HMSNEWS
Historical Metallurgy Society

47 Spring 2001

FORTHCOMING EVENTS

HMS Annual General Meeting on Saturday **19th May** in Rotherham at the premises of London and Scandinavian Metallurgical Co. Ltd (Leaflets have already been sent out).

HMS ANNUAL CONFERENCE will be based at Northamptonshire over the weekend of **14th to 16th September** and will be themed **Iron and Steel**. The conference for 2002 will be in the Weald

HMS and NEWCOMEN
There will be a joint meeting with the Newcomen Society at 5.45pm on **Wednesday 12th December 2001** at the Science Museum, London. Mr E F dark, Dr Paul Shelton, Dr J K Almond and Mr P Heward will present a paper entitled "Metallurgical examination of the tyre of the Lion locomotive"

INTERNATIONAL CONFERENCE OF MEDIVAL AND LATER ARCHAEOLOGY
In Basel (Switzerland) 10th to 15th September 2002
Contact Medieval Europe Basel 2002, c/o Archaeologische Bodenforschung, Petersgraben 11 P.O.B. CH - 4001 Basel (Switzerland) Fax: +41-61-267 23 76 e-mail: info@mebs-2002.org latest information: http://www.mebs-2002.org

FIND RESEARCH GROUP SEMINAR
Supernovas and black holes: Regionalisation in portable antiquities of the Medieval period. Further information from: Quita Mould, Eastmoor Manor, Eastmoor, Kings Lynn, Norfolk. PE33 9PZ Tel. 01366 328910

Obituaries

CHARLES RICHARD BLICK MBE TD RA

Charles Blick had been in failing health for some years, and had spent the last twelve months in a nursing home near Chillington, Devon, where he and Audrey had made their home since leaving Burnham on Crouch. He died on January 10th, having hardly spoken since Christmas, and Audrey had been almost constantly at his bedside. They had shared their 54th wedding anniversary the previous September.

He will be much missed by members of HMS, many of whom were friends of long standing, and who shared his life long interests, above all of steelmaking and the history of early blast furnaces.

He was a founder member of the Historical Metallurgy Group when it was brought into being in 1963. At the end of the first Bulletin was a list of members — 27 of them! — among the list Coghlan, Cleere, Crossley, Gale, Morton and Tylecote — names to conjure with; a dedicated band intent on discovering and recording the crumbling blast furnaces of the past. They not only brought into being a new branch of metallurgical history but also founded a new science — Archaeometallurgy.

Charles was Hon. Treasurer to HMS from 1970 to 1978; he became Hon. Secretary in 1979 and President in 1980 and 1981. He carried on a voluminous correspondence with a number of members and, for many years, was a brilliant Conservation Officer to the Society.

The first HMS conference I attended was at Penzance in 1969. The journey turned out to be much further than I expected and I did not arrive until evening when dinner had already started. As soon as I appeared at the dining room door Charles Blick came over to welcome me warmly, a glass of wine for the newcomer in one hand. It was typical of the care he took of all HMS members. In those days he ran all the conferences and field outings with a meticulous attention to time that led him to apologise if we returned at the end of a long day even a few minutes late. Charles Blick's father was a mechanical engineer who joined Morris Motors in 1927–8, which was how Charles came to be educated at the Henry VIII school Coventry, passing his Higher School Certificate in 1934. He began his working life as an apprentice at the United Steel Company. He then moved to the Workington Iron and Steelworks (a branch of United Steel), famous for their manufacture of steel rails. One of the first things he saw there was the new set of Bessemer converters. Charles used to recount how he spent his first six months in the office, and then moved to working at the blast furnaces in steel shod clogs. He continued his training with the City and Guilds and was awarded their silver medal. By 1938 he was assistant blast furnace manager at the Appleby branch at Scunthorpe.

He took an active part in the Territorials and for his services was awarded a T.D. With the coming of the war he went into the Royal Artillery reaching the rank of Major.

Returning to Workington in 1947 he became assistant to the general works manager and in 1953 was appointed assistant commercial manager. He was at the Sheffield divisional headquarters from 1966 onwards, where he was Public Relations Officer to what became the Midland Group of the British Steel Corporation, and was ultimately awarded the MBE for his services to the Steel industry.

He wrote “The Workington Iron and Steel Company”. In 1991 he edited "Early Metallurgical Sites in Great Britain BC 2000 to AD 1500"; conceived by the Archaeological Committee of HMS it comprised descriptions of the field remains on fifteen sites. He was very interested in sailing and was the Race Officer of the Royal Burnham Yacht Club.

In 1992 Charles suffered a serious illness, and surgery left him in a coma for several months, he fought back with great perseverance; the nurses used to say he was indeed “a man of iron”. He leaves his wife, Audrey, who always attended conferences with him, two daughters and four grandsons.

Amina Chatwin

Professor ALAN E.W.SMITH

The recent death of Dr. A.E.W Smith, aged 96, closes the continuous connection of his family with the whole history of metallurgical science. His grandfather was Director of Laboratories At the Royal School of Mines, at the time when Dr Percy was appointed to the first Chair of Metallurgy there, then the first and most prestigious Dept. of Metallurgy in the world. His father E.A. Smith, was Deputy Master of the Sheffield Assay Office from 1898, having himself trained at the R.S.M. He wrote the definitive book on precious metal dental alloy which Alan continued to update until the 1950s. Alan and his brother both read metallurgy at Birmingham, where Alan took a Ph.D. He became a lecturer at the Military College of Science, where he spent the rest of his career, retiring as Professor of Metallurgy. Security regulations and a heavy teaching load meant that his published researches were few. He will be remembered by generations of army technical staff officers as a superlative and inspiring teacher.

I was posted to the Military College of Science in 1941, until I left the Army in 1946.1 counted Alan as one of my oldest friends, we kept in touch through- out his life. In these notes, I offer my sincere tribute to his memory.

It seems appropriate that a family of Smiths should have played an unrepeatable role in the con- version of an old craft into a new and important science.

O.P. Nicholson.

ARCHAEOMETALLURGY

Roman knives and chisels

Anthony Swiss has recently completed his Masters dissertation at the Dept. of Archaeological Sciences, University of Bradford on the metallographic analysis of Roman ferrous edged tools. The artefacts are from the site of Castle Street, Carlisle, UK, where excavations undertaken during the early 1980's revealed layers associated with the early Roman occupation of the city (1st and 2nd century AD). Importantly, the layers were water-logged and the anaerobic conditions had allowed the survival of a wide range of archaeological materials, including iron, some of which had excellently preserved edges. A comprehensive search by the author had determined that ironwork from this period in Britain had received little attention in the literature, and therefore the Carlisle assemblage represented an invaluable opportunity to study the ironworking technology from the early period of Roman occupation.

Eight edged tools (four knives and four chisels) were chosen and subjected to radiographic and metallographic analysis. The analysis established that the majority (7) of the objects had been manufactured using low-medium carbon iron / steel, which had been cold-worked to enhance the hardness. The single exception was a large knife. This object was found to have a composite construction, with a quench-hardened steel edge welded onto a low-carbon back, thus giving it durability and the capacity to hold a sustainable edge.

The investigation has indicated that the Roman smith had the capability to produce both "simple" utilitarian tools made from low-carbon iron (which would have been good enough for most tasks), and when needed, could manufacture more "specialised" items for tasks such as butchery, where a quality tool would have been essential.

Roman workshops and armour

Excavations being undertaken this winter by **Carlisle Archaeology Ltd, University of Bradford**, have focused on the central range of Carlisle Roman fort, which lies at the western end of Hadrian's Wall. On the south side of the fort's main east- west road, the *via principalis*, a *fabrica* (workshop) dating to the second century was found to contain considerable quantities of iron smithing debris, including much slag and hammerscale in situ. Broadly contemporary with this on the north side of the road was a building tentatively identified as an armourer’s workshop.

Although only one comer of the building was exposed it produced a unique assemblage of Roman armour and other military equipment.

Waterlogged conditions had ensured extremely good preservation of the armour, which includes a scale neck guard and large articulated sections of lamellar limb defences with surviving leatherwork. Although the lifted sections were still shrouded in plastic sheeting to retain moisture, early examination of the material has been undertaken using X-radiography, carried out by **David Starley at the Royal Armouries, Leeds**. This showed the armour to be predominantly ferrous, though the appearance of some scales had been enhanced by a covering of copper-alloy foil. Copper-alloy wire was also used to articulate the scales of the neckguard. Superfluous rivet holes are thought to show the extent to which some plates had been reused. It is hoped that, after conservation, further detailed examination of the armour, metal artefacts, off-cuts and other debris will throw light on the manufacture, supply and maintenance of Roman military equipment for the garrison.

Bronze Age ore processing at the Great Orme

Emma Wager at Sheffield University has sent details of work relating to the 1996 excavations at the copper ore processing site of Ffynnon Rufeinig on the Great Orme, **North Wales**, under- taken by a team from the University under the direction of **Barbara Ottaway**. Several bones which had been stained green by copper minerals; nodules of the copper carbonate ores malachite and azurite; charcoal flecks and a possible hammerstone spall were recovered from a sealed primary archaeological deposit. This comprised a mound of well-sorted dolomitic limestone silts, sands and gravels. The excavated deposit is located close to the water source at Ffynnon Rufeinig and less than a kilometre from the extensive, securely-dated Bronze Age workings on the Orme. It is interpreted as tailings produced during the processing, perhaps washing, of ore from this mine. Two of the excavated bones have recently provided a radiocarbon date of 3360±70 BP (Beta-148793), these give a calibrated calendrical date (1 sigma) of 1880 to 1680 cal BC for the primary deposit, although clear cuts into this deposit indicate later work also at the site.

The early second millennium BC date from Ffynnon Rufeinig is extremely significant, as it is the first time copper processing waste from a site other than a mine has been radiocarbon dated to the Bronze Age anywhere in the British Isles. As a result, it may help to validate Lewis's model of ore processing on the Great Orme during this period (Lewis 1997). There is currently a moratorium on research excavation on the Great Orme. As soon as this is lifted, further work must be undertaken at Ffynnon Rufeinig in order to determine more precisely the range and date of activities carried out there. This will be in addition to the recently completed geophysical and topographic surveys of the earthworks at this site.

References

Lewis, C.A. 1997 *Prehistoric Mining at the Great Orme. Criteria for the Identification of Early Mining*. Unpublished MPhil dissertation. University of Wales, Bangor.

Effectiveness of the Treasure Act

Justine Bayley has passed on news of the publication of the second annual report on the operation of the Treasure Act by the **Department of Culture, Media and Sport**. Under the Act, which applies to England, Wales and Northern Ireland, the number of finds reported in the 15 month period to December 1999 has increased to 223. This is nearly ten times the average number declared Treasure Trove each year under the previous legislation; ninety percent of these finds were made by metal-detector users. There is no doubt, therefore, that the Treasure Act has succeeded in its primary aim of ensuring more important archaeological discoveries are being offered to museums. The Report includes colour photos of many of the coins and other objects reported, some of which are intricate and beautiful examples of gold- and silver-smiths' work spanning the Bronze Age to post- medieval periods. Interestingly, several as-cast or lightly worked bar ingots are included. These reveal a difficulty in assigning a date to such objects, which is not always acknowledged by the recorder. It appears that neither shape, size nor composition are reliably correlated with date, though those weighing multiples of the common Viking unit, which is between 25 to 26g, are usually assumed to be of Viking date.

Roman iron smelting and bloom smithing

Part of a major Roman road-side settlement at Westhawk Farm, 2.5kms south of **Ashford** in **Kent**, was excavated by **Oxford Archaeological Unit** during 1998 /1999. The majority of the finds date to the period AD 70-250. An initial visit to the site was made by David Starley after top-soil stripping and cleaning. Features noted at this early stage included a post-hole delineated structure containing at least four furnaces, including two with possible tapping pits, at least one hearth, and a large area of hammerscale. A high-resolution fluxgate gradiometer survey of this area was then conducted by **Rob Vernon** of **Bradford University** and soil samples were taken.

Excavation subsequently recovered a large quantity (1.4 tonnes) of iron working debris of which more than 80% came from 17 contexts concentrated around two locations, most of it from ditch and pit fills. At the time of writing, a small but representative sample of the material recovered had been examined as part of an assessment by **Sarah Paynter of English Heritage's Centre for Archaeology**. A fairly common find was large lumps of roughly bowl-shaped slag. These were less consolidated than tap slag and, unlike smithing hearth bottoms, had pieces of char- coal embedded within them and rough uneven surfaces and bases. These were described as large hearth slags in the assessment and may derive from the consolidation of blooms i.e. primary smithing. The large quantities of hammerscale present near the furnace features are also likely to have been generated by primary, rather than secondary, smithing. The majority of con- texts contained tap slag, vitrified clay, fired clay, large hearth bottoms and ore. One small, consolidated lump of iron was found amongst the slag assemblage and a large iron billet was also recovered from the site.

The assessment indicated that the main iron-working activity on the site was iron smelting, focused around two areas, one on either side of the road, with tapping bloomery furnaces operating in both locations. Primary smithing of the bloom also

took place. The site is situated on the edge of tile Wealden Roman iron-smelting area and can be interpreted as part of a regional framework. The quantity, and quality, of the material recovered at Westhawk, including the remains of furnaces and slag in situ, charcoal, ore, slag, bloom and billet samples, provides an excel- lent opportunity for further research into the iron-working technology of the Roman period.

Technical studies of ancient Chinese bronzes

The **Isabella Stewart Gardner Museum in Boston** is completing technical studies of two Han Dynasty (4th c. BC – AD 3rd c.) gilt, tin-bronze (estimated) bear shaped mat weights. The bears were discovered in 1900 near Sian-fu, in Shensi province. The bears are practically identical though one has a hole in the back. Both are hollow and retain some traces of green pigment and possible lacquer. One of the bear's right feet is marked with three characters. The bears sit on their haunches with their left hind leg tucked under them. The project is undertaken in order to determine and compare methods of manufacture. Any information, or comparable studies would be very much appreciated. Please contact: Molly McNamara, Conservation Department, Isabella Stewart Gardner Museum, 2 Palace Rd., Boston, MA 02115, USA; or mmcnamara@isgm.org

One of the Han bears from a photograph owned by the Isabella Stewart Gardner Museum Boston

New books

Donald Wagner's new book: ***The state and the iron industry in Han China***. Copenhagen: Nordic Institute of Asian Studies, 2001. 160pp. Is now available, price somewhere around £15 paperback, £30 hardbound. Of particular interest to HMS members is the book chapter on the technical aspects of iron production in the Han period (206 BC - AD 220) and a table with brief summaries of all the excavations of ironworks dated Han or before which have been published so far.

Archiving of Samples

One of the concerns being discussed by the HMS Archaeology Committee is the long-term survival and availability of metallographic samples. Even when investigated and published, these offer a rich resource for future researchers and experience has shown that such material is too frequently lost. Particularly vulnerable are the collections of private researchers, those of institutions whose involvement in archaeometallurgy is limited to the personal interests of individual employees and samples worked on as part of student projects. However, national organisations are not blameless of poor practice.

Some "owners" of an object will insist on the return of any samples taken from it. Where this is not the case a clear agreement should be made for archiving the samples. Arrangements should not only enable the samples to survive, an individual changing jobs or careers, retirement and (it comes to us all) death, but must be accompanied by adequate documentation on the origin of the samples. There is a precedent for national bodies, including the British Museum, agreeing to take care of collections of samples and the possibility of a "donor card" to reside with the samples has been suggested.

If anyone has any suggestions or comments they would like me (DS) to pass on to the committee I would be happy to do so.

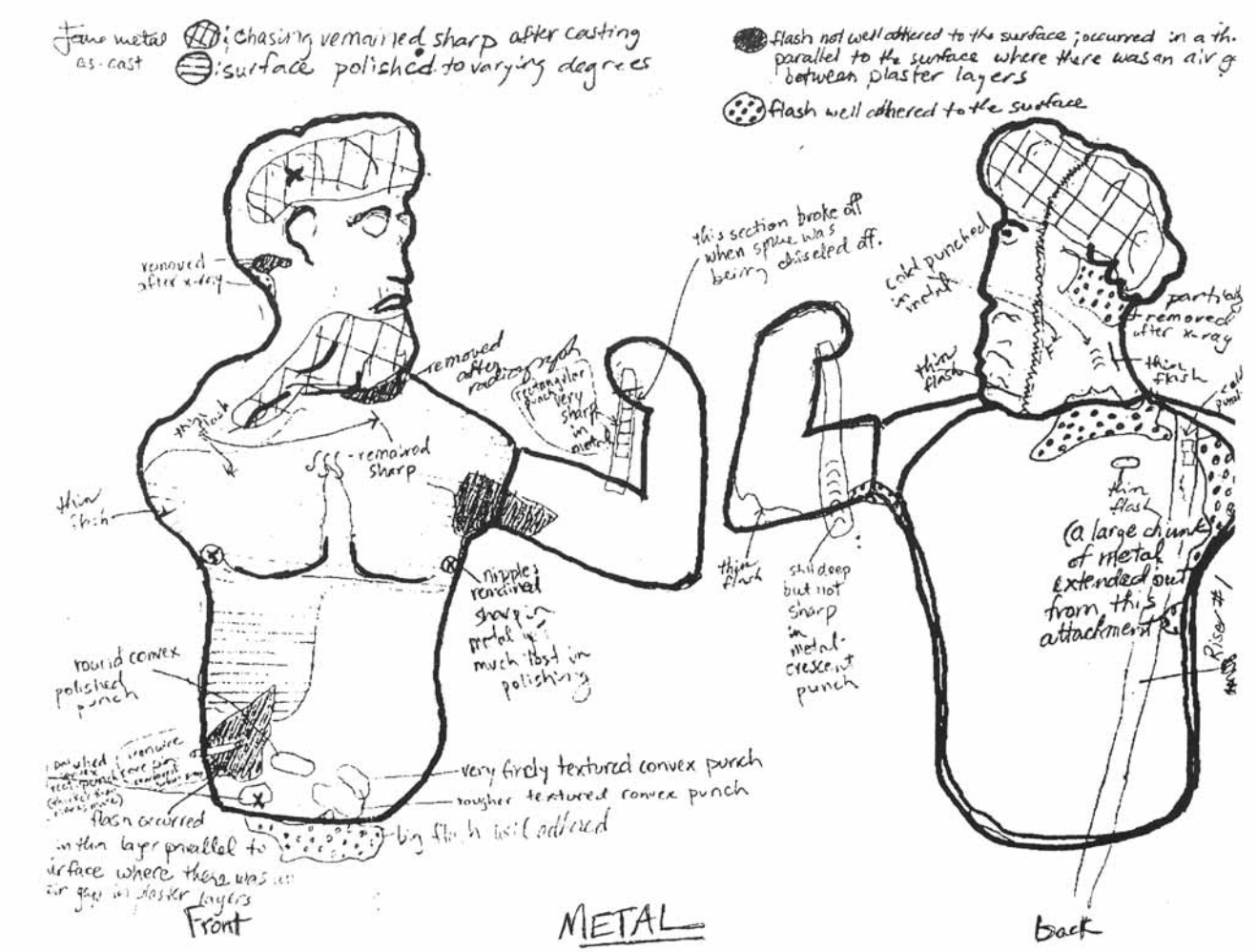
Any contributions to next issue by 1 June 2001 to: David Starley, Royal Armouries, Armouries Drive, Leeds LS10 1LT. UK. Tel. (0113) 220 1919, Fax (0113) 220 1917, email david.starley@armouries.org.uk

CASTING FOR COGNOSCENTI

A REPORT ON THE AMTEC WORKSHOP.
By Francesca G. Bewer and Andrew G. Lacey

Would the likes of sixteenth-century goldsmith-sculptor Benvenuto Cellini be appalled at the thought of a five day course on bronze casting? The practical workshop on "Renaissance bronze casting and the technical investigation of bronze sculptures" held from September 12- 16, 2000 at Ancient Materials, Technology and Conservation CO-OP, Ltd. (AMTeC) in Chatham, Kent was not intended to produce master metalsmiths. Rather, Francesca Bewer, Ph.D. (technical art historian and Associate Curator for Research at the Straus Center for Conservation, Harvard University Art Museums) and Andrew Lacey, M.Sc. (founder, artist, archaeometallurgist and co-director of AMTeC) who co-taught the course, designed it primarily for people who study historical bronzes, such as Cellini's. Most of the seven participants had spent a lot of time handling bronzes in museum collections and had a theoretical grasp of the casdng process, and a couple of them were very knowledgeable of archival documentation regarding the production of sculpture. This made the discussions very lively. The group was made up of Jane Bassett (objects conservator at the J. Paul Getty Museum, Los Angeles), Lisha Glinsman (scientist at the National Gallery of Art, Washington, D.C), Gertrude Helms (independent art historian), Jennifer Montagu (independent art historian), Shelley Sturman (objects conservator at the National Gallery of Art, Washington, D.C), Rebecca Tidswell (objects conservator at the Ashmolean Museum, Oxford) and Robert Wenley (curator at the Wallace Collection, London). They formed a cohesive group which further bonded through the need to find ways to commute between Rochester and Chatham at the height of the fuel crisis.

The course focused primarily on the lost wax process, since technical studies have shown that this was the method predominantly used in the Renaissance. The workshop was designed to provide what is most often missing from art historical curricula: practical knowledge of materials and processes. Such knowledge is part of the necessary basis for a serious critical study of bronze sculpture, which is complicated by the range of possible relationships between an artist's original model and any number of bronzes cast after it. The art historian is also challenged to decipher the contributions of an unknown number of hands to the final outcome.



Each of the participants produced a lost wax replica after an original model of a small bust, which Andrew Lacey had modelled. They began with an indirect wax cast of the bust and of a matching arm, which they joined and customized with a variety of attributes and textures. They experimented with a variety of tools both in the wax and in the bronze; softer custom-made and hard proprietary waxes; and for the mold either used loam provided by the Whitechapel Bell Foundry, London or the traditional quicker-setting investment made of plaster and grog. We had to build up and dry the molds much more quickly than one would normally do in order to fit most of the process into the schedule, and Andrew juggled masterfully the heavy load of demonstrating, prepping and casting at an accelerated pace. This also included coverage of repairing and joining methods, as well as surface coloration processes in a few quick demonstrations. The students fettled and chased their casts with great alacrity as well but could not bring them to perfection, as this required more time (and experience) than we had.

We cast the busts in two groups, one with a higher-tin bronze (88% Cu, 12% Sn), the other with lower tin (94% Cu, 6% Sn). In order to be able to compare working properties and the colour of a variety of alloys, we added a small amount of lead to the crucible before casting the last of each batch. All of the bronze alloys were made up at the foundry. At the end of the course we took metal samples from each of the busts for future analysis. Andrew also cast a large mask that he had prepared by the direct process for demonstration purposes in an LG3 bronze. He has been analyzing various parts of this cast (including the network of sprues) in order to ascertain how the lead and tin were distributed, and how representative of the whole piece one sample site is. The participants were further able to compare the working properties of different alloys by practicing coldworking on a set of small reliefs that Andrew had cast in brass, bronze and silicon bronze.

Documentation was an important part of the experiments, intended to help us gauge what kinds of alterations may occur in the course of the process, and when. We asked the participants to take notes on what they did and observed in great detail in a datasheet/questionnaire, which was handed out to them as part of a packet at the beginning of the course. This also served to help them remain aware of details along the way. One of the questions that recurs in the examination of bronzes, and which we addressed in the course, is whether a feature/mark was made in the wax (possibly in the original model) or in the metal. Some of the participants made marks with the same tool side by side in the wax and in the metal and compared them under the microscope in AMTeC's lab.

The participants suggested adding diagrams of the front and back of the bust and a table to record measurements within and between the replicas, which helped with the documentation immensely (Figure 2). The original model had been inscribed with several crosses, which were reproduced in the replicas and facilitated exact comparison of measurements between the original model, the wax intermodels and the second generation bronze casts of the busts. Although some of these markers were obscured in the course of the process, the measurements that

were gathered showed consistently that there was a small amount of shrinkage in the length of the pieces between the wax and bronze stages. To our surprise though, they had all expanded very slightly during handling and introduction of the core on the first day.

The head and arm had been modelled in the round but the back of the torso was left open in order to make it easier to peer inside the cast bust and thus facilitate comparison of the internal features with their appearance in the radiographs. The busts were radiographed twice: in the wax, joined, sprued and with armatures/core supports and core in place; and after casting and removal of the mold and major flashes on the outer surface. Dana Goodbum-Brown (objects conservator and co-director of AMTeC) radiographed the waxes at the conservation facility at the Historic Dockyard in Chatham on the second day On the fourth, the group took the cast and partly fettled bronzes across the river to be radiographed at CET Medway, a local non-destructive industrial testing company. As is often the case, it took a while to get the settings right, and we spent several hours there waiting for the various exposures and batches of films to be processed. With hindsight, the participants would have preferred to use that time for a slide presentation or more chasing on the bronze reliefs. The period spent at CET was, however, useful on several fronts. It showed the participants the consider- able amount of interpretation which goes on at various stages of the radiographing process in order to obtain the desired (i.e., useful) results (even for an X-ray technician experienced in radiographing works of art, which was not the case here). Furthermore, we had lively discussions as we tried to interpret the radiographic images as they emerged from processing. The experience was certainly humbling for us all, because, even though each participant had been very conscious of what they had done to the wax model, the radiographs revealed many unexpected features that had formed on the inside of the busts during the casting process. The discrepancies between what we expected to see and what the radiographs revealed greatly stretched our interpretative capacities.

Each of the participants was somewhat limited in the number of materials they could experiment with, but everyone learned about how the broader range of materials responded to handling through others' experience as well, via ongoing comments and discussions in the group. The participants took home casts that clearly showed the laborious way to a finished bronze and from the feedback we have received it seems that the experience gave them a good understanding of the materials and a much greater appreciation of the artist's and professional craftsperson's skills. Some of the students have been rallying more interest in the course and, best of all, have been helping us plot about what we would do for a follow-up workshop! This would include, for example, demonstrations from a specialist metal chaser and more time to finish the casts; experiments both with more traditional recipes, such as those for Cellini's investment layers and with ways to build up the core and wax of a "direct" lost wax cast; further controlled experimentation on the shrinkage rate of materials using several generations of casts. We would also have more practice in the technical examination of a bronze. Students would swap casts and have to try to reconstruct what was done to the work (using radiographs as well). Discussions comparing what was done (and documented by the maker) with what we think was done (according to our interpretation of the material evidence) are bound to raise questions about the way we look at works of art, about what we see and about the stories we tell about them. Cellini would, no doubt, appreciate such a contribution to the education of the viewer.

THE TANK MUSEUM AT BOVINGTON, DORSET.
In HMSNews 46 there was a report on the 2000 Conference but the visit to the Tank Museum had to be held over.

Much of Saturday was spent at the tank Museum. **Jim Rowbottom** described the development of the tank track. By the time anyone had thought of a tracked fighting vehicle a few tracked vehicles had been invented. They were often originally thought of as portable railways. They were mostly designed to tow loads in difficult conditions. The Army were using some of them to recover wheeled vehicles and to tow guns. The object was to spread the load to prevent the vehicle sinking in. The tracks were of two types. One was called single pin. In general the working link with double pin construction is simpler to make. At some point a sprocket is needed to drive the tank along the track. This can engage the pin or the track links. As the engine power and therefore the speed increased the track became the preferred location for the drive. One or two horns are need- ed on each link to keep the road wheels on the track, especially with the side thrust when turning. Early tracks were of riveted construction like the tractors. Some of the tractors had wooden feet on the tracks but these were not used on tanks. Ductile cast iron, various cast steel alloys, a selection of rubbers and other materials have been tried. Rubber tracks have advantages but are difficult though not impossible to repair. Most modem track is of the single pin design. It is basically a steel casting with steel pins to join it. Rubber bearings are used between the pin and the casting. Rubber pads are fitted to each track to minimise damage to road surfaces. Spare links and tools are carried on the tank and the tank crew are able to repair the track if it is damaged.

I cannot hope to condense the huge quantity of information in **David Fletcher's** presentation on the development of the tank. Nor can I include the many necessary pictures, or the astonishing video clip of tanks travelling at about 50mph over some rough ground. The first practical tank was the well known "landship" sponsored by the Admiralty. This was a rhomboidal vehicle with the track going around the hull. It was longer than you might have expected because it was intended to cross 8' wide trenches. The tank had no turret (even though it was developed by the Admiralty!) but had a sponson on each side where the guns were mounted. We then progressed rapidly through the many and varied designs in a very entertaining talk.

The afternoon was spent in the Museum display areas. It is difficult to conceive the huge numbers of different vehicles on display ranging from early tractors and the early tanks to the latest designs. There were machines from our allies and captured vehicles from enemy countries, the latest from the Gulf War. The simulated trenches were only short of the smell and the water underfoot. The static displays were enlivened by audio and video sequences and there was a tank simulator for the fairground ride enthusiast.

Peter Hutchison

A FORGOTTEN LITERARY GOLDMINE

The study of ancient mining in this country received a great boost some 20 years ago, when several copper mines in Wales were attributed to the Bronze Age by C14 dating. Since then, there has been almost an industry producing books and papers from popular to academic, combined with a flurry of archaeological activity at many widely dispersed sites within these islands. But unfortunately it does not appear that the same exploratory zeal has been applied to the most fundamental of sources — the written word. It is a common failing to which I myself must plead guilty, even after half a century of keeping my eyes open and yet still somehow missing a vital source until by chance encountering it quite recently in the library of John Bennett. How such a fine work can have fallen so far into obscurity is a total mystery.

I refer to Andrew Del Mar's A History of Precious Metals, first published in 1880. Its absence from the bibliography of early mining is all the more remarkable since in its day and for long afterwards, the work was heralded as a classic in its broad approach and sheer scope, unlike the narrow treatment of many modem studies, its 500 pages covers with a depth of practical learning not only of mines and mining all over the ancient world, but equally important, the economic and political factors behind such activities — influences which very often were quite different to those assumed today. Del Mar was an American mining engineer of widespread experience. He exposes, in country after country, the rapacious greed of conquering nations for gold and silver, and the appalling effects of slavery and how such methods renders void any attempt to apply modem economic ideas to such activities.

Del Mar was well equipped for such a task, for he was also Director of the U.S. bureau of statistics and a Commissioner to the U.S. Monetary Commission, enabling him also to explain the important role of coinage in the demand for precious metals and copper. He gives details of the enormous quantities of gold obtained in the ancient world from alluvial and placer deposits, pointing out that hard-rock mining came relatively late on the scene. His evidence is backed up by production statistics and a very extensive bibliography, much of it from classical authors.

"A History of Precious Metals" was revised in 1902, and a reprint appeared in 1969 as one of a series of economic classic published in New York. It sometimes turns up in booksellers catalogues and I have been lucky enough to get one. I feel it is the most important and informative book in early mining history I have ever read.

David Bick, Pound House, Newent, Glos.

Abstracts for Journal

We would like to extend the range of abstracts published in Historical Metallurgy; in particular historical articles, technical metallurgy, and non-British history and archaeology of non-ferrous metals are not as well covered as we would like. This can best be remedied by the concerted efforts of many HMS members. If you publish elsewhere something that is likely to be of interest to HMS members, please send abstract to Janet Lang, the abstracts editor, or if you come across something recent which ought to be in the abstracts, write an abstract yourself and send it in. It is easiest to email contributions to Janet at :j.r.s.lang@btintemet.com though you can also write to her at 100 Mildred Avenue, Watford WD1 3DX. Peter King is assisting Janet in the area of early modem history for iron and, to some extent, other metals. If you do not feel able to prepare an abstract yourself, please send the full reference by e-mail to Peter at: peterkingiron@yahoo.com and he will attempt to find the publication and produce an abstract

Justine Bayley

Stamped Markings on Euterpe / Star of India

I responded to the request in the last Newsletter received from Olaf T. Engvig for information on stamped markings found on the barque Euterpe built at Ramsey, Isle of Man, in 1863, since renamed Star of India.

The mark CONSETT on the Euterpe's bulb iron and angle in the deck beams most probably came from a works of the Derwent and Consett Iron Co. Ltd, which was styled in that form until 4 April 1864 and then thereafter as the Consett Iron Company Ltd. The town of Consett is about 14 miles South West of Newcastle on Tyne. It was a large works at that time with 151 puddling furnaces with 10 associated hammers and mills at the CTC in 1871. The company became a bulk steelmaker using various processes finally closing in 1980.

The marks LW and WALKER are possibly marks of material manufactured at the Walker Works of Losh, Wilson, and Bell. The two marks may indicate different levels of quality. It is interesting that if this is correct why there is no 'B' in the mark which would reflect the Bell contribution to the company name. In 1871 there were 57 puddling furnaces with 4 mills and forges. The works had closed by 1912, and the site possibly taken over by the shipbuilding yard of Armstrong-Whitworth. Walker Works were situated on the north bank of the Tyne about 3 miles east of Newcastle, and are noted for being the site of a blast furnace which was built by Lowthian Bell specially for the smelting of iron ore from Cleveland..

The mark BRUNSWICK BEST possibly refers to the 'BEST' grade of wrought iron from the Brunswick Works of the Patent Shaft and Axle Company situated at Wednesbury, about 15 miles north of Birmingham in the Black Country District. In 1871 there were 54 puddling furnaces there. It was described in 1873 as "one of the most prosperous and paying concerns in England, and we believe will continue so". Patent Shaft works at Wednesbury were one of the last works in the country to make steel by the Open Hearth steelmaking process and closed down about 1980. The name Brunswick has survived in the area, there being a public park of that name close to Wednesbury town centre.

The iron would have been transported to the ship-building site at Ramsey, from Consett and Wednesbury by rail and then by sea, 40 foot lengths would not have been a problem on railways. For example Consett had a good trade sending plates to the Clydeside shipyards, about 120 miles to the north. As Walker Works was on the bank of the Tyne it could ship products direct by sea.

Olaf. Engvig describes himself as mariner, scholar in maritime history, and ships' restorer. The first that he restored is a wrought iron ship, the HANSTEEN built 1866, made of Swedish, Norwegian (Fritzoe) and British iron from Bloomfield and Low Moor, followed by the Euterpe. He has reported on the stamp marks found on the two ships and discovered that in Norway and the USA very little is known about the iron marks which indicate the brands of iron used in the construction of those iron ships which have survived. He is seeking information on the location of Brunswick Works' files, if they still exist.

The Euterpe, now named Star of India, is based at present at the historic ships centre at San Diego Maritime Centre in California. For more information see the web-site at www.sdmaridme.com/

Duncan MacCallum

Centre for Archaeology Guidelines Archaeometallurgy

English Heritage has just produced an attractive colour booklet giving guidelines that aim to improve the retrieval of information about all aspects of metalworking from archaeological investigations. They are written mainly for curators and contractors within archaeology in the U.K. and will help them to project briefs, project designs, assessments and reports. It has been compiled by Justine Bayley, David Dungworth and Sarah Paynter with the assistance of the Historical Metallurgy Society's Archaeological Committee, with contributions by Peter Crew, Vanessa Fell, Brian Gilmour, Gerry McDonnell, Cath Mortimer, Peter Northover and David Starley.

Copies of these guidelines can be obtained, free of charge, from English Heritage Customer Services: Telephone 01793 414575 or 414576; address Customer Services, National Monuments Record Centre, Great Western Village, Kemble Drive, Swindon, Wiltshire SN2 2GZ.

Technological Exchange between Britain and Germany, 1710–1850.

Prof. Dr-Ing. Kurt Schwerdtfeger of Potsdam is interested in German mining and foundry engineers who visited Britain between 1710 and 1850, and also when and where British novelties were introduced in Germany.. He would welcome dialogue with readers to share or exchange information. He believes that one of the aims of the 70 visitors was to inspect the steam-engine installations which involved either flat-rod pumps, back-pumping systems to enable waterwheels to be used in summer time, or cylinder blowers for furnaces in smelters and foundries. Likewise visitors showed interest in air-furnaces, puddling processes, rolling mills and boring machines. He observes that the records of these visitors — several extending to more than 1000 pages — give precise pictures of the different situations identified, from Wheal Vor in Cornwall to Can-on in Scotland.

Professor Schwerdtfeger's chronological list starts with Justus Bartels and Johann H Webber (in 1713), Bernhard Ripking (1717), Joseph E Fischer v. Eriach (1720), and Johann G Borlach (1738).

For the period 1751–1800 the list continues with: v.Uslar, Walther, August F v. Veltheim, Claus F v. Reden, Benno v. Heinitz, Bemhard and Herberger, Johann L Hogrewe, Johaim J Ferber, Johann S Clais, Friedrich W v.Reden, Friedrich A.v. Heinitz, Johann P Waitz v. Eschen, Carl F Buckling, Johann T Fischer, Friedrich A Eversmann, E A Jagerschmidt, Carl de la Roche, Heinrich F C v. Stein, Johann C Friedrich, Friedrich O B v. Reden, Alexander v. Humboldt, Johann F Wedding, Johann G Studer, George Reichenbach, Johann G Schuiz, Karl and Begleiter Haidinger.

During the half century 1801–50 the names of those identifiedd are: Neuwertz and Vogel, Cristian F Brendel, Phillip A Nemnich, Johann G May, Eckard and Heinrich F Kriger, Johaim C Fischer, Johann and Ludwig v. Habsburg-Lothringen, Ernst Neubauer, Friedrich A Engells, Friedrich Harkort, Carl F Remy, Peter C W Beuth, E Hoesch, Franz Haniel, Hermann W Lueg, Johann W Wedding, Carl A L v. Oeynhausen, Heinrich v. Dechen, Carl W Bormann, F Hoffmaim, Werlisch, Karl Jordan, Dr Peter N C Egen, Carl A Henschal, Kurt A (?) Winkler, Heinrich Wildhage, Alfred Rrupp, Carl E B Hoffann, Meyer, Hans G P Schonian, A Diek, and Heinrich Schroer with Friedr. W Haniel.

In the same time frame, British technological men who spent periods in Germany (either as students, advisors, engineers, or factory proprietors) included:
Isaac Potter 1720 Foundry-Director in Schemnitz (Austria-Hungaria); Mathew Rawsthome 1765 Factory-Founder in Fahrafeld (Austria); George Collins 1765 Partner of M Rawsthome James Watt 1778 visited the Harz, Member of Mining Society; John Hawkins 1784 studied in Frieberg, Member of the Mining Society; Henry James Wattjr 1786 went to school in Stedfeld (Thuringia) u. Freiberg; William Richards 1786 Foundry-Inspector in Hettstedt (Prussia); Samuel Homfray 1786 Adviser for foundries near Berlin and in Silesia; M Robinson Boultonjr. 1788 studied pharmacy in Langensalza (Thuringia); William Wilkinson 1788 Adviser for foundries in Silesia and the Harz; John Baildon 1792 Engineer in Silesia, later owner of an iron-work; Thomas Lighthowler 1793 Engineer in Lippitzbach (Carinthia); W.E.Sheffield 1793 Partner of Lighthowler; Niclas Harvey 1810 Engineer and Factory- Partner in Sterkrade (Westfalia); Samuel u. Georg Aston 1818 Engineers and Factory-Founder in Magdeburg; Samuel Dobbs 1818 Engineer in Eschweilwe (Westfalia); Edward Thomas 1819 Engineer and Partner of Harkort in Wetter (Westfalia); John Player 1826 Factory-Founder in Neuwied (Rheinland); William Wilson 1835 Railway-Inspector in Numberg

Professor Schwerdtfeger's address is 14482 Potsdam, Jagersteig 6, Germany Telephone 0331 716979

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 Mack or ascii.

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