

# HMSNEWS

## Historical Metallurgy Society

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Winter 2000/1

### Forthcoming events

**The HMS Annual General Meeting will be held on Saturday the 19th May in Rotherham** at the premises of London & Scandinavian Metallurgical Co Ltd. It is intended to have a presentation of LSM's new catalyst plant after the AGM. Following lunch there will be an opportunity to visit MAGNA.

Peter King will lecture to **the Newcomen Society** at 7.p.m. on **March 7th** on "Sir Clement Clerke and the adoption of coal in Metallurgy". It will deal with iron, copper and lead in Dudley, Bristol and Putney etc. There will also be evidence of iron being made with coke at Coalbrookdale in the 1690s. This is part of the Newcomen Society's regular lecture series in Birmingham, to which non-members, are welcome. These are currently held in the lecture room at the Birmingham Science Museum in Newhall Street, but there is doubt about the actual venue, because it is to be demolished. Anyone interested should contact nearer the time by e-mail peterkingiron@Yahoo.com or telephone 01562 720368.

**The HMS Annual Conference will be based in Northamptonshire over the weekend of 14th to 16th September**, it will be termed "**Iron and Steel**". Booking forms and particulars for both HMS events will be included in the Spring Newsletter.

### Sign up for Slag Days

English Heritage Centre for Archaeology (incorporating the Ancient Monuments Laboratory) will be holding a series of Slag Days at different locations across the country from Mid-February through to April 2001. Anyone interested in learning to identify the archaeological remains of metal and glass working should contact the Ancient Technology for details: English Heritage, Centre for Archaeology, Fort Cumberland, Fort Cumberland Road, Eastney, Portsmouth, P04 9LD. Tel. (02392) 856700.

### Applications for grants

Applications are invited to the R.F. Tylecote Travel Fund and the Coghlan Fund. Application forms may be obtained from Michael Cowell, Hon. Treasurer, Little Gables, 17a Thorncote Road, Northill, Beds .SG18 9AQ. Forms should be submitted by February 12th 2001. E-mail mcowell@british-museum.ac.uk. Forms are also on the HMS web site - inst-met Ovg.

### CORNISH TIN

#### Tin mining days may not be over

The Western Morning News reported in June that the owner of South Crofty is negotiating with a locally-based company that wants to buy the site and reopen it as a tin mine.

South Crofty plc, owned by David Giddings, sent out a brief statement saying that confidential talks were taking place with Baseresult Ltd, and that the company would be asking Cornwall County Council for an extension of planning permission to use the area as a mine. The talks involve the purchase of all land and buildings at South Crofty, which covers an area of 60 acres.

Baseresult also wants to buy the processing equipment at another former tin mine - Wheal Jane, at Baldhu, near Truro, which is the site of South Crofty pi's offices. Former miner, Mr Kaczmarek said Baseresult had identified large areas of unmined tin and was planning to pump the water out gradually, while working higher, dry levels.

Involved in Baseresult are Kevin Williams, former mine manager at Geevor, David Stone, former chief engineer at South Crofty, and Alan Reynolds, a mine surveyor at Geevor and Crofty; director is Charmian Lark. It is understood that the South West Regional Development Agency wants to buy the Crofty site, and has multi-million pound plans for the area.

### WEALDEN IRON

#### Wealden Iron Research Group

Jeremy Hodgkinson sends news of the latest volume of *Wealden Iron*. WIRG has been flourishing for thirty years and is still finding plenty to do and write about.

Several discoveries of early ironworking sites are included in the Field Notes of the latest Bulletin of the Group (**Wealden Iron, 2nd series Vol. 20, 2000**). Bloomery sites dating from the late Iron Age and Romano-British periods have been identified at **Waldron** and **Buxted** in Sussex, and undated sites have been found at **Nutfield**, in Surrey, **Egerton** and **Pluckley**, in Kent, and at **Forest Row**, **Withyham** and **West Hoathly**, in Sussex. The discovery of evidence of early-Medieval ironworking at **Mersham**, Kent, prior to construction of the Channel Tunnel rail link is also reported. There are also reports of the sectioning of the London-Lewes Roman road, and on evidence for a bloomery site near **Ightham Mote**, in Kent.

More substantial articles include a description of an unusually crystalline, fayalite slag from a Romano-British bloomery near

**Heathfield**, Sussex. Two bloomery sites on the northern edge of the Weald Clay formation, near **Bletchingley**, Surrey, have provided the opportunity for the identification of a hitherto unrecognised band of iron ore in this stratum. Surface evidence of re-filled minepits on the dip-slope of a minor escarpment was revealed after wet weather left shallow patches of water in the hollows formed by the settled contents of the pits. The standard reference work on Wealden iron, Cleere and Crossley's *The Iron Industry of the Weald*, includes gazetteers of Roman and post-Medieval water-powered sites, but not of Medieval ones. An article rectifies this situation with locations, references and brief descriptions of 33 sites recognised to date.

The landscape of the 16th-17th century **Iridge furnace**, near **Hurst Green**, Sussex, including a survey of the furnace site, is described, particularly in relation to the water management system of the estate in which no less than 30 ponds supplied water to sustain the furnace campaigns. Land was purchased prior to the building of the furnace to ensure that the whole water system was under single ownership and control.

An intermittent series of articles on the dealings between Wealden gunfounders and the Office of Ordnance is concluded with an examination of the demands placed by the government on gunfounders during the First Dutch War. The monopoly of gun production held by the Browne (and Foley) family was weakened by the exigencies of war, and occasioned the emergence of Nathaniel Powell, whose activities as a gunfounder, albeit still lacking in some important detail, have been unrecognised hitherto.

**The volume concludes with a quinquennial index. It is the intention of the Group to publish a cumulative index of all the volumes of Wealden Iron since 1969, later this year.**

For information about WIRG contact the Chairman, Jeremy S Hodgkinson, 3 Saxon Road Worth, Crawley, Sussex RH10 7SA or phone +44/0 1293 886278.

E-mail [Jeremy.Hodgkinson@ukgateway.net](mailto:Jeremy.Hodgkinson@ukgateway.net)

## THE TREVITHICK SOCIETY

HMS has received Newsletter No 110 for August 2000 and Journal No 27 2000 from The Trevithick Society. Bill Newby has recently been awarded an MBE in recognition of his services to Industrial Archaeology; he was, for a number of years Hon. Secretary to the Society and more recently has been President of the Trevithick Trust. The Newsletter gives news of the Trevithick 2001 Project concerning the construction of the Camborne locomotive. There is also an article on *William Brunton of Calceiner Fame and his son William*.

Journal No. 27 (2000) contains articles on *The Severn Tunnel Pumping Engines*, *St. Michael's Mount Tramway*, *Chaos on the cliffs: a history of Morvah Consols Mine*, and *An insight into the working of the chipping department at Harvey's Foundry 1851-1856*.

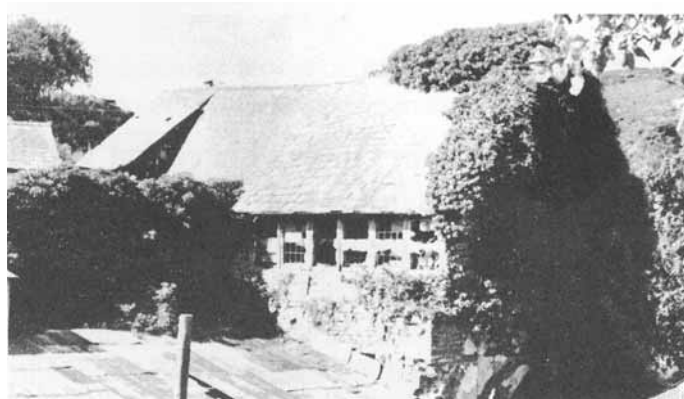
A single subscription for the Society is £15 annually. For further particulars contact the Hon. Secretary, Tony Brooks, Polstrong Cottage, Polstrong, Camborne. TR14 OQA. Tel. 01209 713506. (An index to Volumes 1 to 27 [1973 to 2000] is also included.)

## GUNNS MILL

**First steps taken to save early blast furnace.**

*Our last news of Gunns Mill appeared in HMSNews No 30 Summer 1995.*

Gunns Mill Blast Furnace, Mitcheldean, Gloucestershire, built in the 17th century and reputed to be England's earliest surviving complete charcoal-fired blast furnace will be saved from further decay following English Heritage's erection of external scaffolding to make the building weather tight.



*Gunns Mill in 1964*

The move follows an agreement reached between English Heritage and the owner of Gunns Mill, Mr W Parker, to allow English Heritage access to the site. A Grade 2\* listed building, Gunns Mill is in a perilous state and is on the English Heritage Buildings at Risk register.

Dr Kevin Brown of English Heritage said: Gunns Mill Furnace is a key element in the industrial history of the Forest of Dean. It predates the Victorian Bessemer industrial furnaces by over 150 years and is the only visible example of its kind remaining in this area. Its preservation is crucial. We are very keen to hear from any organisations and members of the public who are interested in becoming involved with its regeneration.

Mr W Parker, the owner of Gunns Mills said, "I am delighted that the importance of this striking building is being recognized by English Heritage, and hope that their recognition of its significance in illustrating the history both of the British iron industry in general and the Forest of Dean in particular will ensure its conservation. That is why I bought it in the first place, so this is something of a dream come true".

Gunns Mill is a Scheduled Ancient Monument and archaeological studies are currently being undertaken to provide a more detailed understanding of the site. They will determine what future uses would be appropriate for the building and surrounding site. English Heritage are working in partnership with the owner Mr Parker and the local Authority will look closely at any viable proposals which offer to re-use the buildings and benefit the local community.

1. For further details on plans to regenerate Gunns Mill Furnace please write to Tim Steene at English Heritage, 29/30 Queen Square, Bristol BS1 4ND.

2. The blast furnace existed in England in its more advanced modern form by 1496. Its first commercial application in the iron rich Forest of Dean occurred in the early 17th century, when William Herbert, Earl of Pembroke obtained grants for their use. It was not until 1855 that Sir Henry Bessemer (1813–1898) perfected the blast furnace process and invented the Bessemer converter.

## **Iron Production in the Forest of Dean**

### *Historical note*

The Forest of Dean was Britain's leading area of iron production in medieval times and remained very important until the eighteenth century, when reduced timber supplies and the development of new technology using coke instead of charcoal reduced its advantages, since the local coals were unsuitable for coking.

Gunns Mill situated between Mitcheldean and Littledean had easy access to charcoal, iron and water-power from Westbury Brook. The furnace worked on the principle that when air was blown through a mixture of burning iron ore and charcoal, the smelting temperature was raised and a high yield of iron was produced. The pair of bellows was driven by a 22' diameter water wheel; it took approximately one and a half tons of charcoal to produce one ton of pig iron.

Iron production on the Gunns Mill site, previously a corn mill, began as early as 1629 and continued until the 1730s. The local industry began its decline when the navy's demand for timber to build their ships conflicted with the needs of iron production and the vast timber supplies for charcoal needed by the mills were restricted. A measure of the Forest of Dean's importance was demonstrated in 1629, when 610 ship guns were ordered by the crown on behalf of the States General of Holland.\* By 1640 some 11 furnaces were recorded and in their hey day the furnaces would have operated day and night employing a significant labour force.

In 1743 the site was converted into a paper mill and the large water wheel continued to power much of the machinery on the site. A substantial half-timbered building was erected on top of the blast furnace, giving the structure its present remarkable form. Originally linen or cotton rags would have been used to make the paper but as paper making processes grew more advanced in the 19th century wood fibres were used. However, the chemicals used were harsh and in 1879 Sir Thomas Crawley complained that pollution from Gunns Mill was killing the trout in the stream.

The paper factory closed in the 19th century and was subsequently used as a farm building. It had become thoroughly derelict by the 1950s and its condition has caused concern ever since. In an attempt to preserve the property Mr Parker purchased it in 1993 and carried out various emergency repairs, but was unable to prevent a continued decline in its condition.

*\* This information was sent in by Tim Smith, who noting that the spelling of Gun's Mill had reverted to the double 'n' as used in the early days, consulted Ian Standing who felt it was probably more correct as there is no evidence that guns were ever cast there. However I have, personally, to admit that when one sees the circumstantial evidence laid out by Nicholls in his*

*"Forest of Dean" in 1858 the case/or believing a Gunn's Mill founding is very tempting — "In 1621 Messrs Chaloner and Harris appear to have succeeded to the works under a rent of £2,000, and who, we may presume, cast the 610 guns ordered by the Crown on behalf of the States General of Holland in 1629. The spot where they were made was, it would seem, ever after called 'Guns Mills'. It certainly was so called as early as the year 1680, an explanation of the term which is confirmed by the discovery there of an ancient piece of ordnance. 'Guns Mill' was the place where they were afterwards shipped".*

*Editor.*

## **GENUINE WROUGHT IRON**

Chris Topp, Carlton Husthwaite, Thirst, North Yorks YO7 2BJ, Director of **The Real Wrought Iron Company** is, as far as we know, the sole world supplier of genuine wrought iron. He now has a website [www.realwroughtiron.com](http://www.realwroughtiron.com) which has information on history, restoration, availability, working techniques, specification advice etc. Also there will shortly be a web site for Chris Topp & Co (specialist in historic and bespoke ironwork) which will be linked to The Real Wrought Iron Company site.

## **Samples from Maryport Furnace.**

Allan Banks FIM. FIBF of 11 Heather View Avenue, Dove, Sheffield S173DJ contacted us recently regarding some material samples obtained from Maryport Furnace (1752–1783) during investigations into its "demise" in 1963. He was seeking "a safe and logical haven" for the samples and we can report that owing to the good offices of HMS Conservation Officer Dr. S. Mossman they have now been taken into the care of the Materials Science section of the Science Museum, London.

## **ARCHAEOLOGICAL METALLURGY**

### **Medieval iron production and working in the Western Urals**

Vladimir Zavyalov of the Russian Academy of Sciences' Institute of Archaeology directed a project on "The History of Ancient Udmurt Blacksmiths' Craft" which has examined the archaeological sites and metalwork of these inhabitants of the Western Urals from the tenth century AD. The excavated sites along the Chepsta River have produced remains of iron smelting furnaces and smithing hearths as well as much slag, many finished iron bars, tools (including hammers, tongs, anvils, chisels and grindstones) and products (including weapons and domestic items). The greatest centre for the production and working of ferrous and non-ferrous metals in the region was the fortified settlement of Idnakar. Bog ores, of low quality but easily accessible from the surface, were available along the

bank of the Chepsta River. Bloomery shaft furnaces appear in the tenth century, although pit furnaces of earlier date were also found on the sites.

Metallographic examination by Dr Zavyalov has revealed the wide range of techniques and high level of skill of the Udmurt blacksmiths. The smithing techniques are within the East European tradition, with standardised techniques for particular categories of object: axes usually have welded-in cutting edges and knives are of (steel in iron) sandwich construction. These composite artefacts show not only the wide-spread availability of steel to the blacksmiths, but also their mastery of its heat treatment. It is also apparent that pure iron and phosphoric iron could be distinguished, as some artefacts utilise a combination of the two. It is concluded that in first half of the second millennium AD a complex technical and technological trade network existed in the territory of the Western Urals. Although strongly influenced by North Russia (Novgorod Lands) iron working preserved some specific, local, features.

### Harvard's Helmets Hammered? Ongoing work on ancient Greek helmets

The Straus Center for Conservation at Harvard University in co-operation with the Center for Materials Research in Archaeology at MIT is completing technical studies of four ancient Greek tin-bronze helmets. The objects include: two Corinthian helmets dating to the 6th century BC, a 5th century BC Illyrian helmet, and a 5th century BC Cretan helmet. The helmets are part of the Harvard University Art Museums' collection. Examination by metallography, electron microprobe, X-radiography, and micro-hardness tests are being completed in order to determine and compare the helmets' methods of manufacture.

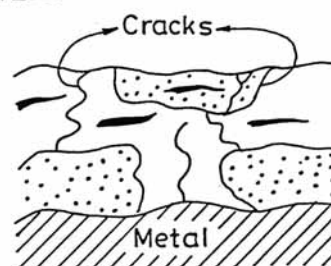
At present only two published metallographic studies of ancient Greek helmets have been found: J. Swaddling, *The Antiquaries Journal* 47 (1987), and P.H. Blyth, *JHMS* 27 (1993). Any information on comparable helmet studies published or unpublished is very welcome. Please contact Molly McNamara, Straus Center for Conservation, 32 Quincy Street, Cambridge, MA 02138, USA; or [mmcnamara@isgm.org](mailto:mmcnamara@isgm.org).

### New Insights on the corrosion resistance of the Delhi iron pillar

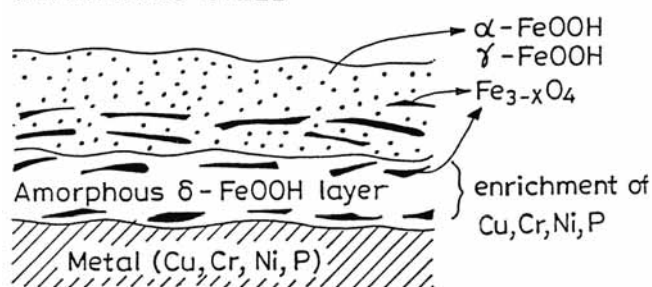
**R. Balasubramaniam** of the Department of Materials and Metallurgical Engineering, Indian Institute of Technology, Kanpur 208 016, India,

has been investigating the nature of the protective passive layer on the corrosion resistant Delhi iron pillar. Rust samples from the pillar were characterised by X-ray diffraction, Fourier transform infrared spectroscopy and Mössbauer spectroscopy [1]. The major constituents of the scale were crystalline iron hydrogen phosphate hydrate ( $\text{FePO}_4 \cdot \text{H}_3\text{PO}_4 \cdot 4\text{H}_2\text{O}$ ),  $\alpha$ -,  $\beta$ -,  $\delta$ - $\text{FeOOH}$  and magnetite. The iron oxide/oxyhydroxides were present in the amorphous form. The process of protective rust formation on the Delhi pillar iron has been outlined based on the rust analysis [2]. The iron contains a relatively high percentage of P compared to modern steels. Initially, the corrosion rate of iron is high due to the presence of entrapped slag particles.

MILD STEEL



WEATHERING STEEL



DELHI IRON PILLAR

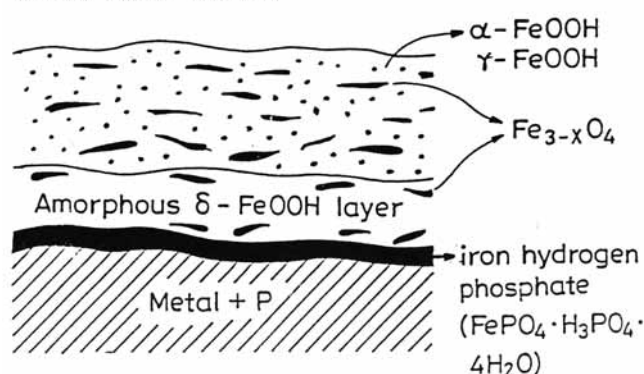


Figure 1

This results in enhancement of surface P content. In the presence of P, the formation of a protective amorphous compact layer of  $\delta$ -FeOOH, next to the metal surface, is catalysed and this confers the initial corrosion resistance. The critical factor aiding the superior corrosion resistance of the Delhi iron pillar, however, is the formation of iron hydrogen phosphate hydrate, as a thin layer next the metal-oxide interface. The amorphous to crystalline transformation of the phosphate is aided by alternate wetting and drying cycles (i.e. the environmental factor). The rate of corrosion is further lowered due to the low porosity content of the crystalline phosphate phase.

The structure of the passive film on the Delhi iron pillar is schematically shown in Figure 1 and compared with the films that form on mild and weathering steels. The rusting of normal mild steel and weathering steel proceeds as follows. When iron is exposed to the environment, the first oxyhydroxide to form is  $\gamma$ -FeOOH. With time, a part of  $\gamma$ -FeOOH transforms to another allotropic modification ( $\alpha$ -FeOOH) and the rust at later times is composed of both these oxyhydroxides. Both these oxyhydroxides are not protective against corrosion and they readily crack allowing for ingress of oxygen and moisture to reach the metal surface and cause further corrosion. However, with time, a part of the FeOOH formed transforms to magnetic oxides of iron, which are much more protective than these oxyhydroxides. In addition to  $\alpha$ - and  $\gamma$ -FeOOH, there can be another amorphous oxyhydroxide  $\delta$ -FeOOH, which can form on atmospheric exposure of iron. In ordinary mild steels, this phase forms in a discontinuous manner as it results due to dehydration-oxidation of the Fe(II) complexes. Therefore, the  $\delta$ -FeOOH that forms in ordinary mild steels is not protective in nature. However, it is possible for this  $\delta$ -FeOOH to form next to the metal surface as a continuous layer in which case the steel obtains corrosion resistance. The formation of  $\delta$ -FeOOH as a continuous layer next to the metal surface is catalysed by the presence of P and Cu in steel. The presence of this amorphous layer is the reason for the superior corrosion resistance of weathering steels, although the time required for forming the protective layer is determined by the exposure conditions.

1. 'Characterization of Delhi Iron Pillar Rust by X-ray Diffraction, Fourier Infrared Spectroscopy and Mössbauer

Spectroscopy' by R. Balasubramaniam and A.V. Ramesh Kumar, *Corrosion Science*, 42 (2000) 2085-2101

2. 'On the Corrosion Resistance of the Delhi Iron Pilla' by R. Balasubramaniam, *Corrosion Science*, 42 (2000) 2103-2129

## New books

Two new books covering very different aspects of metallurgy have just been published by the British Museum, and Paul Craddock has provided the following summaries:

The first, *King Croesus' Gold: Excavations at Sardis and the History of Gold Refining* by Andrew Ramage and Paul Craddock, ISBN 0-7141-0888X, BMP, 45, includes the full report on the excavation and scientific study of the gold refinery in the ancient capital of Lydia. The refinery dates from the time of King Croesus in the 6th century BC, and is the earliest and arguably the most famous refinery in the world, for it is here, in response to that other Lydian invention, coinage, that the problems of gold refining were tackled and solved. The furnaces, cupellation hollows, etc. were remarkably intact, the Lydians even obligingly left behind dozens of bits of gold in various stages of purification, from which the full technical history of the process could be determined using XRF, XRD and ICP analysis, backed up by extensive SEM and petrological work on the parting vessels, furnace linings and cupellation debris. The book also provides a complete history of gold refining around the world from the earliest times to the 20th century, with special sections devoted to subjects as diverse as amalgamation processes, the ancient knowledge and use of platinum group element inclusions and assaying in antiquity.

The second publication is *The Ferrous Metallurgy of Early Clocks and Watches: Studies in Post Medieval Steel*, edited by M.L. Wayman, British Museum Occasional Paper 136, ISBN 086159 136 4, ii22.50. From the 16th to 19th centuries there were remarkable changes in scientific and technical knowledge, and this is nowhere better exemplified than in ferrous metallurgy. In the 16th century the nature of steel was unknown and its manufacture was necessarily a hit or miss affair. By the 19th century liquid steel of high purity and exact composition was being regularly prepared. The heart of the book is the detailed metallographic examination of the components of many dozens of clocks, watches and springs, from which the improvements in steel through the centuries can be charted. As their movements became ever more compact so the demands made on the steel of the components, above all the springs, became ever more exacting. The introduction of crucible steel, developed specifically for clock and watch springs was, of course, pivotal to the production of quality steel, guaranteeing for the first time a high carbon steel of uniform composition,

with minimal impurity levels, but can be seen here to take its place in the more steady improvement in steels through the 17th and 18th centuries. The book also describes processes such as spring-making and charts the progress of Europe's leading horological centres. In the 16th century London clockwork was pretty poor compared to its continental rivals, but by the 18th century had gained total ascendancy, in no small part due to the quality of the steel being used.

Any contributions to next issue by 23 Feb 2001 to: David Starley, Royal Armouries, Armouries Drive, Leeds LS10 1LT. UK. Tel. (0113) 220 1919, Fax (0113) 220 1917  
Email david.starley@armouries.org.uk

## **Ironmasters 2000 Massachusetts: Roots of Iron**

This year's Ironmasters Conference was held in Saugus, Massachusetts from 5–7 May. The conference included field trips to Saugus Iron Works National Historic Site and Bromington Forge. Saugus (16-68) was excavated by Roland Robbins from 1949–53 and the furnace, finery forge, rolling mill, and smithy were recreated by the same architectural firm responsible for Colonial Williamsburg. On Sunday Matt Kierstead and Cassandra Michaud led a tour of "Bromington" Forge, a 1670s bloomery operated by Henry Leonard in Boxford, MA. The site is unexcavated and consists of the mill pond (reused by a grain mill), slag, and a series of earthworks.

Cassandra Michaud presented a paper on "Bromington" Forge, based on material she collected for her MA. The site was also known as the Rowley Village Ironworks. Court records were used extensively and included some interesting data on the cost of charcoal.

David Ingram, "Observations on the Historiography of the Colonial Iron Industry in South-eastern Massachusetts". Mr. Ingram gave a brief summary of the colonial iron industry of Massachusetts. Included was an excellent overview of the documents available for study and where they are held.

Susan Maier, "'Artificers in the German Way', Workers and Technology at Peter Hasenclever's New Jersey Ironworks". Between 1764 and 1769 Hasenclever brought more than 535 German and English workers to New Jersey to build and operate three ironworks. Ms. Maier's multi-year project is to identify Hasenclever's workers and trace them back to their points of origin in Germany. She has been able to trace many of them and develop a great deal of data on the 17th and 18th century German iron industry.

Robert Gordon, "Steel in America". Dr. Gordon provided an overview of the American 19th century steel industry. He covered production techniques and problems.

Walter Landgraff, "Richard Smith's Forge at Colebrook, Connecticut". The forge is late 18th century and produced bar iron and tool steel during the American Revolution. There is some evidence that the steel was used to make bits to bore cannon at Smith's blast furnace in Salisbury, CT. The paper

covered the Ogden, Rockwell, and Morgan families; the archives, and field evidence.

Kellysmyth, "Blacksmiths: Images Through the Ages". Kellysmyth is a practicing blacksmith who has produced reproduction hardware for 18th century houses and the Kalmar Nyckel, a 17th century Dutch pinnace. Her presentation was on graphic depictions of ironworking over the last 1000 years.

Bierce Riley and Joseph Macasek, "Bartleyville Bloomery". The bloomery and forge were originally built in the late 18th century and operated through the middle of the 19th. The paper covered the history of the site and the extensive physical remains (stone and earth dam, raceway, stone forge building, and coal house).

Fred Wamer "Excavation and Rebuilding of Beckley Furnace, East Canaan, CT". Beckley operated from 1847 to 1918 and was placed on the Natl. Register in 1988. At that time it was stabilized, investigated, and partially rebuilt. The investigations revealed that Beckley was being rebuilt when it was shut down and that it had five subsurface drains.

Walter Jacob, "Joanna Furnace, Iron Making Technology Changes and Results". Joanna operated from 1791 until 1898 and is undergoing excavation and restoration. The furnace was extensively altered over time to include raising the stack, hot blast, and adding a hoist and bell. The charcoal house and engine house are still standing. The Hay Creek Historical Association is excavating the furnace and the Jacobs have written a book on it.

Donald Linebaugh, Univ. of Kentucky (Lexington), closed the program with "Roland Robbins' Excavations at Saugus: Separating Fact from Fiction" using materials from his Ph.D. Dr. Linebaugh discussed both the excavations at Saugus and the problems Robbins had with the architects and restoration committee. These irreconcilable differences led to Robbins' resignation and are one of the reasons much of his work has never been published. This material is to be published as a book in the near future.

Following dinner, the 1955 Golden Reel Award winning film "The Saugus Iron Works Restoration" was shown in conjunction with additional comments by Dr. Linebaugh. *The Conference Program included addresses and e-mails for most of the participants, if anyone would like to follow-up a specific topic*

J.H. Brothers IV [mailto:jhbiv@erols.com]

(A description of the Saugus Ironworks appeared in HMSNews No. 33 Summer 1996. Editor )

## **The 2000 conference was held at Allenby Barracks and the Tank Museum at Bovington in Dorset**

After an excellent dinner 27 members assembled in the West Wing, where they were welcomed by Paul Cort, Chairman of the Programme Committee. As an introduction to the area Andrew Lawson, Unit Director of Wessex Archaeology told us about the prehistory of the area. Dorset has a remarkable diversity of historic monuments and a long history of archaeology. His talk was based around Maiden Castle, which

is a complex, largely iron age defensive monument. This was relatively late structure because people had been living in the area for more than half a million years. During most of the time they did not build monuments, or anything else that we have found. The only records they have left are objects that they made and used. There are other complex monuments too such as Hambledon Hill to the North of Dorchester. Besides the prominent banks and ditches there are two earlier enclosures and a burial mound dating back perhaps 6000 years. The evidence of the standing stones was enhanced by the discoveries made possible by the rescue excavations carried out on development sites such as the new Southern by-pass. At Maiden Castle there is an older enclosure beneath the iron age monument which is the earliest known monument in Dorset dating back to around 3700BC. There is a large collection of pottery finds from the infill in the ditches. There is a ridge along the hilltop that is the remains of a long barrow. This is not unique in the Dorchester area. In some of the ditches flanking other, now levelled, barrows there are cows skulls buried at intervals. We cannot guess what rituals were involved in the burials. No domestic remains have been found other than rubbish pits. Dorset also has a number of henge monuments, some of them below the Roman remains. Later civilizations had different burial customs, of which the round barrows belong to the bronze age. The earliest bronze age finds are weapons, and they are often associated with gold ornaments. In the later bronze age people began to divide up the land and in many places there are enclosures and round houses. Cremation burials began at around this time, with burial urns. Metal detectors quite often find large caches of bronze objects, often from across the channel. Towards the end of the bronze age we begin to see the development of defensive structures which culminated in the iron age forts.

The first members' contribution was a paper presented by Ruggero Ranieri. The replacement of sheet rolling by continuous strip rolling made possible the post-war expansion of the motor industry and the production of reasonably priced 'white' and 'brown' goods for the furnishing market. The cost savings resulted in goods that could be bought by almost everyone. While cold rolling in tandem mills was important the major advance was the wide hot strip mill. This is more difficult to operate than a cold rolling mill because the strip cannot be guided through the mill. This was first developed in America in 1928 and introduced into the United Kingdom at Ebbw Vale in 1938. It took another 25 years before the second UK mill at Port Talbot followed. We were presented with a table showing the progress of the technology in Western Europe. This was to some extent publicity for the forthcoming conference in Manchester.

Peter King presented facts from the port books and other records relating to the first successful production of tinplate at Pontypool. There is little doubt that rolling of iron started in 1697 but there is no evidence that any tinplate was made before 1720. In particular there is no record of tin being shipped to Pontypool in the 17th century. The articles produced from the rolled sheet in contemporary records from 1697 must have been made from blackplate.

The paper by David Starley was concerned with iron arrowheads. Little attention has been given to the structure of arrowheads. Some were clearly military, others were difficult to

categorise. There was little documentary evidence to show what was produced or where. He showed us a drawing of arrowhead types, though there were others that didn't fit into these categories. Many thousands were produced. At St. Brevells in the Forest of Dean there are records showing the production of 100 cross-bow bolt heads per day with a total of 25,000 per year. There are recorded complaints that some arrowheads were too soft. He included work by other people. He illustrated various methods of 'steeling' the arrowheads, rather similar to the processes used for knives.

Anthony de Rueck has been studying the armour produced to withstand, or not as the case may be the arrowheads. Much of the data has been published by Alan Williams. The situation in various parts of Europe was very different at this time. While much of Europe was fairly peaceful the situation in Italy was one of continuous warfare. Armour produced at the time could be made from various grades of iron or steel, probably depending on who you were. The armourers had various techniques for hardening steel, mostly savouring of black magic. There are recipes from the Medici archives which, it was hoped, would do the job needed – one hardened surface. Most were probably unsuccessful. It was noted that the Germans produced hardened armour to resist a sword thrust. The Italians were happier with soft armour, which was more likely to stop a bullet.

Geoff Lucas told us of the involvement of John Brown and Thomas Firth in the production of forged gun barrels for the armed services. In the early years of the century they were major producers. This continued until the Second World War. Over the years forging machinery had improved but the changed circumstances meant that the firm was now only making barrels for tank cannons.

Styria was threatened by the Turks for some 200 years. When threatened the men of Graz would rush to the Armoury and equip themselves from the 32,000 pieces kept there. Amina Chatwin had been to the Armoury and showed us some of the stock that is still kept there.

On Sunday morning Brian Bastow told us about the development of armour for ships. Until the 19th century ships were made of wood and were not armoured, though it had been suggested at various times. The Navy were not interested. The flying pieces from damaged armour could cause more damage than the shot, and damaged armour was not easy to repair. The controversy continued until the Crimea when in 1853 the Russians blasted the wooden Turkish fleet to pieces. In 1855 two French armoured floating batteries were subjected to a prolonged bombardment and returned essentially undamaged. The French were developing armour for ships during the following years. The British Navy carried out some trials which showed that 4" thick armour was sufficient at that time. Having done the trials they did nothing about it. The French launched their first armoured wooden vessel, *Le Gloire*, in 1859. The *Warrior*, the first British armoured vessel was launched at the end of 1860. This had a wrought iron hull, with timber cushioning and the armour outside that. Brian showed a graph of the material used for general ship building. It showed the gradual replacement of wood by iron and then mild steel. Bessemer steel gave problems because of ageing due to nitrogen. Open hearth steel was eventually adopted for

shipbuilding. The term “steel armour” probably refers to open hearth steel. Expert opinion was that you needed a hard material for armour. Trials showed that wrought iron was superior. A wooden backing was used to absorb splinters. Production of plate 4” thick was by no means run-of-the-mill. Composition was a problem too. If you had low phosphorus you had high carbon. Micros prepared by Sorby showed variations in grain size and unwelded junctions. Thermodynamic studies showed that steel shot was the best to penetrate the plate. The thickness of armour had to increase to 24” on HMS Inflexible to resist the improved shot. Compound plate made from steel and wrought iron was better. Alloy steels began to be used — nickel, chrome and nickel-chrome-moly steel. This was then carburised, (later gas carburised) and hardened on the outer surface. It was no secret and for many years the defence of naval vessels of all the worlds navies depended on the carburisation of steel.

Peter King spoke of the development of the iron industry of South Staffordshire. The foundation of an ironworks was a commercial project of unprecedented scale in the 17th century. The only possible comparison was with the activities of the London overseas merchants. It is difficult to estimate the import of iron in the 16th century. It seems to have peaked at around 1520, and ceased by the end of the century because of the war with Spain. This coincided with the growth of the Walden iron industry which could have been producing 9000 tons per year by the 1690s. The expansion into other areas followed the introduction of new technology. Pig iron was produced in a blast furnace and converted to bar iron in a forge. The processes used prodigious amounts of charcoal. This meant that the ironworks were distributed around the countryside to minimise the distance that it had to be carried. Though in the Weald the aristocracy were not usually involved in iron production this was not so elsewhere. He discussed the leasing of some of the works. The object was to convert unsaleable trees into valuable iron. He described the siting and interrelationship of various ironworks, and discussed the origins if the workmen needed.

The last paper was presented by Amina Chatwin. She spoke on the art of the blacksmith from early until recent times and the session was largely visual. The earliest example was the Capel Garmon firedog, which has a date somewhere around the start of the first millennium. We have little early ironwork left. One place it has survived is as hinges and grilles on doors. The various methods of production were briefly described as examples of them were shown. Later decorative ironwork has survived in churches as grilles and great houses as banisters. In the 16th century some houses had balconies, many of which were of iron. As time went on more has survived. The last examples were very recent, many of them coloured, textured and mobile. Some of the examples were very large.

Peter Hutchison

*The Editor regrets that it has been necessary to hold over the description of the Tank Museum until the next News.*

### Help Wanted.

Does anyone know where there is a copy of the film of the last firing of the Doncaster’s cementation furnace in Sheffield? Answers if any to the Secretary please.

## Old Stamps on the Star of India

I have found old stamps on the hammered iron on board the still seaworthy sailing merchant ship, THE STAR OF INDIA ex EUTERPE, built at Ramsey. Isle of Man in 1863.

I did an investigation of her hull this spring and found the following company or quality stamp or markings on the iron that was used to build her: On her bulb iron and angle iron in the deck-beams all over the ship, I found the word CONSETT. Her ribs or frames were marked with LW & WALKER. In 1976, during docking, dock workers found the mark BRUNSWICK BEST on one of her bottom hull plates.

I have made a report on my findings on board the ship. (I also did a report on the iron in the Norwegian ship HANSTEEN built in 1866 of iron from Norway, Sweden and the Bloomfield and Low Moor iron- works). But I have been unable to identify the iron producers for the STAR OF INDIA, where this particular brand was made and which quality we are looking at? Request to county Durham, the scout group at Consett and others posted on the internet have given me nothing on the Derwent or Consett Ironworks, which I suppose must be responsible for the Concert markings. Do you know anything of the ironworks during the 1860s , and when they stopped producing hammer iron of ship quality ? Could LW & Walker be two brothers in charge of Consett in those days ? Where do BRUNSWICK BEST fit in ?

I do hope someone will be able to help me with these intriguing questions. Something about the company that made the iron, and possibly how these, heavy plates and 35 feet long beams got from the iron producer to the shipyard on the Isle of Man would be also most helpful. Olaf T Engvig, 500 N. Lamer Street, Burbank, CA 91506. Voice/fax (818) 5567-0411 omengvig@hotmail.com

**Gads of Steel again.** Mike Davies-Shiel writes re. HMSNews 42 the quote dated 1430. "On his body lay gaddes read brenning". This is northern English ex Norse language. Local to Cumbria and N. Lanes the old name for a man burning bracken for soap or glass mfr., was Aschbrenner, later Ashburner so, to me, it reads “gads red burning”.

**The Hon. Editor Amina Chatwin**, The Coach House, Parabola Close, Cheltenham GL50 3AN. Tel 01242 525086 welcomes contributions for HMSNews by, the end of February, June 11th, and November 5th. If possible on Apple Mac or ascii.

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