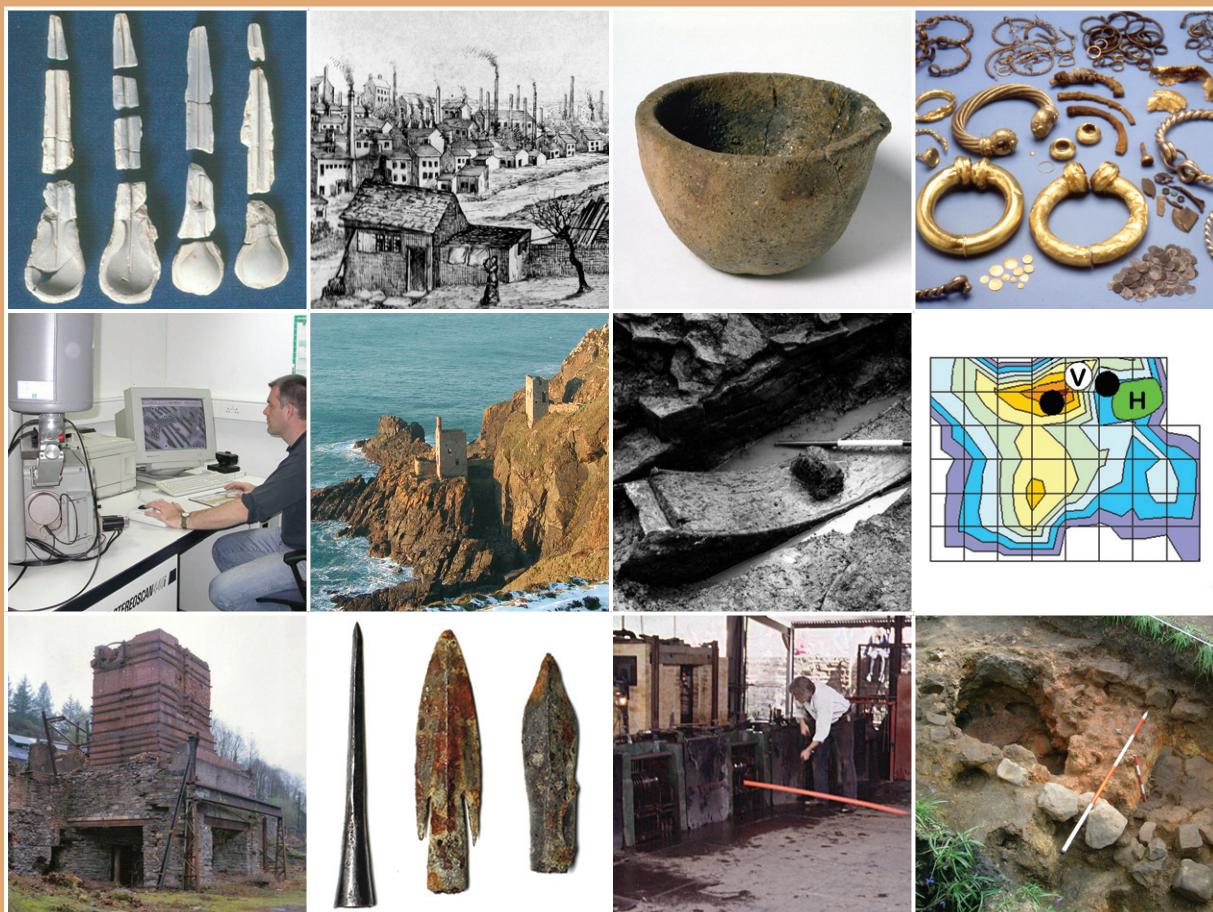


METALS AND METALWORKING

A research framework for archaeometallurgy



Cover images (from left, top, middle and bottom rows)

- 1 Mould fragments for casting late Roman spoons, from Castleford, Yorkshire. The fronts and backs were paired up and then assembled into a cone-shaped multiple mould, with the handles up, so 16 spoons were cast as once. Spoon length 150mm.
- 2 A view of the Sheaf valley, Sheffield in the mid 19th century showing many small workshops with their forge chimneys (see p.7).
- 3 Late medieval flat-bottomed crucible from the City of London, with gold droplets trapped in the vitrified internal surface. Diameter 100mm.
- 4 Hoard of complete and fragmentary precious-metal Iron Age torcs from Snettisham, Norfolk (see p.14).
- 5 Scanning electron microscope in use. The screen shows a high-magnification image of the sample in the chamber to the left (see p.35).
- 6 The Crowns engine house, Botallack mine, Cornwall is set at the foot of a cliff on an outcrop of a rich tin and copper lode. This mine was worked from at least the 16th century (see p.11).
- 7 Part of a water-wheel in position in a wheel pit at the bloomery at Rockley, Yorkshire (see p.58–9).
- 8 Plot of hammerscale distribution on the floor of a Roman smithy at Westhawk Farm, Kent. Warmer tones show increased hammerscale concentrations (see p.29 for full details).
- 9 Charcoal-fuelled blast furnace at Backbarrow, Cumbria, with 18th-century origins. It was continuously modified into the 20th century, to use hot blast and, eventually, mineral fuel.
- 10 Three medieval arrowheads made for battle; from left: 11th-century bodkin type for penetrating chain mail; 14th-century winged-and-socketed for plate armour; 15th-century version developed to counter more sophisticated armour. Image width 110mm (see p.34).
- 11 Red-hot wrought iron being rolled at the re-erected rolling mill at Blists Hill, Ironbridge. Traditional metalworking skills are being preserved as 'living history' (see p.24).
- 12 Excavation of a Roman-British bloomery iron-smelting furnace at Little Furnace Wood, Mayfield, East Sussex (see p.47).

Metals and Metalworking

A research framework for archaeometallurgy

Compiled and edited by Justine Bayley, David Crossley and Matthew Ponting

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SUMMARY

Metals and metalworking: A research framework for archaeometallurgy

The volume provides a research framework for archaeometallurgy in Britain, including a resource assessment, a research agenda and an outline research strategy. The first section identifies the nature of the resource. The evidence ranges in scale from landscapes and townscapes to sites and structures; it includes artefacts and residues from production as well as documentary sources. This section is particularly directed at curators and planners as it also deals with the management and protection of the resource, for which they have responsibility.

The second section, on methods in historical metallurgy, demonstrates that the subject goes beyond the work of the laboratory-based specialist, whose methods of examination and analysis are described. Also essential are the methods of field archaeology, landscape survey, geo-prospection and experimental archaeology, and the skills of metal-smiths and palaeo-environmentalists. The current pattern of development-led archaeology, in particular work on brown-field sites (which may be regarded as contaminated land), threatens the loss of sub-surface archaeological evidence for metal industries; appropriate methodological approaches to investigation, recording and sampling are discussed. The strengths and weaknesses of methods are examined, and areas for further development are outlined.

The third section summarises what is known about metalworking in the past, focusing on selected topics which illustrate either the considerable progress that has recently been made, or the need for further research. The examples include both ferrous and non-ferrous metalworking of all periods. The earliest metallurgy in the British Isles belongs to the Bronze Age and Iron Age. For the Bronze Age the concentration is on metal mining because so much new information has recently come to light. For the Iron Age, the focus is on the introduction of iron as an everyday metal, though copper alloys continued in use. The Roman period saw increasing use of metal and hence metalworking; the two examples given are the iron industry of the Weald, and the widespread adoption of brass as a common copper alloy. In the medieval period the lack of evidence for copper production is highlighted and the use of various copper alloys is discussed. Medieval methods of steel production are considered, as are later steel-making processes. After the medieval period there is a major change of scale, with the industrialisation of many metal industries. Relevant categories of documentary evidence are outlined, emphasising those which complement the archaeological record. An overview is presented of current knowledge of two metal industries important in post-medieval and modern Britain: lead production and the iron and steel industry. Archaeometallurgical studies can show how these industries, and the questions surrounding their development, are linked to changes in British society and the lives of its people.

Finally, the research agenda identifies major gaps in knowledge and suggests how they might best be filled. These comprise multi-period topics relating to methods in fieldwork and scientific examination, and other topics divided by period,

from prehistoric to the present day. This section also outlines a strategy for promoting best practice in the discipline.

RÉSUMÉ

Métaux et métallurgie: un cadre de recherche pour l'archéométallurgie.

Ce volume propose un cadre de recherche pour l'archéométallurgie en Grande-Bretagne, présentant dans ce contexte une évaluation des ressources, un agenda de recherche, ainsi qu'un résumé de la stratégie de recherche établie. La première partie répertorie la nature des ressources : celles-ci sont présentes à différentes échelles et varient de paysages et scènes urbaines à des sites et structures archéologiques. Elles incluent également des artefacts et des résidus de production ainsi que des sources documentaires. Cette section est tout particulièrement destinée aux archéologues et historiens locaux ainsi qu'aux principaux entrepreneurs impliqués dans des projets de développement et travaillant pour la commune ou tout autre autorité locale, puisqu'elle est aussi consacrée à la gestion et à la protection de ces ressources, pour lesquelles ils sont responsables.

La deuxième partie concerne les méthodes utilisées en métallurgie historique et montre que le thème abordé va plus loin que le travail d'un spécialiste, uniquement établi dans son laboratoire, dont les techniques d'investigation et d'analyse sont décrites. Les méthodes d'archéologie de terrain, de reconnaissance du paysage, de géo prospection et d'archéologie expérimentale, ainsi que les compétences des artisans du métal et des paléo environnementalistes sont tout aussi essentielles. La tendance actuelle de l'archéologie menée dans le cadre de projets de développement, en particulier les travaux sur des sites urbains à l'abandon (qui pourraient être considérés comme des terrains contaminés), menace d'entraîner la perte d'indices archéologiques liés à des industries métallurgiques, qui sont présents dans les sous-couches de surface ; différentes approches méthodologiques adaptées à l'investigation, l'archivage et l'échantillonnage dans ce contexte sont discutées. Les atouts et faiblesses de chaque méthode sont examinés et les domaines permettant de développer plus avant ces problématiques sont exposés.

La troisième partie résume les connaissances que nous avons du travail du métal comme il était réalisé dans le passé, mettant l'accent sur des thèmes bien définis, qui illustrent, soit le progrès considérable qui a été réalisé récemment, soit le besoin pour des recherches plus approfondies. Les exemples choisis comprennent aussi bien le travail du fer que les non ferreux de toutes les époques. La métallurgie la plus ancienne des îles britanniques date de l'âge du bronze et de l'âge du fer. Pour l'âge du bronze, l'emphase a été mise sur les travaux miniers en raison du nombre important de nouvelles données qui ont récemment été mises au jour. Concernant l'âge du fer, l'attention s'est plus particulièrement tournée vers l'introduction et l'usage du fer dans la vie de tous les jours, alors que les alliages de cuivre étaient encore utilisés. L'époque romaine voit une augmentation de l'utilisation des métaux et par conséquent du travail des métaux ; les deux exemples choisis pour cet ouvrage sont l'industrie du fer du Weald, et l'adoption très répandue du

laiton comme alliage courant de cuivre. Durant le Moyen Age, le manque de preuves liées à la production du cuivre est mis en avant, et l'usage des différents alliages de cuivre est discuté. Les méthodes médiévales de production d'acier sont également expliquées, tout comme les procédés plus récents utilisés en sidérurgie. A la suite du Moyen Age, un changement d'échelle majeur s'est produit, en raison de l'industrialisation de nombreuses usines travaillant le métal. Les catégories pertinentes de sources écrites sont présentées, mettant particulièrement l'emphase sur celles qui complémentent les preuves archéologiques. Une vue d'ensemble de la connaissance actuelle de deux industries du métal qui ont été importantes dans la Grande-Bretagne médiévale et moderne sont présentées : la production du plomb et la sidérurgie. Les études archéométallurgiques peuvent montrer comment ces industries et les questions, qui entourent leur développement, peuvent être liées à des changements au sein de la société britannique et au mode de vie de sa population.

En conclusion, cet agenda de recherche identifie les lacunes majeures de nos connaissances et suggère comment elles pourraient être comblées au mieux. Celles-ci impliquent des thèmes qui comprennent plusieurs époques et qui sont liés à des méthodes de travail de terrain et de recherche scientifique, ainsi que d'autres sujets divisés par époques, allant de la préhistoire à aujourd'hui. Cette section présente aussi succinctement une stratégie permettant la promotion de la meilleure voie à suivre dans cette discipline qui est l'archéométallurgie.

Translated by Aude Mongiatti.

ZUSAMMENFASSUNG

Metall und Metallhandwerk: Ein Rahmenplan zur Forschung in Archäometallurgie

Der vorliegende Band präsentiert einen Rahmenplan für archäometallurgische Forschung in Großbritannien, bestehend aus einer Bewertung der vorhandenen Datenbasis, einem Forschungsplan, und einer übergreifenden Forschungsstrategie. Der erste Abschnitt beschreibt die Natur der Datenbasis, von spezifischen Landschaften und Stadtanlagen zu individuellen Gebäuden und Strukturen; er umfasst Funde und Produktionsabfälle ebenso wie Textquellen. Dieser Abschnitt richtet sich speziell an Denkmalbeauftragte und Planungsbehörden, da er auch die Verwaltung und Unterschutzstellung der Datenbasis betrifft, für die diese die Verantwortung tragen.

Der zweite Abschnitt, über Methoden in der historischen Metallurgie, zeigt daß das Arbeitsgebiet mehr umfasst als nur die Arbeit des laborgebundenen Spezialisten dessen Methoden

der Untersuchung und Analyse beschrieben werden. Methoden der Feldarchäologie, Landschafts- und geophysikalischen Prospektion und experimentellen Archäologie, und die Erfahrungen von praktizierenden Metallhandwerkern und Umwelthistorikern sind alle ebenso wichtig. Der momentane Trend von Baumaßnahmen-getriebener Archäologie, und insbesondere die Regeneration von Industriebrachen (einschließlich kontaminiert Böden), bedroht die Erhaltung von Bodendenkmälern der Metallindustrie; angemessene Methoden der Erforschung, Erfassung und Beprobung werden diskutiert. Vor- und Nachteile bestimmter Methoden werden abgewogen, und Gebiete zukünftiger Entwicklung skizzieren.

Der dritte Abschnitt gibt eine Zusammenfassung des Wissensstandes über Metallverarbeitung in der Vergangenheit, mit Schwerpunkt auf ausgewählten Themen die entweder die beachtlichen Fortschritte beschreiben, die in jüngerer Zeit gemacht wurden, oder die der weiteren Forschung besonders bedürfen. Die Beispiele umfassen Eisen- und Nichteisenmetallurgie aus allen Epochen. Die früheste Metallurgie in Großbritannien gehört in die Bronze- und Eisenzeit. Für die Bronzezeit liegt der Schwerpunkt auf dem Metallbergbau, wo in den letzten Jahren viele neue Informationen zutage gekommen sind. Für die Eisenzeit liegt der Schwerpunkt auf der Einführung von Eisen als alltäglichem Metall, obwohl Kupferlegierungen weiter in Gebrauch blieben. Die Römerzeit sah einen generellen Anstieg von Metallnutzung und –verarbeitung; die zwei Beispiele hier betreffen die Eisenindustrie im Weald und die Verbreitung von Messing als wichtiger Kupferlegierung. Das Fehlen von Hinweisen auf Kupferverhüttung bei gleichzeitiger Nutzung von verschiedenen Kupferlegierungen im Mittelalter wird hervorgehoben und diskutiert. Mittelalterliche und spätere Methoden der Stahlherstellung werden präsentiert. Nach dem Ende des Mittelalters ändert sich mit der Industrialisierung der Umfang der Metallproduktion ganz erheblich. Relevante Klassen von Textquellen werden skizziert, unter Betonung derjenigen die die archäologischen Quellen ergänzen. Der momentane Wissensstand für zwei wichtige nachmittelalterliche und neuzeitliche Metallindustrien wird als Übersicht präsentiert: Bleigewinnung und Eisen- und Stahlindustrie. Archäometallurgische Forschung kann zeigen, wie diese Industrien, und Fragen bezüglich ihrer Entwicklung, eingebunden sind in Änderungen der Gesellschaft und der Lebensbedingungen der Bevölkerung.

Der Forschungsplan benennt abschließend wesentliche Lücken im Wissensstand und macht Vorschläge, wie diese gefüllt werden können. Dies beinhaltet zeitunabhängige Aspekte der Feld- und Labormethoden ebenso wie zeitspezifische Themen von der Vorgeschichte bis zur Neuzeit. Dieser Abschnitt skizziert auch Strategien zur Verbreitung vorbildlicher Praxis.

Translated by Thilo Rehren.

INTRODUCTION

Knowledge of the sources, production and uses of metals is a central theme in the development of almost all societies and cultures, so understanding the history of metals and metalworking is a route to the heart of understanding our past. This history, which we call archaeometallurgy, is therefore a significant body of knowledge, and this volume is intended to aid the understanding of the subject and to demonstrate its place in the national research agenda for archaeology.

The need for archaeological research frameworks is widely accepted but the archaeometallurgical content of the emerging national and regional research frameworks (see section 4.5) has been uneven. There is thus a need for a research framework for metal production and use throughout Britain, spanning all regions and all periods, from the origins of metallurgy to the decline of the metal industries in the 20th century (Fig 1). The Historical Metallurgy Society has therefore produced this volume which provides a research assessment and an agenda for future work.

The current pattern of development-led archaeology places particular stress on the need to know more about our metallurgical past. In particular, the development of brown-field sites threatens the loss of important subsurface evidence for the archaeology of industry. What is generally regarded as contaminated ground often preserves a significant archaeological record, which frequently relates to metal industries. This situation is fuelling an imperative to develop a new methodological approach to the investigation and recording of such sites. If archaeologists, curators, planners and policy-makers, often with little previous interest in metallurgy, are aware of the problems involved in securing a satisfactory record of metallurgical processes, then the information provided by structures, residues and artefacts can be effectively captured. This volume has been compiled to assist them.

What qualifies the Historical Metallurgy Society to undertake this work? The Society's membership draws on three areas of expertise and experience, the first two of which are familiar to archaeology. There are

academic researchers and other specialist archaeometallurgists, many of them university-based or working within agencies such as English Heritage, but also including independent consultants. The second group are curatorial professionals, including those from museums who are responsible for the artefactual component of the record and those working with field-based agencies such as local authorities, who have responsibility for management and protection of sites. The third area of expertise is perhaps unique to the society, and comprises professional metallurgists



Figure 1: The blast furnaces at Stanton, Derbyshire, being demolished in 1976.

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who have spent their lives working within the metal industries. This group has specialist knowledge of more recent processes, which extends the influence of the society beyond that more usually represented within a specialist archaeological society and provides a continuum between past and present.

The volume has been divided into four parts, each viewing our metallurgical past from a different perspective. The first part deals with the resource. The evidence ranges from landscapes and sites to structures and townscapes. It also includes of moveable material, artefacts and the debris from production. These resources are recorded, inventoried and audited; they are studied and communicated to the wider community. This section is primarily directed at curators and planners who have responsibility for the management and protection of the resource.

The second part deals with methods in historical metallurgy. It has been included to demonstrate that the subject goes far beyond the work of the laboratory-based specialist, examining and analysing minute samples of metals and metallurgical debris with

ever-increasing precision. The repertoire incorporates the skills of field archaeologists, landscape specialists, palaeo-environmentalists, those with geo-prospection skills, metal-smiths and those involved in experimental archaeology. With this range of skills, the tools available for the study of metallurgy are expanding. This section examines the strengths and weaknesses of our methods and flags those areas where further development is needed.

The third part reviews the present state of our knowledge. Given the scope of the subject, this cannot cover everything. The attempt here has been to select not only those subject areas about which we have a good degree of understanding but also those areas which highlight our lack of knowledge and the need for further research.

These three parts can be viewed as a resource assessment, providing an overview of current knowledge and practice. The final part builds on those that have gone before, and provides a research agenda that identifies major gaps in our knowledge and suggests how they might best be filled.