

Book Review

BOOM AND BUST IN BRONZE AGE BRITAIN – THE GREAT ORME COPPER MINE AND EUROPEAN TRADE BY R. ALAN WILLIAMS

Archaeopress 2023, 343 pages (10 chapters, 5 appendices), 36 tables, 218 figures, ISBN 978-1-80327-378-5 (£60).

This catchily-titled book is, in essence, a masterpiece of research investigating an important Middle Bronze Age mine in its British and European context. Its most important contribution is the author's pioneering and refreshingly logical approach to the task of defining the trace element and isotopic signature of Great Orme metal, enabling its recognition within the corpus of Bronze Age metalwork. Through a comprehensive sampling of the mineral veins, and through bulk analyses, it has been possible to determine the likely Bronze Age ore, and to show how some of the significant trace elements present have partitioned into the metal and slag. The work on the mineral ores has been combined with a study of the Late Bronze Age slag and copper droplets from the nearby site of Pentrwyn, an additional series of smelting experiments, and some new metal artefact analyses designed to compliment the large number of already-published examples. The main object of this field and laboratory-based study was to establish a 'mine-based metal group' that could be accurately matched with an 'artefact-based metal group'. Although technical and science-based throughout, Alan's account of this research is well-written and also well-illustrated, including plenty of background information on the geology of Bronze Age mines, plus a comprehensive review of over 30 years of mining archaeology and archaeometallurgical research. More to the point, he has helped to make the subject an engaging, if not an inspiring one, for the moderately well-informed non-specialist.

The first three chapters provide an archaeological background to the mine, introducing British (Welsh and English) and Irish Bronze Age copper mining studies and covering the formation of ores, and relevant geochemistry and metallurgy. In addition, they compare Early Bronze Age sites to the much bigger and predominantly later mine on the Great Orme. This is followed by a description of the mine and an account of the previous archaeological work, both

here and at the nearby smelting site of Pentrwyn (a Late Bronze Age site processing the same type of ore, perhaps in the same way, as the earlier mine). Chapter 5 is a review of metal characterization and provenancing techniques, looking at existing database(s) of ore analyses, at ideas on trace/ minor element partitioning during smelting, and the development and application of lead isotope analysis to British/Irish Bronze Age metalwork and mining studies. This includes a very useful discussion on metal re-cycling. The next chapter outlines the methodology employed to re-interpret the ores and metal coming from the Orme. It does this through the establishment of a mine-based metal group, based upon the analyses of ore types, (using copper prills from Pentrwyn and the result of the smelting experiments), and analyses of a few of the many minute bronze fragments recovered from the mine (perhaps the burr metal ends detached from the tips of bronze mining picks or chisels). Alongside a comprehensive programme of sampling ores underground, these analyses of minerals, raw metal, slag and metalwork were carried out using a wide range of different scientific techniques – forming the basis of the author’s PhD work at Liverpool.

Chapter 7 provides an account of the results - work that fairly convincingly defines the parameters of the Great Orme mine-based metal group in terms of its chemistry (based mostly upon trace element correlations such as between nickel and arsenic, lead and antimony, and nickel and cobalt) and its lead isotope component; the latter referring to the relevant data point cluster for the ore and metal within the England and Wales Lead Isotope field. The potentially complex chemistry of these ores is well-explained; such as how Great Orme metal produced from secondary (oxidized) ores came to have a moderately high arsenic (up to 2.2%) and nickel content on account of the bulk chemical composition of the ores chosen. These ores included iron hydroxides which acted as a sponge to the trace element metal ions originally present in more dilute amounts. Both this and the anomalous lead content in Acton Park metalwork can thus be explained (to some degree) as a result of accidental inclusion. More to the point, the correlation between the main mine ore, Great Orme metal and Acton Park metalwork appears to be good, with some evidence also for the continuing use of the main mine ore into the Arreton (later Middle Bronze Age) metalwork phase. Additional results focusing on a study of the mineralogy of the ores and the results of the analyses of the Pentrwyn and experimental smelting slags and copper prills are discussed in Chapter 8. These assist in the interpretation of the smelting process, its dynamics, and the partitioning of the elements between metal and slag. The smelting process itself seems to have been rudimentary and poorly reducing, with a relatively high copper loss into non-fully liquid slags (of which there was little), from which

prills of copper were extracted by crushing, and subsequently (one presumes) re-melted and therefore refined.

The final chapters (9 and 10) provide a very wide-ranging discussion of the Great Orme mine and its products, in particular the period of its operation, its significance within British, Irish and Continental trade/exchange networks, the implications for the social organization of mining and metalworking, alongside specific information on its products – the Acton Park shield palstaves, spearheads and dirk rapier groups (with maps of their spatial distribution). The conclusions are succinct, and provide a very useful summary to the book, alongside important suggestions for future work. The comprehensive bibliography which follows will likewise be useful for anyone who wishes to delve further into this subject. The inclusion of an index, combining both object/topic and place-name words, was a helpful addition.

These days many PhD projects get turned into books. Many are scholarly in their own specialized ways, yet it is rare to find one which actually sets a precedent to the way we analyze the subject in question (in this case metal production in the Bronze Age), whilst at the same time being both readable and easy to understand. This is one of them. Having also been a geologist and archaeologist investigating British Bronze Age mines, I have likewise wondered and despaired at the sorts of assumptions made by archaeometallurgists regarding the nature of the ores mined, the types of metal produced, and the scale or organization of the work. In respect of the Orme, mistakes were made when claims to understand this site were based upon far too few analyses of micro-mineral samples (rather than actual mineral mixtures or ores) and an incomplete knowledge of the mine, its geology and archaeology. This time, however, the study has been thorough, and I think the narrative is more or less correct. Indeed, its contribution to the field of archaeometallurgy and mining archaeology far outweighs the results of this particular study. The scientific approach adopted here is already setting a standard for things to come, and we will soon find this model being applied to all future studies of ancient mining and the provenancing of metals to sources.

Alan Williams' book compliments much of the work carried out over the years by mining archaeologists and geologists investigating the copper sources of the Irish Chalcolithic/ Early Bronze Age and the British Early Bronze Age in West Wales, Anglesey and Central England. Within this body of work are the numerous papers produced by the Early Mines Research Group (including within PPS), as well as books on the Alderley Edge (Timberlake and Prag 2005), Cwmystwyth (Timberlake 2003), Mt. Gabriel (O'Brien 1994) and Ross Island

(O'Brien 2004) mines, and O'Brien's publication *Prehistoric Copper Mining in Europe* (2014). Some of the lead isotope data used in the current book came from the study carried out by Rohl & Needham in *The Circulation of Metal in the British Bronze Age: The Application of lead Isotope Analysis* (1998), though the relevant conclusions drawn from this are different and original. The current study is soon to be complemented by a project which to some degree has grown out of it – the AHRC-funded Project Tin – Williams' subsequent investigation of the role that Cornish tin ores played in the early adoption of bronze in the British Bronze Age.

In conclusion, this book is a valuable contribution to the study of ancient mining and the provenancing of metal during an important period of the British Bronze Age. It will no doubt be of interest to British prehistorians generally, but also to any field archaeologist who has encountered during his or her work one of the commonest bronze artefacts of this period – the shield palstave. The study sheds new light on the role of British copper and bronze within Bronze Age Europe, providing an interesting and very readable narrative for the general consumer of new archaeological books.

There are some minor things to note, which could have been improved. In production terms, the colour images are excellent, although in some instances, the line drawings are a little blurry. In terms of content, some topics could have been discussed in more detail, such as the ideas concerning the whereabouts and nature of the main smelting sites on the Great Orme. One also has to be a little cautious about extrapolating the nature of the ephemeral Pentwyn smelting evidence, as this may not be that representative of the earlier period. Likewise, I would question the suggestion that Acton Park (1600-1400 BC) was the only period where Bronze Age Britain was self-sufficient in copper - it remains possible this was also the case during parts of the Early Bronze Age. As regards the important smelting experiments carried out by Williams and colleagues - all of which have proved very useful - caution must be applied when comparing mechanical blowing with pulsed bellows. This should not detract from the fact that experimentation in this case has significantly helped in understanding the actual parameters of the partition of elements between metal and slag. Finally, I would add that zinc in oxidized ores (as I know from experimental work) does partition into the copper metal, and sometimes quite easily under poorly-reducing smelting conditions. This is therefore a factor to look for in metal coming from some British Bronze Age mines.

I would highly recommend this book to anyone with an interest in ancient mining, metallurgy and the origins of Bronze Age copper in Britain and Europe. It will satisfy the

interest of anyone with a good grounding in archaeological science, whilst at the same time remaining accessible to the non-specialist interested in a clearly explained study of an archaeological investigation with far-reaching implications. For the scientists out there, this model of a mine-based metal study needs to be looked at afresh in British Bronze Age studies, perhaps to investigate the corpus of other identified prehistoric mines? There are some more PhD studies to be had here.

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References

O'Brien, W. 1994, Mount Gabriel: Bronze Age Mining in Ireland (*Bronze Age Studies no.3*), Galway: Galway University Press.

O'Brien, W. 2004, *Ross Island: Mining, metal and society in Early Ireland*, Bronze Age Studies no. 6, Department of Archaeology, National University of Ireland, Galway.

O'Brien, W. 2014, *Prehistoric Copper Mining in Europe*, Oxford: Oxford University Press.

Rohl, B. & Needham, S. 1998, *The Circulation of Metal in the British Bronze Age: The Application of lead Isotope Analysis*, London: British Museum Press.

Timberlake, S. 2003, Excavations on Copa Hill, Cwmystwyth (1986-1999): An Early Bronze Age Copper Mine within the uplands of Central Wales, BAR British Series 348, Oxford: BAR.

Timberlake, S. and Prag, A.J.N.W. 2005, *The Archaeology of Alderley Edge: Survey, excavation and experiment in an ancient mining landscape*, BAR British Series 396, Oxford: BAR.

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