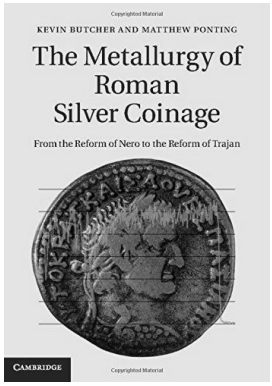
Book reviews

The metallurgy of Roman silver coinage: from the reform of Nero to the reform of Trajan by Kevin Butcher and Matthew Ponting with contributions by Jane Evans, Vanessa Pashley and Christopher Somerfield. *Cambridge University Press, Cambridge, 2015, 245 x 175mm, xxxii+797pp, 213 figs (some colour), 118 tables, index, ISBN 9781107027121, £110 ($170), h/b.*



Bearing in mind that this 800 page monograph only deals with the first 100 years of Roman Imperial silver coinage, its rather modest title *The metallurgy of Roman silver coinage: from the reform of Nero to the reform of Trajan* perhaps underestimates the wealth of information that has been presented. In essence, this book provides a framework with which to evaluate the economy of the Roman Empire in the 1st century AD through a close analysis of the incremental debasement of its silver coinage. It should be noted at the outset that one of the strengths of this book is that it provides evidence for potential narratives to emerge, rather than supporting an existing narrative which links debasement solely with decline and eventual currency collapse. In fact, rather than accepting debasement as a general consequence of historical decline, it uses its fluctuations to reveal a much more complex picture of how the Roman state attempted to influence its fiscal health – potentially identifying episodes of recycling and stockpiling silver.

The new programme of analysis is the hub of this work. Compositional analyses that investigate the major, minor and trace elements as well as lead isotope ratios are presented alongside metrological data and evidence (and its biases) from hoards. The first section of the book outlines how and why this information has been determined and relates it in a general way to the factors affecting production and stability. This section is a coherent and welcome summary to anyone interested in this area as it provides readable background to the Roman monetary system and the motives behind debasement, as well as the scientific techniques and associated issues with data quality which are used to make subsequent inferences. The second section is a chronological treatment of the denarius, in which groups that emerge from compositional plots are presented alongside their historical context, especially in relation to reforms, often identifying mints and potential ore sources. This data-rich section could be quite dry for some readers. However, each chapter within it is provided with a conclusion which can be read independently to get an overview, before going back to the plots. Furthermore, there is an overall summary chapter where the conclusions from the analyses are presented alongside historical inferences which range from Nero's possible capitulation to public sentiment by raising the silver content of the denarius, to Domitian's attempt to remedy the problem of a two-tier system of debased and finer coinage in circulation. The third section deals with coins in circulation outside the Empire proper and is organised geographically – again each chapter has a conclusion and the section has an overview chapter which relates these provincial coins to the denarius.

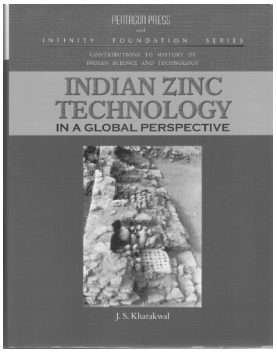
The index is comprehensive and the bibliography has separated out the lead isotope references which are used to create the source fields in lead isotope plots, which is convenient for those interested in sourcing silver. Unusually for this type of book there are not the almost obligatory multiple pages of photographs of coins. This may have been a conscious attempt to keep the book to one volume (as other volumes using the same framework are already planned for later Roman periods) and to lower costs (although it is still quite expensive). This was a good decision, as all coin photographs are on-line and can be accessed. On the other hand, the lead isotope plots (which are in colour) are placed in the centre of the book, which tends to disrupt the flow. However, the main criticism is that although compositional plots are presented, the compositional data itself is not. This, to some extent, means that any reader has to buy-in to the way this new data has been analysed. Although there is no reason to question the approach used *per se*, the compositional data produced could provide a valuable resource for different types of analyses to be conducted: for example, multivariate approaches applying log-ratio transformations. In other words, the strength of a programme which provides new evidence from which new

narratives may emerge could be further strengthened if the evidence is provided in its raw as well as analysed state.

Overall, this is clearly a remarkable piece of work, which provides a framework for the following volumes. Parts of this book are beneficial for historians and numismatists, while other parts are of interest to archaeometrists. However, it is the way this book has been put together, encouraging each of these disciplines to appreciate different aspects of the field, which could attract a much needed cross-breed of researchers.

Jonathan R Wood

Indian zinc technology in a global perspective by J S Kharakwal. *Pentagon Press and Infinity Foundation series, New Delhi, 2011, octavo, xxxvii+340pp, plates and figs, ISBN 9788182744912, Rs1500 ($57 or £59 from Amazon), h/b.*



This book on the early history of zinc production, specifically concentrating on the Indian contribution, is part of a series of major publications entitled *History of Indian Contributions to Science and Technology*, sponsored by the Infinity Foundation. Part of their remit is to 'document and discuss the history of scientific and technical achievements in the Indian Sub-continent until the end of the 19th century'. There are volumes on agriculture and architecture, together with four on early metallurgy: this volume and *History of metals in eastern India and Bangladesh* by P K Chattopadhyay and G Senqupta, *Marvels of Indian iron* by R Balasubramaniam, and *Iron technology and its legacy in India* by V Tripathi.

The series is a valid response to a very real and still prevalent lack of appreciation of the Indian contribution to so much of the global cultural development. Overall western perceptions of antiquity have been to a large degree centred on the Mediterranean, Egypt and the Middle East, and dominated by Graeco-Roman thought. Given the central place of the Bible and the Classics in Western Education until well into the 20th century, this is perhaps inevitable (Latin tuition was almost universal but how many could handle Sanskrit?). Those of us who work in India are frustrated that this narrow blinkered perception of world culture should continue. For example, the casting of large bronze statuary by the Greeks and Romans has attracted considerable attention and debate for well over a century, not least because there is so little direct technical evidence other than the statues themselves. Hoffmann and Konstam (2002) put forward a very controversial theory that the figures were not cast vertically but instead lay on their sides. All manner of evidences were advanced to support this idea, but the authors failed to mention, and clearly did not know, that this was how such large statuary had been cast in south India at centres such as Swamimalli in Tamil Nadu for at least the last 800 years (Craddock 2015). None of the comprehensive modern treatises on classical bronze casting ever mention the contemporary bronze casting traditions of India.

Similarly, H A P Littledale was lauded in the 1930s, after many years of experimentation, for replicating the wonderful gold filigree work of the Etruscan and Greek goldsmiths, by using a solder of gum and powdered copper salts (a method that he promptly patented, as discussed in Ogden 1982, 4-6). This had baffled classical scholars for generations, but if they had gone to India they could have watched jewellers in every major centre using this technology, as indeed they still do (Untracht 1997).

With this background it is hardly surprising that that the major works on the history of science and technology in antiquity, although ostensibly global in their scope, such as those of Partington (1935), Forbes (1971, for metals) and Singer *et al* (1956, for the ancient world) should concentrate on the Mediterranean-Egyptian-Middle Eastern world.

The great exception is, of course, Joseph Needham and the *Science and Civilisation in China* series, where the Far East is the centre and we are shown how many 'western' techniques from moveable type to the concept of +ve and –ve fundamental particles, were in fact Chinese in origin. Many Indian scholars (including Rajiv Malhotra, in the Introduction to the present volume), bemoaning the lack of comprehensive Indian treatises, cite the *Science and Civilisation in China* series as what is needed for India.

The foregoing is not to deny India any major works. Chandra Ray's excellent *A History of Hindu Chemistry*, first published back in 1902, written by a scientist, remains the best overall survey of the subject. Currently there is also the major History of Science, Philosophy and Culture in Indian Civilisation series, projected to run to 75 volumes, sponsored by the Indian National Academy of Science, together with journals such as the

Indian Journal of History of Science, now in its 51st year.

Kharakwal's work is a comprehensive survey of early brass and zinc production, focussed very firmly on the evidence from the excavations made at Zawar in Rajasthan. The work is a compilation, bringing together material from published work, rather than presenting original archaeological or historical research, but does provide detailed background information on the technical history of brass and zinc, expanding on the work already published, most notably in *2000 years of zinc and brass* (Craddock 1998). This book objectively discusses the outside world realistically and comprehensively. In particular the likely transmission of the zinc smelting technology from India to Europe is well treated. Furthermore the author has clearly read (and understood) very widely on early metallurgy from around the world.

The work is divided into nine principal sections: The antiquity of zinc and brass generally, Zinc and brass in early Europe, Africa and the Middle East; Zinc and brass in China; Zinc and brass in South Asia. The work then moves on more specifically to Zawar: Zinc and lead ore mining in Rajasthan; Zawar, archaeology and history; Zinc smelting at Zawar; The transmission of zinc and brass technology from India; and finally a chapter on early and traditional distillation techniques.

There is an underlying desire to push the dates of brass and zinc usage in India back as far possible which can result in unsupported claims, such as (p82) 'no doubt brass was common in India prior to the dawn of the common era' and it was 'quite popular in India from the 5th and 4th centuries BC if not earlier', before admitting that the relevant analyses have yet to be performed and in truth there is no evidence for this at all. There are also some odd and unexplained statements, such as the belief (p87) that if the zinc content of a brass exceeds 22% this suggests that it was made by the cementation process.

Throughout the work there is this conflict between accurately recording and assessing the evidence and then a few paragraphs later pushing it way beyond what was previously stated. The dates for zinc production at Zawar provide a good example. At several places it is stated that production is likely to have started in the 12th century AD, which is indeed likely, but then in other places it states that the presence of mines dating back to the late first millennium BC at Zawar shows there must have been zinc smelting taking place, the evidence for which lies buried under the vast later retort heaps. The reality is that there are extensive slag heaps on the surface at Zawar contemporary with the early mines where it is likely that zinc oxide and lead were smelted (Craddock and Eckstein 2003).

As noted, Kharakwal relied on *2000 years of zinc and brass* for his latest information. Since then there have been a number of significant new developments. The present understanding is that in the last centuries of the first millennium BC there were very major Mauryan mining operations in the Aravalli Hills of Rajasthan, for silver at Agucha and Dariba (Craddock *et al* 2013) and for zinc oxide at Zawar (Craddock and Eckstein 2003). The production of metallic zinc on an industrial scale probably began from about the 12th century AD, but not just at Zawar. There was certainly another major centre in the north of India, probably in the Punjab-Himachal Pradesh region (Craddock *et al* 2015). The major period of zinc production at Zawar seems to have been from the 14th century AD, before being interrupted by the Mughal invasions at the end of the 16th century, from which it never fully recovered. The development of zinc smelting in China was completely independent, although ultimately inspired by the import of brass from India with the first Buddhist monks (Zhou *et al* 2012). In the post medieval world Chinese zinc dominated world markets up to the end of the 18th century, with India being one of the principal markets (Craddock 2013).

The present work has to be used with some caution, but there is a wealth of information, with a most interesting discussion of the place of Indian metallurgy in a world perspective; that this comes from an Indian study is most welcome and encouraging.

Paul Craddock

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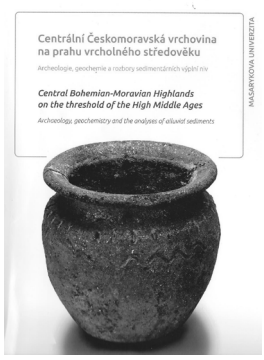
Centrální Českomoravská vrchovina na prahu vrcholného středověku. Archeologie, geochemie a **rozbory sedimentárních výplní niv** [**Central Bohemian-Moravian highlands on the threshold of the High Middle Ages: archaeology, geochemistry and the analyses of alluvial sediments**] by Petr Hrubý, Petr Hejhal, Karel Malý, Petr Kočár and Libor Petr. *Masarykova Univerzita (MUNI Press), Brno, 2014, 160x230mm, 264pp, 116 figs, ISBN 9788021071261. Czech + 33pp English summary. Price not stated.*

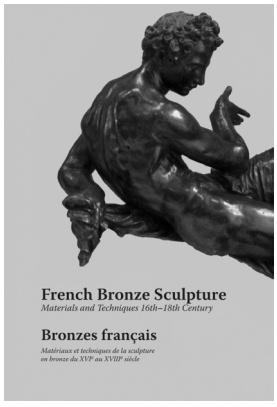


An archaeological and geo-archaeological/ palaeo-environmental study of medieval (12th-13th century AD) lead-silver and alluvial gold mining within the Central Bohemian-Moravian Highlands in the Czech Republic, centred on the old mining town of Jihlava. This book includes an extensive summary in English which briefly but succinctly summarizes the content of each of the three main chapters (Introduction, Case Studies and Discussion/ Conclusion). Included are some 45 sub-headings on a variety of studies relating to this mining landscape which range from mining history, archaeological excavation, geochemical soil and alluvial analyses, mineralogy, sedimentology and archaeobotany (macroplant remains, pollen, dendrochronology and C14 dating); all part of a multi-disciplinary study coordinated by ARCHAIA Brno. Although a more comprehensive translation might have been preferable, the book is well illustrated with 116 mostly B&W figures, all of which have captions in both Czech and English. These illustrations include large numbers of reasonably well-reproduced photos, plans and maps, pollen diagrams, histograms, and artefact drawings, with up to ten in colour, including photographs of minerals and finds.

The number of rotary ore-dressing quern stones and waterlogged wooden objects recovered from surface excavations at some of these mineral processing and smelting sites is astounding, although somewhat surprisingly there is very little or no mention of the extent and form of the underground workings, nor of the technology of mining at this early date. However, the sort of data provided on silver and gold ore processing, water use, and the effects of contemporary pollution and environmental impact remains exemplary in the context of current scientifically-based historic mining studies. This particular approach to understanding archaeological mining landscapes is not however unique to Central Europe, as a rather similar series of multi-disciplinary investigations of the Bronze Age-Iron Age copper mining within the Western Alps have been reported on within the publications of the HiMAT project based at the University of Innsbruck. However, as an archaeological record of medieval mining in Moravia, and as a model of geo-archaeological investigation, this book is to be strongly recommended; it deserves to be widely referred to in future.

Simon Timberlake

French bronze sculpture: materials and techniques 16th-18th century edited by David Bourgarit, Jane Bassett, Francesca Bewer, Geneviève Bresc-Bautier, Philippe Malgouyres and Guilhem Scherf. *Archetype, London, in association with the Musée du Louvre and the Centre de Recherche et de Restauration des Musées de France, 2014, 268pp, A4, 183 colour figs, ISBN 9781909492042, £65.00/$140.00, h/b, in English/French.*



This volume brings together 18 of the 32 papers presented at an international symposium organised by the Musée du Louvre and the Centre de Recherche et de Restauration des Musées de France (C2RMF) held in June 2012. The symposium followed on from the international exhibition *Cast in Bronze: French Sculpture from Renaissance to Revolution* (Paris, New York and Los Angeles 2008/9) which stemmed from many years work by an internationally renowned group of specialists who formed the French Bronze Study Group. The symposium and this resulting volume are excellent examples of collaboration between scientists, conservators and curators/art historians.

The papers in this volume (10 in English, 8 in French, each with bilingual abstracts) concentrate on the producers and production of important French 'bronze'

sculptures, but also include a number of papers on decorative and utilitarian objects, all dating to the 16th-18th centuries. The volume is divided into three sections. Six of the papers in the first section, From Primaticcio to Houdon: some key points concentrate on the sculptures and methods of individual sculptors, founders and sculptor/founders, including Francesco Bordoni, Barthélemy Prieur, Hubert Le Sueur, Jean-Balthazar Keller and Jean-Antoine Houdon, with a further paper focussing on regional sculptures produced in the Languedoc, perhaps by craftsmen more used to producing cannon or bells. The papers combine to give a fascinating overview of the sculptures and the methods used to produce them.The second section, Small castings and multiples, concentrates on smaller sculptures, decorative items such as gilt bronzes, and functional objects such as grinding mortars.

The final section of six papers, Casting techniques: transmission and evolution, combines papers on the use of technical examination of sculptures with studies on archaeological investigations of foundry sites and information from historical records, with some of the papers considering the movement of craftsmen and ideas. The section finishes with a paper on the Foundry de Coubertin (founded in1963), which brings the casting of large sculptures up to the present day.

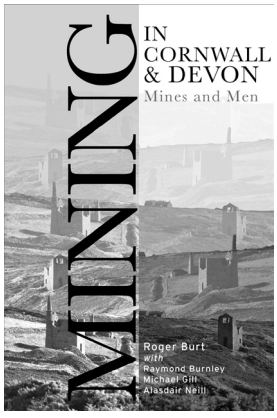
The volume has been produced to a high standard, with the vast majority of the copious illustrations being clear and informative. These include numerous X-radiographs which show how critical it is to use scientific techniques when examining large bronzes to understand them fully, revealing such features as armatures, wires, cracks, patches and porosity. Many of the papers include the results of elemental analyses, some of which should be fully quantitative (such as those by ICP-AES or AAS), but many also include XRF analyses. It could be argued that some qualitative analyses are better than none at all, but I do share the widespread concerns about the accuracy of results of XRF analyses when performed on uncleaned metal surfaces. They should always be accompanied by suitable caveats, and preferably not published to two decimal places. A little more information on the details of the analytical methods used could have been included in some papers, and all should have comments on precision, accuracy and errors. A technical glossary of casting and foundry terminology in both languages would also have been a useful addition.

However, the volume is so much more than just a conference proceedings. It is a fascinating read and brings the period to life – a period of frequent wars, the French Revolution, the Enlightenment, the early years of the Industrial Revolution and the start of mass production. It spells out the technical challenges associated with producing the largest statues, and touches on the patronage of royalty, the aristocracy and the church. It provides much information which allows geographical comparisons with other areas of Europe and beyond, and of course allows changes over time to be studied. It reminds us to take care when considering dates of technological change, as for example some founders may have continued with well-loved practices long after they may have been replaced by other more innovative ways of working at other foundries, with the obvious implications for authenticity studies. It also serves as a great reminder on how to 'look' properly at artefacts, including the benefits of using a range of scientific techniques if possible, and also reminding us to go back to the texts of Theophilus, Cellini and Biringuccio. It is an informative and inspiring volume, an example of what can be achieved, and a great step forward in the study of French 'bronzes'. As inevitably it is unlikely to be the final word, it would be wonderful if all the information, analyses and images could be put onto a maintained website that could be added to as more work is carried out, and accessed by all. The authors and editors must be congratulated on producing an excellent volume, and one which will be referred to many times in the future.

Note: a list of the individual paper titles can be found on the Archetype website at: http://www.archetype.co.uk/publication-details.php?id=194

Duncan Hook

Mining in Cornwall and Devon – mines and men by Roger Burt, Raymond Burnley, Michael Gill and Alasdair Neill. *University of Exeter Press, Exeter, 2014, 272pp, 15 figs, 1 CD, index, 227 x 150mm, ISBN 9780859898898, £25, p/b.*



This book, sub titled ' An economic history of the mines, mineral ownership and mine management in the South West of England' is complimented with an extensive database on an interactive CDROM. This offers searches by mine name, ownership and management, company, location, mineral production and source of data. Close to 1470 mines are listed (including renamed mines) with mineral output, dates of operation and location. Data sets cover the 19th-20th centuries. The Duchy

returns provide rents and royalties due rather than metal production, and only for those mines on Duchy land. Mineral Statistics record tonnages of tin concentrates (black tin) or ores produced and, occasionally, metal output or metal content by assaying. Manpower numbers are also accessible from these returns. Stannary returns provide tonnages, value and key personnel information while Ticketing provides tonnages and value, often for different periods of the mine's life than the Mineral Statistics. Mining Companies data provide company name and key personnel for the period 1850-1920.

The work is far more than simply a collection of statistics, describing, for example, the evolution of mining in the region briefly covering the medieval period and in more detail the 19th-20th centuries. In this period, first copper was exploited in relatively shallow shafts but by the 1860s the value of this fell abruptly due to competition from richer ores imports from Chile, North America and Spain. Thus many mines turned to the deeper deposits of tin and later to arsenic. Copper, tin and arsenic were not the only minerals mined. Indeed, over the period of Mineral Statistics returns, iron ore topped the list at 310 million long tons. In the years 1850 to 1909 Cornwall provided close to half of all UK's non-ferrous mineral ores the figure ranging from 54.6% (1900-09) to 41.9% (1870-79).

The author does not ignore production in the 20th century. A table of combined output of tin concentrate from Cornwall and Devon for 1920-2006 shows a sharp decline post WWII from 3.1k tons in 1920 to 900 tons in 1946, recovering slowly to 1.7k tons by 1969. With the setting of artificially high prices for tin under the Fifth Tin Agreement, output peaked at 5.2k tonne in 1984 and 1985 and then declined following the failure of the agreement in 1986, although output continued close to the 2k tonne level until 1998 when it dropped rapidly to just 500 tonne. Subsequent years are unrecorded as they fell below 100 tonne. In these failing years, output was confined to Geevor, South Crofty and Wheal Jane – the latter being a new mine opened in the 1970s, closed in 1980 but revamped and amalgamated with South Crofty in 1982. Closure was inevitable at the now low price for tin. Geevor stopped pumping in 1991, Wheal Jane ceased mining in 1992 but remained in action processing ore from South Crofty until that too closed in 1998. An attempt to reopen South Crofty finally failed in 2012.

The book contains 219 notes and references, an index of around 300 named mines, a bibliography of mine-related books and articles, bibliographical notes on 41 mine managers, and appendices listing the financial situation of 105 Cornish copper mines and costs of production. For the selling price of £25 it is exceptionally good value.

Tim Smith