ben upright during construction of the Jubilee Line. The process of compensation grouting involved injecting measured amounts of concrete at regular intervals from underground steel tubes inserted beneath the structures and carefully monitoring the results.

The Crossrail project includes 31 kilometres of sub-surface twin bore tunnels and 8 new sub-surface stations. The stations themselves are complicated. For example, Finsbury Circus is a 250 metre long cavern with a "dropped circular" shape. Here the tunnels are lined with fast-drying concrete sprayed onto the walls. The concrete is reinforced with steel needles. This technique has the advantage that fibre optic can be embedded into the sprayed concrete to allow constant monitoring of any subsequent movement. The many photograhs in the lecture illustrated not oinly the machinery used, but also the physical scale of the project such as in the group shot at Stepney Green.

When completed Crossrail's line, recently named the Elizabeth Line, will run from Reading and Heathrow in the west to Abbey Wood and Shenfield in the east. Stations are integrated into the tube network and it will take about 15 minutes from Heathrow to Tottenham Court Road on the Elizabeth Line. Similar schemes, using the same technologies, are now being engineered beneath Madrid and the Bosphorus, linking the two parts of Istanbul.



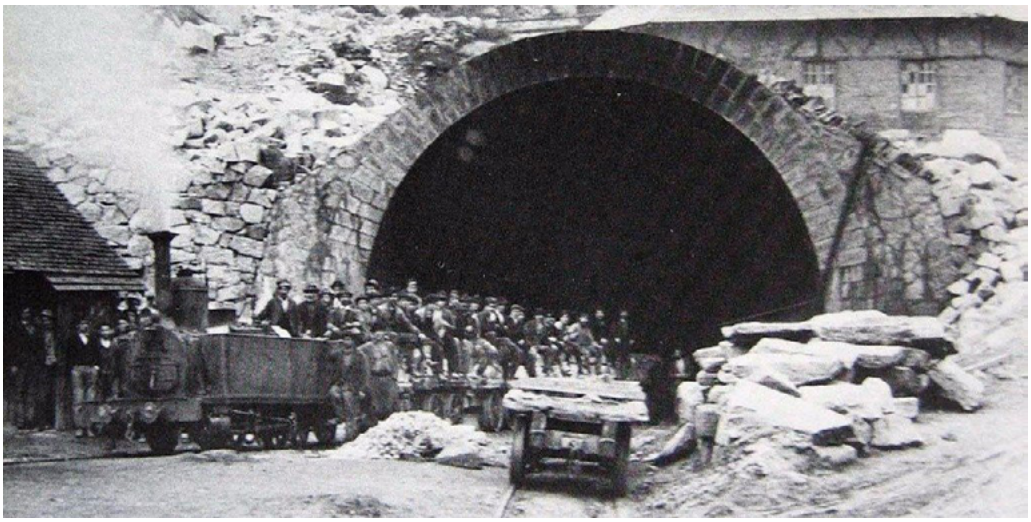
Work at Farringdon Station. Image © Crossrail Ltd

1. For details of these machines search on line for "Crossrail + tunnelling +machines" or go direct to:
www.crossrail.co.uk/construction/tunnelling/meet-our-giant-tunnelling-machines/
and click on the you-tube video.

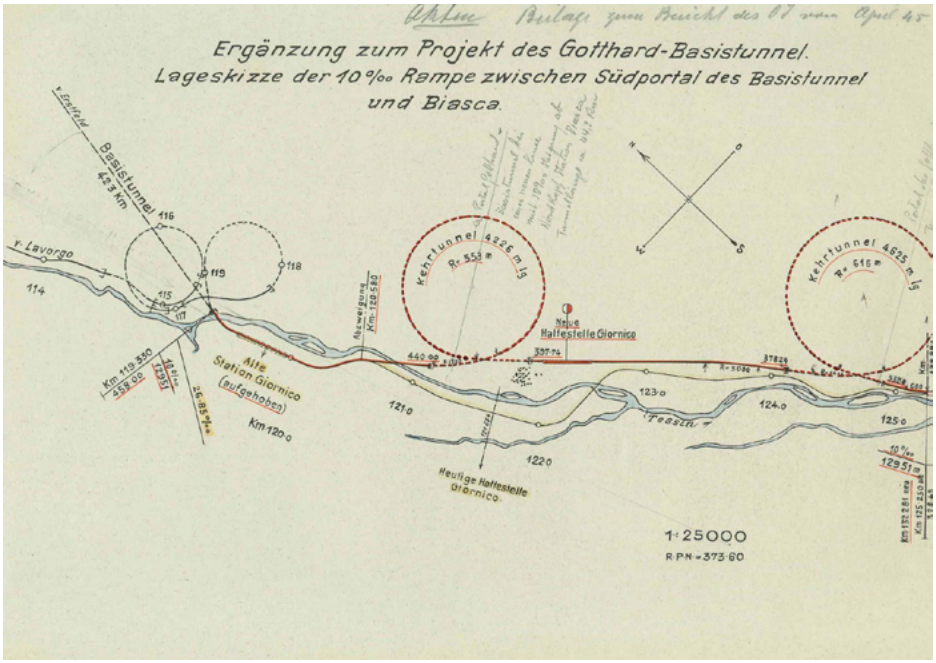
Completion of the Stepney Green sprayed concrete cavern, 40m below ground. Image © Crossrail Ltd



The Gotthard Tunnels through the Alps



As we go to press the opening of another tunnel is celebrated. This one is the third through the Gotthard in the Swiss Alps.



The first tunnel on the Gotthard axis through the Alps connecting Zurich and Milan by train, was completed in 1882 as a joint venture by Switzerland, Germany, and Italy, all of which benefit from trade along the vital north-south route. A road tunnel was completed in 1980.



Initial plans for the new, third tunnel, which opened this month, were conceived 68 years ago. It is now the world's longest tunnel and took 17 years from the first blast of rock to completion. Engineers used a 410m long tunnel boring machine as a 'rolling factory' to bore 2300m deep into the mountain. There is 152km of tunnel system within the mountain that will allow for a capacity of 325 trains a day further developing the trade route through Europe. *Ed*

The excellent website of the SBB, the Swiss railways, and its partners is well worth looking at for technical information, images and videos. www.gottardo2016.ch/en

A Tunnel for Cows in New York



A wood engraving by V. L. Kingsbury, 'Tunnel From Dock', showing the emerging cattle, published in Harper's Weekly, July 7, 1877

Alan M. Levitt

Although tunnels - whether they be built for railways, trams, automobiles, pedestrians, canals, as water or sewerage courses, or for mining, or military purposes - feature in the Society's publications, discussion of cow or cattle tunnels is wanting.

At least three such cow or cattle tunnels have been identified in the United States. The oldest is the Walden Street Cattle (or Cow) Pass in Cambridge, Massachusetts. It dates from 1857, was in use until about 1870 and was added to the National Register of Historic Places in 1994. The Pass (or tunnel) linked a Fitchburg Railroad (later, the Boston and Maine Railroad) facility, providing the cattle – which arrived in long trains from 'the west' – access to the cattle market that served the Boston abattoirs, without impinging upon street traffic. Originally built as a part of a bridge, the tunnel still supports a newer Walden Street overpass built in 1914. The latter was slated for replacement in 2008, but was deemed important to the community and was retained. The interior of the Walden Street cattle pass arch is about 9 feet (2.7 meters) high, 12 feet (3.7 m) wide, and 30 feet (9.1 m) long consisting of a linear brick tube.

The oldest New York City cattle tunnel dates to the 1870s. An underground passage was built by the Manhattan Abattoir Company to link its cattle dock (at the foot of the present West 34th Street) with its slaughterhouse. The tunnel allowed cows to be driven under – rather than across – Twelfth Avenue, the street closest to the North (more popularly, Hudson) River. The Manhattan Abattoir Company's facilities were located between Twelfth and Eleventh avenues. This cattle dock was later leased by the Pennsylvania Railroad.

Another such tunnel, built in 1932 by the Pennsylvania Railroad, was located at Pier 78 – West 37th Street and Twelfth Avenue – and extended for about 200ft (70m) beneath Twelfth Avenue to the block between West 38th and West 39th Street. The Pennsylvania Railroad's specially-fitted Pier 78 received the cattle that had been transported across the North River on the railroad's purpose-built cattle ferries from similar facilities in Jersey City, New Jersey. The West 37th Street tunnel is probably intact, and the West 34th Street tunnel is likely so, although no archaeological investigations have yet been undertaken. Information shown on infrastructure maps is not conclusive, and somewhat contradictory.

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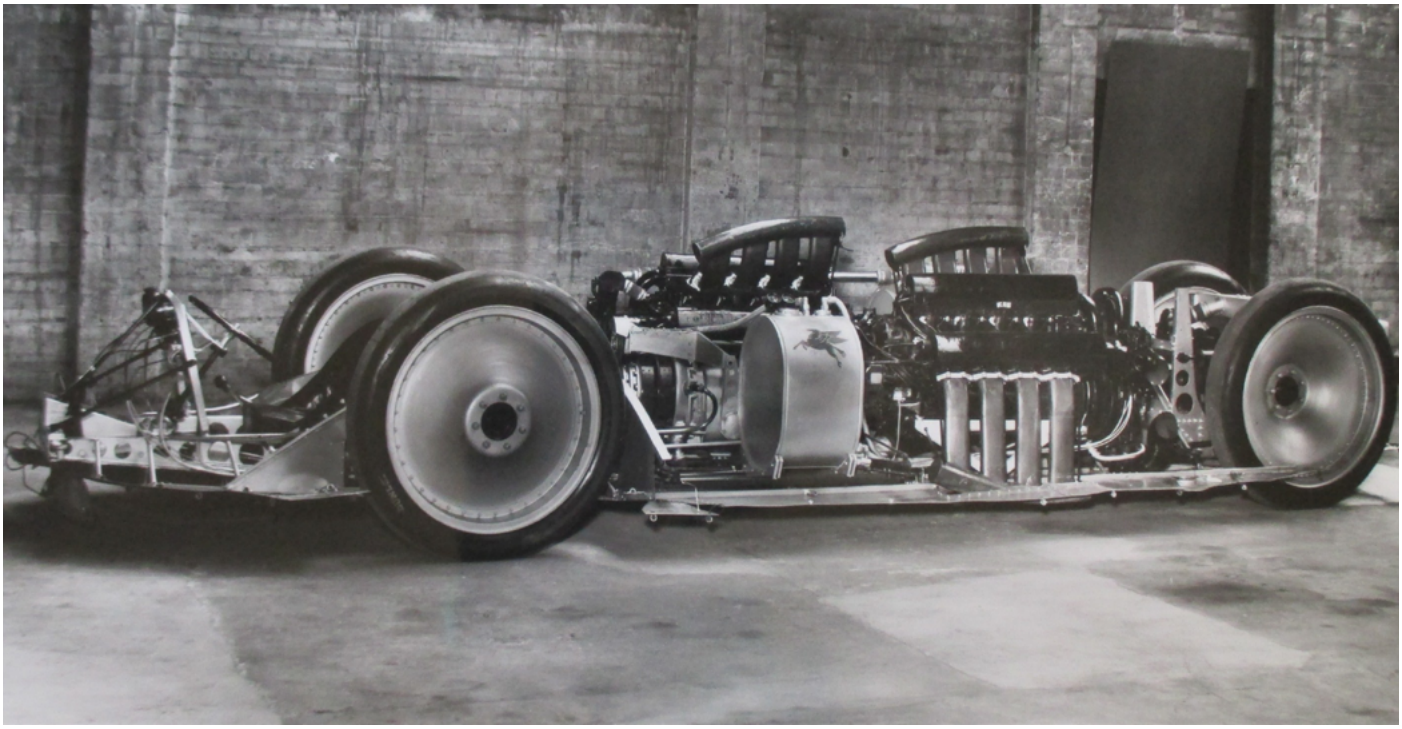
1 August for September
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The Napier Lion Aero Engine a record breaking power plant



The Napier Railton 400 mph car with two engines

At a meeting in Birmingham in April Jim Andrew spoke about The Napier Lion Aero Engine – a record breaking power plant

Jim Andrew

After producing aero engines under licence, Napier's Chief Designer, A. J. Rowledge came up with a broad arrow 12 cylinder engine giving 450 h.p. in a compact design of 24 litres which weighed just 860 lbs. The engine entered RAF service at the end of World War One and was the most powerful aero engine to see service in that war. It was used in a variety of British aircraft with some remaining in service until 1935.

In service use the engine's power was steadily increased to 570 h.p. but it also powered several record breaking aircraft at a time when such records were a source of much national pride. Napiers steadily increased the all-out power for record breaking to 670 h.p. In 1925 a Supermarine S4 seaplane set a world record for seaplanes of 226 mph. Napiers then raised the performance to 875 h.p. in 1927, to 930 h.p. in 1929 and finally to 1,350 h.p. in 1931 but, of course, such engines were only for record breaking with a very short life at full power before major rebuilding was needed.

In the 1920s both Malcolm Campbell and Henry Segrave fitted the Lion engine in land speed record cars which took the world land speed record from 146mph to 254mph. Campbell then moved to using more powerful but much heavier Rolls Royce engines, finally bowing out at over 300 mph.

A few years later Reid Railton was commissioned by John Cobb, a fur trader and gentleman car racing driver, to build a record breaking car capable to exceeding 400mph. Railton used two secondhand Lion engines in Cobb's car which competing with George Eyston with two Rolls Royce engines giving a total of 5,000 .h.p. The 2,500 h.p. Napier Railton car managed some 40mph faster by 1947 setting the record at 394mph with 403mph in one direction. This record breaking vehicle is displayed in the Birmingham Science Museum where it can be seen with the body raised to reveal the two engines and the ice tank cooling system used to avoid the need for a cooling radiator.

Henry Segrave used a Napier Lion engine to set the World water speed record for single engine speed boats to 93 mph in 1929 and later Hubert Scott-Paine raised that record to 110mph. All these records were set with modified aero engines but the Lion's reliability and low weight encouraged Napiers to develop a version for reliable use on water which remained in production until 1953. These Sea Lion engines were used as single, twin and triple engine installation in launches up to the RAF air-sea rescue craft which even operated close to enemy coastlines in World War Two.

Video clips showed two preserved Lion engines, one run at rallies on a trolley and the other fitted in Bentley vintage racing car. The sound of these two engines set the meeting up for a lively discussion, much assisted when two of the audience were found to be the owners of the two units which had just been heard. One had brought an engine connecting rod with him. It clearly showed how the three banks of cylinders used a master rod for each central piston and a shorter rod pivoted each side for the side pistons.

Thinktank, Birmingham Science Museum
Millennium Point, Birmingham B4 7XG

www.birminghammuseums.org.uk/thinktank

At Enderby Wharf

Campaigners have laid out ideas "to inspire enthusiasm and support" at a recent seminar about the Enderby Wharf site in East Greenwich, focusing on the now derelict Enderby House. It was from Enderby Wharf that the first Atlantic cables were loaded onto cable laying ships, most successfully Brunel's Great Eastern, in the late 1850s, forever transforming global telecommunications.



This was an important manufacturing site for underwater cables, a huge percentage of early cables were made here. There was also an important research division where many breakthroughs in cable and other communications technology were made. Alcatel Lucent continue to have a manufacturing base on much of the site, although the riverside is now being developed for residential purposes. The group is very aware that the history and technological development of subsea cable is an important subject and members are keen publicise this. We also noted the recent Nobel Prize awarded to Woolwich educated Charles Kao for work on optical fibre technology. The Enderby name comes from the famous family of whalers and explorers who used the wharf and built the house in the mid-19th century, where early meetings of what became the Royal Geographical Society were held. In the 17th century the Government gunpowder depot was here and there was also an important rope walk.

Guests at the seminar took a guided walk followed by presentations about the history of the site where developer Barratt Homes are building flats and a cruise terminal has been given the go ahead. The invited audience was made up of well known industrial historians and local decision makers. The local Council leader, MP, GLA member and Mayor were all there along with some of the developers. The campaign has focused round Enderby House, which is listed and has only recently fallen into disrepair. We would like to see some recognition of the heritage of this important site and also of the industrial history of the Greenwich Peninsula and Greenwich itself. There were many other technological and scientific breakthroughs in Greenwich which remain to be acknowledged.

There is a write up of the event at
http://onthethames.net/2016/03/14/enderby-campaigners-discuss-future-historic-site/
Cable making and the Atlantic cable
http://atlantic-cable.com/
On the immediate area www.ballastquay.com/history.html

More information or to provide a speaker for society, contact: meetings. marymillsmmmmm@aol.com

Blue Plaque for Benjamin Baker

Mike Chrimes

Julia Elton represented the Society at the unveiling of a Blue Plaque to Sir Benjamin Baker on 21 April. The plaque was placed on Baker's London residence (1881-1894) at 3 Kensington Gate. It can be argued that it was long overdue recognition for one of Britain's great engineers.

Best known for designing the Forth Railway Bridge, at the time when Kensington Gate was his home, he played a significant role in the development of the London Underground, and designed the Aswan Dam and its first heightening, as well as masterminding the transport of Cleopatra's Needle from Egypt to the Embankment. The plaque was unveiled by Mayor of Frome, Kate Bielby, who spoke of that town's recently rediscovered pride in one of its most distinguished 'children'. Also in attendance was Pippa Goldfinger, who curated an exhibition about Baker in Frome in 2009, which eventually involved 2500 local schoolchildren through associated events. She spoke eloquently of Baker's talents as a communicator as well as of his engineering achievements.





Howard Spencer, historian of the Blue Plaque Scheme, administered by English Heritage and now 150 years old, put in a plea for more engineers to be suggested by the public as they are currently seriously under-represented. Coincidentally, it is a year since a plaque was placed at 74 Shooters Hill Road, the Blackheath home of the Lindley family of engineers, but there are no more in the pipeline. The event was organised by Cathy Power, Blue Plaques Manager, at English Heritage.

Chepstow Wye Bridge

Stephen K. Jones

The 200th anniversary of Chepstow Wye Bridge will be celebrated on 24 July with events including a re-enactment of the 1816 opening ceremony and a procession led by the President of the Institution of Civil Engineers, Sir John Armitt. The bridge was designed and built by John Urpeth Rastrick FRS (1780-1856) and opened on 24 July 1816.

Chepstow Wye Bridge was the third largest cast-iron arch road bridge in the world and is now the longest survivor of that period. A civil and mechanical engineer, Rastrick is remembered as a railway pioneer. He built the first steam engine to run in the USA; chaired the Rainhill Trials for the Liverpool & Manchester Railway in 1829 and built numerous railways in Great Britain. The iron arches were cast at the foundry of John Hazeldine at Bridgnorth in Shropshire where Rastrick was the engineer. There will be a report on the celebration in the next issue.



Abandoned in Place: Preserving America's Space History



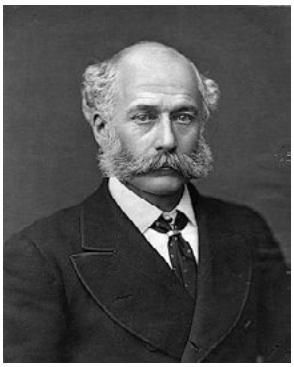
Hardcover: 176 pages
Publisher: University of New Mexico Press (30 Mar. 2016)
Language: English
ISBN-10: 0826356257
ISBN-13: 978-0826356253

Stenciled on many of the deactivated facilities at Cape Canaveral Air Force Station, the evocative phrase "abandoned in place" indicates the structures that have been deserted. Some structures, too solid for any known method of demolition, stand empty and unused in the wake of the early period of US space exploration. Now Roland Miller's color photographs document the NASA, Air Force, and Army facilities across the nation that once played a crucial role in the space race. This is a large format book, with excellent full colour and detailed photographs. It shows how quickly pieces of engineering and technology can become historical artefacts.

THE WILLIAM SHIPLEY GROUP FOR RSA HISTORY

SEWERAGE AND HEALTH

Symposium to mark the 125th anniversary of death of Sir Joseph Bazalgette



Thursday 22nd September 2016

at The Gallery, 70 Cowcross Street, London EC1M 6EJ

10.30am	Introduction by Susan Bennett
10.45am	History of public conveniences by Rachel Erickson
11.05am	Sir Joseph Bazalgette and sewers by Dr Stephen Halliday
11.25am	Q&A
11.40am	Coffee/tea break
12.00pm	Sewage treatment by Dr Nicholas Cambridge
12.20pm	From Cholera to clean water by Howard Benge
12.40pm	Sir John Hawkshaw (awaiting title) by Mike Chrimes
1.00pm	Q&A
1.30pm	End

To register for a place look us up on Eventbrite.
For further details please email the WSG Honorary Secretary:
Susan Bennett at susan@bennett.as or ring 0790 5273293

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Copy dates
for Newcomen Links

1 August for September
1 November for December
1 February 2017 for March

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The Society's events are on the following pages

PRISM Fund 2016/17 Now Open

The PRISM Fund, which helps to support the acquisition and conservation of heritage objects from the fields of science, technology, industry and medicine, is now open for applications.

Since its inception, the Fund has helped hundreds of non-national museums and preservation groups in England and Wales acquire or conserve thousands of objects of industrial or scientific importance. All fields of science and industry are eligible, including natural history, medicine, engineering and geology.

The maximum grant amount for projects is £20,000, with a match funding requirement of at least 10%. PRISM is open to museums, archives and charitable groups in England and Wales and supports a huge range of objects, including medical instruments, boats, steam engines, archives, trams, agricultural equipment and more.

Applicants to the PRISM Fund do not have to be Accredited organisations but they do need to have charitable purposes and exist for the public benefit. Rather than funding on-going maintenance costs we support specific projects; and we are particularly mindful of the long-term sustainability of access and care to the object.

PRISM is a rolling fund and has no deadlines. If you are would like some more information and our guidelines please look at our webpage:
http://www.artscouncil.org.uk/funding/prism
For more information, please contact the team at prism@artscouncil.org.uk

NATIONAL WOMEN In ENGINEERING DAY
23 June 2016

National Women in Engineering Day is taking place again on 23 June 2016

This is a chance to support, inspire, celebrate and raise the profile of women in engineering. It is also an opportunity to draw attention to the amazing careers in engineering for girls and young people.

The Women's Engineering Society has a Resource. The subtheme for the day is Raising Profiles and the event will be accompanied by the publication of a list of 50 Influential Women in Engineering, which is being coordinated by The Daily Telegraph at: tgr.ph/we50 .

A number of other campaigns and competitions are running on that day too, and full details can be found at: www.nwed.org.uk.



The Newcomen Society Calendar

A complete calendar for the 2016/17 events will be published in the September issue. See the conferences and visits on offer here.

Please check the Events pages on the website for updated information:

www.newcomen.com

London
Please note change of venue. Lectures will be held in the The Dana Studio, The Dana Centre, 165 Queens Gate, London SW7 5HD. Time 17.45. Visitors welcome, admission free. Members and guests go to a nearby restaurant afterwards.

Midlands
Meetings are held in the Thinktank Theatre, at the Birmingham Science Museum, at Millennium Point, Curzon Street, Birmingham, B4 7XG. Time: 18.30 for 19.00. Visitors welcome, admission free.

North Eastern
Meetings are held at the Discovery Museum, Blandford Street, Newcastle upon Tyne NE1 4JA. Times vary.

North West
Meetings are held at the Museum of Science and Industry, Liverpool Road, Manchester M3 4FP. Time 18.30 unless specified otherwise. Visitors welcome, admission free. Members meet at a nearby restaurant from 17.00.

Scotland
Events are usually held at the National Museum of Scotland, Chambers Street, Edinburgh EH1 1JF. Times vary

Southern
The meetings are planned to be held in lecture room PO1-11 in the University of Portsmouth's Portland Building on St James Street commencing at 6.30 p.m.

Western
Meetings are held in Room 1, BAWA, 589 Southmead Road, Bristol, BS34 7RG, 7:30-9:30 pm.

www.stickssn.org
@stickssn

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STICK

Conference:
Scotland's Unsung Innovators

Save the date for STICK's annual conference this October exploring Scotland's unsung innovators.

Inspired by the new science and technology galleries at the National Museum of Scotland opening in July 2016, the conference will explore Scottish innovation in science, technology and industry by redressing popular misconceptions and bringing lesser-known heroes into the spotlight.

Friday 28th October 2016 | Edinburgh
National Museum of Scotland
£10 (£6 concessions)



Images: David Osborne's Jompy boiler, Robert Stirling's engine, Touch Bionics' iLimb, Alexander Bain's electric clock
All images © NATIONAL MUSEUMS SCOTLAND

NEWCOMEN
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Ri

Annihilating Space & Time: 150 years of Transatlantic Telecommunication

Date & Time: 5th September 2016. Registration opens at 09.15.
Place: The Royal Institution of Great Britain, 21 Albemarle Street, London W1S 4BS
Fee: £65 including coffee and lunch.

To book
Online here: Eventbrite

By cheque: send a cheque for £65 made out to The Newcomen Society with your name, address and a note of the conference title to: The Administrator, The Newcomen Society, The Science Museum, Blythe House, 23 Blythe Road, London ,W14 0QX

Catalyst Science Discovery Centre and Newcomen North-West

"Industrial Chemistry in the North West": Visit and Workshop

Saturday 2 July 2016 at Catalyst, Widnes (Cheshire)

Programme

11am	Opportunity to tour the galleries of Catalyst and see progress with the new Mersey Crossing bridge from the top-floor Observatory
11.30 to 1pm	*Lunch will be available for purchase in the Catalyst cafe.*

Workshop: Industrial Chemistry in the North-West

1 pm	*Welcome*
1.10	Peter Reed (Catalyst Trustee), "Synthetic Indigo, Patents and Ellesmere Port"
1.50	Dr Viviane Quirke (Oxford Brookes University), "Making Medicines in the North West: ICI from Blackley to Alderley Park"
2.30	Professor Martin Adams (University of Surrey), "The acetone-butanol fermentation and the birth of modern industrial microbiology"
3.10 to 3.45	*Tea and Tour of nearby Spike Island to see some of the surviving remains*
3.45	Paul Meara (Catalyst), "Introduction to the Catalyst archives and library collection"
4pm	Howard Hopwood (Catalyst Trustee), "History of Photography – It's There in Black and White".
4.40	Dr Fred Starr (Newcomen Society), "Steam Reforming and Other Catalytic Processes: British Gas in the Swinging Sixties".
5.20 to 5.30	*Closing remarks*

The workshop is jointly organised by Newcomen North-West and the Catalyst Science Discovery Centre to develop an understanding of some of the lesser known aspects of the history of the chemical industry in the North-West. A modest fee of £10 will be charged **on the day** for the workshop to cover admission to the site and help defray expenses. Please register with newcomen.ajc@btinternet.com.

There is free parking on the site which is very easy to reach from either the M62 or the M56. The site is a short taxi ride from Runcorn Station for north-south train routes and a mile-and-a-half from Widnes station on east-west routes.
The venue address is: Catalyst, Mersey Road, Widnes WA8 ODF. The site is well-signposted.

We are sure it will be an excellent day: Jonathan Aylen and Peter Reed. Queries to jonathan.aylen@manchester.ac.uk

Newcomen Lectures are on You Tube

A number of Newcomen Society lectures are now available to view on You Tube. These include those given at the Swords into Ploughshares Conference last October. The lecture on Steam Under the Sea, given by Chris Hodrien to Newcomen Midlands in February, is also there. More are to follow.
'\
They can be accessed at:
www.youtube.com
and then searching for Newcomen Society - where they are all listed.

Copy date for the June issue of

Newcomen Links

1 August 2016

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www.newcomen.com

International Early Engines Conference 2017
Preliminary Announcement

Newcomen & colleagues' achievements untainted by the smokescreens of Watt

The Ironworks, Elsecar, South Yorkshire
May 11-13, 2017

The inaugural International Early Engines Conference (IEEC) will be held at The Ironworks, Elsecar, South Yorkshire in May 11-13, 2017. Organised by Newcomen in conjunction with Barnsley Borough Council and others, the purpose of the conference is to provide a forum for presentation and discussion of new research into heat engines prior to 1812.

A wide range of new field and desk research into early engines lacks an obvious outlet, forum or focus and this is the underpinning rationale for IEEC. The event design is based on the International Early Railways Conference (IERC). Repeat conferences are anticipated every 4-5 years.

The conference will open at 12.00 on Thursday May 11, 2017 and close at 16.00 on Saturday May 13. Twenty papers, each of thirty minutes duration are planned, plus visits to local engine houses and related sites. Catering will be provided and relevant publications will be on sale by the sponsoring organisations. Delegate costs are likely to be around £100/person and will offer options for partners and day tickets. Conference transactions will be published as a themed edition of the International Journal for the History of Engineering and Technology.

Annihilating Space & Time: 150 years of Transatlantic Telecommunication

5th September 2016
at The Royal Institution of Great Britain

The first successful working transatlantic telegraph cable began transmitting 150 years ago on 27th July 1866. The history of this remarkable achievement and the developments which sprang from it are explored in this one-day symposium.

Stewart Ash: The First Steps – Joining the Dots & Dashes.
Nigel Linge: Encircling the globe.
Donard de Cogan: From Mirror Galvanometer to Telex: how they increased the bit rate of telegraph cables.
John Moyle: Looking for a Needle in a Haystack - Locating causes of malfunction in Victorian submarine telegraph cables.
Ron Shearer: An urgent message: North America's obsession with the Atlantic Cable.
Keith Schofield: Submarine cable protection and security in the modern world
Jacob Ward: The Politics of Automating the Telephone Network in Post- WWII Britain
Derek Cassidy: Submarine networks, the next stage in their evolution.

Date & Time: 5th September 2016. Registration opens at 09.15.
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