

Book Reviews

Metallurgica Antiqua: in honour of Hans-Gert Bachmann and Robert Maddin edited by Thilo Rehren, Andreas Hauptmann and James D Muhly. *Deutsches Bergbau-Museum, Bochum, 1998 (Der Anschnitt, Beiheft 8). 304pp, A4, many figures (some in colour). ISBN 3-921533-60-0. Price 80DM from the Museum.*

The name of the Bochum journal is most apt for this particular occasional publication: It brings together its three different meanings into a sharp triple point. The word at its simplest refers to any 'first cut'. It is extended by the miner, quite fairly, to 'working face'. The metallurgist then 'borrows' it to mean '(casting) gate'. All three aspects are represented in this major work which reflects great credit on all its participants, not least on the Bochum Museum, and of course on the farsighted vision of Volkswagen.

We start with personalia - and what a 'first cut'! Fourteen whole pages of lists of international exploits, collaborations between the two main protagonists and with others who add their comments. There follow 23 contributions, by well-known specialists, in alphabetical order, to the other two aspects of *Anschnitt* - again international, both in topic and author (if you're looking for addresses you'll find them at the very end) - as well as full period and material cover: from mine to ore to metal to slag, even with a couple of socio-philosophical lollipops thrown in (93G: 'Is mining wicked?'; 213G: 'The "Two cultures" dementia - fact or fiction?'). [In brackets: numerals = page numbers; G = German text].

Picking on thematics, we find articles on gold (25G) and silver (57, 69, 123), and eight on copper and bronze (77, 99, 177, 197, 223, 235, 263, 279G), two on iron (37, 163), one on lead (183), two on various mixtures (113, 291G) and two of more general character (45, 135). Seen crosswise, there are the esoterics (113, 291G), a re-interpretation (69), reflections of metallurgy in physical properties (77), information from slags (177, 223, 235), on metal production - theory (235) and practice (263) - and working (45, 57, 123), the inevitable oxides (99) and geology of mines and mining (136).

The editors deserve special credit for having worked so smoothly and well under the cloud of secrecy and ensuring that the quality of the presentation does full justice to the original, especially to the superb photomicrographs, always a great worry to authors, and of course the excellent and astonishing colour: very 'moreish'!

Sifting out the specials, Pleiner's study of Manching

ironwork (163) intrigues, showing generally ferrite, though some contains portions of both pattern-welded and quenched metal. But mostly it is, like the present example, merely strips of heterogeneously carburized metal, rather poorly edge-to-edge welded but showing the characteristic high-phosphorus 'white lines', sporadically containing globular phosphides with up to 20% P. Perhaps the most remarkable feature of this object is cast-on bronze decoration, 15% Sn average rising to >25% interdendritic. It fully deserves its 5 b&w and 6 colour-etched micros here. So far this is the only sword but some ceremonial horse furniture of this kind is known.

Results of ICP/OES and XRD analyses of metal and patina are rigorously compared and elegantly interpreted in terms of desilverization skills and economics, as between sets of 1st century AD Germanic and 13th century BC Egyptian lead objects (183). Re-examination of certain Rio Tinto crucibles shows that speiss was not worked up for Ag residues in Roman times (69). Examination of the 6000 BC Can Hasan macehead proves it to have been forged from native copper (279). Organisation of early Iron Age workshops in east Alpine Italy is compared in detail with respect to skill in handling Sn:Pb in bronzes (45).

I-section cramps in Inca sandstone ashlar water canals of the later 1st millennium, some 'cast in situ', were made of equi-proportioned As:Ni copper alloys smelted directly from local ores (77). Finds in NW Arabia, including 'Midian' pottery and iron jewellery, are linked with rock drawings at Timna and reliefs elsewhere, dating to late 14th-mid 12th century, to identify with 'sea peoples', ie Philistine metallurgists active with Egyptians (197).

The only sad comment is raised by the actual title of the book, *Metallurgica Antiqua*, which somehow suggests that this is IT - and there will be no others. Hopefully, this is a misapprehension ... ?
Leo Biek

An archaeometallurgical survey for ancient tin mines and smelting sites in Spain and Portugal: mid-central western Iberian geographical region 1990-1995 by Craig Meredith. *British Archaeological Reports International Series 714. Archaeopress, Oxford, 1998. 205pp, A4, 59 figures, 49 plates, 19 tables, no index. ISBN 0-86054-892-9. £46 (pb).*

This volume is the product of the author's PhD research at University College London (UCL), completed in 1995; apart from the Abstract, and Appendix 2, it appears to be a virtually-unaltered PhD thesis. The volume is well-

produced, the print, photographs, and other illustrations (including a few colour micrographs) being very clear. The binding on the reviewer's copy, however, shows signs of coming apart.

The first seven chapters (44 pages) consist of background material on the geography, geology and archaeology of tin and of Iberia. They are consistently long-winded, and give the impression that all the sources consulted are being regurgitated, rather than digested and synthesised. The author appears to be more at home with the geological than the archaeological literature. He also relies almost solely on workers at UCL/Institute of Archaeology, and the British Museum – the book relies far too much on the pioneering, but now dated, work of Tylecote while totally ignoring (for example), the Crift project in Cornwall or the Kestel project in Turkey, or the broader work on early smelting of Budd and others in Bradford, or Salter and Northover in Oxford, and indeed very few non-Institute or -BM publications later than 1980 are cited.

Chapter 8, the field survey, forms the bulk of the book, consisting of rapid assessment surveys of 42 sites, some of which were then investigated in more detail. This section contains important information, notably the identification and detailed survey of a probable Late Bronze Age mining site at Cerro de San Cristobal, a Roman tin-smelting site at Torre Romanum Centumcellas, and a potential Chalcolithic mining site at Berrocal. The artefact drawings, notably the stone hammers, are excellent. However, the section is again long-winded (perhaps even padded?) and poorly organised, and much of it reads like a travel diary rather than a publication report. Clearly the author has put a lot of effort into his fieldwork; the result would have been more impressive, not less, and certainly more affordable, had he confined his detailed publication to the positive results, confining the negative and inconclusive bulk to a brief gazetteer.

Following a brief chapter on analytical methods, Chapter 10 contains the analytical results. This is the best part of the book; the author appears to have a confident mastery of his methods and results, and these include important new information. Ores (or potential ores – many proved not to contain tin minerals), slags, and metal artefacts have been analysed from many of the field survey sites. Perhaps the most important results are from Mina Golpejas, Castelejo, and Alegrios. At Golpejas, experimental smelting of a mixed tin/copper ore showed that, under laboratory conditions, it could be smelted directly to 'natural' bronze (though there is no proof that this was actually done in antiquity). At Castelejo and Alegrios, the samples consisted of Late Bronze Age crucible fragments (from excavations by Coimbra University); some of these samples contain prills of metallic copper in association

with fragments of crushed cassiterite, giving evidence for bronze production by the addition of tin ore to molten copper. These results are discussed in the final, rather brief, chapter; here, and here only, is evidence that the author has engaged with colleagues outside London, in the form of a valuable discussion of McDonnell's alternative interpretations.

This book contains some important new data on the development of metallurgy in Iberia, but requires serious criticism on two counts. Firstly, the valid, and valuable, new information could have been presented far more accessibly in a medium-length journal article – £46, and the time to read over 200 pages, are not well-spent on this volume. The decision to publish at such length may reflect the self-indulgence of the author, or the institution's pressure to maximise its Research Assessment Exercise rating – in either case, it should have been resisted.

Most seriously, the poorly-structured and long-winded nature of the thesis, the limited understanding of the background, and the failure to keep abreast of the wider academic debate on early metal smelting, raises concerns about academic standards at UCL. This is a hard thing to say, and no disrespect to Meredith's evident hard work and field and analytical competence is intended. The impression given is of a seriously under-supervised piece of research, carried out in something of a backwater from the main currents of archaeometallurgical research. This is especially sad, given the pivotal role played by the Institute of Archaeology (as it then was) in the early development of archaeometallurgy. In these times of academic competition, the downward pressures on academic standards are all too obvious; on the evidence of this book, UCL has not resisted them, and needs to give serious attention to its standards of supervision and assessment.

David Cranstone

Beyond the bloom: bloom refining and iron artefact production in the Roman world by David Sim. *British Archaeological Reports International Series 725*. Archaeopress, Oxford, 1998. xix+155pp, A4, 104 figures, 46 tables. ISBN 0-86054-901-1. £29 (pb).

The research for this book, carried out between 1991-4 was submitted by the author as his PhD thesis; but some new material has since been added. The major part of the book details practical experiments replicating as far as possible the work of Roman blacksmiths, using tools, workshops, and the environment with which they were familiar. He is careful to record the time it took to turn raw bloom iron into workable iron and the amount of fuel and other materials consumed. He also records the time needed to make iron objects such as were made by the Romans. It is very much aimed at archaeologists and requires a fairly committed readership. He has considered,

at considerable length, what one might hope to learn from hammer scale on archaeological sites. Processes are carefully and clearly described and the book should promote good overall understanding of early blacksmith practices.

The author has concentrated more than previous writers on the actual processing of bloom iron as it comes from the smelting furnaces, to prepare it for working into artefacts. This is a lengthy and skilled process, as experiments at Plas Tan y Bwlch by Peter Crew and Hector Cole have also shown. David Sim considers a number of furnace types, but in an effort to see the Roman furnaces developing in a progressive and tidy fashion produces some rather dogmatic theories. Many people might take issue with his suggestion that Tylecote's Ashwicken furnace was 'the principal type used in the Roman period'. He also shows a diagram of a furnace suitable for heating large pieces of iron suitable for Bath House lintels without pointing out that Tylecote considered it the re-use of a lime kiln.

The author takes the reader through a number of experiments building hearths to refine blooms, none of which proved particularly satisfactory. He concludes that if special hearths were constructed for this purpose their use is by no means proved.

In his experiments of making artefacts careful attention is given to the time required for each object – culminating in 125 hours to make a pattern welded sword.

One of the most interesting parts of the book, which is likely to appeal to historians, is that on chain mail. The author has studied the making of mail in considerable detail. This has always been a somewhat problematical and difficult area, both for historians and the practical smith. The majority of chain mail coats were made using solid rings joined by riveted wire rings. In the past various methods have been postulated for making the solid rings but David Sim found to drill solid bar with a spade drill driven by a bow drill penetrated only 1.0mm after 45 minutes – clearly not a feasible method. Similarly a sheet of wrought iron 1.5mm thick drilled in a similar way and filed to shape on the outside took 32 minutes to make. He came out in favour of punches and dies using simple technology such as would have been available to the Romans. He found that when a die wore out, a new one could be made in less than twenty minutes, and that a ring could be punched from sheet and hammered to shape in 60 seconds.

What of the riveted rings? At the time Schubert wrote his history it was believed that draw-plates to produce wire were not in use until, at the earliest, AD 800. It has never seemed to me possible that iron wire about 1mm in

diameter, as displayed in Roman chain-mail at the museum in Caerleon, could conceivably be produced without a draw-plate. I was therefore very pleased to learn from this book that Thomsen and Thomsen brought to notice a cast of a draw-plate from the Burg Altema Museum in Germany, which they date to cAD 45 (*Journal of Engineering for Industry* Paper No 75-WA/Prod-6. 1-5).

David Sim takes us through the making of various Roman artefacts, a hammer, a pilum, bolt head, a spear head and an arrow head. He must be very patient to go through, for instance, two different ways of making nails, only to find that the quickest and most efficient is that practised by smiths today – hardly surprising.

The book ends with a detailed treatise on the evaluation of microscopic debris from bloomsmithing and blacksmithing experiments. From careful study of hammer scale on a site the archaeologist may hope to learn what type of forging has been going on and where it has taken place.

Amina Chatwin

Iron-making societies: early industrial development in Sweden and Russia, 1600-1900 edited by M Ågren. *Berghahn Books, Oxford, 1998. xii+356pp, 215x140mm, 17 figs, 1 table, index. ISBN 1-57181-955-X. £28.*

This book is the successor to an earlier volume, *Ironmaking in Sweden and Russia: a survey of the social organisation of production before 1900*, published in 1993 and reviewed in Vol 27 of *Historical Metallurgy*. This volume, like its predecessor, is a collaborative venture between researchers from the universities of Uppsala and Stockholm in Sweden and the Institute for Archaeology and History in Ekaterinburg (formerly Sverdlovsk), once the centre of the Urals iron industry. It embodies the findings of a major research project on the comparative history of the two most important iron-exporting regions in early modern Europe.

This is a work of social rather than technological history. Indeed, the question which the contributors pose is why, given the essential uniformity of technique employed in the two countries for much of the period under discussion, the organisational form of their respective iron industries differed so radically. Although the direct reduction of bog ore was still to be found in both Russia and Sweden, by the 18th century the dominant form of ironmaking was indirect reduction via blast furnace and forge. Yet ironworks in Sweden differed markedly from their Russian counterparts. Furnaces and forges were small, sometimes worked for only part of the year, and dispersed across *bergslagen*, the mining district to the north and west of Stockholm. In Russia ironmaking plant tended to be centralised and colossal in scale, often with two furnaces

standing adjacent to one another and boasting forges with a dozen or more hearths.

The contributors seek to understand these differing forms of production by examining firstly the agrarian context in which ironmaking developed. The essential inputs of ore and charcoal had usually to be provided by peasant households. But how were supplies to be guaranteed? Because ironmasters had no direct control over the production of fuel or the extraction of minerals they had to employ legal and institutional pressures to ensure the cooperation of the rural population. The ways in which pressure was applied varied, naturally enough. *Bergslagen* was a long-settled district in the heart of the Swedish kingdom, subject to regulation by well-established state agencies. The ironmaking districts in the Urals, by contrast, were thinly populated, at the edge of the Russian empire and subject to a state apparatus that was poorly developed at local level. Russian ironmasters did, however, have resort to a powerful means of coercion in the institution of serfdom, at a time when peasant freeholders in Sweden could claim some degree of political enfranchisement.

This discussion sets the tone for much that follows. The iron industries of both countries were orientated toward the international market for bar iron, but the response of ironmakers to the stimulus of international demand was shaped by complex institutional and political forces. As successive contributors make clear, the making of iron must be considered in relation to household and family structures in mining communities, to changing conceptions of property rights, to the control and dissemination of technical knowledge, to issues of authority and resistance within the workplace. Throughout, major issues of state policy on industrial development are related back to the social networks which governed the process of production.

On the whole, the essays presented here provide a rich and sophisticated analysis of developments in the two regions, perhaps more fully than can be captured in a short review. The material is well organised and provides the reader with a genuinely comparative – and often dialectical – perspective on the nature of two of the most important metalworking societies in northern Europe before the modern era. The text is clearly presented and accompanied by a useful glossary of technical and administrative terms. There are some good illustrations, particularly from the Swedish side, but the two maps are not at all adequate.

This is an important contribution to the history of industry in Sweden and Russia, and indeed of industrial development more widely. It can be recommended.

Chris Evans

Connecticut's Ames iron works: family, community, nature and innovation in an enterprise of the early American republic by G Galer, R Gordon and F Kemmish. *Offprinted from Transactions of the Connecticut Academy of Arts and Sciences*, 54 (1998), 83-194. 111pp, illustrated. Obtainable from the Academy, PO Box 208211, New Haven, CT 06520-8211, USA. Email: caas@yale.edu.

This is a scholarly account of an ironworks of unusual interest. Colonial exploitation of the rich sources of iron ore in the Salisbury district of Connecticut began in 1735 with the establishment of a bloomery, and the region's first blast furnace began to operate in 1762. A cluster of manufacturing enterprises including a saw mill and a paper mill developed near the falls on the Housatonic River, but most were destroyed in a fire in 1800. In 1832 Horatio Ames, John Eddy and Leonard Kinsley set up a forge on the site of a former paper mill. The partners had many family links with the iron trade. Ames's father's company produced 78,000 shovels a year, while Eddy's kinsmen were renowned makers of hardware. At the settlement which came to be known as Falls Village the partners used locally-smelted pig iron to make wrought iron by puddling, but employed wood rather than coal as their fuel, and utilised water power to operate hammers and mills. They produced large forgings including axles for locomotives and crankshafts for steam boats and from the 1840s specialised in tyres for locomotive wheels. Steam hammers from James Nasmyth's Bridgewater Foundry at Patricroft were installed in 1850 and 1857, the first of them ordered in person by Horatio Ames when he visited England in 1849. From 1855 the process used for making tyres was based on operations observed at the Low Moor ironworks in Yorkshire. Initially the use of wood for puddling was copied by other works in the Salisbury region but as transport facilities improved coal was substituted. During the 1860s Horatio Ames began to make wrought iron cannon, but failed to gain large orders from the federal government. After he died in 1871 the works was sold to the Housatonic Railroad who converted it to a locomotive and carriage repair shop, which closed after the railroad was taken over by another company in 1893. The site was subsequently cleared, and occupied by a hydroelectric power company which still operates. There are no remains of the works buildings, but in the river is a large slab of iron removed from one of the puddling furnaces during the clearance of the site, and some Greek revival houses once the homes of ironworkers still stand in Puddlers' Lane.

This study will be of interest to many historians concerned with ironmaking and engineering. The use of wood as fuel in the puddling process is a classic case of the adoption of a technology developed in one country to the circumstances of another. The ways in which the Ames works met the needs of the first generation of locomotive

builders, the mechanisms by which the company gained knowledge of developments in Britain, and the importance to engineering establishments of armaments contracts are well portrayed. The referencing is exemplary and there is a useful glossary. The book poses many questions which will stimulate historians of the nineteenth century iron industry in Europe.

Barrie Trinder

Derwentcote steel furnace: an industrial monument in County Durham by David Cranstone. *Lancaster Imprints 6. Lancaster Archaeological Unit, Lancaster, 1997. viii+143pp, A4, 25 figs, 49 plates, 9 tables, index. ISBN 1-86220-011-4. £20 (pb). Distributed by Oxbow Books.*

Derwentcote Steel Furnace, south-west of Newcastle-upon-Tyne in the Derwent Valley, County Durham, is a remarkable survivor from the early days of the industrial revolution. Although its significance as a monument to the development of steel production, one of the key technologies of the industrial revolution, was recognised from at least the 1960s, it was not until 1985 that the Department of the Environment purchased the site and English Heritage took into care the cementation furnace and adjacent forge and initiated the programme of structural survey, archaeological excavation and historical research, the results of which form the subject of this book. Following the on-site investigations, the furnace was consolidated and repaired, and opened to the public in 1991.

The Derwent Valley was the centre of the UK steel industry by the late seventeenth century; in the following century British cementation steel dominated European production in both quality and quantity, although the main focus later moved to Sheffield. The significance of Derwentcote furnace, built in the heart of the County Durham steel district and dating from about 1733, is illustrated by the likelihood that it was responsible for producing between 10 and 20% of annual British steel output by 1737. The furnace was operational until the late nineteenth century, still using the cementation process whereby wrought iron bars surrounded by carbon (charcoal) were roasted in sealed chests, converting the iron into steel.

As mentioned above, practical recognition of the site's significance included a programme of field and documentary investigation. This work, and subsequent production of the report, was carried out under the direction of David Cranstone, then of the Lancaster University Archaeology Unit.

The published report is as comprehensive as is appropriate to the greater understanding of the furnace and its role, with most useful preliminary chapters briefly describing

the research programme, technological background to the early processes of steel-making, the geological and physical setting of the site and its historical context. The main body of the report comprises three chapters covering in meticulous detail the description and survey of the standing structure, an account of the excavations and an examination of the finds, including an assessment of the slags and process residues found, much in tabular form; all sections are illustrated with appropriate drawings and photographs. Although several specialist reports were prepared for the finds, only the information relevant to the steel-making process has been extracted and published, the full reports being held in the site archive. Finally, a discussion and synthesis brings together field and documentary evidence. A useful glossary of 18 steel-making related terms is provided and, in the absence of individual references in the text, a bibliography listing over 50 published sources.

The report concludes that the forge at Derwentcote dates from 1718-9, the cementation furnace was added c1733 and operated until 1875, and the whole site was closed in 1891. The works was run by a series of short lived partnerships except between 1790s and 1872 when it was under the control of the Cookson family. Although internal repairs to the furnace have taken place, the exterior structure is very largely original and as such is by far the earliest known cementation furnace in Britain, if not the world. Excavation has revealed various floor levels, with evidence for hand smithing and a charcoal grinding mill; outside, evidence for three timber buildings and a paved yard was found. Most of the finds related to the period after closure of the furnace, but ironwork included fittings from the furnace. The discussion and synthesis includes speculation on how the furnace would have operated.

Overall, the presentation and design is excellent, the narrative being easy to read backed up by a good index. A decent quality ground plan with a north point and a proper scalebar would have been useful; the plan in figure 3 is too sketchy. The line drawings would all have benefitted from a more detailed scale bar; one subdivision is just not enough. This reviewer has a personal dislike of separate numbering systems for figures and plates – it is not necessary nowadays and is confusing when browsing through and looking for particular illustrations. Another old fashioned feature is the grouping of the photographs (bar two) in a block of pages at the back; placing the photos near their references in the narrative would have broken up the mass of the survey and excavation text and complemented the line drawings, which are spread throughout.

As to the photographs themselves, it is commendable that the size of ranging pole visible is noted in some captions; this could be usefully extended to all. Several photographs

are devoid of any scale and would benefit from such; a few are poorly lit or have dark shadows and one image has been repeated but with a different caption.

These are minor criticisms which should in no way deflect from the solid worth of the report and David Cranstone is to be commended for so successfully pulling together the programme of survey, excavation and research at Derwentcote into a substantial but readable publication. This authoritative study has done justice to a long neglected internationally important site and will be an essential reference work for archaeologists and historians researching the development of steel production.

Brian Malaws

Scienza e mistica del damasco contemporaneo by Ivano Comi. *Casa Editrice G Stefanoni srl, Lecco, 1994* [*? privately published*]. 300pp, 350x220mm, many figures in full colour. No price given.

Acciaio Damasco: la tradizione orale nella pratica di forgia by Ivano Comi. *Editore Ulrico Hoepli, Milan, 1996*. 141pp, A5, figures. ISBN 88-203-2297-8. 32,000 lira.

‘Questo lavoro non è l’espressione di uno storico o di un metallografo, ma quella di un appassionato collezionista ...’ [This work is not the work of a historian or of a metallographer, but of a passionate collector ...]. With these words, the author effectively describes the first of these books. It is divided into two parts. The first discusses damascus steel, from a historical and technical point of view, including the pattern-welded blades of the Vikings, Indian wootz steel and Japanese sword blades, almost entirely from a wide range of secondary sources. The second examines the work of six modern bladesmiths, producing highly decorated knives, most in the collection of the author and many made to his commission. Each knife is photographed apparently full size and in colour with a detailed description of the technique used, and of the decoration and the theme behind it.

The second book is in effect a new version of part I of the first. Describing itself as a discussion of the oral tradition behind forge practices, it examines the published sources in Italian, French, English and American, Russian, German and Arabic and compares the different technical descriptions they contain.

Sarah Barter-Bailey