

Links

NEWCOMEN

The New President

Newcomen Matters Seen

The 2013 Summer Meeting

Anniversaries Books

Events Conferences

Photovoltaic Power Generation

Pickfords Heavy Haulage

Patents & Historical Research

Driving a Model T

Audio Compact Cassette

Engineering in Cathedrals

A Tour of Indiana

Observation & Replication



Newcomen Links Editor & Layout Designer:

Deborah Jaffé

editor.links@newcomen.com; 07798 603000

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The Newcomen Society,

The Science Museum,

London SW7 2DD.

+44 (0)20 7371 4445

www.newcomen.com

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Writing for Newcomen Links

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

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

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

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**The copy date for the next issue is
10 May 2013**

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

The Editor,

Deborah Jaffé at:

editor.links@newcomen.com

07798 603000

Notes on Contributors

Jonathan Ayles is Senior Lecturer in Manchester Institute of Innovation Research at Manchester Business School, the University of Manchester, England. He has travelled throughout the world steel industry, advised a range of national and international bodies on steel issues and has published widely on steel and on the history of technology.

John Bolter joined C A Parsons & Co Ltd, Newcastle upon Tyne in 1949 and became a design engineer in the Gas Turbine Department. In 1965 he moved to the Steam Turbine Department, later becoming Chief Turbine Engineer, Engineering Manager and Engineering Director, he retired in 1991.

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

Dr Robert Carr, a university lecturer, joined the Newcomen Society in 1978. He has served on Newcomen Council and used to organize the London Visits.

Hugh Cameron is senior lecturer at the Manchester Institute of Innovation Research within Manchester Business School of the University of Manchester. Hugh trained as an economist and joined the University as a researcher on innovation after time spent with Leyland Trucks. He has also enjoyed an international career in track cycling.

K.S.G. Hinde is Chairman of the Stretham Old Engine Trust.

Rev Canon Dr Michael J Jackson read civil engineering at Liverpool in the 1960s and then joined consulting engineers Freeman Fox, and Partners. After working for 12 years in industry in design and construction he became a lecturer at Newcastle University. He was awarded a PhD in 1984. In 1984 he left engineering and became a priest in the Church of England. He is an honorary canon of Newcastle Cathedral.

Deborah Jaffé is a design historian and the editor of Newcomen Links. She is the author of eight books including 'Ingenious Women' and 'The History of Toys'.

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.

George Nairn worked for Pickfords Heavy Haulage from its Birtley (Gateshead) office for 32 years. He was then Northern Area Sales Manager and his remit included organising the transit of large industrial equipment for all the major engineering manufactures in the North. Since retirement, he has concentrated on being a dealer in old postcards.

Victoria Owens MA PhD, a member of the Newcomen Society, is a freelance writer and volunteer guide at Bristol Cathedral.

Professor Nicola Pearsall is head of the Northumbria Photovoltaics Applications Centre at Northumbria University, Newcastle upon Tyne.

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 I_A, organising regular lecture series, and arranging field visits and conferences.

John Porter. After degrees in mechanical engineering and naval architecture, John spent all his working life with merchant ships. Sailing on steam driven ships led to an involvement with the preserved Cornish engines at the Kew Bridge Steam Museum. He enjoys travel with NS and AIA, finally having time to see more of the countries he flashed through in his working days.

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.

Stephen van Dulken recently retired from being a patent expert at the British Library, and is now a patent consultant. He has written both academic and popular science books on patents and inventions including 'Inventing the 19th Century'.

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

The copy date for the next issue is of
Newcomen Links is
10 May 2013

From the Hon Secretary

Fifty five members attended the Annual General Meeting. Past President Julia Elton called the meeting to order and the Honorary Secretary/Company Secretary, Roger Cline read the notice calling the AGM. Martin Gregory proposed and Dan Hayton seconded the motion to approve the Statement of Accounts, the Report of the Directors and the Reporting Accountant's Report for the year ended 30 June 2012. The motion was passed unanimously. Professor David Perrett then proposed the motion to approve the Report of Council for the Session to 30 September 2012, seconded by Professor Frank James. The motion was passed unanimously. The motion to elect the Honorary Officers of the Society *en bloc*, to serve for one year from 8 February 2013 until 30 September 2014, was proposed by Paul Saulter and seconded by Professor David Perrett, the immediate Past President, who is an ex officio Member of Council. The motion was carried unanimously. The Honorary Officers are: President, Mr Geoff Wallis; Vice-President, Mr Michael Grace; Hon Treasurer, Professor Frank James; Hon Secretary, Miss Julia Elton. The motion to elect to Council the nominated members of the Society *en bloc* was proposed by David Worth and seconded by Robert Carr. The motion was carried unanimously. New Council members are: Mr John Bolter, Mr Alexander Hayward, Dr Fred Starr, Mr Robert Taylor. The motion to approve the appointment of Errington, Langer, Pinner, Pyramid House, 956 High Road, Finchley, London N12 9RX, as Reporting Accountants and to authorize Council to fix their remuneration was proposed by Martin Gregory, seconded by Dan Hayton. The motion was carried unanimously. Julia Elton asked Roger Cline, who had acted as returning officer for the ballot of members in the ballot regarding the proposed increase in subscription level from 1 October 2013, to announce the result of that ballot. The proposed subscription levels are: Full Member / Newcomen Fellow £55.00; Associate Member £35.00; Student Member £17.00. Roger Cline reported that: *197 votes were cast. Of those that complied with the rules of returning the ballot paper in the envelope provided with the member's name on the back flap 165 voted for the increase and 11 against. Of the envelopes with no name anywhere, 20 voted yes and 1 no.* Thus the recommended increase in subscription levels will take place from 1 October 2013. The meeting closed at 6:10pm.

Following the AGM a short ceremony was carried out when Professor David Perrett, as the immediate Past President, presented the Presidential badge of office to Mr Geoff Wallis, using the Society's standard form of words. The new President then took the opportunity to address the meeting with his thoughts for how the Society should move forward and the actions that he foresaw as necessary for its developing health (see page 4). This was greeted with spontaneous applause by the attendees.

From the Hon Treasurer

With this issue of Newcomen Links is a supplement containing the revised text of the Newcomen Society's Memorandum and Articles of Association. Usually when revising such documents, only specific changes are made and then incorporated into the main text and this has happened on a number of occasions during the past few years. However, as the Society is both a Company and a Charity, the provisions of the Companies Act 2006 and the Charity Act 2011 needed to be incorporated into the governance of the Society, which has not been done until now. Council also thought that this would be a good opportunity to generally revise, update and bring into line with current practice how the Society is governed. To this end I was tasked by Council to undertake, in conjunction with our solicitors, a whole scale revision of the Society's governance documents and to submit them in their entirety to the Membership through the calling of an EGM, which will be held on 10 April 2013; a formal notice convening the meeting is enclosed with this mailing. No change has been made to the Memorandum as this would require the prior approval of the Charity Commission and since any changes here would be minimal, Council decided not to make any alteration at this point. So far as the articles are concerned, there are a number of changes reflecting how the Society is run. For instance there was no reference to the function of the President, nor any reference to the position of Honorary Secretary and both these omissions have now been rectified. Please do read this document carefully and I will be more than happy to respond to any queries you might have. I very much look forward to seeing you at the EGM in April. Frank James: hontreas@newcomen.com

From the Editor

The front cover of this edition of Newcomen Links reflects its contents. We have a new President and his views and ideas for the Society are reported on page 4. I urge you to read the guide to using the events' calendar on the website on page 7. It is an easy to use calendar and enables everyone to keep up to date with the Society's diary. There are many other interesting articles and I look forward to receiving feedback on them. Please, send me ideas for possible subjects to include in Newcomen Links, and of course any news and articles. Many thanks for your support.

The Presidential Acceptance Address Given by Geoff Wallis at the AGM on 13 February

Thank you for honouring me with this position.

What do I bring to it? I am entrepreneurial and a strictly practical person. I have spent three decades as a contractor, conserving metalwork and machinery as founder and former managing director of Dorothea Restorations Ltd, which my son now runs.

I am also an industrial history enthusiast, and am excited to be taking up the role of President at a time when the importance of engineering and technology is increasingly being recognised. After decades of faith in the services' sector, the government is now realising the key role manufacturing, engineering, and technological excellence will play in our recovery from a deep and protracted recession.

The public too is increasingly aware of, and interested in, modern technology and engineering, reflected in media coverage, and fostered by it. We increasingly take pride and interest in constructing the tallest building (The Shard) and most expensive new railway (Crossrail) in the EU. We wonder how it is possible to construct the first twenty three stories of a tall building before the foundations are finished. We are fascinated by the 1,000 tonne moles that tunnel under London and find that Ada, Phyllis, Sophia, Mary, Victoria and Elizabeth are not just 'boring' machines. But, most excitingly, interest in the history of technology is also rising. An estimated one billion people worldwide watched the opening ceremony of the Olympic Games in London, and not only experienced a celebration of the UK's pioneering role in world industrial development, but also marvelled at it, and surprisingly perhaps, have remembered it.

Having hardly heard the names of Newcomen or Watt broadcast for decades, over the last year their names and achievements have been wonderfully popularised by a series of TV programmes on the history of technology. I cannot recall the Black Country Living Museum's Newcomen Engine having been shown once in its 25 years existence, but it has featured four times over the last six months on prime-time TV. Mr Newcomen's name is gradually becoming as well-known as it should be.

Increasingly, our industrial and technical history is interesting, and being recognised as somehow important in our understanding of the present. Our Society has been saying this since 1920, and has

played a modest part in this reawakening through the tercentenary celebrations last year.

The Society has vital resources to help fuel this resurgence of interest in the history of engineering and technology. In over 1,000 Transaction/ Journal papers we have a world-class repository of knowledge, and amongst our members and contacts we have vast reserves of skill, experience, and knowledge. Newcomen Links and our many activities bring the subject to life, provide social interaction, and motivate us.

But to further promote a wider understanding of the history of engineering and technology we need to engage more. We must strive to connect with more career-engineers, (particularly youngish ones), with people who already have relevant specialist interests, with people overseas, and looking around this hall, with more women. We need to do this for the benefit of our modern world which needs to be reminded continuously about how the past has shaped us and the lessons we can learn from the process.

Also, we need to engage better for the benefit of our Newcomen Society. We have traded at a loss for two years, a situation we must address by increasing our activity, our membership, and our income, whilst controlling costs and maintaining the quality of our 'offer'.

How can we deliver this? Today Council have approved a Strategy which endeavours to:

- Improve our products and services
- Widen their appeal
- Publicise them better
- Contain costs

But neither Council nor the Executive Group can deliver these, every one of us must be involved.

It is essential that you contribute papers for the Journal, provide news and reports for Newcomen Links, propose worthy speakers, organise activities, run the Branches, operate our web-technology, help Tim Crichton in the office. In short, do whatever you can. Please volunteer your skills before you are asked! Above all, be enthusiastic and motivate others.

I see this as probably my most important task for the next two years. We need to be dynamic, outward-looking, and profitable, and it is this vision that I look forward to developing and delivering with you.

It starts here and now with each of us, so please consider what ideas, expertise, knowledge and energy you can offer to your Society.



Geoff Wallis, the new President, is founder and former managing director of Dorothea Restorations. He has thirty years of experience as a contractor conserving metalwork and machinery.

THE NEWCOMEN SOCIETY

EGM

WEDNESDAY 10 APRIL AT 5.45PM

IN THE FELLOWS' ROOM,
SCIENCE MUSEUM,
LONDON SW7 2DD

AN EGM HAS BEEN CALLED
TO SUBMIT THE REVISED
MEMORANDUM AND ARTICLES OF
ASSOCIATION
TO THE SOCIETY'S MEMBERS.

FOLLOWED BY THE LECTURE:
PLUTO
LIFEBLOOD FOR D DAY AND
BEYOND
BY ALLAN GREEN

Congratulations

The Society congratulates The Reverend Dr Richard Hills on the honour he has received from the Gianfranco Fedrigoni Foundation of the European Institute for the History of Paper and of the Science of Papermaking, Fabriano, Italy. Its Administrative Council has conferred the title of Honorary Member on him to mark its appreciation for the particular merits he has acquired in the promotion of the studies of the history of paper and for the important publications that carry his name.

For some years Richard Hills was President and is now Honorary Member of the International Association of Paper Historians. He is also one of the founders and now President of the British Association of Paper Historians. His book 'Papermaking in Britain, 1488 – 1988' and sixty articles to various paper-history journals are an invaluable contribution to the subject. Richard Hills is also a long standing member of the Newcomen Society.

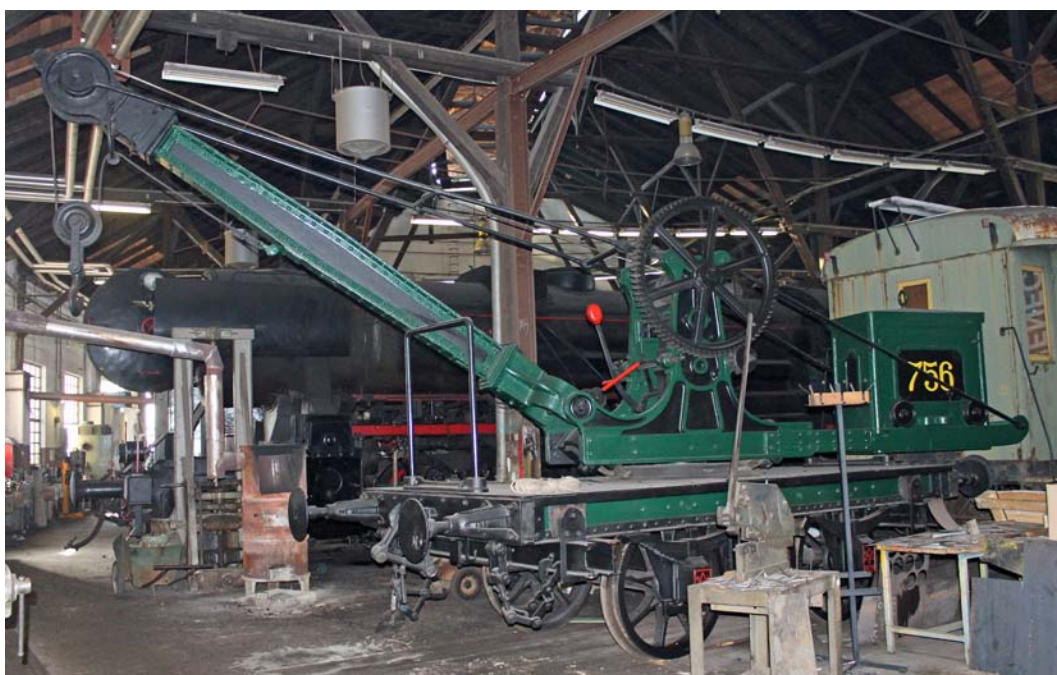
Members

The Society welcomes the following new members:

Brian Cherrington, Keith Crawford, James Frost, David Gibbs, Nigel Hobden, Dr Maclaren North, Miles Pearce, N J Pleydell-Bouverie, Michael Robinson, R V Rogers, R K Taylor, James E Thompson, Dr Matt Thompson, Jonathan Tripp.

The Society is saddened to report the deaths of:

Paul Calvorcoressi, R H Goring, G W B Lacey, W H MacLeod, Eric Pinder, H D Taylor



Seen.....



David Perrett

There is an extensive Museum for the Slovenian State Railways in Ljubljana with a large number of historic locomotives with some in working order and others waiting to be cannibalized to keep the others running. The oldest locomotive is the former Southern Railway 718, built in 1861. The workshops are not normally open to the public but I was able to visit on a very cold day in January and came across this rail mounted crane. On the axle boxes

is cast "R S Co P 1874" and the staff there say the crane came from Robert Stephenson's in Newcastle. Michael Bailey was not aware of the crane and is not too sure of its provenance! Any other information welcome.

Please send comments, feedback and contributions to Seen:
editor.links@newcomen.com

July in Manchester

17-20 JULY - THE NEWCOMEN SOCIETY'S 2013 SUMMER MEETING

22-28 JULY - THE INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE,
TECHNOLOGY & MEDICINE

Manchester is the location of this year's Summer Meeting and also the 24th International Congress of the History of Science, Technology and Medicine (ICHSTM) will be held there immediately afterwards. The Society will have a presence at the Congress. So, members will have the opportunity to continue their stay in Manchester and attend the Congress.

17-20 JULY - THE NEWCOMEN SOCIETY'S 2013 SUMMER MEETING

To complement the visits to historic sites at this year's Summer Meeting we are delighted to announce that we have been able to secure a visit to the very new SAICA paper plant at Partington, little seen by outsiders. The plant is the first to be built in the UK for several generations and is one of the most advanced in the world. And we are negotiating to add another modern manufacturing plant visit.

We are also pleased to be able to include a trip to the historic Lion Salt Works, which is closed to the public, for a unique tour led by site industrial archaeologist Chris Hewitson.

The itinerary for the rest of the meeting includes visits to the best surviving examples of textile mill machinery, each very different, involving water and steam power, carding, spinning, weaving and fulling led by Ian Gibson recently retired from a distinguished career as Head of Collections for Lancashire County Council.

Further, by special arrangement for Newcomen, we can also confirm that the big McNaught twin-tandem compound engine, the Marsden horizontal engine, the historic Petrie Beam engine and the vintage Mather & Platt sprinkler pump at Ellenroad will be in steam.

We have also arranged guided walks: to see the Marple Aqueduct and locks led by Ian Moss, past President of the Railway & Canal Historical Society and a look at Ancoats led by David George, popular speaker and member of the Manchester Region I A Society.

In the evenings we will hear talks by Dr Mike Nevell Head of Archaeology at the School of the Built Environment, University of Salford and Paul Rees noted researcher and author of the industrial history of the North West.

Options include a trip over the Pennines to see all the six surviving Gresley A4 Pacifics, including Dominion of Canada and Dwight D. Eisenhower, assembled for the anniversary of the record breaking 126mph run of Mallard, and which can only be seen together at this time.

Prices from as little as £217 (non-residential) £355 (residential)

The management of the tour is being organised by Heritage of Industry. Full details and booking forms are available from:

www.heritageofindustry.co.uk

or contact Bill Barksfield by email: info@heritageofindustry.co.uk phone: 01494 873677

or fill in the form on the flyer with this issue of Newcomen Links.

22-28 JULY - ICHSTM THE 24TH INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE, TECHNOLOGY & MEDICINE

ICHSTM is the largest event in the field, and takes place every four years. Recent meetings have been held in Mexico City (2001), Beijing (2005) and Budapest (2009). The 2013 Congress will take place in Manchester from Monday 22 - Sunday 28 July. Congress facilities will be provided by The University of Manchester with tours and displays on local scientific, technological and medical heritage co-ordinated by members of the University's Centre for the History of Science, Technology and Medicine.

Further information at: <http://www.ichstm2013.com/>

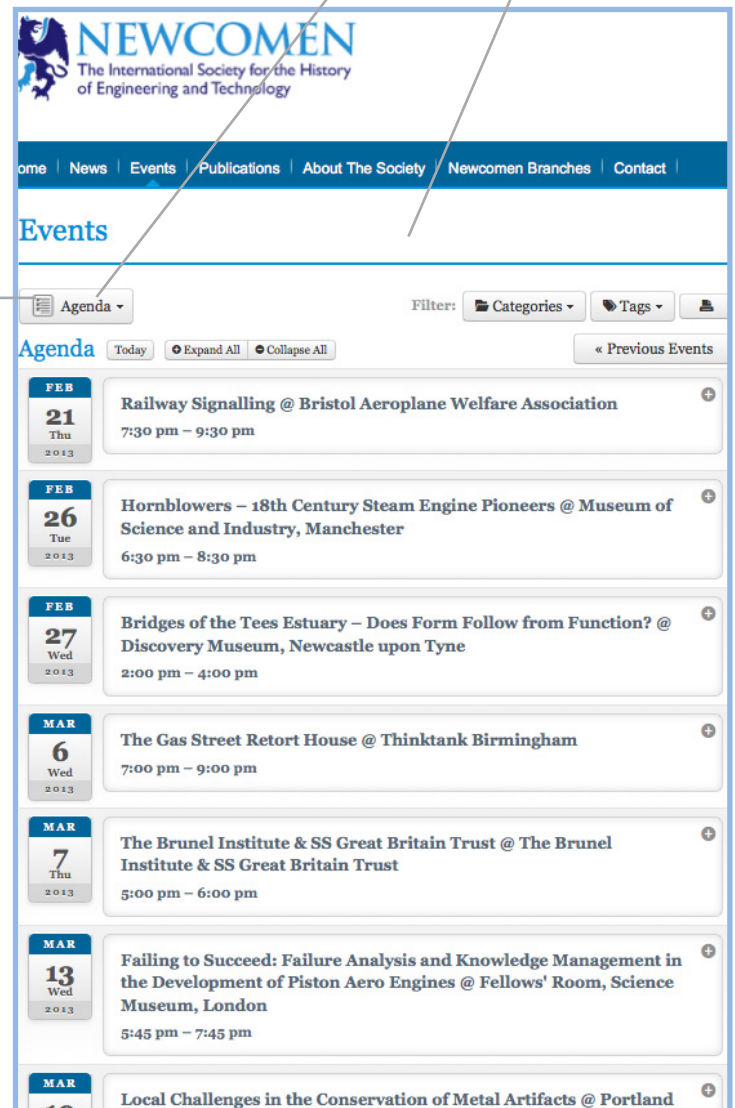
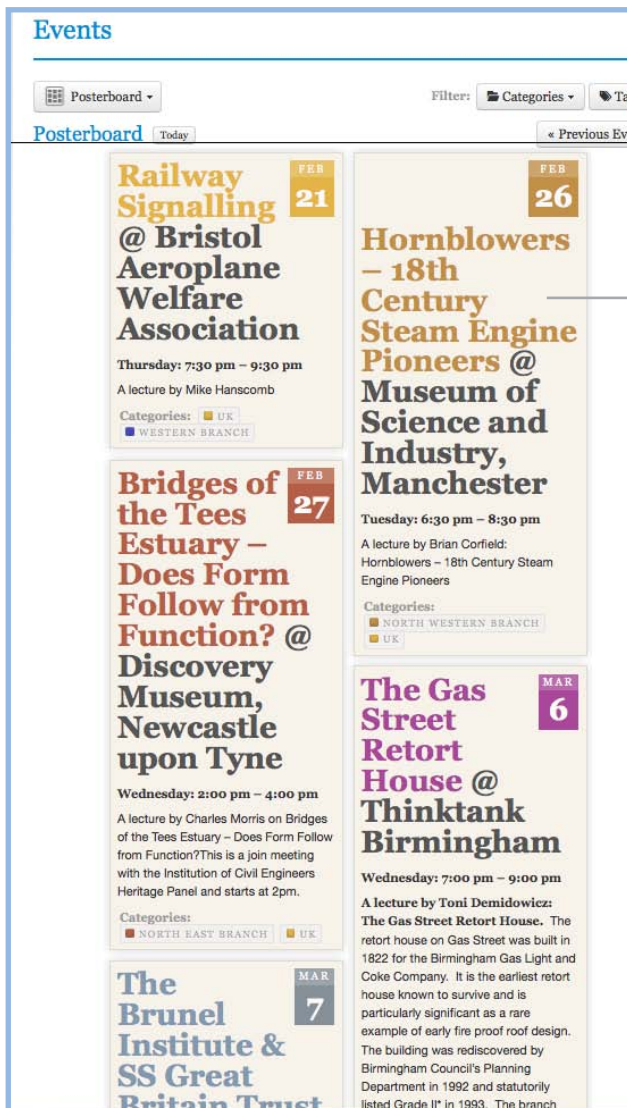
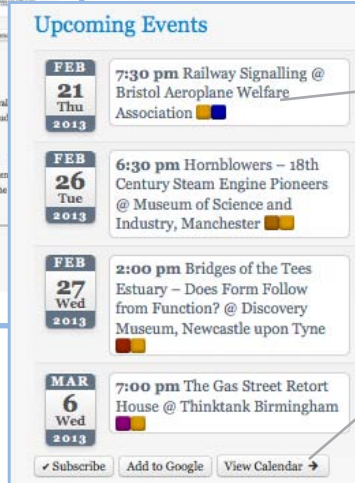
Events on the Website

There is now a fully working, easy to use and extensive events diary on the web site. All Branch and Society events are listed and with a few clicks more details will be revealed. These include a synopsis (where appropriate), date, time, venue and map of the location. Below is a quick guide of how to use the diary - it is very easy, please try it!

On the HOME PAGE look at UPCOMING EVENTS on the right hand side. The next four events are listed. Click on a specific event to get more detail. Or, for further events, click on VIEW CALENDAR and see them all listed, keep scrolling down. Click on the + in the top right corner to get full details. Click on AGENDA to see the events laid out as posters. It is very easy!



Click on SUBSCRIBE for all events to be posted automatically into your electronic diary (if you have one).



Power and Energy: Some Aspects of Electrical Power Generation. A further report from the North Eastern Branch's Tercentenary Conference.

Professor Nicola Pearsall gave a paper on Photovoltaic Power Generation: a discussion of the current status and future of solar electricity.

A report by John Clayton

Introduction

Prof. Pearsall began by observing that consideration of solar energy was well placed in the programme following Prof. Younger's (*see Newcomen Links 224, p10*) presentation on geothermal power generation. Both are renewable energy technologies, and their contrasting nature and characteristics serve to demonstrate the breadth of opportunity in this field.

A rational approach to meeting energy needs involves researching and developing a range of renewable energy technologies, so as to secure diversity in provision. All viable technologies have a role in meeting demand, and Prof. Pearsall is optimistic about the potential of all renewables to contribute to energy supply.

She explained that solar energy systems fall into two groups:

- Those that gather energy for distribution as heat (eg for space or water heating), or which utilise solar energy directly for the heating or cooling of living spaces (passive solar design).
- Those which gather energy with the primary purpose of electricity generation, whether for local use or wider distribution.

Solar photovoltaics (solar PV), the direct conversion of energy in sunlight to electricity, are in the second group.

Clearly the availability of solar energy varies across the earth's surface, but scientific measurement sometimes contrasts with popular belief. Prof. Pearsall illustrated this with a diagram 'Solar Electricity Potential in European Countries'. It shows that, to many people's surprise, Spain has only twice the potential for solar electricity generation as the UK (on a year-round basis per square metre). However, the extent to which potential for solar electricity generation is actually realised varies widely. Factors include consistency of government policy and the availability of incentives. For example, the diagram showed that Germany and the UK have very similar potential to generate electricity by solar PV. While Germany is one of the world's top solar PV installers, the UK has been much slower in taking up the technology.

Solar PV Technology

Some of the core principles of solar PV technology are:

- The photovoltaic effect is the direct conversion of light to electricity;
- Commercial solar PV devices are made from semiconductor materials, usually crystalline silicon although other materials are also available;
- The PV cells are generally encapsulated behind glass to protect them from the environment and to form a module that can be transported and installed easily;
- A PV system consists of a collection of modules, electrically connected to provide the voltage and current levels required;
- The addition of an inverter allows AC electricity to be produced.
- The output of the system is mainly dependent on the

light intensity, but bears an inverse relationship to the module temperature; thus conversion is generally more efficient in cooler northern and southern latitudes than in equatorial regions.

Solar PV is one of the easiest renewable energy technologies to use on a small scale.

The photovoltaic effect was discovered in 1839 by Alexandre-Edmond Becquerel. In 1873 Willoughby Smith observed that the resistance of selenium reduced in sunlight. Four years later William Grylls Adams and Richard Evans Day published their research on a selenium cell. In 1885 Charles Fritts made the first photovoltaic 'module' in the USA. Russell Ohl developed the silicon p-n junction in 1941 and three years later the American researchers, Gerald Pearson, Calvin Fuller and Daryl Chapin, designed a silicon solar cell capable of 6% energy conversion efficiency of sunlight.

The first practical use of solar PV was in the late 1950s, providing power for radio transmitters aboard artificial satellites. Terrestrial developments in the 1970s and 80s concentrated on reducing cost and finding suitable applications. These tended to be in marine and remote environments. The attributes of reliability, lack of moving parts and no fuel requirements were the main selling points. These characteristics, together with portability and ease of use, make solar PV one of the best technologies for electrification of developing areas. The most important applications are water pumping, medical applications, communications, lighting and small power.

Since the 1990s most solar PV capacity has been grid connected, meaning that the system runs in parallel with the grid to supply local loads, or it feeds directly into the electricity network. At the end of 2010 around 97% of the cumulative solar PV capacity was grid connected. In 2010 solar PV generated about 22 TWh of electricity in Europe.

A common approach is to integrate solar panels into a building's roof or façade. Northumbria University's *Northumberland Building* has the UK's first solar PV façade, operational since January 1995. As well as electricity

generation, systems can be made multifunctional to support building operational needs in several ways - for example shading, ventilation and aesthetics.

During the past 15 years the global installed capacity of solar PV has increased by between 30% and 40% each year - a high rate of growth. In 2011 new solar PV capacity installed in the EU (21.6MW) was only slightly less than the total new capacity created there in that year with all other generation methods. However, current world installed solar PV capacity of around 70GW remains



Northumbria University's Northumberland Building has the UK's first solar PV façade, operational since January 1995.

a very small proportion of total generation capacity.

In many countries solar PV and other renewable energy technologies are supported by market development policies that either subsidise the installation costs or provide an extra payment for the electricity produced. The motivation behind these policies is reduction of carbon emissions, security of supply by use of indigenous resources, development of the solar industry and job creation. The economics of solar PV is vulnerable to sudden changes in these incentives.

Comparing Solar PV with other Energy Technologies

Prof. Pearsall explored how meaningful comparison is made between solar PV and other methods of power generation.

Capacity Factor: The rated capacity of power plants, of different technologies, cannot necessarily be directly compared since they will not all operate at full rating continuously. Rated capacity can be multiplied by a *Capacity Factor* - the ratio of actual energy produced over a period to the energy that would have been produced during constant operation at rated capacity. However, this still does not provide for reliable comparison because:

- For plants using stored fuel (e.g. fossil, nuclear), the capacity factor is often a measure of down time, or periods when despatch is not economically advantageous but
- For wind or solar, the capacity factor is dominated by the availability of the resource so is, by definition, significantly lower

The challenge for the grid operator is *Variability*, not Capacity Factor.

Variability: The output of a solar PV system is directly dependent on light intensity and so it changes with the weather, including short term fluctuations as a result of clouds. The variability of a large number of solar PV systems spread over a reasonably wide area is much lower than that of a single system. To address the Variability of solar PV we can:

- Use it alongside other power sources
- Use stored energy when solar PV output is reduced
- Use load control: shed load from the system when solar PV output is reduced

The control of variable and distributed resources is one of the challenges that the modern 'smart grid' concept is being developed to meet.

Costs – where are we now?

It is sometimes claimed that solar PV is too expensive, but costs have been reducing rapidly as the market grows and due to international competition. Capital costs vary with system size and the type of application. A recent DECC report (January 2012) indicates current costs in the UK of £4,200 per kW installed for small systems, decreasing to £1,200 per kW installed as the system size increases.

The cost of electricity from a PV system depends on the initial capital cost, the annual energy produced by the system (which depends on location), the system lifetime, maintenance costs and any assumed decrease in performance over the years. Larger systems can achieve around 15p/kWh – and there is a good chance that the smaller systems will also achieve close to this by 2020.

Environmental Impact

A popular fallacy is that solar PV modules take more energy to make than they produce during their lifetime. Solar PV systems have no emissions in operation, but there is some impact in manufacture and disposal. For current processes, this amounts to between 21g and 65g of CO₂/kWh, depending on technology. This translates to an energy payback time of 0.5 to 5 years, depending on location, against a lifetime of around 25 years.

At the end of its life almost all of a solar PV module

can be recycled; system components will come under the WEEE (Waste Electrical and Electronic Equipment) Directive at the end of 2012.

Technology – current trends

Crystalline silicon devices represent 80-85% of the solar PV market. Thin film devices - based on cadmium telluride, copper-indium-gallium-diselenide (CIGS) and amorphous silicon - account for the rest. The best efficiency obtainable with silicon is around 20%. The record efficiency for solar PV is 43.5% for a high efficiency triple junction cell, as used in concentrator systems.

The Northumbria University Photovoltaic Applications Centre (NPAC) is researching new materials based on the CIGS family. The aim is to replace indium and gallium, which are relatively expensive and volatile in price, with more abundant elements such as zinc, tin and aluminium. Organic and polymer devices are being developed.

Where do we go from here?

The current economic climate makes short term predictions difficult, but longer term growth, based on continuing cost reductions, appears in all international scenarios. The 2011 EPIA/Greenpeace Solar Generation report suggests that over 1,000GW of solar PV will be installed worldwide by 2030, meeting between 4% and 9% of the world's electricity needs, employing more than 4.5 million people in the industry. By that time, solar PV generation will be cost competitive across Europe. We can also expect efficiency improvements, developments in functionality, and solar PV arrays on all sorts of surfaces and in an increasingly diverse range of materials.

The Audio Compact Cassette and the Digital Format Wars, a lecture by Hugh Cameron to the North West Branch

Jonathan Ayles

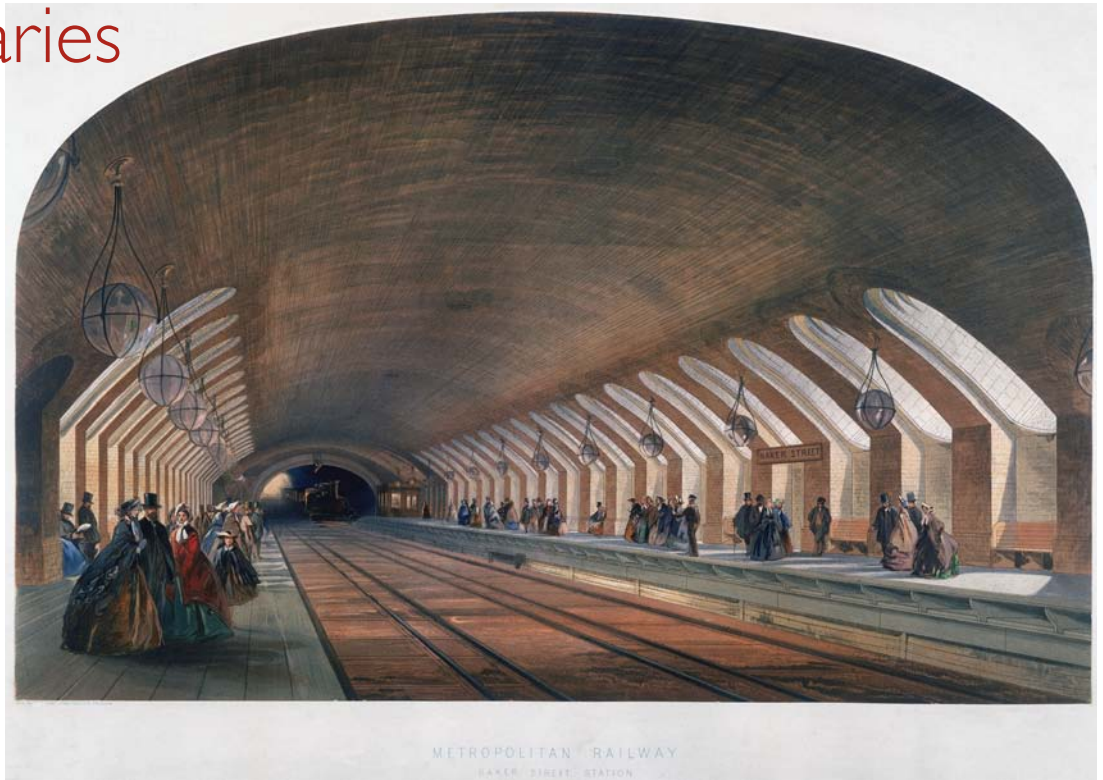
The audio compact cassette survived for so long because the format provided an "agenda for improvement" within the constraints of a clearly defined standard. Engineers were able to markedly improve sound quality, tape recorders and players, the materials used and tape duration within a standard initially defined by Phillips. These were the conclusions of Hugh Cameron's lively talk to the North-West Branch on "The audio compact cassette and the digital format wars"

Helped by a fine collection of audio equipment, Hugh outlined the early history of sound recording and demonstrated the shortcomings of an elderly reel-to-reel tape recorder. There were many attempts to replace reel-to-reel tapes with packaged tapes, including the 8 track system fitted to Ford cars and featured in the Simpsons.

The familiar Phillips cassette won out in the format wars because the precise overall standard allowed room for improvement in materials and playing equipment, culminating in the Sony Walkman. Cassette tapes were easy to use and appealed to consumers. An accumulation of technical improvements allowed the cassette to fight off a range of rival digital formats including Digital Audio Tape, the Digital Compact Cassette and the Mini-Disc until the tape cassette finally succumbed to the MP3 player. Discussion after the talk focussed on the parallels between audio recording history and a range of other technologies where standards have proved crucial in helping promote technical development within a clearly defined overall engineering framework. In this fashion, established technologies are improved step-by-step to the point where they can often fight off new entrants to the market.

Anniversaries

London Underground 150



Above: Baker Street station, London, 1863. A chromolithograph by the Kell Brothers after their original drawing, showing passengers waiting on platforms at Baker Street underground station. A steam train is arriving at one of the platforms. The Baker Street line, built by the Metropolitan Railway, was the first underground line to be built in London. It was opened on 10 January 1863 and ran from Baker Street to King's Cross. Credit: National Railway Museum / Science & Society Picture Library. All Rights Reserved.

Below: Testing the Steam Run at Baker Street Station, December 2012. Credit: London Transport Museum. All Rights Reserved.



Just after 1.00pm on 10 January 1863 the inaugural train of the world's first underground railway pulled out of Paddington station to begin a three and half mile journey under London's streets. The ground-breaking line had been built and financed by a private company, the Metropolitan Railway, to link the mainline stations at Paddington, Euston and King's Cross with the business district of central London through the new tunnels of the Metropolitan line between Paddington and Farringdon, which are now part of the Circle, and Hammersmith & City Line. The journey was recreated on Sunday 13 and 20 January when a series of special trains was hauled by the newly restored Met Steam Locomotive No.1 along part of the original route. No 1 was the last locomotive to be built at Neasden in 1898 by the Metropolitan Railway. It pulled the Metropolitan Railway Jubilee Carriage No 353 - the

oldest operational underground carriage in existence - which has also recently been restored with support from the HLF, as well as the Chesham Shuttle Coaches from the Bluebell Railway. Ex Metropolitan Railway electric Locomotive No. 12 Sarah Siddons was also be part of the train. Met Steam Locomotive No.1 will also run throughout the year across the Metropolitan line network on special occasions, and in August it will be steaming during an extensive programme of activities at the Buckinghamshire Railway Centre and at other locations.

There will be exhibitions and events throughout the year at the London Transport Museum in Covent Garden, London WC2E 7BB and at The Museum's Depot in Acton. Further information at: www.ltmuseum.co.uk

For many engineers, who grew up in the 20th century, playing with Meccano was an influence in their choice of career. Its inventor, Frank Hornby, was born on 15 May 1863 in Liverpool.

Anniversaries

Frank Hornby 150

Deborah Jaffé

Frank Hornby was an inveterate amateur inventor and professional book keeper, who was aware of many of the construction kits already available, especially in Germany. Notable amongst these were those designed by the Bing Brothers in Nuremberg who made ranges of working, miniature mechanised lathes, pumps, circuits and engines and gave children the components and technology with which to actually design and make their own machinery. Suddenly, education and play using mechanics had entered the playroom. Using distinctive perforated coloured sheets of tin plate, nuts, bolts, rods and wheels as a basis; Frank Hornby devised Meccano as if by accident whilst making a train journey in 1900:

One Christmas Eve I was travelling from London to Birmingham to spend the holiday with a relation who had some children. I had been wondering on the way there what I could do to amuse them. The train stopped...opposite a goods yard and there was a small crane there. It occurred to me that I could make a crane like that for children using strips of steel. I sat in the carriage dreaming about it. New possibilities kept coming; I saw what this game could mean...Meccano started in my workshop.'

Finding it difficult to source many of the component pieces Hornby made them himself in his workshop at home. His determination to succeed far outweighed the revenue he initially received; he even had to borrow £5 for the patent registration fee in 1901 from his former employer. According to Anthony McReavy, Hornby's biographer, he followed in the tradition of many British toy makers of the time, working independently in small workshops unlike the huge and successful operations around Nuremberg, where the Bing factory alone, in 1900, employed over 5000 people. However, as the German exporters to Britain had found, there was a growing market

for new types of toys amongst the newly affluent middle classes and Hornby was able to market to this group. The first Meccano was sold in boxed kits and called Mechanics Made Easy. The accompanying booklet described the possibilities for Meccano and also how to assemble specific models from it including a crane and a moving trolley.

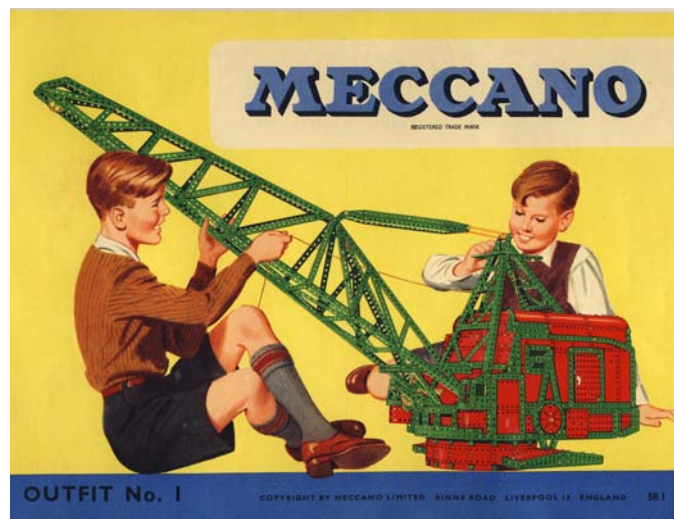
A move into slightly larger premises in James Street Liverpool enabled Hornby, in partnership with his boss and investor David Elliott, to concentrate on improving his kits and marketing them. This was all done in his spare time, it was not until 1907 that he could afford, financially, to concentrate on Meccano full time. In 1902 he took out an advertisement in Model Engineer and Amateur Electrician, emphasising that Meccano was unbreakable and that making the models was a creative past time. Then there were the competitions, for those under 15, to make models from Meccano. The competitions were very popular and as the kits now included basic gear sets children's imaginations were fuelled by the reports and pictures of the many new engineering successes of the time. Competition entries included wagons that tipped, cranes powered by motors, models of the Forth Road Bridge and the Eiffel Tower. Meccano was by 1910 being regarded not just as

a toy for use at home but also as an educational tool in many schools.

Meccano went from strength to strength, the kits grew in size and components and exports to Europe and the USA enabled a move to a proper factory in Binns Road, Liverpool. Offices were opened in Paris and Berlin and Hornby operated closely with the German Märklin Brothers, makers of tin toys, supplying them with motors. War was declared whilst he was in Berlin in 1914 forcing him to return swiftly to Liverpool. However, this experience of German toy making combined with the Government's campaigns for British toy manufacturers to replicate their designs spurred Hornby on to enter the toy train market and Hornby trains and the O Gauge was introduced in 1920 followed by die cast Dinky Cars in 1933, three years before Hornby's death. Two more patents were registered one for a Spring Motor to drive clockwork trains and an electric motor for the exhibits they showed at the British Industries Fair in 1915. From 1909 Meccano had been, manufactured under license in the USA and in 1916 its own factory was set up in New York.

There were more Meccano kits in the distinctive red cardboard boxes with pictures of boys and constructions

and the Meccano lettering on the lid. Inside they revealed an array of different red and green perforated metal shapes, wheels, tyres, cogs, rods, nuts, bolts, screws, spanners, screw drivers and string. The manual introduced the possibilities for the set, as well as all the different extra parts that could be bought – extra girders, compression springs, rod sockets swivel bearings, driving bands, to name a few. It was possible even with the most basic set to make a station truck, lawn mower or simple working elevator. Hornby recognised early the importance of inviting his child users to read the Meccano



The cover of the instruction booklet from a set of Meccano c1948. D. Jaffé

Magazine and to join the Meccano Guild. On joining each member received a triangular badge and would be instantly recognised as a fellow Meccano Guild. Members might join the Correspondence Club and run their own Meccano Club. Years later in the unrest of the 1930s membership of the Meccano Guild was spoken of as a junior version of the League of Nations.

Sadly, by 1964 the company, like many others was struggling with high labour costs and different, newer competitors producing cheaper toys, usually in plastics and the company was sold. All production ceased at Binns Road in 1979 and the Meccano, Hornby, Dinky names were passed on to different holding companies. However, Frank Hornby's legacy is enormous, there are still collectors' clubs devoted to Meccano and one wonders if, in an age of computers, virtual reality and digital media, it would be pertinent to reintroduce a generation of children to mechanical workings before expecting them to invent and design from a screen.

But no doubt Frank Hornby would have addressed these challenges and introduced appropriate Meccano kits.

From: The History of Toys by Deborah Jaffé. Sutton 2006.

Stretham Old Engine

Stretham Old Engine, erected in 1831, is the last survivor in the southern Fenland of over 100 steam-powered pumping stations applied to fen drainage in the 19th and early 20th centuries. K.S.G. Hinde, Chairman of the Stretham Old Engine Trust, reports on recent progress.

The [Newcomen] Society can take much credit for its part in the creation for the Trust for the preservation of this plant some 50 years ago. The past year has been particularly successful in making progress with the exercise. Never having obtained much grant aid, the finances have been materially improved by a legacy of over £6000 from the late John de Marchi, of the USA, as well as donations from Ian Palmer of Stowbridge Farm, The Worshipful Company of Cutlers and an appeal by Waitrose.

The Committee has continued to provide invaluable support in staffing at no expense to the Trust, and producing publications and other material. In addition, the Hon Engineer, Edward Hinde, has assembled a group of very capable volunteers who have carried out much repair and maintenance work. Amongst this, they have entirely rebuilt the bridge over the inlet channel with timber donated upon demolition of St. Germans Pumping Station. This bridge had become very rotten and unsafe. This work has saved a considerable amount of money. In addition, an Easton Amos & Anderson centrifugal pump c1870 was obtained from Mount Pleasant Farm, near Chatteris, and has been renovated and installed at the far end of the bridge. General painting and renovation has also been carried out by this group. In December, the Engineer held a dinner for them at a local inn, which was much appreciated.

Stretham Old Engine, Green End, Stretham, ELY, CB6 3LF. Tel 01353 648578.
www.strethamoldengine.org.uk

Waitrose at Kings Cross

Waitrose has announced plans for a scheme which will create up to 170 jobs, and include a 21,000 sq ft supermarket, as well as a state-of-the-art cookery school in the Kings Cross Regeneration Zone in London. Subject to a successful planning application, the supermarket and cookery school will see the restoration and refurbishment of the Midland Goods Shed and the East Handyside Canopy. The goods shed was originally built in 1850 by the Great Northern Railway as the temporary Maiden Lane passenger railway station while the original Kings Cross station was under construction. A wide variety of jobs, including highly-skilled chef tutors, retail apprentices, management positions and product specialists will be created as a result of the proposed scheme. In addition to offering paid for courses, Waitrose will work with Kings Cross Central Limited Partnership and Camden Council to provide a series of free sessions throughout the year for schools and other priority groups from the local area. Applications for reserved matters approval and listed building consent are likely to be submitted in May. If successful, work will start in late 2013 with the project set to open in spring 2015.



The End for London Bridge Trainshed



Robert Carr

There is now no point in visiting London Bridge railway station to see the London Brighton & South Coast Railway (LBSCR) trainshed. The whole terminus has been boxed in and shrouded since about the end of November. Demolition work is in progress so by the time you read this there will probably not be a great deal left. The photographs published in the last issue of Links show scenes no longer there, see number 224 page 16. A crash deck has been built over the whole of this part of the station just above the top of the decorative foliate spandrels. All platforms remain in use, the public being protected from the dismantling work by hoarding.

The main lattice girders and ribs of the roof were supported by two parallel lines of cast-iron columns. These were reed moulded, with attractive bulbous palm-leaf bases redolent perhaps of the Mediterranean or botanic gardens. Demolition work is most advanced at the eastern end of the train shed. The cast iron columns here have been removed and elsewhere nearly all the column bases have been boxed in so that the decoration is hidden from view. The architect C H Driver who worked with F D Banister on this station had previously worked with Joseph Paxton on the Crystal Palace. Driver was an energetic proponent of cast iron and an expert in how to cast it. The bulbous column bases might well be his work. At the Crystal Palace he designed the Orangery.

The view of the trainshed published with this article no longer exists. When this photograph was taken building work had already started. F D Bannister was the engineer for this station but it is likely that Sir John Hawkshaw also had a hand. Banister was an engineer-architect from 1849 practicing in Brighton. In 1860 he accepted the post of Chief Resident Engineer to the LBSCR in which capacity he was involved in a prodigious body of work. His obituary published by the ICE in 1898 is most impressive. Among the enormous number of works he was responsible for is Newhaven harbour. The splendid grade II listed station at Eastbourne, 1886, is by him. He was also involved in constructing the route from London to Eastbourne via Eridge. There was also an alternative route to Brighton via Uckfield. This line is currently the subject of a vigorous campaign, to reopen the section from Uckfield to Lewes and provide sorely needed extra capacity for commuters from the South Coast to London.

Patents as a Source of Historical Information

Stephen van Dulken

Patents are potentially a valuable source of information for researching technology, but continue to be under-used. They are often the only source available, or perhaps the only easily accessible source. This brief article explains some of the ways they can be used, and problems that may arise, using my experience as a patent specialist librarian since 1987.

Patent specifications have been published by numerous countries since, usually, the 19th century. And there are a lot – about a million for each of the USA and the UK by World War I. Each country separately decides if they will allow new applications and has its own numeration and layout. Ideally, those researching an inventor or company should check for patents in different countries as the information often varies.

For example, American patents rarely give information on the marital status or trade of inventors, while British patents commonly did until the early 1920s. Exact addresses also occurred only occasionally in American patents while in British patents they frequently did so.

The technical details can also vary from country to country – German patents are less detailed than American for example – and sometimes different illustrations are used.

The procedures used vary as well. In Britain for example, you could from 1852 send in a short “provisional” application which had to be followed within a time period by a longer “complete” specification. This would be published, and following payment of a sealing fee the patent would be granted protection. Until 1884 if only the provisional was sent in that was still published. From 1884 onwards nothing was published in such cases, yet the name of the applicant still appeared in the annual name indexes as “phantom” patents. From 1916 such applicants ceased to be listed.

British numeration itself was in one sequence to September 1852 and then in annual sequences to 1915 and then in a continuous sequence. Hence the year is needed, and most British artefacts give, say, the name and the number but not the year. It can be awkward finding the right number. Equally difficult can be American patents, where the date of grant was normally given – and this can be either a “utility patent” or a “design patent”. The enquirer has to check all patents published on that day, either using the published gazette or perhaps Google Patents.

The main online source is the free Espacenet database at <http://worldwide.espacenet.com>. It holds as PDFs American patents from 1837, German from 1884, and British from 1893, for example. That does not mean that it is easy to search them. The US early patents are only accessible if the number is

known. From 1890 it is generally possible to search them by title, while name searching is often possible from 1900 and sometimes before. The addition of data has been somewhat sporadic.

British patents are much more likely to be available in all fields except by the CPC classification, which is from about 1908. Previously American patents could only be searched by the CPC from 1920 but a lot of earlier material has recently been added.

All this means that any search using online sources has to be cautious and involve a mixture of strategies. Not finding something does not mean it does not exist. Experienced searchers guiding the search are ideal as your knowledge of the technology can be joined with their expertise.

Sometimes there is no substitute for paper. The British Library holds all British patents in numerical order from 1617 onwards plus, on the open shelves for consultation, a series of 146 technical classes covering 1855 to 1930. Two examples are Aeronautics, and Life-saving and Swimming. In each class, illustrated summaries of the patents are indexed every 5 or 10 years by name and by subject.

If you want to know more, for British patents, there is my own ‘British patents of invention, 1617-1977: a guide for researchers’, a book published in 1999. Nothing similar exists for other countries. It is best to start by asking for help at a specialist public patent collection such as the British Library’s Business & IP Centre who can refer enquirers to other centres in the UK.

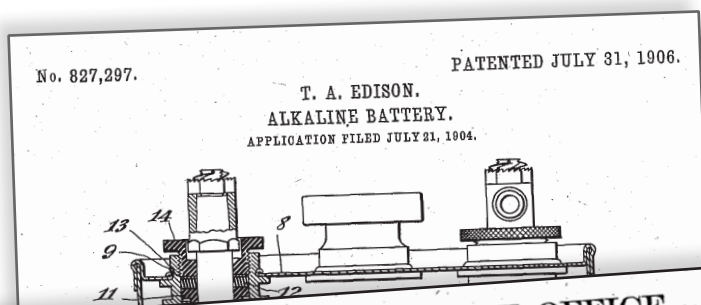
Further Information:

Espacenet database: <http://worldwide.espacenet.com>

Google Patents: www.google.com/patents

van Dulken S. *British Patents of Invention, 1617-1977: a guide for researchers*. The British Library 1999,

The British Library Business & IP Centre, www.bl.uk/bipc/
Phone: 020 7412 7454



UNITED STATES PATENT OFFICE.
THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY, ASSIGNOR TO EDISON STORAGE BATTERY COMPANY, OF WEST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ALKALINE BATTERY.

No. 827,297.

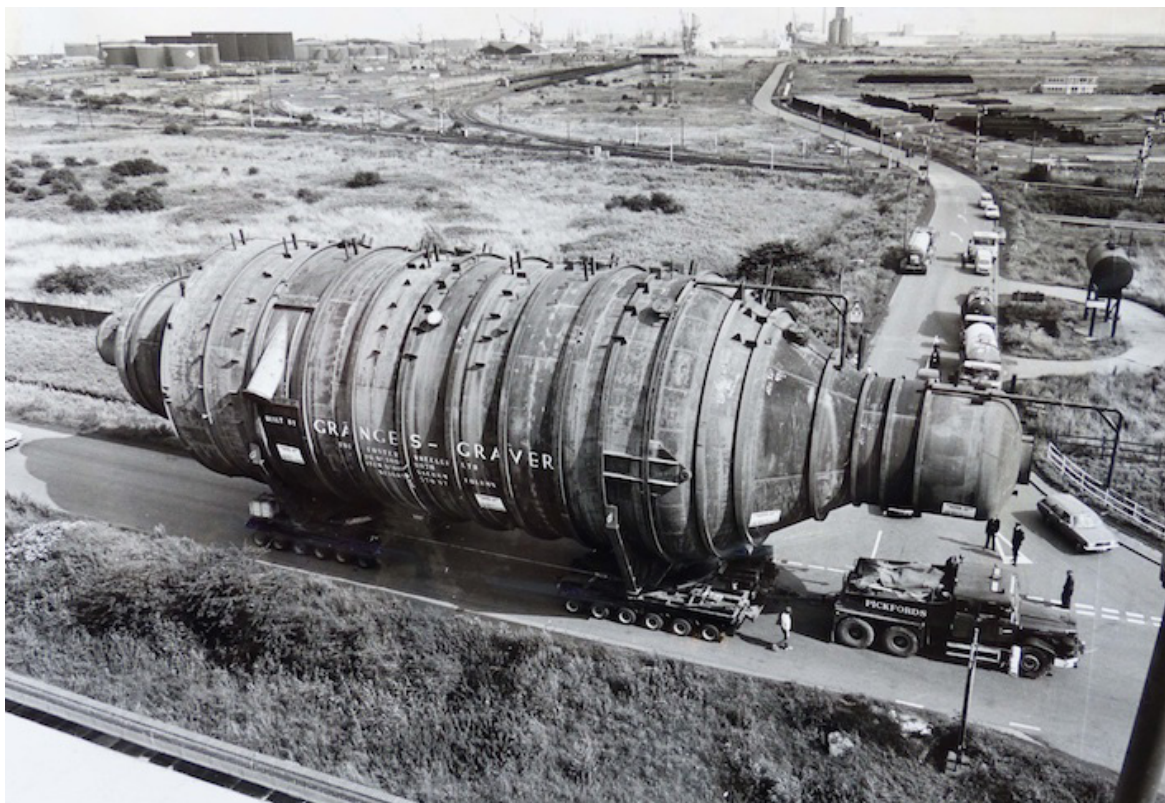
Specification of Letters Patent.
Application filed July 21, 1904. Serial No. 217,538.

Patented July 31, 1906.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, New Jersey, New Jersey, do hereby certify that the following is a true and correct copy of the original specification of my invention, as the same appears in the files of the United States Patent Office.

The battery shown is of the Edison type, and is a storage battery embodying my invention; but I do not consider my invention limited to this or any particular type of cell, as it may be employed in any alkaline battery. The battery shown is of the Edison type, and is a storage battery embodying my invention; but I do not consider my invention limited to this or any particular type of cell, as it may be employed in any alkaline battery.



A Foster Wheeler oil refinery load en route from Immingham Docks to the Lindsey Oil refinery, Southkilling Holme, Lincolnshire, August 1978.

Pickfords Heavy Haulage

Report from the North East Branch

George Nairn was a member of the Pickfords' staff, having served with them for over 30 years before his retirement. He elaborated on his employment by saying he had been in the section which calculated the rates for transporting heavy loads and then organising the loading, routing, safe passage and delivery of this freight. His talk was littered with anecdotes and stories of the jobs he was involved in and was augmented with a wealth of slides to illustrate some of those contracts.

As an introduction to talking about his 30 years of experience, he outlined the history of the Pickfords company from inception to the present day. Despite a reference to a Mr Will Pickford of south Manchester being a carrier in the 1630s, the first established record of the Pickfords Company roots, is attributed to the family of Thomas Pickford. He was a yeoman farmer of Adlington, about 10 miles south east of Manchester. In 1646, the Pickford family, having had their lands sequestered for cooperating with the Cavaliers, engaged in the road mending business. As they also owned a quarry, they transported their stone by packhorse train to the required sites. To utilise the packhorses on their return journeys, they understandably sought goods to carry and thus not travel empty handed. As this trade developed, Pickfords became established as carriers. Illustrations of typical packhorse trains were shown and reference made to the bells which were attached to the horses to broadcast their coming.

By 1720, James Pickford was established as a London to Manchester Waggoner with offices in London, at both Blossom's Inn in Lawrence Lane and at the Bell Inn, Wood Street, Cheapside. In 1756, James Pickford died and his wife, Martha and his sons, Thomas and Matthew took control of the business. A later move saw the company headquarters in London being established in the Bear Inn, Basinghall Street and Matthew assuming the prime control of the company.

By the 1780s, Pickfords had developed the fly wagon for the 'rapid' transport of both goods and passengers between London and Manchester six days a week. The journey at that

time took 4½ days, travelling at just over 42 miles per day. The cost was £3-6s (inside) or £1-11s-6d (outside). The company also had interests in the emerging canal transport system. At this time, Matthew and his brother Thomas had accumulated 50 wagons, 400 horses and 28 barges. Twenty years later, their assets also included 11 road depots and 8 canal depots.

During the 19th century the business suffered decline, but was saved by being bought out by a group that included Joseph Baxendale, Charles Inman, Zachary Langton and (later) Hugh Hornby Burley. However the Pickfords name was retained and the company invested in new wagons to run on the fast growing railway network. The now familiar Pickfords domestic removal market was firmly established.

In the early 1900s the heavy haulage side of the company was developed, when steam tractors were first employed to tow low pantechinons on the road system. This era saw the beginning of the demise of the multi-horse towed loaders, an example of which was shown as World War I tank being transported. It was from this point of Pickfords' history, that Mr Nairn explained the further evolution from steam tractor and traction engine haulage to diesel powered units (typically Scammell tractors) of increasing size up to the present time. He also described the development of low loaders from the basic, to the multi-axle bogie units of today. In his talk, he was able to show many examples of the abnormal loads he had been responsible for transporting, some of which were of gargantuan proportions. These included turbine rotors, transformers, boilers and other industrial items. Detailed planning was needed for deciding safe and practical routes and obtaining the necessary police and local authority consents, road closures and related matters.

Mention was made of the nationalisation of Pickfords in 1947 to become part of British Road Services (BRS) and then of its subsequent later privatisation. However, on privatisation, the Pickfords name was restored in its own right to live on once again. At the end of his talk, George Nairn answered questions, some of which touched on local

(Newcastle upon Tyne) haulage interests; these included the transport of Parson's boat Turbinia from its previous location to the Discovery Museum, as well as many other industrial loads from numerous works sites in the North East.

Undoubtedly, the illustrations were of immense interest to the audience. Together with his inexhaustible store of anecdotes, George Nairn's talk made for a very memorable occasion.

240 ton Scammell Contractor hauling a 120 ton stator outer casing for Drax Power Station from Hawthorn Leslies, St Peter's Works (Newcastle upon Tyne) to C A Parsons, Heaton Works. The load is pictured having just climbed Byker Bank and turning into Shields Road, Byker. The load is on an 8 axle Nicholas trailer.



A Drive in a Model T

Fred Starr

As a 70th birthday treat, from my daughter and son, I was taken for a drive in a 1919 Model T by Mr Austen Bromley, Chairman of the British Model T Register. The Model T was the car that brought motoring to the masses, and from 1909 to 1927, 15 million were built. At its end, the Model T looked dated and primitive, the main selling points being price and reliability. But how was it as a passenger, on a very cold January morning? I needed to find out.

Once Austen had started the engine going on the handle, because he was the driver, he had to get in first, from the passenger side, as there is no drivers door. It is a precaution against the clutch lever, on the driver's left hand side, which looks like a long handbrake, being knocked down. If that happens, the car will start moving forward of its own accord. After manipulating the pedals, the important one being that which controlled the two speed planetary transmission, Austen



The petrol tank is beneath the seat.

started us off without a jerk. We went down a track to the main road, at about 10 mph, the car taking it easily over ruts and bumps. Here I should explain that Austen's car was the basic model; no speedometer, wing mirrors or windscreen wipers! We did have a windshield, which gave the front seats some protection, but my daughter and partner, at the back, got very cold, especially when we reached a steady 30-35 mph on the A3. The only heat comes from the exhaust pipe under the floor.

Normal speed was more like 25 mph. The four litre engine, although not quiet, was no distraction to conversation. It was noisier going uphill, when the throttle was opened and the ignition advanced. These are controlled using little levers on either side of the steering column. Braking seemed to be only as good as on a bicycle. Austin used the engine to help (one can use reverse to brake because of the characteristics of the planetary transmission), as just the two back wheels are braked.

There was some amusement when we pulled in for petrol, as it goes into a tank directly under the front seats, the feed being by gravity to the engine. No pumps are needed, but

if the fuel level is low, on hilly terrain, the engine will stop. The solution? Back up, swing round, and proceed up in reverse! If only our politicians knew of this routine.

After our hour long trip round the leafless but scenic roads of Oxshot, we returned back to Austen's "spread" at Holmerise Stables in Cobham, Surrey. He then explained some of the features of the Model T. The good ride largely comes from two massive leaf springs which span the front and back axles. Each has got eight vanadium steel leaves, and the damping is so good that shock absorbers are not necessary. Austen's 1919 model has a battery to energise the magnets in the magneto during engine start. Older cars require a good swing on the handle to generate enough current.

Austen has a number of sheds where he keeps more Model Ts in various states of attire, plus a single cylinder 1902 Oldsmobile. He explained to me how the yellow high voltage coil to the spark plugs works. I mentioned my paper in the Newcomen Journal on exhaust valves, where I had pointed out that Henry Ford had done things his own way. Not for him expensive alloys for the valves. The Model T had a two part valve; a cast iron head and an alloy steel stem, but I imagined that they must all be scrapped. However, to my surprise, Austen handed me an original valve for me to keep!

Since then, Gordon Nolan, editor of "Model T Topics" has asked me to write a short article about early automotive valves. In return I hope we will be able to get a least a couple of talks from the club. There may also be a chance for Newcomen members to hitch a ride, so watch this space. And if anyone in the London area wants an interesting day out, there is a Model T meet at Polesden Lacey on the 7 July, which has to be in more balmy weather than our drive!



The driver has to get in on the passenger side

Bristol Cathedral

Bryan Lawton

Last June a small group met at Bristol Cathedral to visit the two sets of bells, guided by the tower captain, Derek Carr, and then to enjoy a tour of the Cathedral led by Victoria Owen. The visit to the bells involved a considerable amount of climbing and scrambling over the lead roof between the west tower, where the current peal of eight bells is hung, and the central tower, which houses a more ancient set of four bells. The oldest bell dates from about 1300 and others from the 15th and 16th centuries. Originally there were ten bells but by 1553 they were reduced to “One great belle for the clocke and iii other belles”. In 1670 the present tenor bell was cast or recast by Roger Perdue, a Bristol bellfounder. By 1802 there were five bells, but one was cracked and useless and was sold by the Dean for scrap. The bell frame is a massive structure (21ft x 26ft) and dates from before the Reformation. The eight bells in the west tower are from the ancient Temple or Holy Cross Church, Bristol, which was destroyed by enemy action in December 1940, and were transferred, tuned and hung with all new fittings and framework in Bristol Cathedral, in November 1958.



Crossing the roof to the central tower.

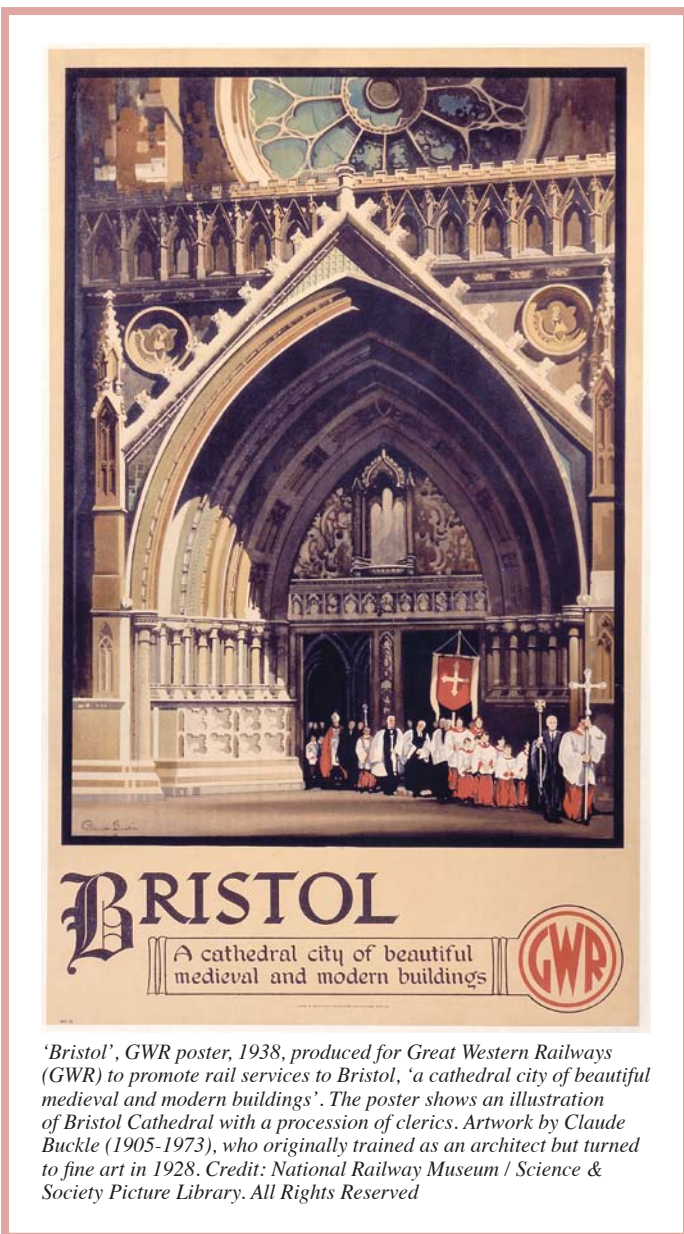
Victoria Owens

Besides visiting the Cathedral bell towers, we also made a tour of the building. The original monastic foundation owes its origins to Robert Fitzharding, known as ‘the devout.’ A Bristol landowner of Anglo-Saxon descent. In 1140 he established a modest community of canons on the site of the present Cathedral to live according to the precepts of the Rule of St Augustine of Hippo, in an abbey dedicated to St Augustine of Canterbury.

The place may well have held sacred associations long before Fitzharding’s time. In the south transept stands the vast Saxon Stone. Carvings on it depict the Harrowing of Hell – we see Adam and Eve clinging to Christ’s crozier as He draws them out of the gaping jaws of a monster. The stone came to light in the 19th century, when builders found it under the Chapter House floor. No-one knows how it got there, but it may well have come from the shrine of St Jordan which once stood on what is now College Green. According to tradition, Jordan went with Augustine to meet Welsh Bishops near the Severn in 603AD and came to be much venerated in Bristol thereafter. Indeed, Fitzharding named one of his sons Jordan as a mark of devotion to the local saint.

In the war between Stephen and Mathilda that followed the death of Henry I, Fitzharding gave Mathilda his loyal support. When her son was crowned Henry II, in his gratitude the new king not only made Fitzharding Baron of Berkeley, but also poured wealth into the Bristol monastery. The Romanesque Chapter House, which we visited first in our tour of the building, dates from about 1165 and may well owe its magnificence to the King’s generosity. Its decoration, which we viewed sitting in the restored monastic *sedilia*, takes the form of patterns – nail-heads and chevrons on the roof-ribs; arcading and vigorous zigzags around the walls. The spirals around the shaft, above the main door, make an abrupt change of direction about the third of the way down. An intriguing, if unproven, theory suggests that the unknown masons wished to leave some deliberate fault in their work, much like the intentional fault in a Persian carpet, lest its perfection should otherwise seem an affront to God.

Around 1220, Abbot David of Bristol sought the help of master mason Adam Lock of Wells ‘to hew out the seven lamps of Wisdom’s House.’ He was referring to building a lady chapel, the lady mass being at this time second only in importance to the monastic high mass. Although only 55 years separate Abbot David’s chapel from the Chapter House,



the difference in their respective architectural styles is vast. By the time of Abbot David and Adam Lock, the pointed Gothic arch has supplanted its round Norman predecessor. Whereas abstract designs cover the Chapter House walls, in the elder Lady Chapel carved faces, all of them different, abound under the north wall lancet windows. On the chapel's south side carved goats and rams play pipes and fiddles among the pillars. It is as though the masons set out to create a small-scale bestiary in stone. Fragments of medieval painting survive on either side of the east window, traces of the biblical scenes that would once have covered the chapel's walls and vault. A more modern embellishment is a large bowl of Bristol blue glass that stands in the entrance, commemorating the abolition of the slave trade.

Abbot David's small Lady Chapel lies just off what is now the north transept. Future generations were to provide the Abbey with a second Lady Chapel, the eastern Lady Chapel, which stands behind the high altar. It is altogether grander in scale and design. Here, three mitred Abbots of Bristol, who effectively held the rank of bishop in recognition of the Abbey's increasing wealth and power, lie entombed in stellate recesses, star-shaped openings in the walls. The reredos carries the royal arms together with blazons of the Berkeley and Clare families; behind it, the great east window traces the Christ's lineage back to Jesse, father of King David. At the start of the Eastern Lady's Chapel's construction Abbot John Newland thought his new project so significant that he recorded not only the date when work began on 21 August 1298, but also the time, nine o'clock in the morning.

Much of the dynamic inspiration for the new wave of building came from Newland's successor Edmund Knowle, who was the Abbey's treasurer from 1298-1306 when he was elected Abbot. He was to oversee the development of the Abbey as a hall church, one where there is no clerestory, but where the central and side aisles are the same height and have large windows to make the greatest possible use of natural light. Certainly, the architecture of the choir gives a sense of airy grace which the lierne vault – that is, a roof which has no central rib, but where short, decorative lierne ribs connect in patterns – enhances by drawing the eye upward. For day-to-day direction of the works, Knowle had the services of master mason William Joy, who was later to devise the distinctive scissor arches which support Wells Cathedral's central tower. Joy, so the story goes, left a portrait of himself in the Bristol vault – a carved face surrounded by flaxen hair which looks out from the point of one of the arches on the choir's south side.

Going into the choir, we saw some of the misericords, small, hinged seats intended to provide inconspicuous perching places for the Canons so that they did not have to stand throughout the longer offices. The Bristol misericords have exuberant, often irreverent, depictions of secular life carved on the underside. Many of them draw on stories of Reynard the Fox, a popular hero of medieval low-life. Others portray domestic scenes like a man and wife quarrelling over a cooking pot or a woman on a horse carrying a sack of corn to a windmill. One of the most striking shows a mermaid who may be there in a heraldic guise, since mermaids were the traditional



Above: Bells in the up-position.
Below: The clock mechanism.

bearers of the Berkeley family arms. At the same time, mermaids are famously sweet singers and it is possible that she furnished a bit of teasing for any Canon known to pride himself on having a fine voice.

In December 1539, Henry VIII's commissioners dissolved St Augustine's Abbey. The former canons were despatched to become parish priests and Morgan ap Gwilliam, the last Abbot of Bristol, was sent into retirement at his retreat house in Abbot's Leigh on a lavish pension of £80 per annum. All building work was abandoned.

From the mid 16th to the mid 19th centuries, the newly constituted Cathedral of the Most Holy and Undivided Trinity existed in a truncated state. Not surprisingly, local people appropriated the stone intended for renovating the Norman nave and used it in their own building ventures. Not until 1850, when Gilbert Elliott became dean, did the Cathedral Chapter turn its attention to the possibility of completing Abbot Knowle's hall church. Concerned about the condition of the central

tower, Elliott sought the advice of Isambard Kingdom Brunel, who agreed to make a brief survey of the fabric on 1 June 1850 at five o'clock in the morning. His time, he explained, was limited, as he had to catch the 7.50am train to Exeter. While he considered that the structure was reasonably sound, he also observed, rather drily, that 'the next or the following generation will probably be called up for [...] extensive restoration and repairs'¹. In the event, it was another sixteen years before construction of a new nave began. As their architect, the Dean and Chapter chose George Edward Street (1824-1881) the sometime business partner of George Gilbert Scott and churchwarden of St Margaret's, Westminster.

Street's nave does not so much imitate the medieval part of the building as offer an affectionate response to it. The shafts of blue lias stone in the clustered columns echo the Purbeck marble of the Elder Lady Chapel; the vaults of the side aisles, like those of the choir, have the same height as the central roof; the flower and foliage designs of the ceiling bosses chime with those in the 14th century transepts. When Street died suddenly before the work was finished, John Loughborough Pearson (1817-97), architect of Truro Cathedral, completed Bristol's west towers. He also designed the high altar reredos and the elegant marble floor of the sanctuary.

The ways in which the Cathedral's architecture reflects its eventful history reveals much about both the tenacity and zeal of the early builders and the inspired vision of their Victorian successors. As well as reflecting on their achievements, in the course of exploring the building we found ourselves discussing such topics as cast iron grave-markers, the martyrdom and attributes of St Victor of Marseilles and the correct pronunciation of 'Berkeley'. As tour guide, I thoroughly enjoyed the visit. Many thanks to everyone who took part.

This article first appeared in The Western Courier

¹ See R. Angus Buchanan, *Brunel – The Life and Times of Isambard Kingdom Brunel* (London and New York: Hambledon and London, 2002) pp. 61-62 and *Bristol Cathedral – History and Architecture*, ed. John Rogan (Stroud: Tempus, 2000) p.105.

Durham Cathedral

The Rev Canon Dr Michael J Jackson gave a paper on The Building of Durham Cathedral to a joint meeting of the Society's North East Branch Meeting and the Institution of Civil Engineers.

Robin Brooks

Dr Jackson set the tone of his talk by sharing that he never knew whether (or not) to wear his 'dog collar' when addressing technological meetings such as this! For the record, he decided he would! He further showed his humorous vein when he asked if the older members of his audience remembered the Saturday morning BBC Radio programme Children's Favourites. He explained that one of the songs popular in that programme was about a little steam engine who's mantra went, "I think I can, I think I can, I know I can." In Dr Jackson's opinion, these words might well have been the theme song of the Institution of Civil Engineers and of the masons who built remarkable buildings like Durham

Cathedral. The masons did this without any of the sophisticated design and construction equipment which we now take for granted.

At that time, the only labour was manual and the largest source of motive power was the horse or oxen; on the calculation front, the arithmetical system in use was the Roman numeral. Dr Jackson quizzed, "Have any of you tried to multiply Roman numerals?" Such was the background of the construction industry in the 11th century.

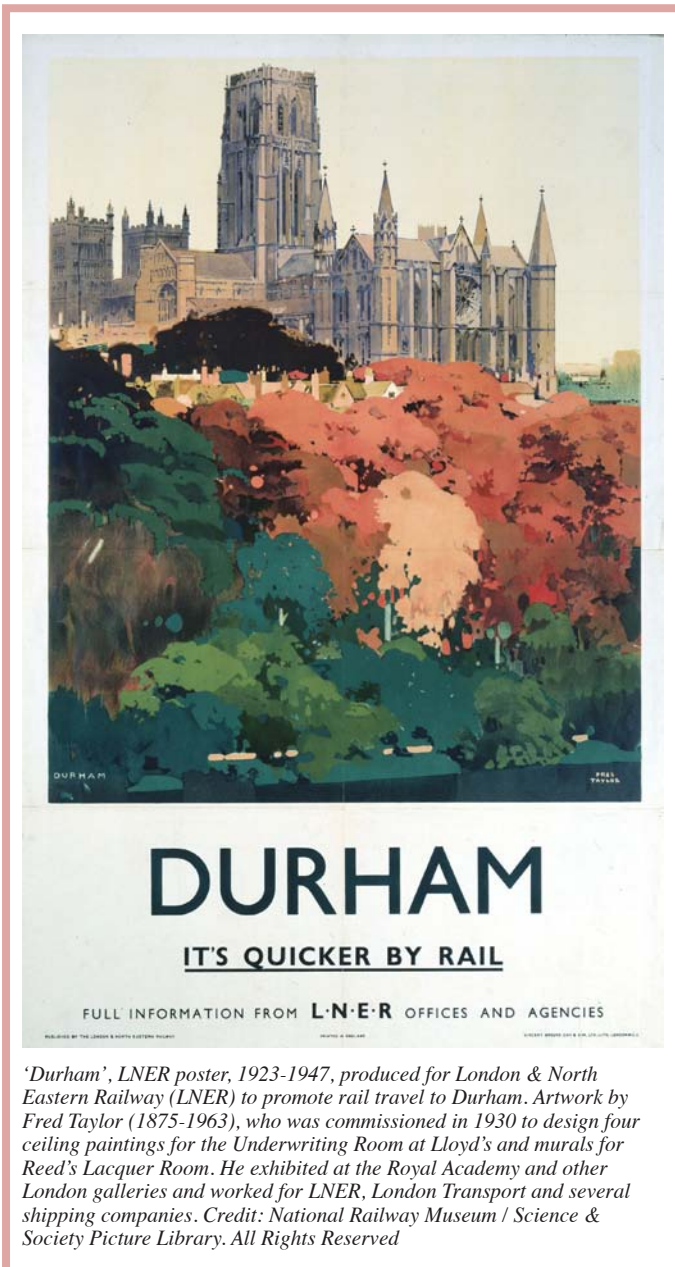
The location on which Durham Cathedral is situated, was already the site of an earlier church dating from 995. The original timber construction had been replaced in the late 10th century by a stone built church made of local white stone taken from the banks of the nearby River Wear. This stone church, known as The White Church, was large by standards of the time, being 60 m long. The overriding purpose of the church was to house the remains of St Cuthbert, the one time Bishop of Lindisfarne (Holy Island) and founder of the monastery there. Due to ongoing Viking raids, the monks of Lindisfarne sought to find a safe resting place for their founder who had died over 300 years before in 687. Dr Jackson recounted the travels and several resting places of St Cuthbert's shrine over those intervening years.

However, in 1066, everything changed, when the Norman conquest of England brought with it the replacement of Saxon bishops with Norman bishops. These new men had to make their ecclesiastical mark and set about building new cathedrals, each one trying to outdo the other. So it was that in 1081, William of Calais commenced the construction of a new cathedral at Durham which was three or four times larger than the White Church it was to replace.

William of Calais was the client/architect/civil engineer/director of construction, who masterminded and implemented the whole project. Dr Jackson explained the evolution of the now accepted Romanesque cruciform layout of a Norman cathedral, with its long nave, choir and two transepts. He also listed the advantages and disadvantages of timber as against masonry construction. Despite the high material and labour costs of quarrying and working stone, its aesthetic and high status, made it the first choice of any aspiring Bishop who was building to the Glory of God (and also of the new ruling élite). Of course, timber still had an important role in forming the roof trusses over the nave and elsewhere.

While on the subject of supports and the distribution of forces in a building, Dr Jackson showed a picture of the roof space (triforium) over the side aisles of the nave, this showed the arched stone supports bracing the nave wall. To the uninitiated these appear to be flying buttresses, but, as was explained, they are not true flying buttresses, but no more than supports for the timber aisle roof, as they do not provide the necessary horizontal thrust as would a true flying buttress. Following on from this, Dr Jackson explored other design developments that Romanesque architecture embraced, such as the semi-circular arch. He then went on to explain the development of the Gothic (pointed) arch that was to appear in later centuries.

From the overview of the design criteria involved, Dr Jackson returned to the practicalities of building such a massive building for over 40 years, at the top of a hill, with the resources then available. The means of transporting the stone from the three quarry sites to the west and south of cathedral site would have been by oxen cart. Two of the quarry sites required the stone to cross the River Wear, and all three required that the stone be lifted from river level to the cathedral, something like a 110 ft elevation. Tradition has said that the route taken was across the river ford to the west of the site and then north up the bank. However, Dr Jackson is of the opinion that the route would have been first north to the site of the future Framwelgate Bridge then on an extended route round and up to the hill top. This route allowed for an easier gradient



than that previously thought. A graph was shown giving load against incline and the speed of an oxen cart which suggested that the 'traditional' route would not have been practicable.

Approximately 80,000 tons of stone was dressed at the quarries and transported to the site. Dr Jackson speculated on the road maintenance required and the never ending demand to clear the mud and oxen dung deposited on the road! He further commented on the fact that the mortar joints between the masonry blocks at Durham are very thin, requiring a very high degree of accuracy by the masons at the quarry. A photograph of a pre-cut decoration on one of the nave pillars, showed a perfect match across the stone block joint.

Once on the site, the blocks of stone still needed to be manhandled to their position. For this rope lashed timber scaffolding was used together with man powered windlasses. Although not from the 11th century, a manual windlass of this type still exists at Durham and a picture of this was shown. Other period pictures of wooden scaffolding and masons at work were also shown. Scaffolding was anchored to the

building with the use of scaffold holes and the regularly spaced plug blocks which later filled these holes are evident at Durham.

Dr Jackson went on to describe the continued development of the cathedral over the centuries as further features were added and styles changed. In conclusion, he reminded the audience that all this was accomplished by one man's vision without the aid of reference books or stress calculations, but only with the courage later epitomised by a little engine "I think I can, I think I can, I know I can."

A question time followed when various aspects of the cathedral's construction were discussed. These covered; the numbers of men involved and their disposition; wall thicknesses; foundations; the sequence of building; spires – their coming and going; Islamic and Arabic influences and stone handling techniques.

A well deserved vote of thanks was given for a talk that engrossed both the civil engineers present and those whose interest lay in the technology of the past.

An Exercise in Observation & Replication

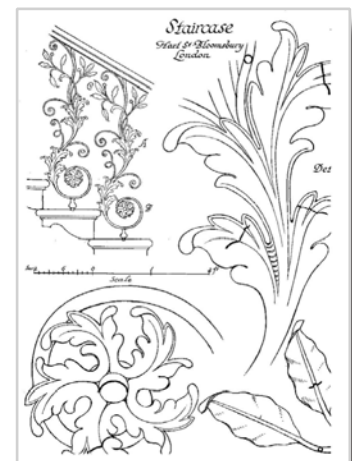
The National Heritage Ironwork Group (NHIG) was founded in 2009 as a not-for-profit organisation dedicated to the safeguarding and preservation of historic wrought ironwork. The Heritage Blacksmith Bursary Project is based upon the National Occupational Standards for Heritage Blacksmithing which NHIG established with Construction Skills in 2010.

Imagine that during a restoration project a section was found missing and a replica was required which resembled the original as closely as possible in every way. This was the brief given to trainees on the NHIG Blacksmith Bursary as in order to complete the task their observation skills would be tested to the full. They not only needed to understand the aesthetics, in design and style, but also to work out from the evidence available how the original was made and what was it made from. What were the materials, tools, jigs and techniques used by the original craftsman? A case of playing detective, as only by making a replica in the same way as the original will the finished piece be accurate.

Trainees selected the design they wanted to work on although the NHIG Training Steering Group were consulted to ensure that the piece would include enough historic techniques to be sufficiently taxing to the maker! Materials were donated by Chris Topp & Co Ltd and the trainees made the pieces using the facilities offered by the workshops that were hosting them as part of their bursary training.

This project was part of a specialist training course set up by the NHIG as part of the Heritage Lottery Fund's (HLF) Skills for the future programme, the fund has awarded grants totalling £26.8m under the scheme. At the end of the project the work was assessed and an award was given for Best Blacksmith which was shared between Matthew Boulwood and Simon Doyle.

Matthew's design came from a book called "Gitter Aus Schmeideeisen" (date unknown) and he said "When I first saw the design I was struck by the intricacy of the 3D form. The design uses traditional motifs in a way that I hadn't seen before, developing depth from details which are often quite flat. As I started to look closer I realised the design was entirely fire-welded and used stacks of many components, something I had not even thought to try before. The real challenge was in the design development and planning the assembly so that everything could be fire-welded cleanly without losing detail. I thoroughly enjoyed the leaf making and seeing the piece come together, although nerve racking on the final weld, it was really rewarding and a huge learning experience. "



Joint winner, Simon Doyle's concept piece (left) which came from 'A Portfolio of English Wrought Ironwork of the late 17th and early 18th centuries' by Tunstall Small & Christopher Woodbridge (right)

Simon's concept piece came from A Portfolio of English Wrought Ironwork of the late 17th and early 18th centuries by Tunstall Small & Christopher Woodbridge, (date unknown). Simon was immediately drawn to the combination of leaf forms and formalised scrolls in the piece, and particularly enjoyed making the leaves and buds in the top section of the design. The piece had a formal element as well, and Simon felt the strict scrolls that form the baluster frame were something that would stretch him. Simon said "The main challenge was in the nature of its making. With no single block of time given over to this project, the work was somewhat disjointed with days and sometimes weeks passing between phases. However, the overall result was very pleasing and I would like to thank my placement providers for their time and use of their facilities." The work is available for exhibitions and trianing purposes.

Further information at: www.nhig.org.uk

Southern Indiana

John Porter

The pre and post tours of the Society for Industrial Archaeology (SIA) conference in Cincinnati, provided a significant contrast. Before the conference, our loop through Southern Indiana took us to places and sites we would never have found on our own. After the conference, we headed north-east to the big stuff; the Carillon open-air museum and the USAF's National Museum in Dayton, to Detroit and its automobile manufacturing, followed by the Henry Ford museums in Dearborn.

In Indiana we enjoyed a very varied programme – the Ohio river and its works; bridges from the old to one under construction; manufacturing from virtually hand-made spades to Cummins truck engines on the latest production lines; a grand town house contrasting with an imaginative conversion of a building that started as a distillery and was now a law office and even a couple of churches designed by the Saarinen, father and son.

This fascinating programme was put together by SIA member, Dr. Bill McNiece, a physician who certainly caught the mood of his visitors with his selection of sites. He did have local help, particularly from John Staicer, President and Executive Director of Historic Madison, Inc. We were expected at every site and the locals turned out in force to greet us.

Perhaps the place that really hit the spot was the Schroeder Saddle-Tree factory. A saddle-tree is the wooden skeleton of a saddle and they were in production here from 1878 to 1972. The variety of shapes for different uses of horseback riders was startling. This was a family business. They lived next to the shop and put a great deal of ingenuity into adapting machinery to the task. The plant was self-sufficient and tucked in the back were a couple of old steam engines and an oil engine. The factory is a time warp and was conserved by a team of enthusiasts before opening to the public in 2002.

Another extraordinary place, just over the road, was the base for a hydro-plane, a water-craft capable of nearly 200 mph, driven by a propeller turning at 20,000 rpm. It is owned by the community of the small town of Madison, Indiana, population 10,000, yet tours the race circuits of the USA and has even been to Dubai. The finances must be extraordinary. Close by were the law offices in an old distillery. We were given a tour by one of the senior partners, a gesture that typifies the hospitality and welcome we received everywhere. One could see the advantages of converting an old factory for legal uses – they had lots of space to store files! Madison has an interesting history from well before the Civil War. It includes the building of the Madison railroad grade with an incline of 5.89% (1 in 17) to carry trucks from river level up to North Madison. We visited the incline which still has rails in place, but is not in active service. We toured the preserved house of one of the more prosperous citizens, admired the unusual spiral staircase in the central hall and speculated on the brick bonding in the basement. This was after inspecting the former railway station building, now restored and a museum.

The Seymour Manufacturing Company is an organisation that has preserved its identity and independence since it was founded in 1872. They make hand tools, with an emphasis on shovelling and digging. As with saddle-trees, the catalogue showed more varieties than we would have believed possible. We were given a close-up tour of the wood processing, metal working and final assembly floors.

The contrast with the tour of the Cummins mid-range truck engine assembly plant was stark. Here, after a safety briefing, we viewed from a gallery and saw the whole process from kits of parts to the run on the test-bed. The test run on fuel lasted seconds, but was long enough for the engine to be proved prior to its journey by road and rail to the truck assembly plant in Mexico. The fuel and lubricating oil are specially scented to avoid upsetting the Mexican operators who assemble the



The Schroeder workshop. Photograph: Clive Penfold.



The spade production line at the Seymour Manufacturing Company. Photograph: Clive Penfold.



The Cummins exploded engine. Photograph: Clive Penfold.

trucks! This new assembly plant, in an old Cummins building, is an example of how US industry is fighting back against low wage economies and successfully re-introducing manufacturing at home. Nor was the factory a cheap conversion from an old building. Much effort had gone into making it eco-friendly and thoroughly built in to the surrounding landscape. We were later to see more of the same situation at Ford's River Rouge pick-up truck assembly plant in Detroit. The Cummins Company is very conscious of its history and devotes a large area of the ground floor of its modern office block in Columbus to iconic examples of its products, including engines made in its UK plants. Particularly striking was the exploded diesel engine hanging from the ceiling and the diesel engine racing car that had taken part in the Indianapolis 500 some years ago. A 19th century mill, the former home of Cerealine, was in the centre of the railway yard being redeveloped for the new office. Rather than knock it down, it was skilfully incorporated into the complex as the staff cafeteria.

Columbus, Indiana, may well be the Cummins company town, but there was much else besides. The city, population about 44,000, is ranked sixth by the American Institute of Architects for architectural design of US cities. We toured the architectural spots and visited two churches by the Finnish architects Wero and Eliel Saarinen. The organist at one was practising on his Holtkamp instrument, giving us a pleasant moment for peace and reflection.

But the Ohio River is what gave this area its initial prosperity. Even here, 530 miles south of Pittsburgh and 450 miles from its confluence with the Mississippi at Cairo, IL, the river is huge to a European's eye. Our visit to the lock and dam complex at Markland was well-timed and despite the rain we were able to watch a raft of 15 empty coal barges entering the lock. As the 1000 ft lock was closed for repair, and the 600 ft not long enough, we saw the barge assembly being split in two. Releasing the tension wires was done quickly by man-power alone. This barge train could move 25,000 tons using a 6000 hp pusher tug.

If there are rivers, there must be bridges and this area has a long history. Within a short radius we had no less than eight covered wooden bridges available to us. The one chosen was the Medora bridge, the longest covered bridge in the USA, constructed in 1875 primarily of oak and yellow poplar, using the Burr arch-truss design as its basic structure. The bridge was retired in 1972 and restoration as a walkway was completed in 2011, driven by enthusiasts several of whom were on hand to greet us.

A variety of iron and steel truss bridges was also inspected. We visited an 1887 double intersection Pratt truss bridge (also known as a Whipple truss as developed by Squire Whipple) which still carries vehicular traffic. We could compare that to the nearby Laughery Creek bridge, with a span of 300 ft and very tall trusses, 40 ft high. It was built in 1878 of wrought iron by the Wrought Iron Bridge Co. of Canton, Ohio. This is the only US survivor of this particular truss design, where the diagonals cross three panels making it a triple intersection Pratt design and commonly referred to as a Triple Whipple. A rather larger truss bridge, built of steel in 1929, spans the Ohio between Madison and Milton. It has a total length of 3180 ft, with the main spans carried on three piers in the water. The bridge is now too narrow for the traffic and new trusses will be installed on the existing piers by being slid across from temporary piers alongside. An engineer described the planned bridge slide as the biggest yet attempted in the Western Hemisphere. The first span, weighing 2000 tons, was lifted 90 ft to the top of the temporary piers shortly after we moved on. The new bridge will open to traffic towards the end of this year.

Outside Medora, IN, we visited a brickworks that was still using processes from 1904 when it closed in 1992. Most of the brick kilns remain extant and Indiana Historic Landmarks



The Tripplle Whipple Bridge. Photograph: Clive Penfold.



Beck's Mill. Photograph: Clive Penfold.

have listed it as one of the ten most endangered sites in Indiana. One wonders if its future is realistic, but a visit to the rural and very picturesque Beck's Mill reminded us that much is possible. The present mill, the third on the site, dates from 1864 and ceased to function in the 1950s. After being abandoned for several decades, it was substantially rehabilitated between 2005 and 2008 and now operates seasonally as a tourist attraction using the water wheel. The mill also had water turbines and these are on display. The installation appeared to be fairly basic, without some of the labour-saving devices we are used to seeing. For example, the grain seemed to be shovelled by hand into the hopper feeding the stones. As ever, we were royally welcomed and invited into every nook and cranny in the building.

It was a wonderful tour for the sheer variety of things we had seen, for the several places being looked after by a bunch of devoted volunteers, to fabulous adaptations of buildings that no longer had their original purpose. We saw churches designed by architects with international reputations, the very latest in American production technology contrasting with still working 19th century methods and finally a beautifully preserved 1900 ice cream parlour.

My thanks to Bill McNiece, not only for making it all possible but also for advice for this article and to Bill Barksfield of Heritage of Industry who made all the arrangements.

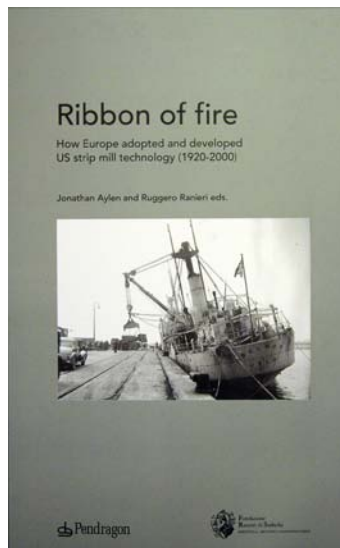
**RIBBON OF FIRE
HOW EUROPE ADOPTED AND DEVELOPED US STRIP
MILL TECHNOLOGY (1920-2000)**

JONATHAN AYLEN AND RUGGERO RANIERI EDS.

(edizioni Pendragon)
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Like railways in the 19th century and the internet in the 21st, steel strip production was a technology that unlocked growth in a wide range of user industries. Invented in America in the 1920s, the wide strip mill spread to Europe, allowing a range of modern manufacturing industries to emerge before and after World War II. Hot ribbons of steel strip were gathered into coils to feed car makers press shops, food canners and a range of consumer durable industries. This pioneering book shows how construction of these giant strip mills spread from the US to Europe, transforming steel from a craft industry into large scale, continuous mass production.



The book shows how these huge projects were planned, built and commissioned - transforming the lives of communities where they were located. Wide strip mills began in Europe with Ebbw Vale and Shotton in the UK and mills in the Ukraine and Germany. But the real building boom took place in the post-war period. The Marshall Plan acted as a midwife, providing vital financial resources. There was an intensive transatlantic flow of technology and know-how from American mill builders to help European recovery. The early post-war mills (Port Talbot, IJmuiden, Sollac, Cornigliano, Linz) sparked off 60 years of technical innovation, including successive generations of wide strip mills - from Generation II (Llanwern, Sidmar) down to the latest Generation V mills (in the Netherlands, Germany and Italy). Now European steel makers and plant builders lead the world in strip technology. Steel strip remains a fundamental part of our living environment. A decade in the making, this book draws upon a wide range of European contributors and extensive research in public and private archives across Europe and America.

Jonathan Ayles is Senior Lecturer in Manchester Institute of Innovation Research at Manchester Business School, the University of Manchester, England. Jonathan has travelled throughout the world steel industry and advised a range of national and international bodies on steel issues. He has published widely on steel and on the history of technology. **Dr Ruggero Ranieri** is Visiting Professor at the Universities of Padua and of Perugia, Italy. Member of the Advisory board of Steel master, ICSIM in Terni. Ruggero has written extensively on the history of the steel industry in Europe and on the workings of the postwar Marshall and Schuman Plans.

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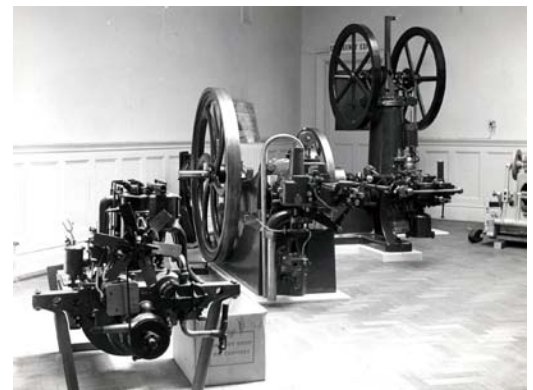
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MOSI, THE EARLY DAYS

Richard Hills

I have written a brief account about the early days of the present Museum of Science and Industry in Manchester (MOSI), drawing on reports written before the Museum was launched. They outline the benefits such a Museum would give, particularly in education. More information has come from the Museum's Annual Reports, covering the opening at 97 Grosvenor Street in October 1969 to the closure of this building in July 1983, during which time over half a million visitors



Rolls Royce and Crossley engines on display at MOSI

had passed through its doors. The first part describes the development of the Museum, the rationale behind collecting the exhibits, how some of the major ones were acquired, moved, restored and in most cases set to work again. The chapters are:- (1) A Successful Start at Grosvenor Street, (2) Problems Facing the Museum, (3) The Power Hall at Liverpool Road, (4) The Mill Engine Collection, (5) The Railway Collection, (6) The Textile Collection, (7) The Machine Tool Collection, (8) Paper Related Exhibits, (9) Smaller Exhibits. Appendices list exhibits collected annually, archive and library holdings, bibliography, etc. There are over 100 illustrations. I could post a CD to anyone interested.

More information from Richard L Hills at: rev.rlhills@btinternet.com

Wanted

A copy of Newcomen Society Extra Publication No. 1 A Short Description of the Fire and Air Engine by Marten Triewald. If any member has a copy they wish to dispose of, would they contact: ian.broom@talktalk.net

Call for Papers.....

HERITAGE IMPACT 150 SYMPOSIUM, 3 - 5 OCTOBER 2013, DUNEDIN, NEW ZEALAND

To celebrate the 150th Anniversary of the Dunedin Gasworks, the first and last site of town gas production in New Zealand. The symposium is intended to bring together people with expertise and an interest in industrial heritage including archaeologists, architects, archivists, curators, engineers, historians, local government leaders, planners, sociologists, and those involved in tourism, heritage maintenance and restoration. The symposium will take the form of plenary sessions and 30-45 minute breakout sessions for presentation of papers, seminars/workshops and 10 minute "heritage bites". A pre-symposium tour of industrial heritage sites in the wider Otago area and a symposium dinner will be part of the programme. Contributions are invited which may be in the form of papers, seminars/workshops, posters, multimedia presentations or trade exhibits. Further information at the Gasworks 150 website: www.gasworks150.org.nz or Ann Barsby at: ann@southernheritage.org.nz

THE FIRST INTERNATIONAL CONFERENCE ON EARLY MAIN LINE RAILWAYS, 19 - 22 JUNE 2014, CAERNARFON, WALES

Abstracts are invited for 30 minute papers to be delivered at the First Early Main Line Railways Conference.

The Conference will cover the pioneering period of the public main line railway, up to the establishment of a regular network of routes with agreed or amalgamated running rights. (this period extends from the opening of the Liverpool & Manchester Railway in 1830 to the major consolidation of companies which had taken place by about 1870; start/end dates will differ for other countries). The emphasis of the event will be on the formation, cultural impact and effects (financial, social, technical etc.) of the early main lines in all their aspects. Papers are particularly sought on:

- Political influences and implications
- Capitalisation and Finance
- Management, staffing and administration of Early Main Lines
- Technology, with respect to all aspects of the Civil and Mechanical Engineering of Early Main Line Railways, including Engines, Rolling Stock, Infrastructure and Buildings
- Social Context and Cultural Impact
- International Context

Further information on topics of potential interest can be found online at <http://www.erc5.org.uk>.

200-word abstracts should be submitted by 30th September 2013

By email: early.main.line.railways@gmail.com

By post:

c/o Mike Chrimes,
Institution of Civil Engineers,
One Great George Street,
London, SW1P 3AA

Conferences.....

17-20 JULY

THE NEWCOMEN SOCIETY'S 2013 SUMMER MEETING

The Newcomen Summer Meeting will be held in Manchester from 17-20 July, with optional extra days. The city, and surrounding area, hold a unique place in the history of engineering and technology. Also, the 24th International Congress of the History of Science, Technology and Medicine (ICHSTM) will be held there immediately after the Summer Meeting (22-28 July). The Society will have a presence at the Congress. This will give members the opportunity to continue their stay in Manchester and attend the Congress. Further details from Heritage of Industry at: www.heritageofindustry.co.uk; email: info@heritageofindustry.co.uk phone: 01494 873677

22-28 JULY

THE INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE, TECHNOLOGY & MEDICINE

ICHSTM, The International Congress of the History of Science, Technology and Medicine is the largest event in the field. Congress facilities will be provided by The University of Manchester with tours and displays on local scientific, technological and medical heritage co-ordinated by members of the University's Centre for the History of Science, Technology and Medicine. Further information at: <http://www.ichstm2013.com/>

25-27 JUNE

MELLOR ARCHAEOLOGICAL TRUST: GREATER MANCHESTER INDUSTRIAL ARCHAEOLOGY TOUR

Highlights are a Manchester walk with Michael Nevell, Peak Forest Canal Aqueduct and Locks, excavations at Mellor Mill and Tottington Mill Printworks, museum visits and a steam train ride. Further information from: Anthea Nicholls Phone: 0161 427 2187 email: antheanicholls@uwclub.net

*The copy date
for the next issue of
Newcomen Links is
10 May 2013*

*Please submit news, articles,
information, details of events etc to:
The Editor,
Deborah Jaffé at:
editor.links@newcomen.com*

Newcomen Diary.....

EVENTS ON THE WEBSITE

All the Society's events are now listed on the website, www.newcomen.com. Instructions on how to use the Events' Calendar are on page 7 of this edition of Newcomen Links. Please check the website for up to date information about new events and also any possible changes to those already listed. It is very easy!

THE NEWCOMEN SOCIETY

EGM

WEDNESDAY 10 APRIL AT 5.45PM

IN THE FELLOWS' ROOM,
SCIENCE MUSEUM,
LONDON SW7 2DD

AN EGM HAS BEEN CALLED
TO SUBMIT
THE REVISED MEMORANDUM AND
ARTICLES OF ASSOCIATION
TO THE SOCIETY'S MEMBERS.

FOLLOWED BY THE LECTURE:
PLUTO
LIFEBLOOD FOR D DAY
AND BEYOND
BY ALLAN GREEN

19-21 APRIL

A WEEKEND IN CORNWALL

Booking is still open for the Cornwall weekend, 19-21 April, which includes visits to the Telegraph Museum at Porthcurno, Rosevale Mine and Hayle. Full details and booking forms are available from:
www.heritageofindustry.co.uk
or contact Bill Barksfield by email:
info@heritageofindustry.co.uk
phone: 01494 873677

22 MAY. 11:00 – 17:00

MERCEDES WORLD & BROOKLANDS MUSEUM, BROOKLANDS ROAD, WEYBRIDGE, SURREY KT13 0QN

There have been many developments at Brooklands Museum since our visit in 2009. So, it seems appropriate to revisit it and this time include Mercedes-Benz World, which is only three minutes walk away. The morning will be spent at Mercedes to watch a film on their history, and see three floors of exhibits of classical and current Mercedes cars, as well as viewing galleries of the outside test track. Lunch may be taken at the Café 1886 or the Gullwing Restaurant. The former serves excellent and inexpensive light lunches and the latter is a reasonably priced bistro. There are picnic facilities outside. After lunch we will go to Brooklands Museum, the home of British motor sport and aviation, where we can view the famous hill climb and the banked racing track. We will have a tour of the motor village, and afterwards view their Wellington Bomber, Harrier etc, and take a 35 minute guided tour of Concorde led by Capt Mike Bannister, BA's Chief Concorde pilot. There are good rail connections to the nearby station at Weybridge, and limited car transport to and from the station can be provided. There is ample car parking at Mercedes World. The cost is £17 per person and the number of places on the guided tour is limited. Please send the details below to: Dr B Lawton, 2 The Elms, Highworth, Swindon, Wilts SN6 7D.

Name of visit, number of places, your name, a cheque for £17 per person, and your email address or a stamped and addressed envelope. Cheques should be made out to "Activities Sub-committee, Newcomen Society".

13 JUNE

A VISIT TO ROYAL PORTBURY AND AVONMOUTH DOCKS

The Western Branch have arranged a visit to the Royal Portbury and Avonmouth Docks on Thursday 13 June starting at 14.30 and lasting about 2 hours, fee to be announced. Details from David Worth:
e-mail nsdavid132@hotmail.co.uk

JULY IN MANCHESTER

17-20 JULY

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