Book reviews

Metallurgy in Numismatics 3. Edited by M M Archibald and M R Cowell. *Royal Numismatic Society Special Publication No. 24, distributed by Spinks, London. Pp. xii + 250, figs and ills. ISBN 0 901 405 29 9. £40.*

Numismatists have always been interested in the scientific and technical aspects of coinage; the work of Caley on *orichalcum* springs immediately to mind as an example of a monograph of great metallurgical significance based on the analysis of coins and published by the American Numismatic Society. More specifically the journal of the Royal Numismatic Society, the *Numismatic Chronicle*, regularly includes articles on the composition or metallurgy of coinage, in fact it is probably true to say that it contains more articles of metallurgical interest than any other journal not primarily concerned with metallurgy. In addition the Royal Numismatic Society have published four monographs specifically on the metallurgy and analysis of coinage. These have recently been generated by meetings now held approximately every five years, with the next taking place in 1994. The first was over twenty years ago and resulted in the well known and still invaluable *Methods of Chemical and Metallurgical Investigation of Ancient Coinage* edited by E. T. Hall and D. M. Metcalf in 1972. Since then the three volumes of *Metallurgy in Numismatics* have followed; I, edited by D. M. Metcalf and W. A. Oddy 1980, II edited by W. A. Oddy in 1988, which are still in print, now joined by this volume. All are produced to a very high standard.

The specific theme of this volume is the techniques by which coins were produced, concentrating on classical antiquity and the post medieval period and industrial revolution of Europe, but with a paper on coin production China and three papers on the techniques of gilded (Oddy), and silvered (La Niece), forgeries and a specific group of medieval tinned forgeries and the debris of their production (Minnitt).

The volume commences with a paper by Hackens, van der Mersch and Delamare. As a preamble they feel it necessary to define the collaborative relationship between numismatist and scientist, and pretty revealing it is too—'Collaboration between disciplines requires, as is well known, considerable planning: it is the role of the numismatist to describe the problems he is hoping to see solved by his colleagues from the material sciences' and further on 'The numismatist can formulate a hypothesis . . . He will ask the technical expert to prove or disprove this hypothesis and provide factors to explain such evolutions.' So there we have it, the numismatist thinks up and directs the research that the compliant scientist performs. Note Tony Hackens is a leading light in the PACT organisation of the Council of Europe on Scientific Archaeology, let us hope that this all-too obviously gentlemen and players attitude is not official European archaeometrical science policy.

The first group of papers is concerned with the evidence from the coins themselves of the techniques by which classical struck coins were produced. Above all the perennial question of how the dies themselves were made is discussed in papers by Healy, Gerin and Tobey and Tobey. The coins were struck in huge numbers and inevitably the dies needed recutting or renewing fairly frequently. They could have been cut afresh each time, but the evidence from the coins suggest there must have been master dies, latterly known as 'hubs'. These would have carried simplified versions of the design, for example the outline of the head, which was hammered into the face on the end of the new die, softened by heating, to produce the basic outline which could then have been quickly finished off by an artisan. The experimental replications of 'hubbing' carried out by Sellwood have shown that coins struck from dies made in this manner are very comparable to ancient coins. There is some evidence that hubbing was only carried out on the obverse die, the reverse dies seem to have been much more variable and rough and ready. Given the use of both high tin bronze and wrought iron dies, one wonders whether there could be a link between the methods used to produce the impression and the material of the die itself. In the experiments of Tobey and Tobey high tin bronze dies were hubbed by David Sellwood. The dies seem to have had rather short working lives before they fractured, but they did contain 20% of tin which would have contained a great deal of the very brittle alpha + delta eutectoid phase, rather than the 15% of tin found in the majority of the few surviving ancient bronze dies, which after prolonged heat treatment could just comprise solely the much more resilient alpha phase.

Goddard produces an interesting paper on the production of Roman brockages, whereby coins which became inadvertently stuck on the die face acted as a die and thus the next blank was struck on the die face acted as a die and thus the next blank was struck by the fact of previous coin rather than the die itself. The job of mass producing coins must have been so mind-bogglingly boring that coin after coin must have been struck with non-one noticing that the obverse was in fact an intaglio of the reverse.

The second section of the book concentrates on the mechanisation of coin production from the late Medieval period through to the present. Here the evidence of the coins, and of the waste *scissel* left behind after the blanks had been cut from the strips of sheet metal (see Brand's paper), is joined by contemporary illustration and descriptions. This

combines to make the story much more comprehensive than in earlier times, and developments are also much more rapid as coin production was one of the crucial areas in the development of mass production technology.

Money brings its own problems in more ways than one. In metallurgy it ushered in mass production techniques across a broad spectrum. The need to reproduce a recognisable image in metal tens of thousands of times over created new problems and potentials. In China multiple casting techniques were developed, but in Europe the majority of coins were struck. By the end of the medieval period there was a need to produce coins accurately by the million, and only machinery could do this. During the late 15th and 16th centuries new metal-shaping machinery appeared, such as the fly press, the screw press and above all rollers for producing sheet, all with coin production as one of the main stimuli. The greater forces and speeds involved challenged both the design of the machinery and the strength of the materials used. Above all the strength of the steel of the new rolls and of the coin dies was crucial, and one of the early uses of Huntsman's crucible steel was for rolls. Indeed many of the advances in steel technology were stimulated by coining machinery. This is a continuing evolution, experimental rotary presses recently developed by the US Mint could produce coins at a truly phenomenal rate but the life of the dies was measured in minutes no matter what material was used to make them!

During the 16th century the sheet metal for making the coin blanks began to be rolled and rollers were also used for impressing the design directly, as described in various papers by Sellwood, Besly, Gaspar and Thompson, concentrating on the evidence from Britain. There were many problems associated with the rotary press, and a much simpler variant, the rocker or *taschenwerk* press was generally much more successful. In Britain the screw press was preferred, impressing blanks cut by a fly press, and to counter coin clipping machinery was developed to mill the edges (Gaspar).

With the advent of the Industrial Revolution the steam press revolutionised coin production both in rates of production and quality. The much greater force exerted by the steam presses enabled the metal to be squeezed into the sides of the die, creating the edges as well as the faces in one operation. Foremost amongst the exponents of steam power were of course two generations of Boulton and Watt, and Doty relates their varying success trying to establish their steam coining plant around the world. He also suggests their prime interest was to promote their steam engines, but following Boulton senior's involvement with the copper producers they were equally anxious, even desperate in the 1790s, to find new markets for copper. the prospect of millions of cartwheel tuppences and their Russian equivalents pouring out of his presses must have been very alluring.

Coin production outside Europe is represented by Cowell on the alloys and techniques used to produce the Chinese *cash*. The study of the composition of the closely dated coinage also dates the introduction of zinc usage in China very precisely, a good example of numismatics working for metallurgical research, what would Hackens and co. think of that?

The volume concludes with an excellent and perceptive paper on the future of coinage, by Hatherley, highlighting new materials and methods of production. Unfortunately something seems to have gone wrong with the diagram showing the rapid increase in the numbers of coins and their overall value; according to the table, in 1987 for example twelve and half billion coins were worth about 17 billion pounds, putting the value of the average coin at over a pound (this was taken up with the author and it transpires that the cash value column has been inflated by a factor of ten and the value of coin in circulation was in fact only 1.7 billion pounds).

Together these papers constitute a fascinating debate and insight into the problem of the application of materials, forces and techniques to the mass production of coins through the ages.

Paul Craddock

Anglo-Scandinavian Ironwork from 16–22 Coppergate. By Patrick Ottaway. *The Archaeology of York, Vol 17/6, 1992. Council for British Archaeology, London. ii + 282 pp. + 20 plates + 2 microfiches. 242 × 184 mm p/b. ISBN 1 872414 29 X. £30.*

There are few reports available on ironwork from early medieval settlements in Britain. This fascicule is therefore a very welcome study of a large assemblage of ferrous slags and artifacts from an intensively occupied urban settlement.

More than 200 kg ferrous slags and over 4700 ferrous artifacts were recovered from early medieval deposits from the excavations at 16–22 Coppergate in York (1976–1981). The majority of these finds are from mid 9th–mid 11th century contexts although there are a few from earlier (Anglian) contexts when the site was unoccupied. The fascicule, one in *The Small Finds* series from York Archaeological Trust, is primarily a typological study of this ironwork. There are numerous analytical contributions, in particular J G McDonnell on ironworking processes, slag analyses, and metallography of artifacts, Paul Wilthew on non-ferrous metal determinations, and Sonia O'Connor on conservation. For reasons of economy, the full descriptive catalogue of the finds and the detailed metallographic data and methodology are supplied on microfiche.

On the basis of the distributions of the smithing slags and also bars, blanks and scraps, Ottaway suggests that

ferrous artifacts were made on or adjacent to the site during the late 9th and 10th centuries. Probable smithies and workshops are identified though no hearths have survived.

To reflect this metalworking activity, the main body of the text is ordered in the manufacturing sequence. A section entitled 'Ironworking' describes the residues (11 categories), smithing processes, and summarises the results of archaeological, metallographic and elemental analyses of the slags and artifacts. Other evidence of ironworking—657 bars, blanks and scraps are discussed including the results of metallography of 24 of these.

The following six sections discuss the varied artifact assemblage notable for large numbers of tools, knives, structural ironwork and fittings, and dress fittings. Of particular interest to HMS members may be the thirty or so metalworking tools including two coin reverse dies. Metallographic interpretations (46 knives, 13 tools and implements, 8 structural fittings and 3 weapons) follow the archaeological discussion of each object category.

Summaries of the metallography in the main text are rather brief and any determined serious reader will need to consult the microfiche data. There are, however, diagrams in the main text illustrating the location of the samples taken and the principal structural regions within each specimen (though an interpretive key is only to be found on p. 512). Ironwork is one of the most difficult archaeological materials to study comprehensively. Fortunately, due to the waterlogged nature of many of the archaeological deposits, most of the ferrous artifacts from 16–22 Coppergate are well preserved. An immense wealth of constructional and technological information has been recognised including surface features such as tool marks and tooled decoration, repairs, and non-ferrous metal platings (even on nails!). This adds greatly to the importance of the assemblage.

The means of presenting the results of archaeological and technological analyses is tackled in two ways. Firstly, the fascicule has reversed th traditional approach of an archaeological small finds volume and begins with the residues, bars and scraps. Emphasis is thus placed on the technological sequence. Secondly, summaries of the scientific analyses are incorporated in the body of the text to avoid segregating technological results in a series of appendices. Overall, analyses are well integrated and this method of presentation has proved successful. Some readers may regret the absence of a table summarising the metallographic data in the way that the X-ray fluorescence results have been made available for quick reference.

The use of microfiche as 'an integral part of the text' is regrettable although print-outs are obtainable at cost from York Archaeological Trust (currently c. £12 for the 195 pages). Furthermore, the ardent researcher will need to consult other fascicules in the series if they are to place ironworking more fully in context, for example with other contemporary industries at Coppergate such as non-ferrous metalworking (Vol 17/7). Economy may also account for the obvious omissions, such as an index, lists of figures and tables, and concordance tables (although a somewhat confusing run of finds' provenances does appear in microfiche). On the other hand, the fascicule is well illustrated with line drawings of representative samples of the artifacts, numerous distribution plots, and reconstruction diagrams showing the use of objects (notably locks and keys). There are also 20 half-tone plates comprising 69 individual photographs ranging from artifacts and their X-radiographs to photomicrographs of metallographic specimens.

In conclusion, this is a successful and well ordered study of a large assemblage of ironwork. Its importance lies in the scale and variety of the assemblage and the information retrieved, and that it is one of the first major publications of early medieval ironwork from an urban settlement. It will therefore be an invaluable aid and reference manual to finds researchers of this period. They should also gain much from the technological discussions, as will technologists with an interest in ferrous metallurgy of any early period.

Vanessa Fell

Mines et métallurgie chez les éduens. Le district sidérurgique antique et médiéval du morvan-auxois. By Michel Mangin, Ingo Keesmann, Wolfram Birke and Alain Ploquin. *Annales Littéraires de l'Université de Besançon, Paris, 1992. 295 × 208 mm. Pp. 364, 104 figs. ISBN 2-251-60-456-1. No price stated.*

The book describes an in-depth, multi-disciplinary research project on the ferrous mining and metal working activities of the area between Dijon and Auxerre in the Côte d'Or region of eastern France. The authors explain that their approach was innovative and as there was no well-developed methodology to follow, they had to evolve their own. They identify the lack of a generally accepted archaeometallurgical terminology as a problem in studies of this type and have therefore provided a detailed glossary, so the meanings of words and the interpretation placed on them are clear.

Geological, geographical and archaeological evidence was collected by aerial and ground-based survey as well as trial excavations. These provided information about ores sources, mines, settlements and workshops. This field work was supported by both historical studies and scientific investigations of archaeological and geological samples. Interestingly, place names record different type of activity with different efficiencies: a third of place names suggesting iron smithing produced physical remains, and one in five of the settlements they

suggested were found. On the other hand, mines were almost absent from the place names.

The study area of 400 sq km covered three distinct geographic zones in which were found remains of 140 mines and 200 iron working sites; a full catalogue of them is provided. Four types of iron ore were identified, though not all were exploited at all periods. The iron working was virtually all smelting, with most of the slag tapped from the furnaces though 'furnace bottoms' and some light, vesicular slags were also found. Some smelting sites were partly excavated and illustrations are provided; the line drawings are good but the photographs have not reproduced well. The authors comment that full excavation of some sites would have been desirable, though the funds available did not permit this. Smelting sites were on uplands and valley sides, but the major factor in determining their location appears to have been proximity to an ore source.

Over 400 quantitative analyses were made, over half were of slags and the rest of minerals and furnace walls; the results are tabulated in full. XRD analyses and optical microscopy of thin sections provided further information on the mineralogical structure of these materials.

The study has shown there was no significant pre-Roman exploitation of the mineral resources of the region. The majority of the sites identified that could be dated were Roman and these were of several types. First are the small individual sites of 1–2 hectares with mining and smelting evidence but usually no associated settlement. Next come the complexes with an average of six workshops in an area of up to 2 sq km, some of which have an associated villa or village. Larger still are the cores of the eleven zones identified in the northern part of the survey area which contain 10–27 smelting workshops each. To the south was a densely settled rural area without any iron industry. It is suggested that the metal produced was exported from the region as blooms or ingots as there is little evidence of iron smithing. The numerous Roman roads would have provided good routes to the surrounding areas which included the heart of the *Civitas Eduensis* to the south.

The 13th century was a second period when iron ores found close to castles were exploited. Two of the castles were in areas with Roman ironworking but a third was in an area that had previously not been exploited. The slag was of a different type and may indicate the use of different ores or a different smelting process. In the late and post medieval periods iron ores were again mined, but were taken outside the survey area to be smelted.

This study shows the benefits to be gained from a multi-disciplinary regional investigation in increasing understanding of the crafts and industries of the past. The complementary roles of survey, excavation, historical research and scientific investigation are clearly demonstrated. It has also begun to establish the relationships of rural hinterlands to the adjacent urban centres and points towards patterns in trade and industry. It should serve as a model for future investigations, in Britain as well as in France; I look forward to seeing them published as fully as this.

For those who do not read French, there is a three page summary that has been translated into both English and German. This attempt to make the contents of the book more widely accessible is to be welcomed, but using the English version was a frustrating experience as some technical (and not very technical) terms had defeated the translator. For those with even limited French, I would recommend reading the original summary rather than its translation as an introduction to the book!

Justine Bayley

Ironmaking in Sweden and Russia; a survey of the social organisation of iron production before 1900. By Göran Rydén and Maria Ågren (eds). *Historiska Institutionen, Uppsala University, S:t Larsgatan 2, 753 10 Uppsala, Sweden (Opuscula Historica Upsaliensia 12), 1993. iv + 120 pp. ISBN 91-506-0961-0. No price stated.*

This is one of a series of reports from a research project jointly undertaken by historians from the universities of Uppsala and Stockholm and their counterparts at the Institute of History and Archaeology in Ekaterinburg (formerly Sverdlovsk). In 1990 these co-workers initiated a comparative project on the social organisation of iron production in Russia and Sweden between 1600 and 1900 and it is anticipated that their findings will eventually be embodied in a substantial volume to be published (in English, as is the case here) in 1994.

This preliminary report is centred around two lengthy essays. The first, a survey of the Swedish iron industry before 1900, was prepared for the Russian participants who, in the last days of the Soviet regime, were not acquainted with recent developments in the historiography of Swedish iron, nor with western historiography in general. This is followed by a complementary contribution from a team of Russian scholars giving an overview of iron production in the Urals between the seventeenth and late nineteenth centuries. These central essays are buttressed by shorter commentaries which aim to reach some tentative conclusions about the comparative features of two of the dominant centres of pre-industrial European iron production.

These essays are intended then as the foundation upon which future monograph work will elaborate. But this is not to say that they are bereft of their own theoretical perspective. On the contrary, this collection is to be valued for its explicit orientation on the question of the social organisation of production: that

is to say, the policital and social structures which regulated iron production in Sweden and Russia, and how these impacted upon the working population. In states that were, in varying degrees, pre-capitalist in character, the shape which iron production assumed was — it need hardly be said — very significantly determined by political, legal and institutional pressures. Quite how is sketched out here.

The Swedish state, which depended heavily upon the export of bar iron as a source of tax revenue, intervened decisively to alter production arrangements during the mid seventeenth century. If Swedish absolutism was to persist with military expansion in northern Europe then its fragmented iron industry would have to be streamlined. Accordingly, the *bergsmän* (peasant proprietors of small, often co-operatively run furnaces and forges) were swept smartly aside. Henceforth, *bergsmän* were restricted to mining and smelting; the production of bar iron was entrusted to a new class of ironmasters, operating larger and more efficient forges in new industrial zones from which *bergsmän*, as potential competitors for charcoal supplies, were excluded. Finally, in an effort to ensure Swedish iron's saleability on the international market, state agencies were instituted to monitor the quality of iron exports.

The Urals industry remained more monolithic. All aspects of production were performed within a single 'mining district' over which the state or a private proprietor had jurisdiction. Mining, the gathering of fuel, the transport of materials and the various acts of metal processing were carried out by a workforce that — unlike the *bergsmän* and forge workers of Sweden — knew no legal freedom before the abolition of serfdom in 1861. Peasants and ironworkers were bound in one form or another to an ironworks or to an ironmaster personally.

Not the least of the merits of these essays lies in their attention to the ecological and agrarian context of iron production. In both countries the inputs of ore and charcoal were supplied by peasants for whom mining and charcoal-burning were only part-time occupations. Relations between peasant households and the ironmasters were therefore governed by the relative prosperity of agriculture. If working the land gave a good return, the effort devoted to preparing industrial materials would be diminished. And given that any growth in the employment of forge workers at local iron works was — other things being equal — likely to boost the demand for agricultural products, the propensity of peasant households to withdraw from industrial by-employment was a persistent problem for ironmasters. In this situation sufficient materials could be obtained only by raising the price offered for charcoal and other products or by coercing the peasantry. In Russia the forcible exaction of labour from peasant producers was perfectly possible. In Sweden such a policy was far more problematic and relations between the ironmasters and the peasantry had wide ramifications. For example, the export strategy pursued by the Swedish crown in the mid eighteenth century, that of deliberately restricting bar iron production so as to maintain a high price on international markets, has often been credited to the foresight and canniness of Swedish ironmasters. In the account offered here, however, the shift in state policy is attributed rather more to the effects of the resistance which the peasantry, as the source of charcoal and transport services, offered to the increasingly onerous demands made upon it. This resistance, it is suggested, could have had the effect of imposing a ceiling on production.

These questions are examined in the light of proto-industrialization theory, a form of analysis more usually applied to pre-industrial textile production. Nevertheless, that theory's focus on peasant households which engaged in both industrial and agrarian activity as a dynamic element in industrial development is shown to have some value in elucidating the features of the early iron industry of northern Europe. The essay on the development of the Swedish industry is to be lauded as a sharply drawn survey of the existing historiography, shot through with revisionist insights and with the promise of more to come. The Russian contribution is rather less digestible and rather less ambitious, both theoretically and in its geographical scope. Even so, both essays hint at the possibility of a social history of iron production that is distinctive and new. Students of the British iron industry — for which a social history of any kind would be welcome — will find much of interest here.

Chris Evans

Sjuttonhundratalets gjuteriteknik enligt Sven Rinman [Foundry technique in Sweden in the eighteenth century according to Sven Rinman]. By Lars Villner. *Gjuterihistoriska Sällskapet [Swedish Foundry Historical Society], Jönköping, 1993. 250 × 175 mm. 64 pp. 8 figs. ISBN 91-87920-02-6. Available from Gunnar Karlsson, Huskvarnavägen 95, 554 66 Jönköping, Sweden for £6 + £2 p&p.*

This short text, which is all in Swedish, introduces two late eighteenth century books describing metal technology in Sweden at that period. There was very little published in Sweden on foundry technique until, in the 1780s, two comprehensive works by the famous Swedish scientist Sven Rinman were published. His *Bergwerks Lexicon* (a dictionary of mines and metallurgy) gives exhaustive explanations of some 4200 terms and his *Järnets Historia* (a monograph on iron) contains the technical knowledge about iron and ironmaking of his time. Although Rinman's main interest lay in mines and iron works, he gives numerous pieces of information on foundries and foundry technique which are of great interest to foundry historians. In order to facilitate access to this rich source of information this publication reproduces in facimile the entries from Rinman's *Bergwerkslexicon*

and *Järnets Historia* that refer to foundry technique. Also included are a short biography of Rinman, summaries of his main publications and a commentary on the reproduced sections of text. The author comments that the techniques of eighteenth century foundries were far more advance than is usually imagined. The craftsmen were clever; they met many of the same problems that still exist today and solved them with considerably fewer resources than are now available.

Justine Bayley

The Historical Metallurgy Society, what it is and how to join

Origins

The Historical Metallurgy Society was established in 1962, and now covers all aspects of metallurgical history and has an international membership of over 500. Currently about half of the membership is outside Great Britain and ferrous and non-ferrous interests are equally represented.

Publications

The Society publishes the results of its research at regular intervals. A Journal, is produced annually normally in two parts, and a news sheet is issued three times a year, with conference details, and excavations.

An index of publications is available and back copies of Journals and special publications are usually obtainable.

Conferences

The Society holds an Annual Weekend Conference each September, and a day of lectures and visits at the AGM in the Spring. These meetings are held in different parts of the country. At each Conference there are lectures by metallurgical historians, and experts with local knowledge of the area. One day is spent in the field with coaches taking members to sites of interest.

The conference weekend also provides the opportunity for members to give short talks on their own particular interests.

Joining

The annual subscription is £15.00 sterling anywhere in the world for an ordinary member. There are alternatives for those who are already members of the Institute of Materials or who are full time students.

Payments of the subscription entitles you to receive the Journal each year. Newsletters, and details of the various activities of the Society.

If you are interested in joining please write to:

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