Book reviews

Metallurgy and Civilisation: Eurasia and Beyond (Proceedings of the 6th International Conference on the Beginnings of the Use of Metals and Alloys: BUMA 6) edited by Jianjun Mei and Thilo Rehren. *Archetype Publications in association with the University of Science and Technology Beijing and the Institute for Archaeo-Metallurgical Studies, London, 2009, A4, numerous illustrations, ISBN 978-1-904982-49-4, p/b, £47.50/$95.00.*

The BUMA conferences are, according to their title, concerned with 'beginnings', but from the start in 1981 their subject has been much broader. These conferences are simply the place to go to find out what is happening in Asian archaeometallurgy of all periods. This book presents papers from the 6th BUMA conference, held in Beijing in 2006. Producing it in only three years, including peer-review, revision, English editing, and printing, has been a major accomplishment, and the book gives an admirable snapshot of what is happening now in its field. There are articles here on bronze and other copper alloys, iron, lead, and silver, in China, Japan, India, Inner Asia, and the Middle East. Most are laboratory-oriented, but a few are broader historical studies. In this review I have chosen to concentrate on a few articles which seem to be of special interest for readers of *Historical Metallurgy*.

The earliest bronze in the vast region between Europe and China is the subject of three papers, by Evgenij Chernykh, Jianjun Mei, and Liangren Zhang (pp 3–8, 9–16 and 17–25). New data and new insights in the past 20-odd years have greatly complicated the subject, and old certainties are fading away without, as yet, being replaced by new. All three articles emphasize the tentativeness of their discussions and the need for more data and more study. Central to the subject is what appears to be an explosive westward expansion of cultural traits from the Altai region, called by Chernykh 'The Seĭma-Turbino Phenomenon', and a somewhat later expansion, in the general direction of China, of traits of the Karasuk culture.

Discussion of early Eurasian bronze was earlier dominated by questions of technological diffusion, and in the 1970s such questions became a part of the Sino-Soviet squabble, featuring cross-accusations of 'Maoist propaganda' and 'Soviet revisionism' as Soviet writers insisted on diffusion and Chinese writers insisted on independent invention. It is fascinating to note how the debate has changed: Chernykh, the Dean of Inner Asian archaeometallurgy, (who seems to have been quietly diffusionist in Soviet times, *eg* Chernykh 1992, 1–4, 269) avers now that the independent invention of bronze technology, in China and several other parts of the world, 'is no longer a subject of debate', but a simple empirical fact (pp 3, 7). Jianjun Mei, on the other hand, has argued for the possibility of diffusion of the technology to China (2000; 2003). In this book, however, Mei finds the question less interesting than a newer trend in research, 'putting more emphasis on local or regional developments and interactions, as well as their socio-cultural contexts' (p 13; note also Mei 2009, 223). One of these regional developments is piece-mould casting, whose origin is clearly the Central Plains region of China, and which filled the function that lost-wax casting had in the West.

Two articles on lost-wax casting once again scramble our ideas on an important question in Chinese archaeometallurgy. In the ancient West most castings of any complexity were made by the lost-wax method, and studies of Chinese bronzes by art historians in the early 20th century concluded that all of the early bronzes were made by this technique. The reasoning behind this belief was that the castings were too complex to be made by any other means. After investigations by a practical man, the Swedish founder Orvar Karlbeck (1935), it became clear that there was no evidence for lost-wax casting of any of the then-known ancient Chinese bronzes; all were made by the piece-moulding technique. For many years thereafter it was almost unanimously accepted that lost-wax casting was unknown in ancient China. The artefacts on which this view was based were virtually all from northern China. As archaeology in southern China matured in the 1970s however, a number of bronzes came to light which appeared to be too complex for piece-moulding (*eg* Fig 1), and investigations by archaeometallurgists concluded that these were cast by the lost-wax technique (*eg* Hua Jueming and Jia Yunfu

Fig 1: Complex Chinese moulding

1983). There was then much discussion of the origins of the technique in southern China and the possibility that it had come from the West (*eg* Hua Jueming 1985; Barnard 1996).

An article by Weirong Zhou and three others (pp 73–78) reports on a re-investigation of these southern bronzes and concludes that none was cast using the lost-wax technique. They are composed of many separately-cast pieces, welded (or rather soldered?) together. The article includes excellent colour photographs of details of the bronzes showing casting seams, casting gates, and welding (soldering) traces, and its arguments are quite convincing. The authors conclude (p 77) that lost-wax casting 'was probably introduced into China to cast statuettes of the Western-style Buddha in the period between the Northern Dynasties and the Sui and Tang dynasties', 4th–9th century AD.

But Christopher Davey's wide-ranging paper, 'The early history of lost-wax casting' (pp 147–154), gives another new twist to this issue. He begins with a very clear and precise discussion of the technique, its history in the West, and the methodology of determining the casting method of an artefact, noting (in agreement with Weirong Zhou *et al*) that 'complexity is not an indication of lost-wax techniques'. He then investigates a number of ancient bronzes, East and West, including one of the remarkable masks from Sanxingdui in Guanghan County, Sichuan, discovered in 1986 (Fig 2). The Sanxingdui bronzes are generally thought to date from about 1300 BC, though a few scholars have argued that this is too early (Barnard 1990; Zhang Zengqi 1999). They are not so complex as to raise doubts that they were cast by piece-moulding, but Davey argues convincingly that

Fig 2: Ancient Chinese bronze from Sanxingdui in Guanghan County, Sichuan

the one he investigated was in fact cast by the lost-wax technique. The article includes photographs of details which show, among other things, lines in the bronze which appear to represent 'false cuts' in the wax model. Davey concludes that the technique came to Sichuan from the West via India and the 'south-western silk road'. This is certainly possible, but would be more plausible if the date were rather later than 1300 BC.

Among six articles concerning iron, an important article by Wu Guo (pp 107–115) dates the earliest iron artefacts in Xinjiang (NW China) to the 9th–8th centuries BC, a better-based date than we have otherwise had. The article then produces some remarkably clear evidence of Neo-Assyrian influences in Xinjiang, and concludes that the technology was introduced here from NW Iran in the 10th–9th century BC. It was from here that it came to the Central Plains of China a few centuries later.

In Japan it seems to be rare that archaeometallurgists are permitted to take samples from ancient artefacts, but Masahiro Kitada gives here (pp 129–133) a very thorough study of two steel swords of the Kofun period, AD 200–600. In addition to a detailed metallographic study the author did something which must be very rare in studies of ancient materials: he cut test pieces (diam 2–3mm) for tensile tests, and gives here the resulting stress–strain curves.

The publisher has generally served this book well, with excellent reproduction of the photographs, many in colour; though the maps are sometimes inadequate to their purpose. On the other hand the book lacks an index, and this is a dreadful fault in a book of this kind. May I suggest to the editors that they remedy this fault by placing an index on the Web?

Don Wagner

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Mining in a medieval landscape. The royal silver mines of the Tamar valley by S Rippon, P Claughton and C Smart. *University of Exeter Press, Exeter, 2009, 245x170mm, xiii+207pp, 56 figs, 4 tables, index, ISBN 978-0-85989-929-7, p/b, £20.00/$36.00.*

The Tamar Valley is of exceptional industrial archaeological and mining importance, containing in Devon Great Consols what was, for part of the 19th century, the largest copper-producing mine in the world. Over the years it has produced tin, copper, lead, arsenic, silver, antimony and other minerals. This rich heritage led to its designation in 2006 as part of the Cornwall and West Devon Mining World Heritage Site, for the 18th- and 19th-century technology of its mining.

However, this book is really about the parish of Bere Ferrers, at the tip of the peninsula between the rivers Tamar and Tavy. The essential chapters of the book concern the silver mines here, worked by the Crown or its lessees from 1292 until a fitful decline in the 16th and 17th centuries, when sources of silver elsewhere rendered the endeavour uneconomic.

De la Beche drew attention in 1839 to the documents relating to these mines, and Booker discussed both them and the sites in some detail in 1967. However, it is the work of Peter Claughton that provides the principal springboard for the present project. His fieldwork over 20 years has determined the course of the Lumburn Leat, a remarkable piece of 15th-century engineering, including cuttings, tunnels and earthworks, running for 10 miles from the river Lumburn to the mines, and he recognised that its purpose was to serve a great technological innovation of the 15th century: the suction pumps that drained the mines, the first examples of their kind in the country (Claughton 1994; 1996). This book results from a Leverhulme project (2006-8) which develops Claughton's work. Chapters cover the metals industries of Devon; silver production and the Devon mines; extraction and processing; the management of resources; and the wider landscape.

Chapter 2, a rapid survey of the exploitation of Devon's metal resources—silver-lead, copper, gold, tin and iron will be useful for readers unfamiliar with the subject, although it omits the recent excavation of a tin mill at Merrivale on Dartmoor, and the publication of 8th–10th century 'non-slag-tapping' iron furnaces at Burlescombe (Reed *et al* 2006). On medieval tinworking, the reference (p32) to 'elluvial deposits' (a persistent misspelling for 'eluvial') will annoy some readers, since this word refers to the extractive process rather than to the deposits themselves.

Chapter 3 is a historical survey of the sources and use of silver in medieval Europe, and is great fun. Professional miners were brought from the Peak District to Bere Ferrers by the Crown, which intermittently assigned the workings to various external parties such as the Frescobaldis when finances demanded. The silver here was apparently discovered in a survey initiated by the Crown after it had assumed control over the silver at Combe Martin, north Devon, in 1292, but unfortunately no documents relating to the actual mechanics of this search have emerged.

The chapters discussing the detail of extraction and processing are the heart of the book, and the field and documentary evidence are most successfully integrated to explain the evolving mining landscape. The changes in mining and smelting processes are discussed, including the move from bole smelting to the use of bellows, advances in adit technology and drainage, and of course the great Lumburn leat itself to power the pumps of the 15th century. The documentary evidence for the sites of the smelters being moved around over time to exploit a variety of timber sources for fuel will be helpful for those researching less-well documented areas, and the detail (p90) of the labour involved in moving the 'turnbole' is absorbing. Ancillary industries such as woodland management, charcoal production and transportation of raw and finished materials are also discussed, and these chapters will be of use to all those studying the field remains of medieval extractive industries.

The final substantive chapter endeavours to set this wealth of mining history into a 'landscape' setting, consisting of a competent Historic Landscape Characterisation landscape regression exercise and an interesting use of documentary material from medieval records to the Tithe Map. However, this does not entirely further the project's objectives as much of it is fairly tangential to the use of the landscape by the mining community itself in the Middle Ages.

It is a curate's egg of a book. Its core material is immensely valuable and it is excellent to see it published. Some other elements seem less integrated, or incompletely covered. A section on Anglo-Saxon silver coinage discusses coins from mints at Carlisle and London. No mention is made of the 10th–11th century mint at Lydford (Allan 2002), a mere 16 miles away, nor of David Metcalf's (1998, 245) extremely interesting, if unelaborated, suggestion that the Lydford mint exploited local silver. If Anglo-Saxon coinage is to be discussed, the local evidence might reasonably appear. However, the book also provides a wonderful example of 'research' discovering things other than in its 'research design'. Documentary evidence for a smelting site at Calstock, on the other side of the Tamar, from 1301 to 1316 referred to a *curia* or *vetus castrum*. This led the authors to carry out a magnetometer survey in the vicinity of Calstock church, on the hill above Calstock town. The *vetus castrum* was not only located but demonstrated to be a previously unknown Roman fort, which helpfully adds to the sparse distribution of these in Cornwall. Subsequent excavation by Smart has provided not only Roman material, but also pottery from the 10th and 11th centuries, and so this one project has spawned other unrelated but worthwhile new research topics.

The book is nicely produced, although some images (*eg* 1.3) are produced at curiously large scale, and it might have been helpful to have a map of the actual area of Bere Ferrers alongside the general location map, rather than to have to wait until page 61. It is excellent value at £20 for the paperback and will be helpful to many other studies in the future.

Frances Griffith

A version of this review also appears in *Landscape History*.

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Zinc sculpture in America: 1850–1950 by C A Grissom. *University of Delaware Press, Newark, 2009, 285x220mm, 706pp, 554 figs (354 colour), index, ISBN 978-0-87413-031-7, £55.50/$71.50, h/b.*

This is a survey of zinc sculpture in America, ostensibly a rigorous catalogue of the surviving and lost pieces, but it is also a comprehensive study of related topics. These include a survey of the materials, methods of manufacture and distribution (including a very detailed survey of the surviving manufacturer's catalogues etc). As Carol Grissom is a metals conservator (at the Smithsonian Institution) and was introduced to the subject by being invited to report on the condition of some of the more famous zinc monuments (Grissom 1994), there is an authorative account on their corrosion problems and the correct conservation and restoration treatments. Thus far this is all very technical, although of great interest to many of *Historical Metallurgy*'s readership, but the book also considers the broader historical and cultural issues of how and why zinc sculpture flourished through the second half of the 19th century. In fact,

although undeniably specialist at one level, the book records for the first time an important aspect of the application of factory production to the material arts in 19th century America, facilitating their relatively cheap mass production. As one of the principal American suppliers boasted in his catalogue:

> 'In other lands, art is left mainly to the care of the few, in America, on the contrary, the culture and success of art and artists depend upon the many. The presence of statuary in so many appropriate situations in the open spaces of our cities and villages, and in the beautiful parks and gardens of the country sufficiently attest the evidence of esthetic (*sic*) taste among the people, and entitle America to the proud distinction of being one of the most generous, because most general patrons of art.' (Quote from M J Seelig & Co's 1876 catalogue)

The broader subject of the multiple production of sculpture is fascinating. There was certainly a huge market for statuary in the classical world, with the works of famous sculptures, statues of rulers etc. being widely copied. However, they do seem to have been free copies rather than exact replicas. It does seem that it was only from the 18th century in Europe that the concept of a sculpture as an edition rather than a single piece became common, marble statuary being produced by the pointing technique and bronze by the indirect lost-wax casting technique (Craddock 2009, Ch 4; Wasserman 1975). These techniques for the reproduction and mass production of sculpture were joined in the 19th century by new techniques such as pressing and electroforming (it always comes as a surprise to most people to discover how many of London's 19th-century statues are electroforms, not castings).

There were also new materials, notably cast iron and zinc. The use of zinc for major statuary and architectural features is rather restricted. Zinc seems to have been championed by the German architect Schinkel at Berlin and Potsdam in the 1830s and thereafter it seems to have had a very Nordic popularity. Germany was always at the centre of European production and it is the northern capitals that are graced with their products (Vosgen 1007; Mottner and Mach 1999; Hierath 2004). By contrast France, Italy and the rest of southern Europe stayed with marble or bronze. Despite zinc statuary having a good exposure at the Great Exhibition of 1851, there are few examples in Britain, except for some German pieces at Balmoral and at Osborne, Isle of Wight, and it comes as no surprise to discover that these were purchased by Prince Albert. Zinc statuary came to America in the 1850s first as direct imports from Germany, but were soon being produced locally, copying a wide range of European sculptures, both ancient and modern, not just German examples, as well as an increasing proportion of American designs.

Through the Post Medieval period there was an increasing use of statuary, either free-standing or as part of architectural features, to embellish prestige urban or rural landscapes. The enormous expansion of cities and their associated public institutions in the 19th century, together with the perception that statuary added not just beauty but dignity and prestige, created a huge market that only the new materials and techniques of production could fill. In addition there were new classes of monument, such as war memorials dedicated to the common combatant. It is likely that the monuments that sprang up all over America after the Civil War, and so often cast or pressed in zinc, are the earliest war memorials to the common soldier as we understand them today. However, the relative cheapness almost certainly contributed to the demise of zinc statuary, especially after the introduction of pressing. As part of the growing reaction by the Arts and Crafts movement etc against factory mass productions in the late 19th century, zinc statues were increasingly seen for what they were: cheap machine-made commodities to be purchased from a catalogue, devoid of the very prestige their predecessors once possessed. Grissom noted that zinc statuary was often banned from memorials, cemeteries etc once the first one had been erected. Whatever the cause, it is very noticeable that the market contracted very sharply from the end of the 19th century, and was almost moribund before 1914. In stark contrast to the very many zinc Civil War monuments around America, there are hardly any World War I or II monuments incorporating zinc sculpture.

The sculptures were made from unalloyed zinc, and almost always made from a number of components held together with soft solder. This meant that common features such as limbs could appear on a number of different statues, a raised arm could, for example, hold a bible if a noted preacher, or a rifle if a gallant infantryman. There were three principal methods of production. The components could be sand-cast, or if hollow, slush-cast, and from the 1870s the components could be very cheaply pressed from zinc sheet at temperatures between 100–200°C. Usually the sculptures were intended to be painted in naturalistic colours or 'bronzed'. Bronzing in Europe refers to chemical treatments usually creating dark red or even black copper oxides or sulphides on the surface, but in this context at least, bronzing was the application of several coats of lacquer, one at least containing flakes of copper or brass in imitation of polished

bronze statuary, and known in America as *orbronze*. Sometimes the zinc was electroplated with copper partly to provide protection, but this was often unsuccessful because an electrochemical cell was set up between the copper and the zinc with the latter, being more electronegative, deteriorating at the expense of the plating. Another popular treatment created the so-called 'white bronze' that was supposed to be reminiscent of marble. The assembled sand-cast zinc sculpture was sand-blasted and then chemically oxidised to give a pleasing bluey-white patina. The sculptures were advertised in catalogues, the purchase price to include the zinc plinth, erection and painting on site to the customer's specific requirements and satisfaction.

Despite the chemical reactivity of zinc, Grissom has found that even the unpainted sculptures seem to be chemically stable in the main (see also Grissom 1994, and Riederer 1997 for conservation issues on the German statuary). Monuments left untended for over a century in cemeteries are often still in reasonable condition, a stable patina of insoluble zinc carbonate having formed. Similarly, zinc sculptures that have formed part of fountains seem to have come through a century's inundation intact. One would have thought that in modern urban environments, with their atmospheres rich in sulphur and nitrogen oxides, that the formation of soluble zinc sulphates and nitrates would pose an ever increasing great threat. In fact at present the major problems seem to physical, cast or pressed zinc is not strong, and occasional deliberate vandalism and more frequent people mindlessly clambering over monuments in public places have taken their toll (all too reminiscent of the problems encountered by the aluminium statue of Eros in Piccadilly, London). Another common failing more specific to zinc statuary is that of creep. Several of the more common statues have their weight unevenly distributed, such as the Civil War infantryman for example, with much of the weight on the back, causing the statue to lean backwards rather alarmingly. The major problem, though, as is so often the case, seems to be well-intentioned but ill-informed restorations. In order to give support to seemingly flimsy statues they have often been filled with concrete in recent decades. On setting the concrete shrinks slightly pulling away from the zinc thereby creating a slight gap into which water can percolate promoting potentially ruinous corrosion.

The majority of the book is taken up with the catalogue of known sculpture, both extant and destroyed. They are arranged by category including trade figures, civic worthies, Gods and Goddesses, animals, fountains, war memorials, soldiers and sailors, tombs, saints and crucifixions, each with an individual history where known, manufacturer, and their trade catalogue entry, etc. The pieces are well illustrated both with historic wood cuts and contemporary photographs together with the author's own photographic record.

This is a massive work in many ways (quite literally in one sense, the book weighs in at 3kg), the tracking down and recording of hundreds of sculptures must in itself have been a mammoth task. This could only have been undertaken by an enthusiast, and one suspects that it grew to be to some degree a labour of love. In the introduction the author recounts how back in 1978 she was asked to advise on the conservation of a zinc sculptural group forming part of the Fourth Ohio Infantry Monument at the Gettysburg National Military Park, and discovered that virtually nothing was published on the technology or history of these monuments, much less on their conservation. She got interested

> 'and I gradually acquired file cabinets full of photos and data ... and as I became known as a source of information on zinc sculpture, I received many enquiries from communities desperate to save their monuments.'

The results of these labours have been superbly assembled into a monograph that is both extremely detailed: ('while I estimate that items listed in the Catalogue comprise less than half of the extant public sculpture in zinc, I believe that they represent fairly accurately its range and quality), and at the same time discusses an important facet of the subject of public sculptural art in an industrial society.

Paul Craddock

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