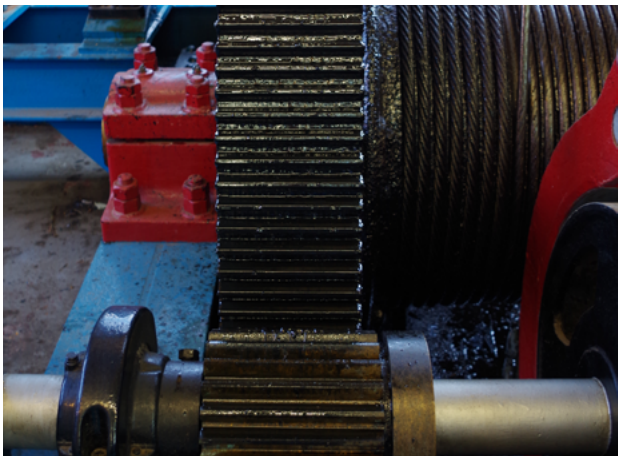
NEWCOMEN Links



A Teesside Summer Tour; Cleveland's Innovative Engineers; Babcock & Wilcox at Twyford; William Menelaus' Drawing; Switchboard at Bourton Hall; K-Class Submarines; Forthcoming Syymposium, the White Salt Industry; The 2018/19 Newcomen Calendar; Seen; News and more.....

NEWCOMEN
The International Society for the History of Engineering and Technology

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Notes on Contributors

John Anning is a graduate from both Cambridge and the College of Aeronautics (now Cranfield University). After a career in the energy and manufacturing sectors of industry in both the UK and Australia he retired to N Somerset. He has had a lifetime interest in the history of technology with a particular interest in engines, machine tools and horology.

Jonathan Aylen was joint organiser of the Newcomen Society Tour of Teesside with fellow member Dr Fred Starr. Jonathan has long-standing connections with Teesside through his research on steel technology and on process plant. He is currently Vice-President of the Newcomen Society.

David Blythe regards himself as Newcomen Society's roving reporter. He trained as a geologist and worked in the coal industry before becoming a geotechnical engineer. He now works as an independent consultant, mainly concerned with mineral extraction in the UK. He has an interest in many aspects of industrial archaeology.

Peter Filcek has a degree in Marine Engineering and worked in marine engineering and the power station industries, he joined Lloyd's Register in 1977. He was Senior Principal Surveyor and the Technical Manager of LR's Technical Investigation Department.

Alain Foote joined GEC Turbine Generators, at their Willan's Works in Rugby, as a student Apprentice. He has a degree in Mechanical Engineering. He worked at Alstom (now GE), where he was responsible for nominating the Willans Central Valve Engine for an IMechE Industrial Heritage Award. Currently, he is helping to catalogue the Willans and Robinson archive in the Warwick County Record Office.

Martin Gregory taught physics at Winchester College and has been a member of the Newcomen Society for over 50 years. He is a trustee of the Twyford Waterworks Trust and the present editor of the Journal of the Hampshire I. A. Society. His specialist interests include sewing machines and the stationary steam engine.

Geoff Horseman is Chief Turbine Engineer at Siemens Energy, Newcastle.

John Liffen is Curator Emeritus of Communications and Electricity Supply at the Science Museum, London.

Sue Parker BSc(Dunelm), CPhys., FIMMM is Technical Events Officer at Cleveland Institution of Engineers

John Porter has degrees in mechanical engineering and naval architecture and spent 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.

Dr Fred Starr is a Metallurgist who has specialised in gas manufacture and electric power generation.

Writing for Newcomen Links

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

Articles should be about 1000 words and sent in Word format by email. Short pieces are also welcome. Longer articles may be submitted after discussion with the editor.
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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It is not possible to receive photographs/scans of images in books etc if they are still in copyright.

The copy date for the next issue is 1 November 2018
Please submit articles, information, details of events etc to:
The Editor,
Deborah Jaffé at: editor.links@newcomen.com
Tel: 07798 603000

From the President, Robert Taylor

This year's Society summer meeting was to Teesside, an area associated with heavy industry and the petrochemical industry. It was a splendid tour, organised by our members Jonathan Aylen and Dr. Fred Starr, with a wide variety of interesting presentations and visits to operating manufacturing sites. Both Jonathan and Fred used their range of contacts, and a great deal of their time, to enable the society members to gain access to a number of engineering sites, which we could study in some detail. As members have indicated on previous occasions, one of the benefits of being a Society member is the opportunity to visit places not normally available to the public in the company of knowledgeable guides who can answer a range of detailed questions. Certainly, our visit to Teesside, provided us with many opportunities to do this.

As with many former industrial regions, our tour to Teesside showed the cycle of industrial change and redevelopment with new industries beginning to replace the old. Our visit to Hartlepool to see HMS Trincomalee, the oldest warship still afloat in the UK, was in the midst of a docks area undergoing redevelopment to provide new housing, employment and leisure opportunities. We toured the ship in a dock surrounded by a range of buildings recently constructed to set the ship in a 19th context. These replica buildings provided an opportunity to interpret the people and facilities that supported a warship built in 1817.

A trip to the vast expanse of the former Teesside steelworks provided a contrast to the visit to the museum at Hartlepool. We had a fascinating tour around the site with knowledgeable guides and heard about some plans for its redevelopment. The steelworks had originally been opened in 1917 by Dorman Long and carried on producing steel under various owners until its final closure in 2015. Now the South Tees Site Company has been established to plan the redevelopment of the site and the preservation of the area's industrial heritage is seen as a key component of this. As with other such huge and complex sites, the question is how to do this most effectively. The structures are large and complex and will be difficult to retain and interpret, particularly as they begin to age. Although parts of similar industrial sites have been retained and reused for heritage purposes such as the Magna science adventure centre in former Templeborough steelworks in Rotherham and a number in the Ruhr Valley in Germany, these are expensive to develop and maintain. Unlike at Hartlepool, where a historic ship was surrounded by replica historic buildings, such solutions are not available to the Teesside steelworks. The challenge for the future will be to preserve evidence of these large industrial sites, and the people who worked there, to enable future generations to be able to study and appreciate our industrial heritage.

From the Editor, Deborah Jaffé

This edition of Newcomen Links is longer than previous issues because of the amount of excellent and interesting material I have received. I do regard myself as very fortunate to have much to choose from and like to publish as much as possible to keep each edition focused on current matters. There is no exception this time. What is different is that the issue is roughly in two parts - the usual range of new, articles and events is followed by reports, a photo essay and an in-depth article from the Teesside tour.

In the first part boilers continue to feature with an article by Martin Gregory on the restoration of the Babcock & Wilcox boiler at Twyford Waterworks, followed by Derek Chatto's photographs of yet another boiler he stumbled across whilst out walking. The lecture to Newcomen North East on the tragedies, long kept secret, that befell K-Class submarines in World War I is recounted. John Anning has more on the Braille Micrometer and Vernier Callipers; John Liffen has located a 'tram engine' drawing by William Menelaus; and Alain Foote writes about the switchboard at Bourton Hall.

This year I decided to have longer reports and articles, accompanied by a photo essay, of the summer meeting/tour - these make up the second part of the issue. The photo essay and reports convey the exhaustive and exhilarating Newcomen Summer Tour of Teesside. It would appear that the organisers, Jonathan Aylen and Fred Starr, made sure no example of engineering was left out of the tour. I am grateful to Jonathan Aylen for his photographs and David Blythe, acting as roving reporter, for writing detailed accounts. Also, in this section, is a long, in-depth article by Sue Parker on the history and formation of Cleveland Institution of Engineers (CIE).

We have decided to trial having longer articles, of about 2000 words, on specific subjects in Newcomen Links. Sue Parker's article is the first. In no way do we want this to be in competition to the peer reviewed papers published in The Journal, more an addition to them. There are, I think, occasions where longer articles are appropriate in Newcomen Links. Please let me have any suggestions.

The copy date for December is 1 November.

Newcomen Matters

Newcomen Southern

Members in the southern part of the country will be aware that Dr Robert (Bob) Otter has for many years been chair of the Newcomen Southern and has been the primary organiser of the region's activities. He has decided that it is time to hand the reins onto somebody else. On behalf of all the members in the area and the non-members who attend our meetings I would like to thank Bob for all that he has done for us over the years. Thanks should also be extended to Jim Coburn for the work that he has done to support Bob.

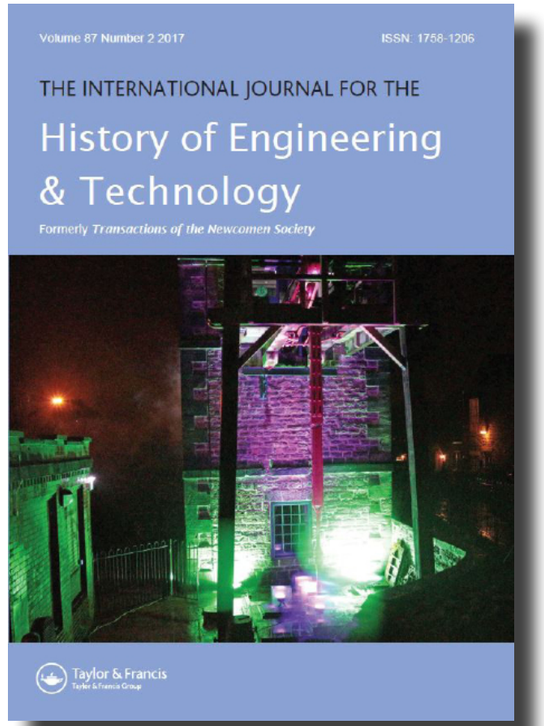
I have agreed to take on the role of chair of the Newcomen Southern. I am a chartered civil engineer that has mostly worked in the structural side of the industry for nearly 40 years. My particular interest is in historic and timber structures. I have presented three lectures on cast iron bridges in the Severn valley, Brunel's timber viaducts and the Severn Tunnel to Southern Region over the years.

In the latest guidance produced by the Council it is recommended that the region should have a small committee of ideally three people. If you are interested in helping the region in this way, please could you contact me via email.

For reasons within and without my control you will see that the programme for the autumn 2018 / spring 2019 has yet to be confirmed. Please could you monitor the events calendar on the web site to check the latest information. Alternatively, you can send me an email asking to be added to our distribution list so I can remind you directly before each meeting. The group normally meets at the University of Portsmouth on generally the third Tuesday of the month. The meetings start at 18.30. Please check on the website for confirmation of the building and room.

Roger Davies
southern@newcomen.com

Have you got what it takes to be an editor?



The Newcomen Society is looking for an editor for The International Journal for the History of Engineering and Technology. The Journal is published by Taylor & Francis on behalf of the Society.

The main responsibility of the editor is to sustain the Journal's long-standing reputation as the leading journal for the history of engineering and technology. Above all, the editor is expected to take a leadership role in shaping the direction of the journal and maintaining its high academic standards.

The editor has a range of other responsibilities including maintenance of a close relationship with members of the Society and its Council; effective liaison with the publishers; establishing a professional relationship with authors, reviewers and referees; and promoting the journal where possible to expand the readership and extend its impact on social-media. Candidates for the post are not expected to be experts in all fields, but would be expected to have a broad knowledge of technology and to maintain an open mind about the range of subjects.

The Council is planning to appoint Deputy Editors who could support the main Editor through their specialised knowledge in particular fields. A facility with electronic communication would be invaluable. Council will make resources available to employ an editorial assistant. They will help develop a modern editorial system and support the Editor with day-to-day management tasks.

Candidates are welcome to discuss their experience and interest in the field with the Acting Editor, Jonathan Aylen (jonathan.aylen@manchester.ac.uk) or submit a formal application to the Administrator (office@newcomen.com). The start-date and duration of appointment for the successful candidate would be by mutual agreement, but an early start would be welcome.

We now have a clothing line - the hi-vis, Newcomen waistcoat in yellow with reflective stripes, logo and strap line

- The Newcomen logo is printed on the front and back of the bright yellow waistcoat.
- The strap line on the back, reads 'NEWCOMEN working for engineering history www.newcomen.com'.
- The two reflective stripes around it increase visibility.
- The waistcoat is in one size - L/XL - so that it may be worn comfortably over a jacket or anorak.
- It is ideal for group visits to sites or for an individual wearer.
- Wearing one will promote the Society and engineering history to a wide audience.

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NEWCOMEN
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The White Salt Industry: Production, Transport and Impacts

Saturday 20 October 2018

A one day Symposium on Salt at Lion Salt Works in Cheshire.

Booking essential:

www.eventbrite.co.uk/e/the-white-salt-industry-production-transport-and-impacts-tickets-48463864724

NEWCOMEN **Links**

Copy dates for Newcomen Links

1 November for December

1 February for March 2019

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Seen.....

Breakfast

On holiday in the USA I immediately thought of my Newcomen friends when I went to the Saturday farmers' market in Margaretville, New York. There I came acrros an engine cooked breakfast. DJ

Teesside's Bridges

Peter Filcek was on the Society's recent summer visit to Teesside and quite by chance managed to take this photo showing the Newport bridge and the Transported bridge lined up. The photo was taken whilst on the A19 crossing another bridge, the Tees Flyover, the railing of which can be seen in the foreground.

The Canals of Amsterdam

Following up.....

Braille Micrometer and Vernier Callipers

John Anning

I was most interested to read in Newcomen Links 246 the article on the Braille Micrometers in the Hawley Collection at Kelham Island in Sheffield. It was always a regret that I never met Ken Hawley personally. Although I enjoyed many a telephone conversation with him whenever I needed some information regarding the Sheffield precision toolmakers. He was always very willing to talk and a most amusing experience it was.

Since the age of twelve, when I got my first of many lathes, I have collected precision tools and instruments. I have been particularly interested in the history of both James Chesterman Ltd and Moore and Wright Ltd. They were the major suppliers of British made, hand held, precision engineering tools and measuring equipment during their heydays from about the 1920s through to the late 1960s.

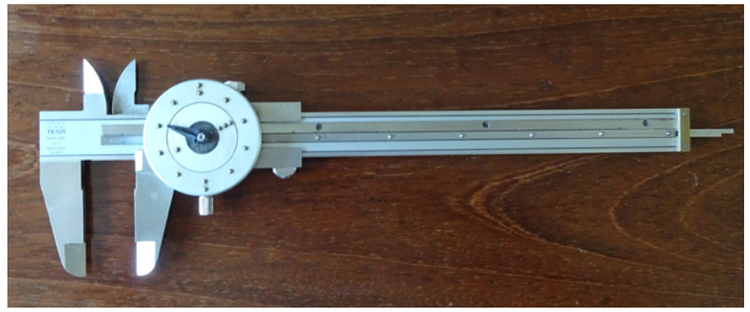
Space does me allow me to write something of their history in any detail but the two companies were in aggressive competition with many products overlapping. James Chesterman, which dates from 1820, were world leaders in linear ruling, vernier callipers[1], height gauges, steel rules and tapes etc while Moore and Wright's speciality was in micrometer manufacture. Incidentally, Frank Moore founded the company in 1905 but Mr Wright never existed! The extra name was added to help win a government contract after WW1 to form Moore and Wright Ltd, to give the impression that it was more than just a small Sheffield tool maker. It has been suggested the "Wright" was the maiden name of his wife! In the event the ruse paid off and won the contract which was to manufacture micrometers, initially under licence from America, and the firm never looked back.

When Chesterman decided to enter the micrometer market around 1950, Moore and Wright warned them of serious commercial reprisals and only a few Chesterman micrometers were made and are now collectors items so it was good to learn of the timely and likely collaboration between the two companies on the development of the Braille calliper which one must assume was still covered under the 1947 Patent 595,016 with Moore and Wright as the Patentee. Although the author has assumed that there was cooperation and has found no firm evidence I would want to endorse this assumption. Through family connections in the region, there was a strong Methodist ethic amongst the Sheffield industrialists.

Kenneth Hume, the lead innovator behind the Braille micrometer, in association with the National Institute for the Blind (NIB), was at the time head of the National College of Horology and Instrument Technology, in Clerkenwell. After a number of positions in industry, he ended up in academia being given a personal chair in Production Engineering at Loughborough University. He contributed to the science of precision measuring equipment and authored several books on Metrology and deserves to be better known.

The range of Moore and Wright Braille Micrometers was first illustrated in their 1949 catalogue. I do not know how many were produced and no doubt the company archive is being well researched by the tool enthusiasts in Newcomen South Yorkshire.

This is not quite the end of this very brief story. I was fortunate to be given, by a late friend and a retired NPL senior executive, a Braille Tesa Vernier Calliper of Switzerland (he also gave me my prized Braille mike!), which I date from the late 1960s. It was probably sent from Switzerland to the NPL for calibration. This date more or less coincides with the expiry of the Moore and Wright Patent No 595016 in 1967 after a life of 20 years. See photograph. If any reader of this note can give me any information on this beautifully made Swiss tool I will be most interested.



[1]*Please note that I have spelt calliper with 2 'll's whereas in the article in Newcomen Links 246 it was spelt with a single 'l'. Calliper was the original English spelling and Caliper is the Amercian spelling and is now universal in all tool catalogues. Etymology creates choices!*

Contribute to Seen

Contributions to Seen are always welcome.
They should be of 'things seen'
and not extracts from archives, books etc.
Pieces should be a maximum of 300 words,
with up to two images. Images should be sent
separately and be a minimum of 300 dpi.

Please send contributions to the editor at:
editor.links@newcomen.com

Following up.....

William Menelaus and the 'tram engine' drawing

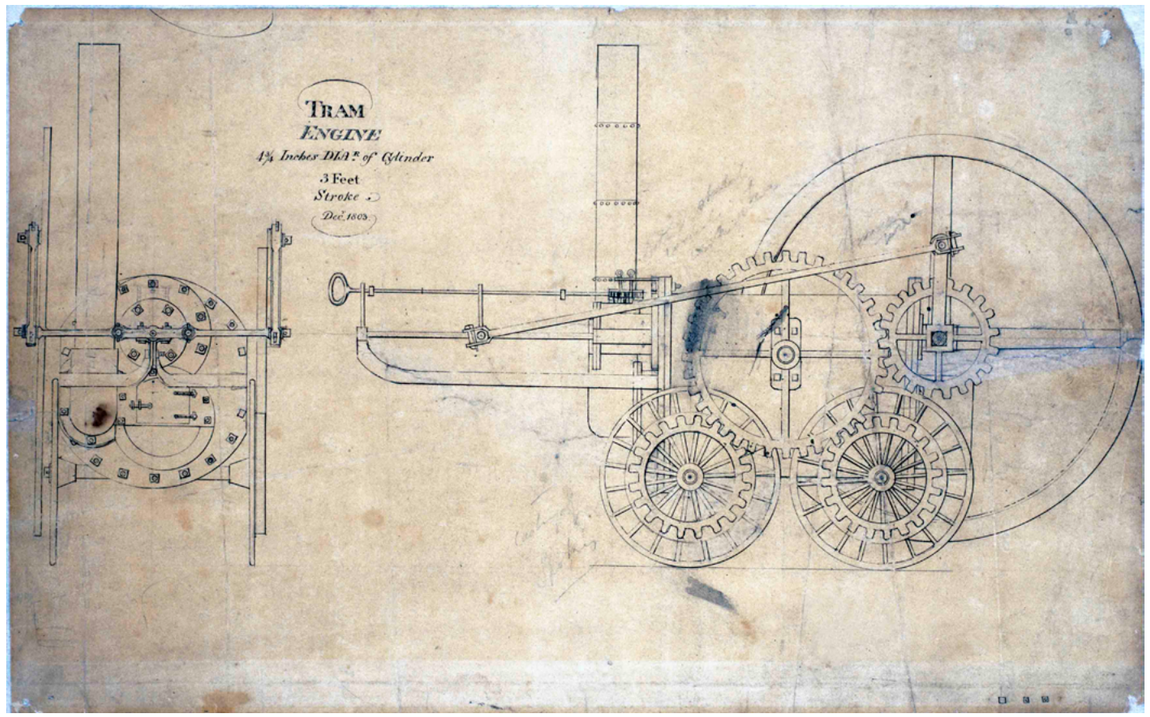
John Liffen

Leslie Shore's article about William Menelaus (Newcomen-Links 246, pp. 12-13) is most interesting. May I add one more reason for which we should hold his memory in high regard? In 1862, when general manager of the Dowlais Iron Company, he was visited by Francis Pettit Smith, curator of the Patent Office Museum in London (a predecessor of the Science Museum). Smith was on an expedition to south Wales to locate, if possible, any physical remains of Trevithick's Penydarren locomotive of 1804. In this he was unsuccessful but during his meeting with Menelaus the latter passed him a drawing, dated December 1803, of a steam 'tram engine' of Trevithick's design. Menelaus told Smith that the drawing was the work of John Llewellin, a mining agent, who early in his career had worked at Merthyr, had known Trevithick and may well have seen the Penydarren engine. Llewellin passed it to his nephew William Llewellin, who in turn gave it to Menelaus in 1855. It was not entirely unknown to the public by 1862 because Thomas Ellis of Tredegar Ironworks had borrowed the original in 1857 to make a lithograph copy which achieved a limited circulation. Smith took Llewellin's drawing back to London and exhibited it in the Patent Office Museum, from whence it descended eventually to the Science Museum.

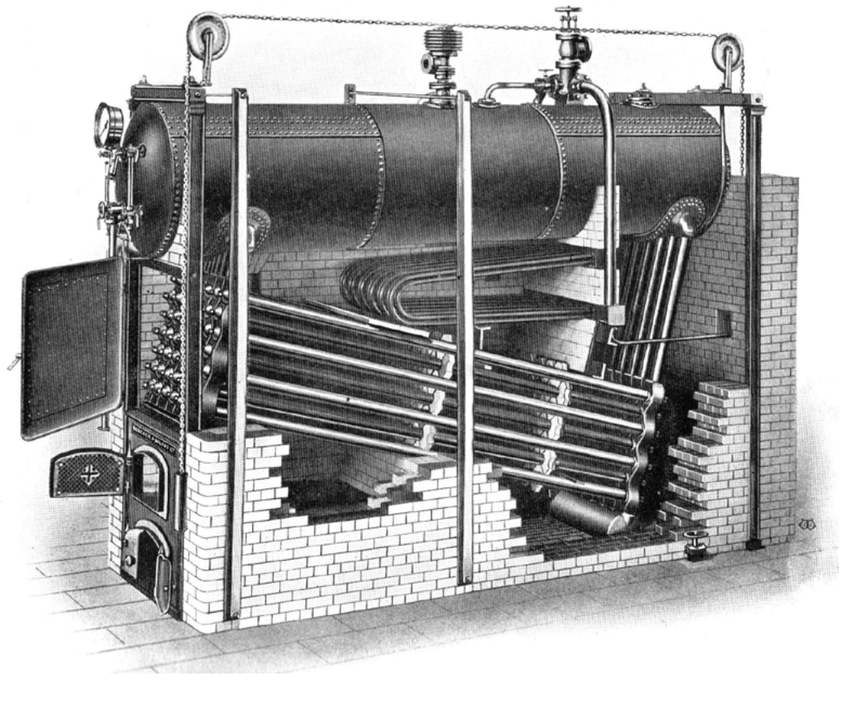
The drawing is now held by the National Railway Museum, York. For many years it was assumed to depict the Penydarren locomotive but its dimensions rule this out. It has recently been the subject of close study by a small group associated with the International Early Railways conferences and a joint paper, principally written by Andy Guy and Dr Michael Lewis, presents their findings. It will be published later this year in Early Railways 6, which will comprise most of the papers presented at the sixth Early Railways conference held at Newcastle upon Tyne in 2016.

Llewellin's drawing is perhaps the most well-known depiction of any early steam railway locomotive, but it has only achieved that eminence through the public-spirited gesture of William Menelaus in donating it to a national museum in the best position to understand its importance.

Llewellin's drawing, dated December 1803, of a tram engine of Trevithick's design. Science Museum Group Inv. 1903-102;. Science & Society Picture Library 10316574



The restoration of the Babcock & Wilcox boiler at Twyford Waterworks



The Babcock & Wilcox WIF boiler (Steam: Its Generation and Use, Babcock & Wilcox Ltd 1904 edn)

Martin Gregory

Babcock & Wilcox (B&W) were one of the pre-eminent boiler makers of the twentieth century. Starting in America in the 1850s they were, by 1900, a global company with manufacturing plants in the USA, Renfrew (Scotland), France and Germany. The 1904 edition of 'Steam' claims that nearly five million nominal HP of B&W boilers were then in use all over the world.

The standard boiler of the time was the WIF (wrought iron front) boiler which they produced in quantity for over fifty years. Given this domination of the water tube boiler market it is surprising that today only four complete boilers remain in the UK, - three at Twyford Waterworks in Hampshire and one at Cheddar's Lane sewage pumping station in Cambridge.

The three at Twyford are almost identical, all having a

The 1916 boiler naked of brickwork and stabilised with scaffolding. Image: Martin Gregory

Replacing a suspect rivet on the steam drum Image: H. A. McEwen (Boiler Repairs) Ltd.)

The 1903 boiler (left) still has tubes but the 1906 boiler (right) has been stripped back to the steam drum hanging from its portal frame. Image: Martin Gregory

The brickwork for the 1903 boiler is complete and the figure shows the completed firebrick wall between the two boilers. The 1906 boiler is ready to be re-tubed. Image: Martin Gregory

New tubes, including the superheater, have been fitted and the boiler is ready for its hydraulic test. Image: Martin Gregory

The tube caps; (A) a tube cap, insert, nut and bolt disassembled, (B) the tube caps in place on the headers showing the gaskets now fitted. Image: Martin Gregory

single steam drum and sixty four 4" (100 mm) diameter water tubes. They were supplied in 1903, 1906 and 1916. They were in use up to the withdrawal of steam in 1969. The 1916 boiler was restored to steam in 1996 and steamed regularly once a month up to the end of the 2003 season, steaming the 1914 Hathorn Davey triple expansion pumping engine. Steaming ceased at this point because Southern Water, the owners of the site, wished to remove all residual asbestos from the boilers. This work, paid for by Southern Water, resulted in the boilers being stripped of all brickwork to expose the steelwork.

Southern Water's work was completed in 2007 and left the Twyford Waterworks Trust with the costs of rebuilding a boiler back to a steamable condition. The Trust launched a 'Return to Steam' project hoping for funding from the Heritage Lottery Fund. In 2012, HLF funding was obtained to restore one of the boilers (that of 1906) to steam plus many other works to improve the visitor and volunteer experience at Twyford. The completion of this project has now been achieved.

The Babcock & Wilcox WIF boiler is a sectional boiler made up of standard parts. All the joints are metal-to-metal and achieved by expanding 4" steel tube into the cast steel headers, steam drum, mud drum etc. Once the steam drum is suspended by two straps from portal frames at front and rear the rest of the boiler can be assembled. The completed boiler is suspended from the two portal frames. Then, the brickwork is built round it to contain the fire and direct combustion products to the chimney. This arrangement is flexible enough to ensure that there are no thermal stresses in the boiler on warming up. Caulking is necessary between the steelwork and the brickwork and for expansion joints in the brickwork. This is where asbestos rope was used in the original construction.

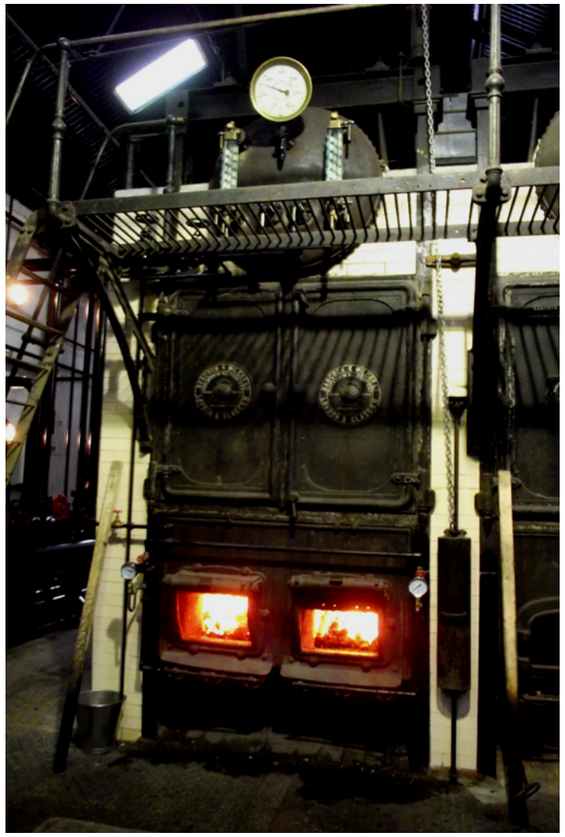
The new low-level control manifold for the boiler. Image: Martin Gregory

Having three boilers enabled the Trust to: restore one (that of 1906), conserve one (that of 1903) so that it is available unrestored, and display one (that of 1916) without brickwork so that visitors can see how it is constructed. The restoration of the boiler steelwork was carried out by H. A. McEwen (Boiler Repairs) Ltd. and the new brickwork for the boilers was built by Gregory Havant Ltd.

Removal of the brickwork removed the rigidity of the boiler and steel scaffolding had to be erected to ensure the boiler components remained correctly aligned. Where the portal frames had been embedded in brickwork, corrosion had weakened the structure so new sections were scarfed and welded in to restore the strength of the uprights. Most of the corrosion probably occurred during the 25 years during which the boilers were cold, damp and unused between the end of steam pumping and the restoration by the Trust.

For the present restoration it was decided to completely re-tube the 1906 boiler and install new pipework as the steel used in the old system was over a century old and untraceable. All the rivets on the steam drum were examined using ultrasound and a handful were deemed suspect. These were drilled out and replaced individually using a portable rivet heater and riveting gun. Inspection of the steam drum, tube headers etc showed that they had been well maintained during their working life and were suitable for re-use.

The rebuild started with building the brickwork around the 1903 boiler (the one to be conserved) which enabled the bricklayers to gain familiarity with the structure and also stabilised the pair of boilers. The firebrick wall between the two boilers could be built before the new tubes were installed in the 1906 boiler and the presence of the new brickwork meant that the portal frames were rigidly braced so that much of the scaffolding could be removed save for that necessary for fitting the tube banks and completing the brickwork. Meanwhile banks of eight tubes, expanded into the refurbished tube headers, were assembled and tested in McEwen's works in Keighley. When the brickwork for the 1906 boiler was complete except for the north wall, the



Steam again! Image: Martin Gregory

sets of tubes, including the superheater, were brought down from Keighley and expanded into place. Fitting the caps onto the ends of the tubes enabled a hydraulic test to be carried out on the complete boiler whilst the tubes were still exposed.

The caps which cover the tube access holes in the headers were originally ground in to give a metal-to-metal steam-tight joint. This is a laborious process and it was felt that, at the reduced working pressure of 100 psig (the original working pressure was 180 psig), modern graphited ptfe gaskets would be suitable. After a few initial problems, this has proved to be the case.

With the hydraulic pressure tests complete a start was made on completing the brickwork. At the appropriate height the grate was assembled and installed. This last wall contained the dusting holes and access doors which now provide the only access to the firebox and tube space. The lever-arm safety valve off the 1916 boiler was recalibrated and fitted and the main stop valves on the top of the boiler were reconditioned. For operation of the boiler on a day to day basis, McEwens designed and constructed a floor level control manifold to avoid the operator having to climb up to the top of the boiler except at the start and finish of operations. Modern specification lagging is fitted to all pipework and this has been covered with 'plaster of Paris bandage' to give the correct appearance for the Edwardian era.

The boiler returned to steam for the first time since 1969 on 23rd August 2017 supplying steam to the Hathorn Davey pumping engine. After several steamings for training purposes the formal 'Return to Steam' for Sponsors and Friends of the Trust took place on 22nd April 2018. The first public steaming took place on 6th and 7th May 2018. Getting back to steam operation has taken 15 years and been a tremendous challenge for the all-volunteer Twyford Waterworks Trust.

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Tel: 07516 458900
e-mail: enquiries@twyfordwaterworks.co.uk

More Boilers

Derek Chatto has found another waggon style boiler whilst exploring the Cromford and High Peak trail. The boiler is almost completely buried and upside down. It is near a disused quarry amongst trees close to the trail and fairly obscured from general view. He thinks it dates from around 1820. But, so far has not been able to find out what it was used for or why it is in this location.It would be interesting to clear out all the rubbish that has been put into the boiler to see just how much survives.

The Switchboard at Bourton Hall

Alain Foote

An electrical switchboard, dating from 1907, has been rescued from Bourton Hall and will be put on display in a museum in Ceredigion, west Wales.

Grade II listed Bourton Hall, in Bourton-on-Dunsmore near Rugby, was built in 1791 for John Shuckburgh. It remained in the Shuckburgh family until 1905 when it was sold to James Frederick Shaw. Between 1906 and 1908 the Hall was extended. At around this time, the house was converted from gas lighting to electric lighting and two direct current generators were installed and connected to a bank of batteries. As part of this installation an electrical switchboard was designed and built by J.B. Cumberland, an Electric Light & Power Engineer based in Battersea in London.

At some point in the mid 20th century the electricity generation installation became redundant when the hall was connected to the mains electricity supply grid. The house remained occupied until after the World War II when it was used as a rest home for Jesuit priests and then used as a school. By the late 1970s the house had become derelict.

In the early 1980s the house was bought by Ingersoll Engineers and restored for use as offices. At around this time the historic switchboard, which was the only survivor of the original electrical installation, was restored by a group of apprentices from GEC Industrial Controls. Their names, which are written on a plaque, were Peter Finney, Balvant Mistry, Michael Wilson and Clive Wynn. The author would be interested to hear from anyone who knows these apprentices.

The hall was sold by Ingersoll Engineers to international development charity Practical Action in 1998 for use as their headquarters in the U.K. Practical Action works with some of the world's poorest people around the world, helping them to improve their lives through simple, innovative solutions to poverty. They will shortly be moving out of the Hall, as the property has been purchased by Northern Powerhouse Developments to become a luxury hotel. Practical Action and Northern Powerhouse Developments recognised the historic importance of the switchboard and it is through their generosity that the switchboard has been donated to the Internal Fire Museum of Power in Wales, where it will be restored and displayed in an appropriate setting next to generators of a similar vintage.

Please send any information to: editor.links@newcomen.com who will pass it on to Alain Foote

Further information
Practical Action
www.practicalaction.org
Internal Fire Museum of Power in Wales
www.internalfire.com

The historic switchboard before removal from Bourton Hall

Book review

The story of the Royal Electrical and Mechanical Engineers (REME) Vol 3 1992 to 2015.

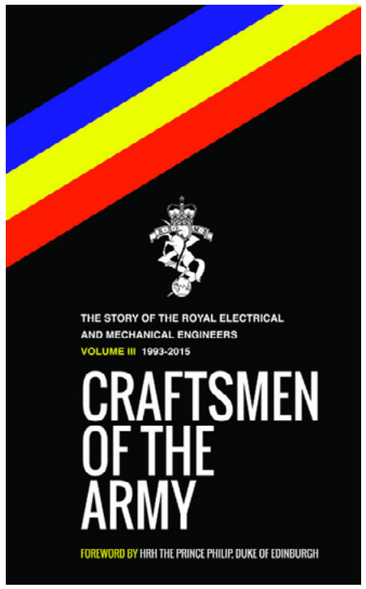
Published by Pen and Sword, ISBN 978 1 47389 988:9

This is the third and latest volume of a trilogy on the history of REME entitled Craftsmen of the Army bringing the story up to date with the ending of the Afghanistan conflict. Vol 1 was first published in 1970 and covered the period from its formation in 1942 in the middle of World War 2 to 1969 and was followed by Vol 2 covering the period to 1992 to the end of the Cold War. This final volume covers the subsequent period when REME was continuously engaged in conflicts in such places as Sierra Leone, Iraq and Afghanistan and the subsequent draw down which was itself a major logistics operation, to 2015.

REME is one of the newest Corps in the British Army and some background on its formation is appropriate because its antecedents go back as far as the Assize of Arms in 1181, which held a soldier responsible for his bow and arrow, pike, sword and battle axe. As such, it bequeathed him to assign his arms to his heirs. Such principles continued to relatively modern times through the Ordnance Board as over the centuries machines of war such as catapults, cannon, muskets, rifles and machine guns led to the formation of the Royal Army Ordnance Corps (RAOC) in 1892. It was the introduction of the tank in WW1 and the subsequent mechanisation of the cavalry regiments and mechanical transport in general that a new branch of the RAOC was formed staffed by fully trained officers who were also professional engineers with a cadre of skilled mechanics to service the armoured fighting vehicles and mechanical transport. Between the wars, military mechanisation continued apace and repair facilities in remote war theatres were urgently needed and so a Cabinet Committee was formed under Sir William Beveridge. As a result a new Corps was formed out of volunteers from both the ROAC and the Royal Army Service Corps (RASC) to form REME on 1st October 1942. It was not long before it grew to be a significant force and by the end of WW2 it was the largest technical Corps in the Army and numbered some 8000 officers, 150,000 other ranks and 100,000 civilians.

Today REME is still a formidable force in a much reduced Army and in 2010 had an overall strength of some 9,500 regular personnel, or around 9% of the Regular Army but all personnel are now trained to be combat ready when tasked and one Military Cross was awarded for bravery in the Afghanistan conflict.

This well presented book has been written by a number of authors who are themselves either serving or retired members of the Corps and in 2005 a Corps Committee was formed to arrange for the preparation of this volume. Colonel Richard Peregrine (a former Regimental Colonel) was invited to undertake the task and authored many of the chapters based on contemporary documents. Much in the book was also taken from articles culled from personal recollections and documents from the Regimental "The Craftsman Magazine" and the Annual REME Journal, both of which can be found on display in the libraries of the professional engineering institutions and they make fascinating reading to anyone with an interest in military matters of a technical nature. The proof reading was carried out by Brigadier Rod Croucher a former Director Army REME (DEME/(A).



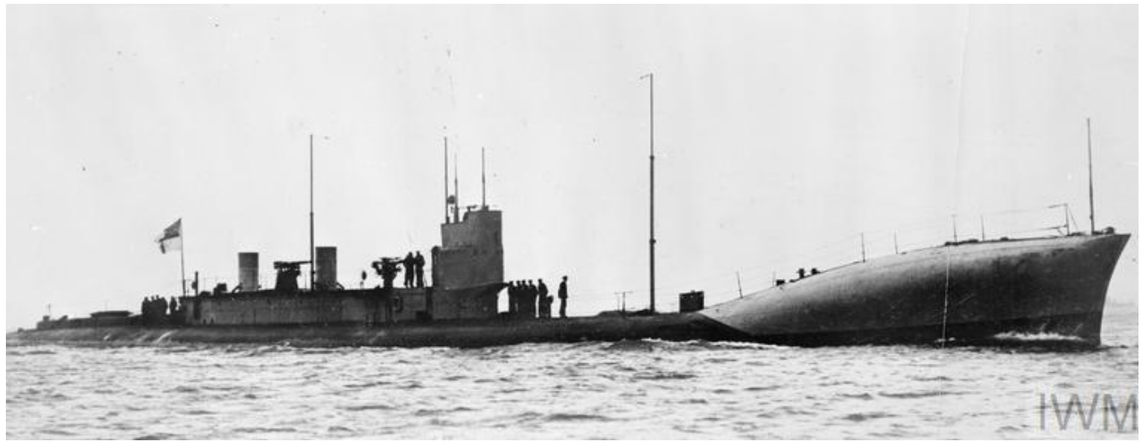
The book is not just about the military but is also well covered by the sporting and other activities of members of the Corps in just about every field in civilian technical roles with, for example, members being seconded to the technical team building the Bloodhound SST vehicle in Avonmouth. There are descriptions of the many sporting activities where the Corps contributes at inter service, combined services and in many instances at national and international level. This book will appeal to every serving and retired member of the Corps but may have only a limited interest to the general public. I was disappointed in the lack of information relating to the actual content of "in house" technical training both on mechanical and electrical subjects at trade level which traditionally was carried out at Arborfield and Bordon but since 2015 the whole Corps is now based and headquartered at Lyneham in Wiltshire, near Calne at the old RAF station and where the writer is looking forward to visiting the recently opened REME museum.

The book is a most impressive piece of work which should be on the shelves of every public library and Pen and Sword, Military, are to be congratulated on publishing such a well presented book for just £30. However, apart from all former and current members of the Corps it will also appeal to all those readers with an interest in military history. Readers who are not familiar with "military speak" may be rather confused and irritated by the great number of acronyms. But do not despair. There is an Appendix which gives 16 pages of terminology!

John Anning

K-Class Submarines
the 'Kalamity' Class and the Suicide Club

A report of the Newcomen North East lecture by Geoff Horseman



HM Submarine K16 Image 70007 ©Imperial War Museum

Geoff Horseman, historian at the C A Parsons site in Newcastle, gave a lecture on the K-Class submarines of World War I. This was a story of tragedy and repeated errors, which led to much loss of life and was kept secret until the 1950s. Even today, it is not well known. In remembrance of the people who lost their lives and the families which suffered, it seemed appropriate to retell the story of their sacrifice in the centenary of WWI.

The K-Class were unusual steam powered submarines in which the novel engines were successful, but they otherwise suffered numerous design and operational errors, which resulted in many disasters. Over their brief service period these incidents resulted in the loss of over 200 lives, the worst tragedy being on 1 February 1918. As a result of the reputation that this class of submarine earned, it became known as the Kalamity Class and the submariners who crewed them, as members of the Suicide Club.

The speaker explained why these submarines were developed. Early in the war, observers reported that German submarines appeared to be capable of 19 knots while travelling on the surface, that was 3½ knots faster than British designs. Although report was incorrect, the Admiralty decided, nevertheless, to develop submarines which could achieve 21 knots in response to the German 19. First, they invested effort in the diesel engined J-Class, but this did not achieve the required speed. It was realised that only steam turbines could produce the power needed to meet the target. The K-Class was commissioned after joint trials with a French steam powered submarine (with reciprocating engines) and an experimental British turbine driven submarine, HMS Swordfish, where operating problems were experienced but lessons were not learned.

The K-Class submarines were designed in 1913 and first entered service in 1915. Twenty one K-Class vessels were ordered, of which 17 were made. The K-Class could reach speeds of 23 knots but were beset with many problems as was explained.

The required steam to supply the turbines was generated by two oil-fired Yarrow boilers. When the submarines dived, these boilers were shut down. Even though they were no longer running, the stored heat from the boilers raised the temperature inside a submerged submarine to almost intolerable levels. Large ventilation ducts had to be provided to enable the boilers to at least partially cool down before they could dive. These ventilators would then be sealed, but if they were not completely watertight, they could sink the boat. The procedure to seal and dive a submarine could take at least 5 minutes, where 30 seconds was the more usual requirement, leaving the submarines open to attack. In addition, the boilers often produced black smoke, which was hardly compatible with the submarines navigating unnoticed while on the surface.

There were many vents to seal, each of which relied upon only a single rubber O-ring to keep the water out. The two funnels had to be lowered into wells in the superstructure and also sealed. In addition, in early service, the crew did not physically check the vents were water-tight. Initially, they just relied upon an indicator light to show that a vent was closed. So, it was possible for foreign material, like a piece of sea weed, to obstruct the seal, which would then lead to water filling the boiler room and subsequently flooding the whole submarine. Supposedly watertight compartments were provided but speaking tubes and electrical wiring were routed through holes drilled in the bulkheads, so no part of the submarine was completely watertight. If water did get in, not only could it cause the submarine to sink to a depth at which it imploded or sat irrecoverably on the sea bed, but it could also extinguish the lights, start electrical fires and produce chlorine gas if the sea water reached the batteries.

The original submarine design had insufficient forward buoyancy, which caused many of the submarines to dive without the captain wanting them to! On one such occasion in December 1916, K3 submarine dived involuntarily and buried its bow at an angle in the seabed. At the time, Prince Albert (the future King George VI) was on board. Fortunately, people on the surface could see the plight of the submarine and summoned help. After 20 minutes the vessel was released and the future monarch was saved. K5 was less fortunate. It dived involuntarily in deep water off the Isles of Scilly and never resurfaced. All 57 members of her crew were lost. The remedy for this lack of front buoyancy was to add a swan bow which gave the vessel its rather distinctive outline, but this tendency was never fully cured. There were many other calamities that befell the K-Class submarines, which often resulted in crew fatalities.

That worst disaster, on 1 February 1918, became known as the Battle of May Island even though no enemy forces were involved and the title is an ironic one. This event was a Naval night exercise which involved half the British Grand Fleet sailing in line astern from Rosyth to join the other half of the fleet coming from Scapa Flow. The disaster occurred near May Island in the Firth of Forth and involved two light cruisers, five battle cruisers, three battleships and nine submarines at the front of the convoy. Since they suspected U-boats were waiting for them at the mouth of the estuary, they sailed at 20 knots, nearly full speed, so they would make a hard target for torpedoes. All vessels were blacked out apart from a single red light at the stern which was shuttered to restrict the light to a narrow $\pm 11^0$ field of view and radio silence was kept. With the aid of sequential diagrams, Geoff Horseman explained how the convoy was thrown into disarray with disastrous consequences. The fleet was unaware that requisitioned trawlers were sweeping for mines across their path, and were also blacked out. Once the risk of collision became apparent, ships and submarines steered to port and starboard in emergency manoeuvres. Since they were no longer in a single line, the red lights could not be seen and so ships and submarines started to strike each other. Some submarines sank immediately with total loss of life or were left floating with their hulls substantially severed or punctured with their crews standing on the deck or in the water. Those in the water could be mown down by the following ships. In the Battle of May Island, 104 people lost their lives, two submarines (K4 & K17) were sunk, another three submarines (K4, K6 and K22) plus HMS Fearless & HMS Inflexible were heavily damaged.

The Admiralty refused to accept that there was anything wrong with the design of the submarines and attributed everything to failings of the officers in charge, which was a great injustice. The submarines continued to be used until the mid-1920s when disarmament treaties led to the retirement of the class.

Geoff Horseman spoke in great depth on the K-Class submarines and all things 'turbine'. In answer to a question, he gave a short impromptu talk showing the engines of HMS Lion and other ships of WWI for example.

Above: Royal Navy submarine HMS K6 in Firth of Forth. Image 74870 ©Imperial War Museum
Below: K8 submarine looking forward. Image 73981 ©Imperial War Museum

On Teesside: The Newcomen Summer Tour

The five day Newcomen Society Tour to Teesside was novel in many respects. It was the first visit to Teesside by the Society and included a Saturday morning conference at the University of Teesside. Here there were talks on *Ammonia at Billingham*, on the *Cleveland Institution of Engineers*, *Building the Tornado* and *No. 2007 Prince of Wales* - Britain's most powerful steam locomotive. It was hectic with over thirty separate sites and events – not to mention the dinners. The hospitality from the hosts was remarkable and the welcome universally warm. The following reports consist of an extensive photo essay by Jonathan Aylen and David Blythe describing the full breadth of the visits on the tour and an in-depth article on the history of Cleveland's Innovative Engineers by Sue Parker. A further article will be published in the December issue.

Royal Naval Museum, Hartlepool and HMS Trincomalee

David Blythe

The tour began with a trip north of the Tees to Hartlepool. Here the Royal Navy have established a museum around a former shipbuilding dock, adjacent to the Museum of Hartlepool. The centrepiece of the site is HMS Trincomalee restored to her 1817 condition after long use as a training ship. A guided tour of HMS Trincomalee was provided by a member of the Royal Naval Museum staff, although Newcomen members on the tour also proved exceptionally knowledgeable on Naval matters.

Unusually, HMS Trincomalee was built in India. The frigate was ordered from the East India Company shipyard in Bombay in 1812 when Britain was at war with France. The ship was constructed by Jamsetjee Bomanjee Wadia, a master ship builder, (1792-1821) and a member of the Wadia family who had been shipbuilders since 1736. The family built a total of 15 ships for the Royal Navy featuring a trademark barley twist design. The vessel was made of Malabar teak at a time of shortage of oak in Britain. HMS Trincomalee took 17 months to build and cost £23,788 (equivalent to £964,160 in 2008). It was launched on the 12th October 1817 and arrived in Portsmouth on the 30th April 1819. The return journey cost £6,600 (equivalent to £276,672 in 2008). By this time, hostilities with France had long ended and the ship went into, 'ordinary', with its rigging and masts removed and moored with a cover over the top deck.

The ship was given its first commission in 1845 under the captaincy of Richard Laird Warren. HMS Trincomalee left Portsmouth on the 12th September 1847 with 240 officers and men to patrol the West Indies, Cuba and the Caribbean as part an anti-slavery patrol. In 1849, it was transferred to Newfoundland, Labrador and the St. Lawrence River. It was able to patrol areas not accessible to steam ships as it required no refuelling. The ship was recalled to Britain in 1850.

The outbreak of the Crimean War in 1852 led to the vessel's second commission under Captain Wallace Houston to protect the trade routes off the Californian coast from a base on Vancouver Island. In 1854, it received orders to destroy Russian ships in Kamchatkan waters, but saw no action. The ship was ordered home in 1856 and the crew was paid off in September 1857.

HMS Trincomalee was saved from the breaker's yard by a new owner, the wealthy Geoffrey Wheatley Cobb. He bought it to replace the training vessel HMS Foudroyant based in Falmouth and for a short time Milford Haven. Both naval and merchant seamen were trained as officers. The vessel was moved to Portsmouth in 1931 to work alongside HMS Implacable. The latter was decommissioned at the end of the Second World War and since its timbers were rotten, it was scuttled in the English Channel. The Trincomalee continued in its training role as HMS Foudroyant until 1986. It was moved to Hartlepool in 1990 where its hull was stripped out and an eleven year restoration process was commenced. A Siebert gun was used to survey and assess each timber.

The ship was built as a fifth rate frigate with 43 guns (a first rate frigate carried 120 guns, third rate 74 guns). There were up to 239 sailors on the ship.

The toilets, of which there are only two for the officers and crew were located on the stern and were known as, 'heads'. These are simple gaps in the ship's sides where sailors simply squat over the edge of the top deck. An old piece of rope was provided as a substitute for toilet paper and was hung off the ship.

The figure head is unusually male and is named, 'Jamsetchia'. The three masts: foremast, main mast and mizzen mast would have been of timber, but these have been replaced by steel to reduce the weight (some 62% of the ship's timber is original). The platform on the main mast was referred to as the, 'fighting top', from which muskets could be fired on the enemy. There are approximately 12 miles of sisal ropes in the rigging, all tarred for preservation. Hefty baling pins were used to secure the running rigging. These could also be used as weapons in the event of an attack. Sails and anchors were raised using a capstan, one located on the top deck and another on the gun deck below. Six to seven sailors would push on each wooden pole inserted into the slotted sides. The ship's compass was stored in the binnacle on the top deck. Decks were scrubbed using pumice blocks, referred to as, Bible, stones because of their size and shape. There are 43 guns of which only four are original (the remainder are made from fibre glass). They comprise 18, 32 and 9 pounders.

The captain's quarters are located in the stern and were guarded at all times by Royal Marines. A large dining table is centrally located, but areas are set aside for office work and a bed which is surrounded by curtains. For the most part, the captain worked at night, sleeping through the day. There are two toilets on either side of the stern. These are again simple over-the-side arrangements. The captain was equipped with a telescope and sextant. There are four gun ports: guns could be brought into the captain's quarters if the ship was under attack.

The guns fired a mixture of chain, grape and bar shot. A worm and sponge were used to clean out the barrel. A bag of powder was then inserted and pierced with a copper pin to spread the material. After inserting the shot, the firing hole was filled. Firing typically led to a recoil of about 0.60m, although each gun was secured by ropes to prevent further movement. The elevation of each shot was mainly achieved by the roll of the sea with only a small adjustment possible on the gun itself.

Each hammock on the mess deck was numbered. If a sailor died, 'his number was up'. Cannon balls were inserted at either end and the hammock was stitched up with the body inside. The last stitch was passed through the nose of the corpse. An open sick bay was located in the bow.

The mess tables were equipped with square plates ('square meals'). The crew ate mainly salted meat and fish, hardtack biscuits and small beer (4 pints a day for juniors, 8 pints for adults). This was brewed on board. The food ration was equivalent to 3,776 kcal per day (c.f. 4,000 kcal per day on a modern aircraft carrier). Lemon or cheaper lime juice was also served on a daily basis during the 19th century to prevent scurvy, but the ship's crew was reported as showing early stages of the disorder following lengthy commissions in the 1850s. Leftovers were used in stews. Personal belongings were kept in ditty bags hanging from the ceiling.

The officers' mess, which is of a higher standard, was used by lieutenants and warrant officers (including the bosun and gunners). Sailors could progress to officer status on merit.

The hull of the ship is double skinned. Approximately 190 tons of pig iron was used as ballast. The gunpowder was stored in a fully enclosed area lined with copper sheet to eliminate the risk of sparks. Lighting levels were kept to a minimum around the store ('not a glimmer of light').

HMS Trincomalee now floats in the dock where she was restored. Hartlepool has a tradition of ship restoration: HMS Warrior now at Portsmouth was restored in Hartlepool.

SABIC Olefins 6 SABIC's newly refurbished ethylene cracker – Olefins 6 – dominates the huge Wilton chemicals site on South Teesside. This former ICI site is now host to a range of chemical facilities and power plants. The overall site is run by Sembcorp who were our hosts for the visit. (image: Jonathan Aylen)

Energy from waste, conveyor system for bottom ash. Image: Jonathan Aylen

Electricity Generation at the Wilton Site

David Blythe

The Wilton chemical site is on the south bank of the River Tees. After an excellent orientation around the extensive site led by SABIC, members had the chance to see the new Energy from Waste Plant recently commissioned on the site which burns refuse from Liverpool to generate steam and power for the site.

Wilton 11 Energy from Waste Plant

The Energy from Waste Plant is jointly owned by Suez and Sembcorp and was commissioned in June 2016 at a cost of some £200 million. A tour of the plant was given by Phil Stevens, Plant Manager.

The Wilton energy from waste plant is one of a number operated by Suez in the UK. Others are located in Surrey, Suffolk, Kirklees, Cornwall, Isle of Man and Severnside and at two facilities at Haverton Hill, Teesside (lines 1-3 and 4-8).

The plant treats about 400,000-500,000 tonnes of non-recyclable domestic waste each year. It generates approximately 50MW of electricity and steam at three different pressures for distribution by Sembcorp around the Wilton site. The majority of the waste (80-90%) is imported by rail from a handling depot at Knowsley depot on Merseyside. The latter serves approximately 690,000 homes in the Merseyside and Halton areas. The waste is held in two 1,800 tonne bunkers and is then compacted and loaded into containers.

The rail journey from Knowsley to Wilton takes approximately 8 hours. Nine trains are received at the plant each week. The containers are unloaded and the waste discharged using special 'tilters'. Some waste is locally sourced and is imported using articulated road vehicles equipped with hydraulic ram dischargers. The contents are then mixed in two large concrete bunkers each of 10,000 tonne capacity and fed into two furnace hoppers using an 8 tonne capacity grab at a rate of 29-30 tonnes per hour. The waste in the hoppers is maintained at a pre-determined level and the feed will work automatically if required. The bunkers have a rectangular shape, but there are no major issues recovering waste material accumulated in the corners.

The waste feed from the hoppers is controlled using gravity and hydraulic rams. The furnaces are of German design by Martins GMbh. Air is forced through the grate using a large electrically driven fan and over the waste using a smaller installation. The waste takes approximately 4 hours to combust and this is carried out at a temperature of at least 850°C (typically around 1,000°C, but up to 1,110°C) to prevent the formation of harmful furans. Combustion is initiated by gas burners which cut in to maintain the process if necessary.

The imported waste material is subject to acceptance criteria and some has to be sent to landfill because it cannot be handled in the plant. This includes, for example, old mattresses whose metal springs tend to jam in the furnace grate. The heat content of the waste is variable and is partly dependent on the prevailing weather conditions: wet material provides less heat. The calorific value stands at around 10MJ/kg. The company is able to calculate a heat or energy balance for the plant based on the volume of waste incinerated, the steam produced and electricity generated. The overall efficiency of the plant is around 25%. Waste tends to peak after Christmas – discarded Christmas trees burn well.

There are two boilers each of which is equipped with superheater coils and economisers. (It is expected that the superheater coils will be replaced in the next 5-6 years.) These produce steam at around 140°C and at three different pressures for distribution and use on the Wilton site. Condensate is not returned to the plant because of the risk of contamination.

Steam is also delivered through two lines at a rate of 100 tonnes per hour, 60 bar pressure and 410°C to drive a 50 MW turbine. Electricity is generated at 11 kV, but is stepped up to 66 kV. The exhaust steam is cooled in a condenser and cooling tower and the water recycled.

The bottom ash, which presents about 25% of the initial weight of waste material, is cooled and then passed over a grizzly and magnetic separator to remove ferrous scrap. It is then conveyed to an adjacent facility operated by Ballast Phoenix for the further separation on non-ferrous metals and crushing and screening for use as an aggregate. The waste also contains large numbers of coins which survive the heat of the furnaces and are collected and cashed in. Other metal items are also picked up such as domestic iron and food cans.

Calcium hydroxide is used to remove acid gases such as nitrogen oxides, sulphur dioxide and hydrogen chloride. The waste material contains unreacted alkali which is sold to another company for further acid treatment. It is hydroscopic and needs to be stored in a dry fashion. Activated carbon strips out any metal vapours and dioxins, while bag filters are used to remove the dust particles. Plant emissions from the 60m high stack are monitored on a real time basis. Dioxin concentrations have to be monitored by sampling. The sampling and monitoring regime is checked by an independent party and the Environment Agency. Waste emission quality is subject to the Waste Incineration Directive.

The control room is equipped with a number of screens that provide data regarding, amongst other things, the stream flows and the distribution of heat and combustion in the furnaces.

Power for Chemicals

Electricity is generated for the major plants on the Wilton site at 11kV and distributed throughout the complex using one of the largest privately owned distribution systems in the world. This is owned by SembCorp Ltd. The system is connect-

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The crucial emissions filtration system and emission stack. Image: Jonathan Aylen

ed to the National Grid so that surplus electricity can be distributed using four National Grid owned transformers at 65kV and 275kV.

Oil, Gas and Coal Fired Power Station

The first Wilton Power Station was first constructed in 1951 and at its zenith in the 1970s reached a generating capacity of 300MW. At this time, it was burning waste from the chemical site, by-products such as: liquid petroleum gas, tars, waste lubricating oils, emulsion residues, waste from aromatic and olefin plants and hydrogen gas from the nylon plant. In more recent times, electricity has been generated using a combination of oil, coal and natural gas. A second gas turbine rated at 40MW was installed on the site in 2004 to replace the oil fired generator and the use of coal was ended about three years ago.

Wilton 10 (Biomass Plant)

Sembcorp's 33MW biomass plant (Wilton 10) is located alongside another Wilton Power station units. It cost £30 million to construct and commenced operation in September 2007. The biomass plant uses virgin, non-commercial and recycled wood from the Forestry Commission and other sources at a rate of about 150,000 tonnes per annum.

The plant relies on a computer based control system to monitor the grates. Image: Jonathan Aylen

Darlington Locomotive Works

David Blythe

In an impressive double act, Graham Nicholas of the A1 Steam Locomotive Trust spoke on *Building the Tornado and No.2007 Prince of Wales Steam Locomotive* and then acted as guide to the construction work in progress on No.2007. Their works are just one of many railway features in Darlington.

The Darlington Locomotive Works of the A1 Steam Locomotive Trust are located in the former Stockton & Darlington Railway carriage works constructed in 1853. The Works are in close proximity to Darlington North Station and to Skerne Bridge on the Stockton and Darlington Railway, and to Darlington Merchandise Station – the oldest single storey railway goods shed in the world. The A1 Steam Locomotive Trust is now building new railway locomotives at the heart of railway history.

Newcomen members were welcomed to the Locomotive Works by Graham Nicholas. He explained the A1 Steam Locomotive Trust had already built a Peppercorn A1 class locomotive no. 60163, 'Tornado', and has now embarked on its second project, the construction of a P2 class, 2-8-2 locomotive to be named, 'Prince of Wales', based on the original 'Cock 'o the North' engine. The original locomotive was scrapped in its rebuilt, Pacific form in 1960. Its new incarnation will be fitted with rotary valves in accordance with Nigel Gresley's initial design.

The frame of this new P2 class loco is largely complete in the workshop. The boiler will be constructed in Germany (as in the case of 'Tornado') and it will operate at 250 psi which is higher than the 220 psi used in the original P2 class. The steel foundry of William Cook is supplying the most important castings and the cannon boxes have already been delivered. The bearings have been purchased off the shelf from Timken SKF as they are fairly standard items and were used in BR's Class 37 diesel-electric locomotives.

The locomotive frame has been designed on the basis of 4½ and 6 chain corners which will give some flexibility. There is a story that locomotives were dragged round 2½ chain corners at the Doncaster works to test their suitability.

A donation was made to the Trust on behalf of the Newcomen Society by the current President, Robert Taylor. The £500 "dedicated donation" will be spent on part PS0624 - Intermediate coupled cannonbox, axle and bearing assembly for the 'Prince of Wales' locomotive.

The Locomotive Works building is also the home of the North-East Locomotive Preservation Trust. Here we were welcomed by David Crockit from Newcomen North-East. They carry out locomotive repairs at the Trust and a close inspection was made of a J72 0-6-0 tank engine no. 69023. This was in service on the BR network from April 1951 to October 1964.

Darlington North Road Station and Skerne Bridge

Darlington North Road Station. (Image: Jonathan Aylen)

David Blythe

Darlington North Road Station was designed by John Harris for the Stockton & Darlington Railway in 1842.The station was later extended. The booking office was used for the selling of tickets, the collection of house rents from railway workers, the payment of wages and the collection and delivery of parcels. The station buildings are now a museum, with the adjacent platforms in use for everyday passenger traffic. Various displays detail the development of Darlington, its associated railway works and the Stockton & Darlington Railway.

It took 3 years to build the 24 miles of the original Stockton and Darlington track. The first sod was cut by George Stephenson on the 23rd May 1822. The opening was delayed due to a bad winter in 1823 and the ceremony eventually took place in September 1825. One branch of the route included a wrought iron and cast iron bridge over the River Gaunless for horse drawn wagons. The Gaunless Bridge was replaced by masonry in 1901 and the original iron structure is now exhibited at the National Railway Museum in York. However the dramatic sandstone bridge designed to carry the Stockton and Darlington Railway over the River Skerne designed by Ignatius Bonomi remains in use today – the oldest working railway bridge in the world. This bridge was featured on the reverse of the £5 note from June 1990 until March 1993.

'Locomotion', was the first locomotive to operate on the railway hauling 33 wagons of coal, flour and members of the public on 25th September 1825. This together with the loco-

September 1818	Surveyor Overton recommends wagonway to run between Etherley Colliery (West Auckland) to Stockton via Darlington.
	S & D committee starts process for Act of Parliament. Estimated cost £124,000.
November 1818	Committee debates whether to construct a canal or railway. They decide upon a railway and estimate that they can achieve a 5% return.
	Second application to Parliament. Estimated cost £112,000.
December 1818	£80,000 raised by Darlington Quakers.
April 1819	S & D Bill defeated following objections from two landowners and the submission of incomplete plans.
July 1819	Overton carries out second survey avoiding disputed land. Bill submitted to Parliament.
January 1820	George III dies, Bill delayed.
August 1820	Overton's third survey determined a shorter route with a reduced cost of £92,000.
May 1821	S & D Bill passes committee stage.
	S & D Railway Bill becomes law. £100,000 raised - £20,000 in loans, £80,000 in shares.
	Stephenson suggests use of steam locomotives. Henry Pease (1807-1881), a Quaker, visits Killingworth.
July 1821	Committee approves the use of locomotives.
August 1821	New route surveyed, but parts of Overton's third survey adopted. Use of horse and locomotive drawn trains envisaged.
May 1823	Second S & D Railway Act. Use of stationary engines and locomotives for goods and passengers. Estimated cost £74,300.
1827	First recorded fatality on a railway; an unnamed woman. (William Huskisson killed on the Liverpool & Manchester Railway 1830.)
1863	Stockton & Darlington Railway becomes part of the North Eastern Railway.

The former "Merchandise Station", a single storey goods shed completed by Thomas Storey in 1833 . (image: Jonathan Aylen)

Skerne Bridge. (image: Jonathan Aylen)

motive, 'Hope', was ordered from Robert Stephenson & Co. in Newcastle. Several more locomotives were ordered due to the increase in traffic (No. 3, 'Black Diamond', and No. 4, 'Diligence', in 1826; No. 5 'Royal George', which was supplied by Timothy Hackworth in 1827; and No. 6, 'Experiment', in 1828). 'Locomotion', was retired in 1841 and sold to Pease's West Durham Colliery where it was used as a stationary engine powering a pump.

By 1833, the whole of the railway was locomotive hauled with formal timetables and signalling. The use of horses on the line was phased out by 1856. Stations were constructed at Shildon (1842), Egglescliffe (1853), North Station at Darlington (1863), Darlington (1833 using an old warehouse, but replaced by a purpose built structure in 1842).

The museum at Darlington North Road station houses a number of important exhibits including, 'Locomotion', a Tennant 2-4-0 locomotive (No. 1463) of 1885 and, 'Derwent', which is the oldest surviving Darlington built locomotive and was supplied to the S & D by W & A, Kitching, founders of Whessoe Ltd. in 1845. A chaldron wagon is also exhibited. The use of chaldron wagons was stopped in 1887 following a ban on all dumb buffered and unbraked wagons on main line railways. However, they continued to be deployed at collieries until the 1970s.

Next door to Darlington North Passenger Station is the former "Merchandise Station", a single storey goods shed completed by Thomas Storey in 1833 built of sandstone under a slate roof. It was extended as soon as 1839-40 when the square clock tower was added. Goods wagons entered through the north side of the building along a series of short tracks which extended across the width of the shed. The Newcomen Tour was fortunate to secure an impromptu visit to the interior of this remarkable early railway survival.

All in all, the area around Darlington North Station offers a fascinating grouping of structures from the first phase of steam railway development of world significance and deserves to be far more widely known. It is highly appropriate that locomotive building continues in this historic location.

Redcar

Built as part of an ambitious expansion plan by the British Steel Corporation, the Redcar Blast Furnace was one of the few furnaces in Europe with a capacity of 10,000 tonnes of iron a day. The photograph shows the separate combustion chamber stoves for heating the blast, conveyor belt charging to the bell-less top.The 50 Newcomen Society Tour delegates gathered for a photo opportunity in front of the now idle furnace. (image: Fred Starr)

The Leading Lady of Iron Ore

The North York Moors were a source of iron ore for Teesside blast furnaces. Janette Holt has led preservation efforts at Skinningrove iron ore mine where horses were used underground to move the ore to the surface. (image: Jonathan Aylen)

Hartlepool's Fresnel Lens

Hartlepool Museum has preserved an early Fresnel Lens from Hartlepool Heugh Lighthouse made in the UK by the short-lived Swinburne Company in 1845. Julia Elton explained the story of lighthouse optics during the Members Evening, focussing on this development by French physicist Augustin-Jean Fresnel. (image: Jonathan Aylen)

Tees Cottage Pumping Station

David Blythe

Tees Cottage Pumping Station is a large Victorian walled site immaculately maintained by a group of enthusiastic volunteers. The machinery still functions and the site is remarkable for having three different twentieth century power sources on one site, steam, a gas engine and a range of electric pumps. This was the last visit of the Newcomen tour on Teesside and the high point was the working gas engine.

It was established in 1849 to supply Darlington with water, but capacity was later increased to cover Stockton as well. It provided filtered water. Suspended solids were removed using gravel filters in large holding ponds, but there were no measures to treat the water for bacteria. The pumping station comprises a beam engine, two Lancashire boilers, a gas engine and associated producer gas installation and a number of electric pumps. An entirely new pumping and treatment facility, Broken Scar Treatment Works, is operated by Northumbrian Water plc. and is situated across the road from the Tees Cottage site.

The two Lancashire boilers are 28 feet (8.53m) long and 7 feet 6 inches (2.29m) in diameter and were supplied by a local firm - Teasdale Brothers, Engineers & Boilermakers, Darlington in 1902. Only one was used when the beam engine was operating. The second was kept warm as a standby. The fire extends about half way along the length of each boiler. The boilers take about a week to warm up. They had a running pressure of 100 psi, but presently operate at between 60-70 psi. The draught through the boilers can be controlled using a chain which moves metal plates that control the air flow through the chimney. The height of the chimney actually determines the amount of through flow and the Victorian engineers were particularly adept at calculating or judging the required height.

The water level in the boilers was controlled by a Cameron style steam pump dated 1849. This cannot be operated at the present time and the water is pumped using a Weir pump (G. & J. Weir, Cathcart, Glasgow) with a shuttle valve which has been brought from a factory in Darlington. A Hopkinson Deward safety valve will blow on the boilers if the water level is too low.

The two cylinder rotative, Woolf compound beam engine was also made by Teasdale Brothers to a design by Glenfield & Kennedy of Kilmarnock and in accordance with the instructions provided by T & C Hawksley, Civil Engineers, Westminster. It began running in 1904 and replaced an earlier machine in the same building. So it is actually a modern beam engine which helps explain the immaculate condition.

It has the following specifications:

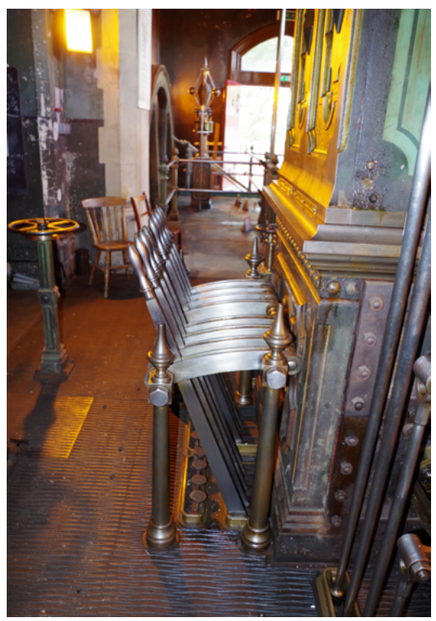
140HP	Working pressure 100psi
18in diameter high pressure cylinder	
29in diameter low pressure cylinder	
Woolf compound	Spray condenser
Stroke 5ft 3in	Stroke 7ft

River pump – simple lift 1900 gallons per minute at 30ft head

Tam pump – ram and bucket 25½in. diameter 6ft 0in. stroke.
1800 gallons per minute at 125ft head.
32in diameter, ram 23 inch diameter 3ft 6in stroke.

Speed 12-16 rpm. Porter governor.
Flywheel 21 ft diameter, 10in rim, estimated weight 14½ tons.
Crank radius 3ft 6in
Beam 30ft 3in long, 5ft central depth, estimated weight 25 tons.

The total cost of the beam engine, pumps and boilers was £10,550. The total estimated cost of the buildings, machinery and construction was £21,490. Even at that late date, the engine house was built with decorative stone dressings around the windows and a wooden roof structure hefty enough to carry the load of engine parts. An atmospheric workshop complete with tools adds to the appeal of the engine house.



Parallel Motion
(image: Jonathan Aylen)

A modern beam engine (image: Jonathan Aylen)

Two beam engines were also located in the building now occupied by the gas engine. The oldest part of the building, dated 1849, has openings in the ceiling to accommodate the larger machine of unknown size and capacity. The building was extended in 1853 and housed a smaller beam engine rated at 29 HP. Between 1854 and 1860 the two engines were operated independently. The larger engine was used to supply the Stockton, Middlesbrough & Yarm Water Company, whilst the other was operated for the Darlington Gas & Water Company. A connecting valve allowed both companies to assist each other in times of shortage.

The two cylinder gas engine was made by R. Hornsby & Sons Ltd., Grantham and Stockport and was put to work operating pumps made by Hathorn, Davey & Company of Leeds in 1914 via leather belt drive. The gas engine ran driving the original pumps throughout our visit. It is, perhaps, the largest working gas engine in Europe.

This large engine was originally supplied by suction gas. This was a mixture of water and producer gas created by passing steam over hot coke.

$H2O + C \rightarrow H2 + CO$

steam coke hydrogen carbon monoxide

$2C + O2 \rightarrow 2CO$

coke air carbon monoxide

The engine demand automatically regulated the gas production (i.e. it sucked through a variable amount of gas dependent on the load on the engine). The gas was passed through wet coke and mineral wool scrubbers. The reactor vessel was loaded with coke from the top. The use of suction gas did not prove successful and the engine was later powered using a piped supply of town gas. The complete "National Gold Medal Suction Gas Plant" survives next to the gas engine. A severe crack in one of the castings helps explain its demise – presumably due to an explosion.

A number of electrically driven centrifugal pumps were installed at the site in 1926 and continued in use until the site was closed in 1980. These are housed in a separate building. Some were supplied by Mackley Pumps of Gateshead and were driven by motors manufactured by the Lancashire Dynamo & Motor Company Ltd. at Trafford Park in Manchester. Some of the pumps were capable of delivering 1,100 gallons per minute for feed to a common pipe.

From 1926, neither the beam nor the gas engine was capable of driving the new pressure filters at the adjacent Broken Scar water treatment plant. Initially they were retained as emergency replacements for the electric pumps, but were later disconnected from the mains supply and the water re-directed into the filter ponds.

William Lanes brass foundry

The Newcomen Tour dispersed to visit three foundries, a wrought iron works and a heavy engineering shop. These ranged in scope from traditional to cutting edge technology. William Lanes brass foundry in Middlesbrough is a remarkable survival of a traditional craft foundry. Members watch sand moulds being prepared for casting.

Bridges

Middlesbrough Transporter Bridge

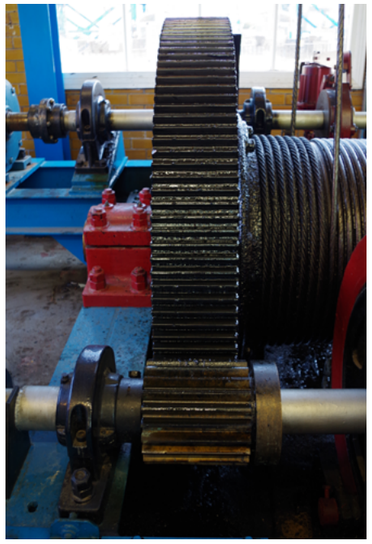
David Blythe

The Transporter Bridge dominates the townscape of Middlesbrough and we were fortunate to gain full access to the bridge and machinery, including the walkway above which ran from one bank of the River Tees to the other with stunning views. It once formed an important transport link for workers travelling between Middlesbrough and the foundries and other works in Port Clarence which employed some 4,000 people. Prior to its construction, the ferry, 'Hugh Bell' (named after a local iron founder and later Mayor of Middlesbrough) with a capacity of 827 passengers would convey people across the river, but because it could only turn round at a wide point on the river, it took some 60 minutes to complete the crossing. The ferry was replaced by, 'Erimus', which could carry an additional 150 passengers, but the need for a more convenient and reliable river crossing became ever more desirable. A number of options were considered by Middlesbrough Corporation: a swing bridge with an estimated cost of £279,100; a tunnel for £153,838 and a transporter bridge which at £67,195 was approved. This was an optimistic cost estimate and the actual cost was £70,000.

The approved scheme was promoted by the Corporation in 1906 and an Act of Parliament was passed in 1907. A contract for its construction was drawn up and six companies were invited to tender. The bridge was initially designed by the Cleveland Bridge Company. The 1879 Tay Bridge disaster led to its re-design and the contract for its construction was then awarded to Sir William Arrol & Company of Glasgow. This company had a good track record with cantilever bridges having worked on the Forth Bridge. The Middlesbrough bridge is a cantilever type.

Construction of the bridge started on both sides of the river. The foundations were excavated using caissons. The superstructure then took some 27 months to erect with the top part held under tension by cables. The anchor ropes and foundations extend some 70 feet (21.34m) to the bedrock on the south side of the river and 90 feet (27.43m) on the north side. These were secured using 6,000m3 of concrete and steel girders. The concrete was allowed to set over a 10 month period.

The gondola is suspended from wheeled carriages mounted on four rail tracks that extend along the top of the bridge. It is pulled along using two cables that extend from separate drums in the winder house. The cables are greased twice weekly. The winder has always been electrically operated, but was originally worked at 440V DC using open contact Westinghouse switchgear equipment. The openings in the winder roof allowed rain to fall onto the motors. In cold weather the grease became stiff and a fire was maintained close to the machinery to counter the effect. The new motors, which operate using alternating current, are sealed. Movement of the gondola was previously slowed using resistors on the motors and on occasion the piers were damaged by collision. A new drive system was installed on the 4th June 2010 by the Deritend Group, Middlesbrough to a design by Enigma FX and movement of the gondola is now electronically controlled. It can carry nine cars and the total travel time is about 2½ minutes.



The Middlesbrough transporter bridge has been fitted with new AC motors, but all the original DC drive equipment has been preserved including the motors and bus bars. The machinery can be readily seen in action from a viewing booth at the back of the winding house. (image: Jonathan Aylen)

Light carbon fibre boards allow visitors to walk from one side of the Tees to the other across the high-level gantry of the Transporter Bridge. (image: Jonathan Aylen)

The bridge has been fitted with new AC motors, but all the original DC drive equipment has been preserved including the motors and bus bars. The machinery can be readily seen in action from a viewing booth at the back of the winding house.

At the time of its construction, the bridge had an estimated design life of 75 years, but is heavily over-engineered. After it was officially opened on the 17 October 1911, by HRH Prince Arthur of Connaught, many workers chose to climb the 209 steps to walk over the top as the toll was half that for using the more direct gondola. In 1940, it became a landmark for the Luftwaffe during bombing raids. Some damage was caused to the winder house whilst another bomb impacted part of the wooden deck. This was subsequently replaced by steel. There was shrapnel damage on the winder house and Bridge Master's cottage. A Mr. Gettins was the first superintendent and remained in service until 1936.

Newport Bridge in a thunderstorm

A highlight of the tour was a surprise, after dark, lighting display at the Newport lift bridge accompanied by thunder and lightning! The Newport vertical lift bridge was built by local firm Dorman Long and opened in 1934. The flexible LED based display highlights a major engineering feature on Teesside that would otherwise pass unremarked. Choice of colour schemes range from the home team's football colours on match days to the red-white-and-blue of the Royal Air Force. (image: Jonathan Aylen)

The spectacular light show at Newport Bridge at Stockton took place in torrential rain. The show was specially laid on for Newcomen through a collaboration between Stockton Council Highway, Transport and Design Services and Stainton Lighting Design Services. Simon Milner, from Stockton Council got soaked along with the rest of us. His enthusiastic support was well beyond the call of duty! Stainton's also provided the after dinner technical briefing at Hardwick Hall. (Fred Starr)

(images: Jonathan Aylen)

Whorlton Suspension Bridge

The main wrought iron "chains" of Whorlton Suspension Bridge were thrown over the piers and moored into the rock on either side on 1st April 1831. A plaque at the north end of the bridge describes the opening on 7th July 1831. There was a procession of a band; the Architect Mr Green and the Committee of Management including Archdeacon Headlam, Thomas Harrison, Captain Dinsdale, the Reverend

William Potts, T. Wheldon and Cornelius Harrison; followed by a train of 27 carriages and numerous spectators on foot. This is a single track bridge with wrought iron suspension bars grouped in two layers of two each. The hangers are joined alternately from the top and bottom pairs of suspension bars so as to spread the load on the "chains". (images: Jonathan Aylen)

Teesside

Cleveland's Innovative Engineers



The founders: Jeremiah Head, Thomas Wrightson and Thomas Whitwell. images © CIE

Sue Parker

Founding of the Cleveland Institution of Engineers (CIE)

The Cleveland Institution of Engineers was founded by Jeremiah Head, Thomas Wrightson and Thomas Whitwell. The first meeting was held in the home of the first secretary, Thomas Whitwell, on September 21st 1864 and the motion was carried that:-

A society be formed, the object of which shall be meeting together at regular intervals, of the Engineers of the Cleveland District for the furtherance of the Science of Engineering.

Forty two members of the engineering community joined the Institution at the outset with a membership fee of one Guinea, which is equivalent to about £120 in 2018. When the CIE was founded the Founders were aged 29, 25 and 25 respectively, which is now classified as a Young Member! All three Founders went on to be President of the Institution:-

- Jeremiah Head in 1871 (aged 36)
- Thomas Wrightson in 1874, and again in 1915 (aged 35 & 76)
- Thomas Whitwell in 1876 (aged 37)

Jeremiah Head died in 1899, aged 64, and is buried in Highgate Cemetery in London. Sir Thomas Wrightson died in 1921 aged 82, and is buried at Erryholme, near Darlington. Thomas Whitwell was sadly killed in an accident at his works during his Presidency in 1878, at the age of 39. He was in the ash pit of a reheating furnace when there was an explosion[1] He was buried at the back of the Friends Meeting House in Dovecot Street in Stockton, which was sold in the 1970s, the gravestones removed, and tarmacked over as a car park.

CIE Archives

The Proceedings of the CIE were published in bound volumes from 1868 until 1942, and a full set is kept at the Teesside Archives. A partial 2nd set is kept at Middlesbrough Reference Library and both sets are available to the public. The Proceedings must have been taken down verbatim in shorthand, since the discussion after the lecture is included in great detail. It seems from the discussion after many lectures, that there was often hilarity, and political jokes. Many of the members were leading citizens of Middlesbrough, and some were politicians as well. Sir Thomas Wrightson was an MP later in his life. Handwritten Minute Books of Council meetings exist from 1864 to 2001. There is only one copy of these at Teesside Archives, and they provide a unique insight into the business of the CIE over 137 years. Handwritten minutes are an exercise in deciphering Victorian handwriting. Since 2001, Council Minutes have been prepared and circulated electronically.

The CIE has digitised the Proceedings, and made copies on CD available to Teesside Archives (and hence the public), and sponsors. They should be on the Institute of Materials, Minerals and Mining's digital library with public access by the end of 2018. The Minute books have been scanned by a volunteer at Teesside Archives, and are currently (2018) being formatted for publication.

Digitisation means that these valuable records are searchable. The Proceedings contain members' lists each year, so can be used for family history searches as well as engineering and industrial research. An Index of Proceedings from 1868 – 1942 is on the CIE website at http://www.iom3.org/cleveland-institution-engineers/cie-archives

The Archived Proceedings cover many topics of engineering, mostly:-

- Iron and steelmaking techniques
- Electricity and its application
- Steam generation
- Industrial relations
- Steel Analysis techniques
- Regular presentations from overseas visitors
- Visit reports by members to overseas works
- Patented inventions
- Civil Engineering – bridges, tunnels and dams

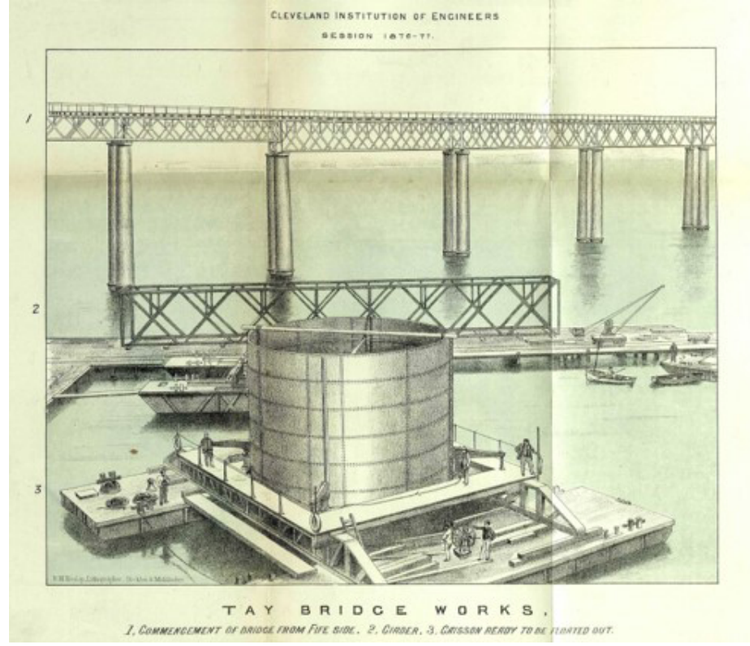
A delve into the Archives gives some interesting insights into the business of the Institution in bygone years including:

Hunnings Micro-telephone of 15th Mar 1880.

The invention was for improvements to the transmitters in telephones, invented by the Rev Henry Hunnings, it was made from carbon granules instead of solid carbon, and this produced a significant improvement in sound quality. The apparatus was demonstrated at the offices of Messrs. Stevenson, Jacques, and Co. on 15 March 1880, as part of a CIE meeting. Alan Swain of York has written a book on Henry Hunnings, with information from the CIE Archives[2]. He tells how Hunnings' transmitter went on to be the device of choice for the next 100 years. The British Post Office used Hunnings' transmitters until the 1980s. Hunnings was dismissed from his job and consequently committed suicide aged 43. He never knew of the success of his invention, and his life was one of hardship and poverty.

Tay Bridge Visit –15th Aug 1876

Hopkins Gilkes & Co were the main contractors for the Tay Bridge, and Edgar Gilkes had been President of the CIE in 1866. Fifty members travelled to Dundee and stayed in the Royal Hotel. They chartered the "...saloon steamer Forfarshire" "...gay with bunting of all colours" to sail out to the ongoing construction works. A band was provided on board, along with "a splendid luncheon" during a cruise up the river! They sailed alongside one of the caissons being towed out into the river and lowered into place.



This beautiful diagram of Tay Bridge Caisson is contained in the Proceedings. Image © CIE

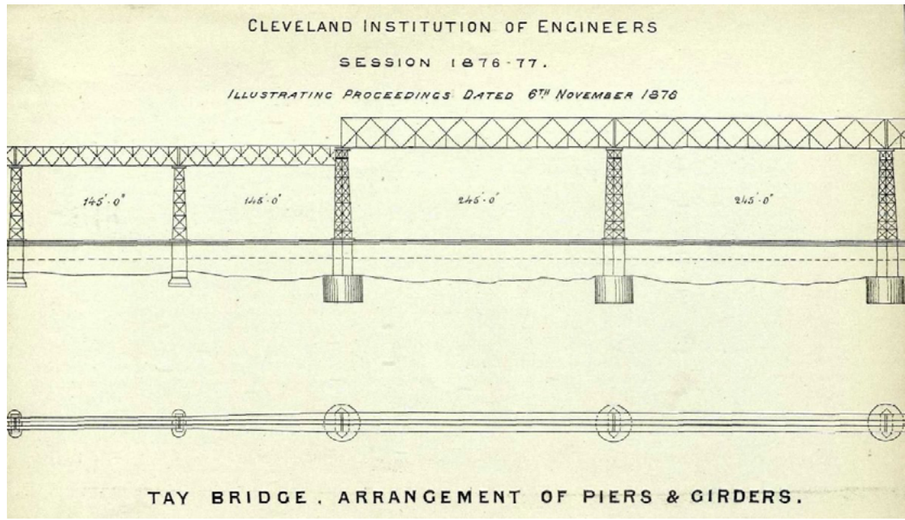
Tay Bridge Lecture on 6th Nov 1876

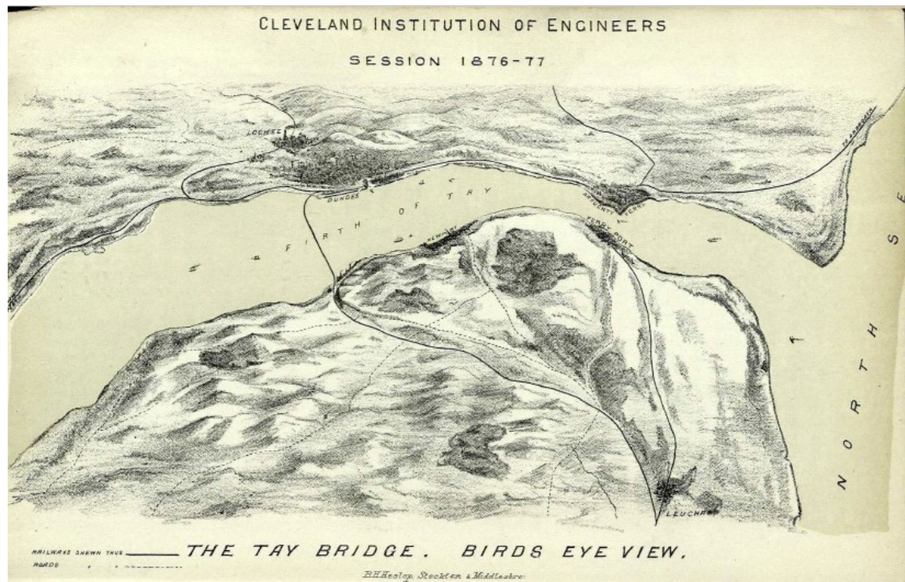
Edgar Gilkes, Hopkins Gilkes & Co

Edgar Gilkes presented a technical paper on the engineering of the bridge on 6th November 1876. This covered all the technical aspects of the design and engineering of the bridge. The first Tay rail bridge was completed in February 1878 to the design of Thomas Bouch, who was knighted. The Tay bridge was nearly two miles long, consisting of 85 spans and at the time was the longest bridge in the world. In 1876, this was the cutting edge of engineering in bridge construction.

Sadly at, 7:15 p.m. on 28 December 1879, the central navigation spans collapsed into the Firth of Tay at Dundee, taking with them a locomotive, 6 carriages and 75 souls to their fate. Sir Thomas Bouch was held chiefly to blame for not making adequate allowance for wind loading. Much has been written on the subject!

The present Tay Rail bridge has been built alongside the pier remains of Bouch's bridge, and the wrought iron girders which remained standing after the disaster were transferred onto the present bridge where they are still in use today.



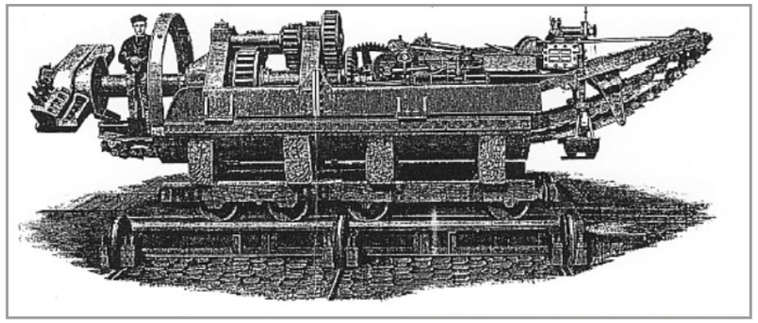


Tay Bridge Arrangement of Piers and Tay Bridge Location. Image © CIE

The Channel Tunnel on 22nd Jan 1883
by Colonel Beaumont, Westminster

Col Beaumont started his address by saying *The making of the Channel Tunnel is now no longer looked upon as impossible. The work has been begun, and at the present time we are in this position: My machinery is lying under the sea at the head of the Dover pier, about a quarter of a mile from the land, and our operations are stopped. The possibility of the enterprise is thoroughly proved...*

Col Beaumont and Captain English had designed a boring machine consisting of a rotating bore-head with changeable cutters rotating at 3 revs/min. Feed rate was ½" per rotation giving a rate of 1½"/min.



Col Beaumont's Tunnel Boring Machine.

Rates of 4 feet in 30 - 36 minutes, including stoppages were achieved. The intention was to have 2 tunnels of 7ft dia., one for each direction, which would be concrete lined to accommodate trains. The original estimate for the cost of the construction was £5m (£575m in 2018) and it was anticipated to take five years. Funding was not granted for the project due to fears of invasion via the tunnel. (In the 1980s we were more concerned about invasion by rats bringing rabies!)

The present Channel Tunnel consists of 3 tunnels, and took six years to build. It cost £9 billion (1985 prices, £26b in 2018). The completed project was opened by Queen Elizabeth II and French President François Mitterrand on 6 May 1994.

The Channel Tunnel photographed in 1988

Transporter Bridges – 11th Mar 1912
by Robert Anderson, Coatham, Redcar (engineer for the bridge)

The transporter bridge may be described as a horizontal railway suspended from or supported by a bridge spanning the waterway to be crossed, at such a height above the water level as will enable tall-masted vessels passing under the bridge at any state of the tide.

It cost £87,000 (equivalent to £9.7m in 2018), was designed by Cleveland Bridge and Engineering Co. Ltd, of Darlington, and was built by Sir William Arrol & Co., Limited, of Glasgow. Construction began in 1909, and it was opened on 17 October, 1911 by Prince Arthur of Connaught, grandson of Queen Victoria. Vintage film of this event can be found on the Internet[3]. Watch out for the man who falls off, and is helped up from the net by onlookers!

The paper describes many other types of bridges leading up to the reasons why Middlesbrough chose a transporter bridge. Transporter bridges elsewhere in the world were described.

Tees Transporter Bridge – 13th Dec 2011
by Dave Allen, Tees Bridge Historian

The Transporter's Centenary Celebrations

To celebrate the Transporter Bridge's Centenary, the CIE had another lecture on the subject. The construction, opening, and history of the bridge were described. It was designated a Grade II* Listed structure in 1985, and floodlighting was installed in 1993. Some details of the 19 other transporter bridges constructed were given, of which 6 were still working in 2011. Since then, a glass lift has been added, and the gondola replaced. The CIE have had 3 visits there, the most recent on 2nd March 2017, when the glass lift was in use. Dave Allen had written a book about the history of the Transporter Bridge[4].

The Transporter Bridge in 1912. Image © CIE

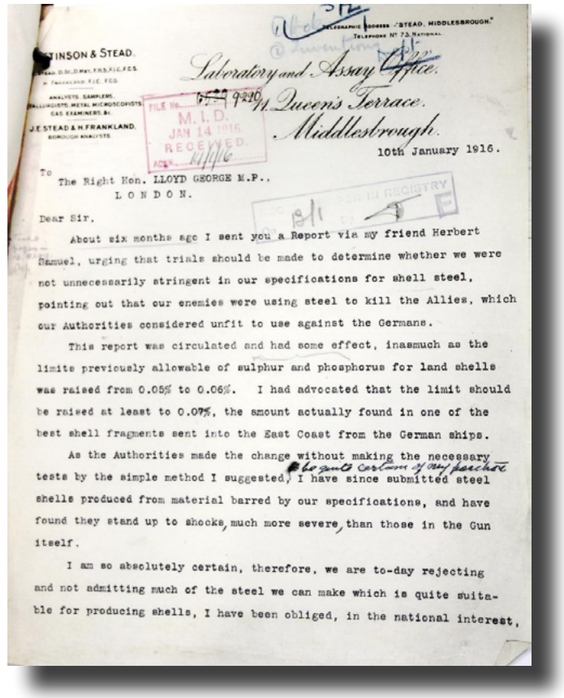
German Shells and the influence of certain elements on the physical properties of steel – 10th Jan 1916
by Dr John E Stead FRS, FCS, DSc, D Met, FIC MAIME

Dr Stead was perhaps the most significant chemist-metallurgist in British 19th century iron and steelmaking. The late Peter Scholes of the Cleveland Industrial Archaeology Society wrote a book about Stead in 2014; sadly he never knew about Stead's work on WW1 shells[5]. Stead's premises in Queens Terrace, Middlesbrough, still stand.

11 Queens Terrace. Image © S M Parker

Stead and others, had analysed fragments of German shells that fell on Hartlepool on 16th December 1914. Dr Stead wrote a letter to Lloyd George, Minister of Munitions, saying that the Germans were shelling us with steel that we considered unfit to use against them! Our composition levels for S and P and restrictive (Acid) steelmaking practice were making shell manufacture expensive and restrictive, which lead to a shortage of shells. There is a file in the National Archives at Kew detailing a long and drawn out saga, which is the subject of an entire lecture!!

To cut a very long story short, the Ordnance Board pinched Stead's idea, conducted their own trials, and concluded more or less what Stead had suggested. Sulphur and Phosphorus limits were raised, and Basic Steel was admitted in March 1917, 15 months after Stead's original suggestion. Stead was not acknowledged for the original idea and early work, he was completely ignored. Credit was given to F W Harbord who was awarded a CBE and made an Officer of the Legion of Honour.



TINSON & STEAD.
Laboratory and Assay Office.
11 Queen's Terrace.
Middlesbrough.
10th January 1916.
M.I.D. JAN 14 1916 RECEIVED
To
The Right Hon. LLOYD GEORGE M.P..
LONDON.
Dear Sir,
About six months ago I sent you a Report via my friend Herbert Samuel, urging that trials should be made to determine whether we were not unnecessarily stringent in our specifications for shell steel, pointing out that our enemies were using steel to kill the Allies, which our Authorities considered unfit to use against the Germans.
This report was circulated and had some effect, inasmuch as the limits previously allowable of sulphur and phosphorus for land shells was raised from 0.05% to 0.06%. I had advocated that the limit should be raised at least to 0.07%, the amount actually found in one of the best shell fragments sent into the East Coast from the German ships.
As the Authorities made the change without making the necessary tests by the simple method I suggested, I have since submitted steel shells produced from material barred by our specifications, and have found they stand up to shocks much more severe than those in the Gun itself.
I am so absolutely certain, therefore, we are to-day rejecting and not admitting much of the steel we can make which is quite suitable for producing shells, I have been obliged, in the national interest,

JE Stead original letter 10-1-16 page 1 published with permission from The National Archives

Presidential Address - 19th Nov 1917
by Mr J H Harrison

Mr Harrison apologised for not preparing a formal lecture, and went on to raise various issues, many of which are still relevant today:

- He encourages members to boast about the region
- He is trying to encourage new younger members to join;
- New development of industry on the North side of the river
- The area needs a better transport system, he describes the tram system as " .....a disgrace to any civilised community"
- Electricity was being generated from waste steam
- Heating and lighting of the town by coke oven gas
- Potash was being extracted from blast furnace gas (and presumably used as fertiliser)
- Waste heat from furnaces being used to raise steam
- A "proper" bridge across the Tees is required (Newport Bridge, opened 28/2/1934)

- Current campaign to "talk up" Middlesbrough
- We are still doing this!
- We are back to redeveloping the south side in similar manner
- STDC want to improve the transport infrastructure, and there are plans to improve Middlesbrough station with Virgin promising direct trains to London by 2020
- Electricity now being generated by domestic waste (CIE visit to Wilton W11 on 15/5/18)
- Sirius minerals are sinking a mine near Whitby to mine polyhalite
- Waste heat and CO_2 from ammonia manufacture is being used to grow tomatoes at Billingham (John Baarda Ltd)
- TVCA are looking into the feasibility of another Tees Crossing east of the A19

Sydney Harbour Bridge – 9th Oct 1924

by Dr J. J. C. Bradfield, MIME, Chief Engineer to the New South Wales Government, Australia

Construction started on 28th Jul 1923, and the bridge opened on 19th Mar 1932, so this lecture was given 15 months into the construction period. The Contract for the Sydney Harbour Bridge had been awarded to Dorman Long & Co. Ltd., Middlesbrough. Clearance for shipping had to be 170ft, (similar to the Forth Bridge), and the arch bridge decided upon was a much more rigid structure than either a cantilever or a suspension bridge, and would give better facilities for railway traffic, as the speed of the trains could be greater, with lower power consumption.

J Bradfield 1st train 19-1-1932

Sydney Harbour Bridge today

The tender of Messrs. Dorman, Long & Co. Middlesbrough, was accepted on March 24 1924 at £4,217,721 11s. 10d. (= £244m in 2018), and was for a two-hinged arch bridge of 1,650 feet span. 50% of the steel came from Australia, that from Dorman Long being beyond the capability of the Australian mills. Fabrication was to take place in Australia. The erection of the world's largest arch span of 1,650ft. was watched with intense interest by the engineering profession the world over.

Today the bridge still carries

- Bradfield Highway (8 lanes)
- North Shore railway Line (2 tracks)
- 1 Pedestrian way
- 1 Cycleway

In Conclusion

Are the aims of the CIE much different today?

- We aim to bring prestigious lecturers at the forefront of engineering
- We aim to promote dialogue between industry leaders
- We aim to provide young engineers access to a variety of contacts and information
- "Engineering" covers so much more today, and CIE tries to reflect this

Details of CIE lectures can be found on:-
www.iom3.org/cie/events

References

1. "The Engineer" Aug 9th 1878, p91
2. Rev. Henry Hunnings MA, Inventor of the carbon granule telephone Transmitter by Alan Swain, published by Quacks Books, York, ISBN 978-1-904446-91-0
3. (https://www.youtube.com/watch?v=rjsMgjueumU
4. The Transporter, 100 years of the Tees Transporter Bridge by Dave Allan, published by Middlesbrough Council, ISBN 978-0-86083-089-6
5. Metallurgist of Distinction, A biography of John Edward Stead FRS by Peter H Scholes, published by The Cleveland Industrial Archaeology Society, ISBN 978-0-905728-08-7

Congratulations!

The orgainsers
of the Teesside Summer Tour,
Fred Starr and Jonathan Aylen
shake hands
at the conclusion
of the very succesful tour.

Guidelines for the Care of Larger and Working Historic Objects
Seminar, Wenesday, 21 November

John Porter writes:

Robert Taylor mentions this valuable update of these Guidelines in his Presidential Notes in Newcomen Links. ABTEM have arranged two well-received presentations of the document at Bristol and Sheffield and there is now a further opportunity in London.

The London Museum of Water and Steam will host an all-day presentation on Wednesday, 21 November. There will be talks in the morning in the comfortable auditorium of the Musical Museum, five minutes walk from the LMWS's Kew Bridge site in Brentford. Lunch will be at LMWS followed by case studies of three of the Cornish engines pumping engines, none currently workable. Indeed, we at LMWS have recently been learning the hard way what the 'care' of working historic objects involves.

The climate for what was acceptable in conservation terms, and the regulatory regime for safely operating steam plant, has greatly changed since those heady early days. Indeed, the Health and Safety at Work Act was passed in 1974 while work was in progress to adapt the old pumping engine to operate in very different conditions from its working days. This Act, alone, has had a great impact on what can, and can not, be achieved nowadays.

The new Guidelines are another major step forward in aiding the task of conserving, restoring and maintaining these historic relics in such a way that their future is assured, together with that of their organisation and its members.

The occasion should appeal to all those who operate, or aspire to operate, large stationary steam engines as visitor attractions.

There will be space for all interested on
Wednesday, 21 November,
The Musical Museum and London Museum of Water and Steam,
Brentford, TW8 0EN, West London.

See ABTEM at: www.abtemguidelines.org
for information about the Guidelines and details of the seminar as they are confirmed.

The Newcomen Society Calendar

2018/19

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

London

@NewcomenSoc

Lectures are held in the The Dana Studio, Wellcome Wolfson Building, 165 Queens Gate, London SW7 5HD, unless specified otherwise. Time 17.45. Visitors welcome, admission free.

10 October at 75 Cowcross St, London EC1M 6EL Professor David Perrett: Henry Ford's Holiday in 1928

14 November Dr Fred Starr: The oxidation of metals; its impact on civilisation, ancient and modern

12 December Alan Hayward: William Marriott: engineer of a Norfolk railway and pioneer of reinforced concrete

2019

9 January Bernard Espion: The 'Vergniais' bridges

13 February Robert Taylor: Presidential Lecture

13 March Ben Marsden: W J Macquorn Rankine's early years

10 April Simon Jump: From Peenemunde to Dortmund via Korea: A history of the Corporal Missile

8 May Richard Byrom: Fairbairn

Midlands

@Newcomen_Mid

Meetings are held in the Thinktank Lecture Theatre, Level 2, Birmingham Science Museum, Millennium Point, Curzon Street, Birmingham, B4 7XG (for Sat Nav, use postcode B4 7AP) Time 19.00. Visitors welcome, admission free.

3 October Dr Bryan Lawton: The R101 Disaster and the Broken Elevator Cable

7 November Ivor Lewis: Development of the Engineering Drawing Office

5 December Jonathan Aylen: Aspects of Steel Making

2019

2 January Jim Andrew: The Cobb Land Speed Record Car

6 February Dr Elizabeth Bruton: Opportunities for Women in Wireless Telegraphy during World War One

6 March Russell Thomas: The History of Gas Manufacture in the U.K.

3 April Mike Potts: The Early History of the Newcomen Engine

North East

Meetings in the Carpathia Room, Tyne & Wear Discovery Museum, Blanford Street, Newcastle upon Tyne NE1 4JA Times vary. Paid parking available on site.

9 October, 18:00 Dr Leona Skelton:The Battle for a Grand and Deep River,The Tyne Improvement Commission's Visionary Engineering Work, 1850 - 1968

13 November 2018, 14.00 Robert Taylor; The Presidential Address

2019

12 February, 14.00 Joint Meeting with the Institution of Civil Engineers NE Region. Dr Miles Oglethorpe: Sir William Arrol & Co Ltd

9 April, 18.00 Jonathan Aylen: Cold War to Coal Trains - TOPS, British Railways' First Computer Based Train Operating System

Newcomen Links

Copy dates for Newcomen Links

1 November for December

1 February for March 2019

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

North West

Meetings are usually held at the Museum of Science and Industry (MOSI), Liverpool Road, Manchester M3 4FP at 18.30-20.15 unless specified otherwise. Visitors welcome, admission free. Members meet at a nearby restaurant from 17.00.

25 September 18.30, MOSI. Regional AGM followed by Peter Reed: George E Davis and the Dawning of Chemical Engineering in Britain. The founder of the Chemical Trade Journal who taught at Manchester Technical College - the foundation of chemical engineering in Britain

20 October A one day Symposium on Salt at Lion Salt Works in Cheshire. Booking essential, see page 25 for details.

30 October Venue to be announced. Dr Robert Pleming: Vulcan to the Sky - the legendary Avro Vulcan

27 November 18.00, MOSI Joint Meeting with Computer Conservation Society. Jonathan Aylen: Cold War to Coal Trains - TOPS - British Railways' first computer based train operating system. How computers helped transform British Rail from a craft based industry to modern management

2019

29 January 18.30, MOSI. Bob Bowden: It's not just about the robot! The development of automated welding

26 February 18.30, MOSI Joint Meeting with the Stephenson Locomotive Society. Dr Michael Bailey and Peter Davidson: Learning Through Archaeology: Killingworth Billy

28March 18.30, MOSI Joint with the Institution of Structural Engineers. Dr Ralph Harrington, Bulldozers

30 April 18.30, MOSI Dr Victoria Owens: Lady Charlotte Guest at Dowlais, 1833-55: how a pioneering Victorian businesswoman came to head the world's largest ironworks

Scotland

Calendar tbc

South Yorkshire

@NewcomenSY

Meetings usually held at Kelham Island Museum, Alma Road, Sheffield S3 8RY at 18.30-20.15, unless otherwise indicated. Visitors are welcome and lectures are free. Free parking at Kelham Island Museum for up to 40 vehicles. This is split between the onsite parking and the Museum car park next to the Fat Cat pub. There are 3 accessible spaces at Kelham Island Museum.

24 September David Boursnell: Armour for the Grand Fleet. The role of Sheffield companies in making the face-hardened steel armour for the British Fleet that fought at the Battle of Jutland.

22 October Professor Roderick A Smith: A history of metal fatigue and the development of an understanding of what it is and why it still causes problems

26 November Dr David Dulieu: The Engineer and the Metallurgist defeat Heat, Corrosion and Cold - 50 years of technical applications of stainless, heat and corrosion resistant high alloy steels 1913 - 1963

2019

28 January Julia Elton: Who Designed the Clifton Suspension Bridge - Fact and Fiction. Construction of I K Brunel's Clifton Suspension Bridge was abandoned in 1853 and not completed until 1864 to a different design developed by Sir John Hawkshaw and W.H. Barlow.

25 February Dr Gillian Cookson: The Age of Machinery – Engineering in the Industrial Revolution

Tbc March Holiday Inn Royal Victoria, Sheffield (Date and speaker to be confirmed). The Ken Barraclough Memorial Lecture

22April Region AGM followed by Chris Hodrien: Steam below sea- the Royal Navy K Class steam turbine submarines of WW1

Southern

The meetings are planned to be held at the University of Portsmouth at 18.30. Toom and building tbc

16 October Paul Jackson: Refurbishment of Hammersmith Viaduct

20 November Duncan Redford: Development of Fleet Submarine 1910 - 1918

11 December TBC

2019

15 January TBC

19 February Tim Shaw: HMS Warrior 1860

19 March Martin Gregory: Twyford Water Works 'Return to Steam' Project

April / May Robert Taylor: Presidential Address

Western

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

18 October David Hardwick: Surveying the UK's oldest complete Newcomen Engine House, Brislington, 1740

15 November Chris Hodrien: Synthetic Natural Gas (SNG) Technology

2019

10 January meeting at BIAS. Two speakers tba.

21 February John Burrows: Chepstow Bridge (1816) and John Rastrick

21 March Stephen Jones: Rise and Fall-Steam and the Suspension Bridge

18 April Don Hillman: Severn Bridge

16 May John Anning:SS Xantho and the Penn Engine

NEWCOMEN
The International Society for the History of Engineering and Technology

The White Salt Industry: Production, Transport and Impacts

Saturday 20 October 2018

A one day Symposium on Salt at Lion Salt Works in Cheshire.

Booking essential:

www.eventbrite.co.uk/e/the-white-salt-industry-production-transport-and-impacts-tickets-48463864724

A Symposium

THE WHITE SALT INDUSTRY: PRODUCTION, TRANSPORT AND IMPACTS

Why is there salt in Cheshire? How is it extracted and turned into "white salt"? How did - and does - it reach the customers? Speakers with a wide knowledge of their subjects will address these and related questions.

SATURDAY, 20 OCTOBER 2018
10.45 - 17.00

LION SALT WORKS, OLLERSHAW LANE, MARSTON, NORTHWICH, CW9 6ES
(Free Parking available on-site)

ENTRY £25.00

includes coffee and buffet lunch

Entry by pre-booking only
Bookings open from 1 Aug 2018
on eventbrite.co.uk

NEWCOMEN
The International Society for the History of Engineering and Technology