Book Reviews

The circulation of metal in the British Bronze Age: the application of lead isotope analysis by Brenda Rohl and Stuart Needham. *British Museum (Occasional Paper 102), London, 1998. vi+233pp, A4, 122 figures, 3 appendices. ISBN 0-86159-102-X. Price not stated.*

The book is based on Brenda Rohl's DPhil research at the University of Oxford, with a significant contribution by Stuart Needham from the British Museum. It is divided into seven chapters of which the first five are mainly Brenda Rohl's work, while the later two were drafted by Stuart Needham. However, rather than simply pasting them together, it is worth mentioning from the outset that the whole book eventually and obviously is the result of the joint work of both authors, and now is a homogeneous piece.

The emphasis put on the various chapters, and their length and academic weight, varies considerably. The first four chapters, with the headings Introduction, Lead Isotope and Chemical Composition Variation in Ores and Metals, Analytical Techniques, and Mineral Deposits and Early Mining, contribute only 18 pages between them. That is, however, not to say that they do not contain a lot of useful information. To the contrary, their brevity is a positive contrast to the length at which students are sometimes driven to write about technicalities in their theses. Here, useful and necessary remarks are made, in particular concerning the analytical, metallurgical, archaeological and natural constraints on such work which ultimately aims to provenance objects, or at least relate objects to ore deposits. While earlier approaches, both based either on lead isotope studies, or on trace element analyses, often raised unrealistic hopes, this work clearly states and discusses the inherent limitations of analysis-based attempts to provenance archaeological objects.

Having thus defined the aims and limitations of their work, the authors present the bulk of their new research in the following two chapters, Lead Isotope Results of Copper and Lead Ores, and Copper and Bronze Age Artefacts. These two chapters contain a tremendous body of information, in text and figures. Particularly strong – as one would expect – are the plots visualising the lead isotope data. Based on their own new work plus already published data, the authors first define an overall England and Wales Lead Isotope Outline (EWLIO), against which they then discuss ore deposits of individual regions. As one would expect, this results in a complex pattern, reflecting the complex origins and geological histories of these deposits, and is not really encouraging in terms of a simplistic provenancing model. A detailed and cautious interpretation of the data, however, is undertaken, demonstrating that there is quite a lot of potential for interpretations of both geological and archaeological aspects.

This becomes more obvious once the metal object data are discussed, following an established chronological sequence for the British Bronze Age. This chapter is particularly important as it combines data from chemical and lead isotopic analyses in an integrated approach, labelled IMP-LI (from IMPurity composition and Lead Isotope composition). Although this approach is not entirely new, it is surprisingly seldom followed, and certainly new for the region and time period covered by this work. It really is archaeometallurgy coming home at long last, after the initial and often harsh lessons learnt in the eastern Mediterranean.

It must be said here that it is difficult to understand why this approach did not develop much earlier; both trace element analysis and lead isotope analyses of metal objects having being done for several decades now on a regular basis. It probably has to do with the still relatively limited number of professional researchers active in archaeometallurgy when compared to the vast amount of work still to be done. However, this volume is a milestone on this way, marking a significant achievement in terms of true co-operation and co-interpretation of scientific and archaeological data within the framework of an ambitious programme. And it is not only an exemplary case study, but also provides us with a substantial body of new data, waiting for further exploitation and interpretation.

The Conclusions, covering the final nine pages of the text, not only summarise the results obtained during the course of the study – positive ones as well as negative ones – but also give some hints as to directions for future work. The appendices list on about 40 pages all

the new chemical and lead isotopic data with their proper archaeological affiliation, making the data fully accessible: again a model which should be followed more widely than is currently the case.

To summarise, this is a very sound piece of work, which will last for a long time to come. It is worthwhile reading for every scholar interested in provenancing metal objects as an integral aspect of archaeometallurgical research, and essential for everybody interested specifically in the British Bronze Age. The outlet via the British Museum Occasional Paper series is also very helpful, in that it offers this volume at a very reasonable price and at a good, though soft-bound, printing quality.

Thilo Rehren

Prince Rupert's patent guns by Sarah Barter Bailey. *Royal Armouries (Monograph 6), Leeds, 2000. vii+153pp, 240x175mm, 15 figs. ISBN 0 948092 29 7. £10.95; postage £2.50 (UK) or £5.00 (abroad) from Royal Armouries Museum, Armouries Drive, Leeds LS10 1LT.*

This book examines the historical and metallurgical puzzle posed by the 'nealed and turned' guns produced under the patent awarded to Prince Rupert, nephew of Charles I. Prince Rupert is well known for his part in the English civil war. After the Royalist defeat in 1649 he travelled in Europe and, after the Restoration, interested himself in the emergent Royal Society while holding a series of offices under the crown, notably as First Lord of the Admiralty from 1673 to 1679. In this and previous posts he experienced the problems of ordnance supply, notably the unpredictable quality of cast-iron guns.

At this time, ordnance founding had changed little from the practices developed in the 16th century by Hogge and his successors in the Weald. Guns were still cast direct from the blast furnace, and hence were made of iron of unpredictable quality. They were cast hollow, the truth of the bore depending on the positioning of the central core, the nowell bar, and they were then reamed rather than bored, on mills whose cutters could follow irregularities in the casting. The worst specimens failed Ordnance-Office proof, either at initial inspection or during test firing. These problems were to persist in the Weald until the middle of the 18th century, as John Fuller's letter-books show. They were solved in subsequent decades by the use of the foundry, which allowed selection of pig iron, and by solid casting, as practised at Carron, which reduced the risk of off-centre boring, particularly when using Wilkinson's newly-developed boring mills.

Prince Rupert's patent was an attempt to reduce the failure-rate of ordnance at proof and the risks in service. It dates from 1671 and, in the manner of contemporary grants, was set out in general terms, defining the aims rather than the methods of the patentees. The author of this book has assembled the extant archive references to the grant and operation of the patent to an extent not previously attempted. She illuminates the problems posed originally by Defoe (1697), North (published in 1740 from an earlier text) and others, who suggested that castings were annealed at a forge in Windsor Park and that turning took place at a mill on Hackney Marshes. Amongst 20th-century authors, Rhys Jenkins and Schubert were aware of the patent, but until now there has been no subsequent analysis. Included is a summary of available information about the experiments at Windsor, 1671-1673, organised by Prince Rupert, the work by the Office of Ordnance, which had an annealing furnace built at Woolwich in 1672, as well as that of the Wealden gunfounders Thomas Westerne and John Browne, the latter the grandson of the Browne who had supplied ordnance to Charles I and who had turned guns in the 1640s.

Turned and annealed guns were supplied for naval use between 1672 and 1676, years when there is also evidence of an interest in the technique on the part of the French government. However, enthusiasm for the patent guns waned, leaving some examples in service but others either in store or still in the hands of the gun founders, who had difficulty in obtaining payment from the crown. There is little hard evidence for the characteristics of these guns, still less for the details of the processes. It was suggested at the time that the annealed guns were less likely to be 'honey-combed', ie to contain voids due to gas trapped within the casting as it cooled. The turning of the exterior gave a smooth surface, improving the appearance of the piece, with more scope for decorative engraving. It may have been possible, by centring the bore in a lathe, to turn a concentric outer surface. It is not clear, however, to what extent any improvement in the internal finish was achieved.

The author attempts to define the terms of the patent for whose products the Ordnance Office was prepared to pay three times the normal price. The attempt is interesting but inconclusive. Contemporary

descriptions, as of Houghton and Réaumur, suggest that heating and cooling softened the surfaces of cast iron, presumably allowing improved machining. They give no satisfactory reason for the claimed reduction in gas-voids, whose frequency is more likely to be a consequence of methods used in the initial casting. A modern view (from Sam Murphy) is cited, that heating the casting to 800°C would give increased strength, which supports contemporary claims that the patent guns were more robust in service. There has been no programme of sampling and examination of the surviving patent guns, work which publication of this volume might encourage.

The book is well illustrated, referenced and indexed. The appendix of known patent guns (pp 136-9) is particularly welcome.

David Crossley

Geoarchaeology: exploration, environments, resources edited by A M Pollard. *Geological Society (Special Publication 165), London, 1999. 255x175mm, 180pp, 72 figs, 11 tables, index. ISBN 1-86239-053-3. £60.00.*

Geoscientists have been trying to define the discipline of geoarchaeology for over twenty years. In the introduction to Geoarchaeology: exploration, environment, resources, Mark Pollard, wrestling with the same problem, has summarised these attempts at providing a guiding definition for this field. I was delighted to find that no progress had been made. Geoarchaeology is still whatever archaeologists, geologists, geophysicists, and materials scientists want it to be. This is not cause for despair, but a healthy sign of a vigorous interdisciplinary field thriving in the interstices of less eclectic disciplines. Geoarchaeology is a taster, not a text book, and in it the reader will not find the reassuring definition of a discipline. It is a wide ranging conference volume containing twelve disparate papers, compiled with the explicit understanding that there is a reciprocal information flow between the earth sciences and archaeology in any study of sites in their geological or environmental contexts. These papers, presented under the three headings of Exploration, Environments and Resources, are a good demonstration of the diversity of interests comprising geoarchaeology in the broad sense.

The first section, Exploration, contains three papers, all of them concerned with remote sensing to detect and identify buried features. Vernon et al report the use of magnetometry to try to locate buried iron and lead smelting sites, and their associated slag heaps. This study was backed up with the successful detection of an experimentally buried iron smelting furnace, including identifying its tap arch. This is impressive and lends considerable support to the conclusion that it is possible to identify and distinguish both iron and lead smelting furnaces by their characteristic magnetic anomalies. Murdie et al attempted to determine the layout and depth of the walls of a Romano-British villa using a fluxgate gradiometer and Euler deconvolution. I find this paper less digestible than the following one by Cuss and Styles, using microgravity measurement with Euler deconvolution in a far more interesting exercise to try to locate buried 150-year old tunnels in urban Liverpool. This paper is very thorough in its discussion of the challenges and difficulties facing such an exercise. These are considerable and I find it impossible to recognise most of the supposedly newly-recognised features on the final anomaly maps.

The second section, Environments, contains three papers of a more geological nature. Latham *et al* present a shrewd reconstruction of the stratigraphy of the Makapansgat Australopithecine site, most of which was quarried away by lime workers. This paper is a description of the residual stratigraphy, based on very careful sedimentological observation in the field. This is not the first time this has been attempted at Makapansgat, and this reconstruction is bound to be modified again, particularly if exploratory palaeomagnetic analyses are successful. The paper by Tipping *et al* reports an investigation to test the rate and depth penetration of bioturbation, and consequent pollen mixing, in a podsol at Lour in southern Scotland. The important implication of their results is that pollen can be confined to organic horizons for long periods of time and that mixing within mor horizons within podsols could confound the interpretation of such assemblages. At Lour the rapidity of thorough mixing was complete within the measured span of 100 years. Varyl *et al* traced the record of early alluvial tin mining on Dartmoor. This well conceived study, sampling fluvial deposits of determinable age, produced strong evidence for the onset of tin mining no earlier than the 12th century AD. Evidence of aggradation of tin-enhanced sediments confirms the historical documentary record, but it is possible that an earlier record had not been intersected in sampling or was destroyed by subsequent medieval reworking.

The third section, Resources, opens with a study to

provenance iron ore from the Magor Pill vessel. This paper is an exemplary integration of petrography, geochemistry, field geology, and history to identify the probably source of ore, and the politics that probably determined its transport, counter intuitively, towards the major ore sources of the Forest of Dean. The geochemical sourcing of ballast granites from two sites in France by Lazareth and Mercier is a similarly satisfying study. These are both truly interdisciplinary papers which would make good teaching material for students in either the earth sciences or archaeology. Millard's short exploratory paper on the geochemistry of the early alum industry in North Yorkshire is a useful introduction to this early large-scale chemical industry. Budd *et al* explore zinc isotope fractionation in brass melting, demonstrating that a weak fractionation effect does occur, but only detectable with quadrupole ICP-MS at very high levels of zinc evaporation. Higher precision stable isotope ratio measurement would be required to apply zinc isotope fractionation to the study of brass production or environmental pollution. The paper by Thomas and Young on the determination of bloomery furnace efficiency through mass balance calculations will appeal to few outside the archaeometallurgy field. Nevertheless, it is a clearly presented account of a graphical means to estimate the efficiency of any particular smelting process on a best-fit basis if representative samples of the original inputs and outputs are available. The example used for illustration shows clearly the realistic constraints on interpretation imposed by this condition. The final paper, by Zaykov *et al*, is a summary of geoarchaeological research in the south Urals, a crucial area in the history of the development of European metallurgy. This brief review touches on the sourcing of stone, studies of Bronze Age copper mines, the analysis of copper and bronze artefacts, corrosion of copper artefacts, and the composition of lead and gold artefacts.

This volume is well edited and produced, with clear and mostly very informative illustrations, and my hard cover copy is attractively bound. (I am puzzled that there is no explanation of the cover photograph, which shows a dry gully with what appeared to be a cache of rifles lying in it!). It will be a useful addition to any academic library, and to the personal libraries of earth scientist and archaeologists alike, but given its breadth of subject matter it is unlikely that most readers will be fascinated by all of it.

Duncan Miller

Arising from previous reviews

David Cranstone writes: My review of a publication derived from a UCL PhD (*An archaeometallurgical survey for ancient tin mines and smelting sites in Spain and Portugal*) published in *Historical Metallurgy* 33(2), contains an incorrect suggestion that needs correcting: the decision to publish at book length was the author's and, since he was not a UCL staff member, it would not in any case have affected UCL's Research Assessment Exercise rating. I apologize for suggesting otherwise, while holding to the rest of my views of this particular work. I would also stress that my comments about academic standards and the effects of the RAEs on publication were not aimed solely at UCL (the Institute of Archaeology's output over recent years has also included some excellent work), but are part of broader concerns about standards and pressures in archaeology (and indeed throughout British academic life), which I believe are widely shared (see debate in *Antiquity* for March and June 1996). In the particular context of UCL's Institute of Archaeology, I am very pleased that (since my review was drafted), Thilo Rehren, a member of our Council, has been appointed to the recently created chair of Archaeological Materials and Technologies—I am sure that this will lead to a fuller participation in the wider debates of archaeometallurgy, and to rising standards all round.