

Book reviews

Outils et Ateliers d'Orfèvres des Temps Anciens

edited by Christiane Eluère. *Antiquités Nationales Mémoire 2. Société des Amis du Musée des Antiquités Nationales et du château de Saint-Germain-en-Laye*, 1993. 297x210mm. 304 pp. Price 200 FF + 38 FF postage; obtainable from Librairie Archéologique, Monique Mergoil, b.p. 10, 34530 Montagnac, France.

This volume is the proceedings of an international symposium on goldsmiths' workshops and tools, held in St-Germain-en-Laye in 1991. The 38 articles are divided into 6 sections; Prehistoric, the Classical world, Medieval, Post-medieval, the Americas and Africa. 19 papers are written in French, 16 English, 2 German and 1 Italian, and are a mixture of short notes, detailed studies and reviews.

The Prehistoric section concentrates particularly on gold wire, both from observation of the jewellery of the Iberian peninsular (Perea), and from experimental replication of types of wire found in filigree work of the western Mediterranean (Nicolini) and Etruscan (Formigli) jewellery, with an examination of Etruscan granulation techniques (Baines). An investigation of the direct use by jewellers in the prehistoric period and antiquity of alluvial gold, concluded that it may have been used to manufacture granules (Eluère *et al*). This paper, like several in this section, describes experimental replication together with examination and analysis in a Scanning Electron Microscope. The earliest gold artifacts discussed are cast and hammered ring ingots dated to the second half of the 4th millennium BC in southern Levant which show evidence of surface enrichment, possibly deliberate (Shalev). The other papers in this section are a metallurgical investigation of mercury gilding and silvering in the 3rd-1st centuries BC in China (Bunker *et al*), and an interesting study of a large group of bronze tools from the western European Bronze Age and their role in the manufacture and decoration of jewellery, and other metal and ceramic items (Eluère and Mohen).

The papers in the Classical section follow various approaches. Deppert-Lippitz's examination of Roman *Opus Interrabile* is stylistic, Beck and Barrandon present analyses of gold alloys and solders, Robert-Haughlustaine uses the evidence of contemporary texts in a discussion of antique and medieval gold solders. The latter two papers conclude that there is no evidence for

the use of cadmium in ancient solders. A paper by Brown considers the use of an interesting screw mechanism in early Christian bracelets. Raub gives a modern chemist's view of the recipes given by Pliny, Leyden Papyrus X, Mappae Clavicula and Theophilus for coating objects with gold. Oddy reviews the evidence, both literary and archaeological, for touchstones in antiquity and the medieval world and Guiraud uses information from inscriptions, funerary monuments and archaeological excavations to examine the status and working conditions of goldsmiths in Roman Gaul.

The Medieval section is the longest, with 10 papers. Four examine excavation evidence for precious metal working in Medieval Europe: Anglo-Saxon England (Bayley), a major metalworking site at Locronan, Finistère (Guignon *et al*), a goldsmith's grave in N. Sweden (Arrhenius), and a Germanic silver/bronzesmith and glassworkers workshop (Gustavs). There is a short paper on the gold and garnet work of the nomadic peoples of 5th century AD central Europe (Damm) and another on 6-8th century buckles and brooches from the Crimea (Aibabin). Duczko examines a group of dies from Scandinavia, and matches them with finished filigree work brooches. The other topics in this section are gold thread manufacture (Jaro *et al*), a review of Byzantine niello and its origins (Schweizer), and research into the sources of gold for Irish and Scottish filigree work, using literary, geological, analytical and archaeological evidence (Whitfield).

The post-medieval section, not surprisingly, includes more papers based on archival evidence. Cakir and Çagman have extracted details of the pay and status of goldsmiths from the archives of the Topkapi Palace before 1600 AD, and discuss the use of mercury gilding and the sources of mercury in Turkey. Arminjon lists the contents of a jewellery workshop in Provence from an inventory of 1498, and Bimbenet-Privat portrays the organisation of 16th century goldsmiths' workshops in Paris from study of inventories. The English documentary and archaeological evidence AD 1100-1500 for goldsmiths' tools and workshops is presented by Campbell, and Vassalo e Silva reports on Gil Vicente, a Portuguese goldsmith and poet. The only analytical and technological study in this section is of a gilded iron helmet of Charles VI (Beck *et al*).

There are only 4 papers on the Americas, which does not do justice to the richness of the goldsmithing traditions of that continent. The earliest is almost a review paper of the gold technologies of the Pre-Christian Era 2000BC-AD1500 (Miller), but has an irritating lack of references to support the tantalising

statements. The short notes by Tisserand on Aztec goldsmiths of Mexico and by Bauer on Precolumbian gold compositions also have bibliographies without any references which tie in with the points in the text. However, Derome's study of goldsmiths tools and workshops in Québec 1660-1840, based on archival material, gives copious references.

The volume closes with 3 papers on African goldworking: a clear presentation of the evidence for the origins of gold production and trade in western Sudan (Guillard); an ethnographic study of jewellery making in Mali, and the archaeological parallels (Armbruster); and a study of the vanishing tradition of manufacturing weights, for measuring quantities of gold, of the people of S Ghana and E Ivory Coast (Rivallain).

This volume is well illustrated, and includes 7 colour plates. As with any conference proceedings, there is some variation in the standards of the papers, but it contains a wealth of valuable information. It is, without doubt, an essential reference work for anyone with an interest in the history of jewellery and precious metal working.

Susan La Niece

Ancient mining by Robert Shepherd. *Elsevier Applied Science for the Institute of Mining and Metallurgy, London and New York, 1993. xv+494pp. ISBN 1-85861-011-7. £65.*

There is a crying need for a new study of early mining, incorporating the new work that is rapidly changing our understanding of the subject. Sadly, this book does not begin to fill the gap; its content is not new, and it does not in fact cover the subject indicated by the title.

The title and advertising for the book are seriously misleading; as the preface makes clear, it is a study of mining in the Classical world, with only incidental coverage of anything earlier. It also gives the strong impression of having been written in the early 1960s, from an already slightly old-fashioned perspective, and 'updated' by adding an erratic selection of more recent references, which have not been properly assimilated. Thus some of the references to Cwmystwyth include Timberlake's recent work, while others do not and simply regurgitate Oliver Davies' work.

Basically, the book is a rehash of Davies and earlier workers (mostly of the 19th century). The author's fieldwork appears to have been limited to a holiday visit to Siphnos, and the secondary sources on which he relies are simply quoted, at length, without any analysis or any apparent comprehension; Shepherd clearly has

little understanding of either archaeology or geology. The book is riddled with errors and obvious misunderstandings, ranging from the trivial to the basic. Occasionally these develop a certain surrealism — thus on p73 Shepherd solemnly interprets the phrase 'woe upon woe' in Herodotus as referring to 'beaten iron', though he seems to retract this by the end of the paragraph. Sadly this does not appear to be the author's sense of humour showing through. The statement on p143 that 'the inferior charcoal used to treat the 60-65% Fe ore resulted in the production of spongy iron of very high specific gravity' might also be a joke, but for the risk that the reader ignorant of metallurgy might believe it.

All in all, *Ancient Mining* reads like a grossly extended essay by a rather dim first-year undergraduate; it is simply a rehash of its sources, with no discrimination or original content, and has not even been properly proof-read. This must count as one of the worst and most overpriced works to hit our subject in recent years. Its appearance under their imprint is a disgrace to the IMM, and its price is an insult to the reader. The serious student of early mining (and s/he will need to be very serious to wade through 494 pages of this!) may find the volume worth about £5 as a handy if unreliable introduction to the non-recent literature; otherwise it cannot be recommended at any price.

David Cranstone

A medieval industrial complex and its landscape: the metal-working watermills and workshops of Bordesley Abbey by G G Astill. *Council for British Archaeology Research Report, York, 1993. 295x210mm. xx+317pp and 2 fiche. ISBN 1 872414 43 5. £36.*

This impressive volume gives the results of twelve seasons of excavation upon a monastic industrial complex on the eastern outskirts of Bordesley Abbey. That Cistercian house was founded in the mid 12th century within the valley of the river Arrow, 20km south of Birmingham. Although now on the fringe of Redditch New Town, the abbey precinct has remained as open ground since the abandonment of the mill site in the early 15th century and the dissolution of the abbey a century later. This has provided and excellent opportunity to survey an industrial landscape and to excavate selectively the watermill and associated workshops.

The report is divided into three unequal parts: the first 35% describes in detail the mill structures and water channels, the second 45% presents the finds, and the final 50 pages provides the discussion of the complex and its wider context within medieval landscapes. The excavation concentrated on four periods of mill

building, together with the pre-monastic landscape and the primary workshops of c.1150. The buildings dated from c.1175 to c.1400 and were remarkably similar, based on a mill-house with two hearths and an attached wheelhouse. The water control was represented by a head race in a plank-lined channel, a wheel pit in a wooden trough and a tail race carried in similar planking. After the abandonment of the mill-wheel, probably due to excessive silting, metal working continues without the motive force of water. The metal-working machinery has not survived. Near the mill was a separate workshop which later became a forge and a farrier's shed. A transect dug across the valley gave details of the millpond, its timber outlet drain and its man-made bypass stream. Other surveys showed substantial changes to the drainage patterns within the monastic precinct.

The finds represented the working life of the mill, its machinery and its rubbish deposits. There were structural timbers, mainly of oak, which are fully illustrated with diagrams of their structural assembly. Stone bearings for a mill-wheel and a large grindstone from a forge survived. The working of iron, copper and lead was indicated, particularly by bar iron, scrap metal and part-forged iron pieces of slender profile, used in making carpentry nails and tenter hooks. Kiln debris showed that ceramic tile making occurred nearby, while the presence of flax seeds, teasels and hemp were evidence of fulling and textile making. Tools of leatherworking (and shoe remnants), of woodworking and of agriculture indicated other aspects of the monastic economy.

The final part of the report is the most valuable to the general reader. The author discusses the provision, control and gradients of water to the undershot vertically-positioned wheel. He examines the building methods and David Walsh reconstructs the appearance of the mill houses and workshops. The operation of the metal-working machinery is assessed, with the probability of three trip wheels being mounted on the shaft of the water wheel to drive two bellows and a hammer. There is a careful analysis of the evidence for the working of iron and lead, and comparative evidence from recently excavated forges is critically examined. The lack of residues may indicate efficient recycling; the absence of diagnostic tools is common. This makes the structural evidence crucial to any identification of a building as a forge, and Astill is doubtful about Chingley and Batsford. The operations at Bordesley are compared with the evidence from the Cistercian abbey of Beaulieu, and problems of local marketing and Bordesley's other milling enterprises are rehearsed.

Any criticisms of this excellent, well-produced report are minor. More use could have been made of winter air photography; Plates 1 and 38 are undated (?1962). The Knaresborough castle forge might provide comparative evidence. Professor Jack's work on fulling mills ('pandy') in Wales shows their frequency there; is the West Midlands so very different? The main thrust of this report is to establish more stringent criteria for identifying milling operations as metalworking, corn grinding or fulling. Such criteria are badly needed, and enhance the value of this report.

Lawrence Butler

A selection from the records of Philip Foley's Stour Valley Iron Works 1668-74. Part II edited by R G Schafer. *Worcestershire Historical Society, New Series, Vol 13, 1990. xxiv+42pp. 1 plate, 2 maps. £20.00*

This volume completes Professor Schafer's labours over many years on the papers of the Foley family in the Herefordshire Record Office: an earlier 'Selection' from the same archive was published by the Worcestershire Historical Society in 1978 and Schafer's well known article on the origins of the Foleys' major partnership of 1692 appeared as long ago as 1971 (*Business History*, XIII, pp. 19-38). His final contribution consists of edited texts of three types of document generated by the activities of Philip Foley, the youngest of the three ironmaster sons of Thomas Foley (1617-77), the founder of the dynasty.

The texts include four inventories of stock at various works at the year-end (1667-69); a seven-year run of 'Yield Accounts' (1668-74), listing physical inputs of raw materials and their cost, plus interest and overheads, set against output figures and receipts; and four examples of what Schafer calls 'Sales Brochures', extolling the merits of various works which Foley was seeking to sell, including performance figures going back in one case to 1650. Both the editing and printing of these extremely difficult documents, which are almost entirely tabular in layout and ranged over enough columns to make the modern spreadsheet designer wince even before he contemplated the fractions and decimals, reflect great credit on Schafer and, equally important, the printer (Maney of Leeds).

The value of the work is further enhanced by the editor's introductory matter, which throws new light on the operations of the Foley family in the years immediately following Thomas Foley's retirement and transfer of his business to his three sons. He demonstrates how each was given a roughly similar-

sized business, of which Philip's proved most successful, and explains how his activities moved from the direct management of a single group of works to the looser supervision of a several businesses spread over a wide area.

The other theme brought out very well is the sheer complexity of the iron industry in this period and the daily and annual grind for someone like Foley in trying to ensure that all his units were profitable. The need for minute cost accounting appears to be the main reason why the industry generated such detailed records which are both a boon and a challenge to the modern investigator. On the other hand, those who have simply extracted figures and recomputed them to suit their own ends have missed the point Schafer makes here that the iron industry, far from being an easy road to wealth, was fraught with problems over the supply of raw materials and water-power, the performance of plant and the quality of the finished product, not to mention failings by management and workers. A huge amount of capital was employed in a business the size of Foley's, on which, at the end of the day, the return was not especially impressive.

This is a well produced book which joins Schafer's earlier volume as an essential source for the seventeenth-century iron industry; its rather high cost is no more than a reflection of the problems inherent in printing the type of material included here, and the Worcestershire Historical Society deserve congratulation, as does Professor Schafer, for seeing this project through to completion.

Philip Riden

Swedish Iron in the Seventeenth and Eighteenth Centuries. Export Industry before the Industrialization by Karl-Gustaf Hildebrand.

Jernkontorets Bergshistoriska Skriftserie 29, Stockholm, 1992. 245x215mm. 182pp. 158 figs. ISBN 91-971474-6-X. No price stated.

This English translation of an earlier Swedish edition; *Svenskt järn. Sexton-och sjuttonhundratalet. Exportindustri före industrialismen* (Jernkontoret, Stockholm 1988) is welcome in providing a detailed picture of an industry which not only has important social and economic implications for Sweden's early industrialisation, but, as the major source of wrought iron bar for many other European nations during this period, has truly international consequences.

The background and introductory chapters outline the

steady growth of production and exports, from 4,000 tons a year in the 1530s to 11,000 tons in 1640 and up to 42,000 tons in the 1740s, from when growth stagnates. The following chapters deal with specific aspects of the industry. Markets and Exports, of particular interest to British readers, emphasises how expansion was tied in with demand for bar iron from first Holland then Britain, not only for the production of steel but also where iron of high durability, toughness and strength was required.

For those who have followed the heated debates, in *Historical Metallurgy* and elsewhere, on the identification of early blast furnaces and the technological process responsible for osmunds, the chapter on Technology and Products adds little. At this late date, all pig iron is assumed to be from blast furnaces, the volume makes no suggestion of contemporary operation of the high bloomery furnace. The technological origin of the osmund is dismissed by the statement that 'There is no question whatever but that the osmund of which we have detailed knowledge from the 16th century onwards...was based on hearth-refined pig iron'. The relative merits of Walloon and German refining hearths are considered in some depth and the lack of success in developing a Swedish steel cementation industry is touched on.

A brief chapter discusses the hazards in interpreting historical documents, particularly financial accounts. Ore is looked at from the viewpoint of the social organisation of mining with no discussion of the mineral resources utilised. Even in relatively well forested Sweden, access to charcoal was of crucial importance. Figures quoted for the close of the 18th century show that a total of 40m³ of charcoal (the product of 70 days labour) was required for each ton of bar iron, with a little over half being consumed in the refining hearth. The chapter on The Labour Force, whilst emphasising the extent to which predominantly agrarian peasants contributed much of the labour to the iron estates, concentrates on the full time employees on the estates, many of whom were of Walloon or German descent. Transport costs were also a major factor in determining the economic success of a furnace. Instances are given of ores being transported several hundred kilometres by boat, yet even short stretches of overland travel could be prohibitively expensive.

The chapter on Iron Policy looks at the intervention of the Government, largely through the Board of Mines, to control the industry. One effect of this was to protect the peasant miners' rights to smelt ore in areas where this had traditionally been carried out, yet encourage the growth of larger scale iron-working estates elsewhere.

However, from the mid 18th century a policy was implemented to restrict the output of the estates. Ostensibly this was intended to conserve the forests, however, it was clearly hoped that the ensuing iron shortage would act to force up prices, or at least maintain current levels. Finally we are reminded that since the 17th century each estate was required to hallmark its products as a means of allowing the quality of output to be checked.

Two chapters contrast the production of iron by the peasant miners (*bergsmän*), with that of the protoindustrial ironworking estates. For the former, who had been responsible for most of the iron produced in Sweden up to the 17th century, mining and iron working making were seasonal occupations which took their place with other work in the field and forest. Although each, communally owned, peasant blast furnace only ran for a short period of the year, the combined output of these plants was considerable. Even by the close of the 18th century about half of Swedish pig iron originated from peasant blast furnaces. However, the fining of the pig iron and forging of the bars was increasingly taken over by the new ironworking estates. The ownership of these estates, discussed at length, identifies three main groups of entrepreneur; foreign capitalists, the aristocracy and town merchants.

Sales and Finance, looks at business arrangements between the estates and the stockists who marketed their iron. The seasonal cycle of iron production tied up large amounts of credit, and indebtedness was a common occurrence, possibly deliberately encouraged by the stockists. A final chapter on Weights, Measures and Coinage briefly explains and quantifies the units of trade; three different weights of *skeppund* for iron are recognised and the *stig* of charcoal could be of several volumes. The relative values of copper and silver *dalers* gradually diverged before the introduction of the *riksdaler* in 1776.

In conclusion, this volume provides a very readable account of a subject that clearly has relevance beyond the immediate bounds of Scandinavian industrial history. The work is profusely illustrated and the translation produced very few errors. Inevitably the very broad, historical, approach to the subject prevents any great depth. I would have welcomed more information in certain areas, for instance the technical details of the actual smelting and refining processes, the nature of the ores, and the survival of the remains. A bibliography is provided for further reading, but researchers will be disappointed to find that few of the statements made in the volume are supported by specific references.

David Starley

A Curious Place: The Industrial History of Amlwch (1550-1950) by Bryan D Hope, illustrated by Keith Shone. *Bridge Books, 61 Park Avenue, Wrexham, Clwyd, 1994. 176pp. ISBN 1 872424 36 8. £17.95.*

Amlwch is a village on the Anglesey coast, with an unusual narrow harbour. Its present appearance belies its importance in the eighteenth and nineteenth centuries when it was a hive of industry. This account covers the rise and fall of this "curious place".

The importance of Amlwch lay in its proximity to the Parys Mountain, where copper ore has been mined from time immemorial. In the introduction the evidence for mining in the Bronze Age is reviewed. The Romans worked the deposits in the first century AD, but from then until the sixteenth century there is no record of mining on the mountain, though it may have continued.

In the Tudor period ore was mined here and they tried to recover copper from the mine water. Although this was successful it was not economic. A map from this period identifies Amlwch as a haven for the export of ore; the probable facilities needed to make it 'fitt for that purpose' are discussed. Any trace of these has presumably been destroyed by the later use of the restricted area around the harbour but there is a possibility that some remain on an unidentified quay. A survey in 1780 shows that there was the beginning of other commercial use of the harbour. Other than this there were only the usual rural industries, including at least one fulling mill.

On Parys Mountain in the late eighteenth century there was increasing activity by the two major landowners. Ore raised was stored in bins on the quayside to await shipment to Dumbell's Warrington smelter, and new bins were built. A succession of disputes between the owners of the mines brought Thomas Williams, an Anglesey lawyer, into contact with the business. This was later to transform the copper industry.

The Parys Mountain ores were not rich in copper, and contained large amounts of sulphur. These sulphurous ores were not acceptable at the smelters, and so were roasted at the mine. The sulphur content was so high that no fuel was needed. The ore was originally roasted in heaps with consequent catastrophic effects on the life in the area of the mine. When it was found that some of the sulphur could be recovered this gave rise to a new industry. Heating highly sulphurous ore drives off some of the sulphur as vapour, which burns at the surface of the heap, or at the top of an open top kiln. If access of air is prevented and the gases are cooled this sulphur can be condensed and collected. This was the basis of a

process that was described by Matthew Boulton in 1787 and John Champion at about the same time. There are several different designs of kiln in the book; the process is described in some detail. There is a minor misunderstanding of the chemistry in the description. Cooling sulphur dioxide does not decompose it to sulphur and oxygen, but cooling the flue gas would deposit the sulphur as described. The product, 'flowers of brimstone', was difficult to transport and was gently melted to form 'rock sulphur'.

Like all miners, the owners of the Parys mines felt that they were being exploited by the smelters. Anglesey has no suitable coal, and there was a duty to be paid on imported coal, even if it came from elsewhere in Wales. This led to Thomas Williams and his partners setting up a smelter in Ravenhead, Lancashire, and buying Upper Bank Works in Swansea. Petitions to Parliament eventually had the duty reduced on internal coal shipments and the way was clear for two smelters to be built at Amlwch, for the Mona and Parys companies.

From a contemporary description of the smelters by Arthur Aitkin only the ore melting stage of the process was carried out at Amlwch in 1797. The product is described as 'rough copper containing 50% of the pure metal'. The Swansea smelters would call this 'coarse metal'. It is neither copper nor metal but a mixture of iron and copper sulphides now called copper matte. This would have to be smelted again either at Swansea or in Lancashire. It would command a higher price per ton of contained copper. The transport costs would be reduced by at least 95% on the basis of the figures in the contemporary report. In the same report Aitkin noted that he saw no drinking parties on a Sunday evening!

By 1799 the mines were becoming exhausted. Mining continued under various managements but with a much smaller output. The Mona smelter seems to have closed by 1812 but the Parys smelter continued in operation. We are not told when the latter began to make refined copper but the Lancashire smelters belonging to the company had closed by 1814. By 1818, after many difficulties, the Mona smelter is said to be in full operation again, producing fine copper. This period was, of course, one of great privation and civil unrest. In 1819 Michael Faraday visited the mines and recorded his experiences, both in the smelters and underground. His account is extensively quoted and expanded. Another account shows that there were '6 roasters, 6 ore furnaces, 3 calciners, 3 precipitates and 2 refiners', and then briefly describes the Welsh process for copper smelting.

The history of the smelters is concluded in a later chapter. It is clear that the best ore has been worked out.

The smelters imported ore from Sygun and Llandudno in Wales and from abroad, presumably to raise the copper content of the charge to a level at which the ore could be smelted. In the end the need to import ore and the coal meant that the smelters were having some difficulties. With the death of James Treweek in 1850 the output of the smelters declined sharply and they closed. He had been with the mines since 1811 and seems to have been the driving force behind the later operations.

The mining and smelting activities take up about half of the book. The rest gives a fascinating account of the other activities in the village. Some of these, such as shipbuilding, were a consequence of the activities of the smelters. Others, such as brewing, were also linked though less directly. There were chemical works of various sorts, brickworks and many of the usual rural industries. As in the mining and smelting sections the author has taken the trouble to explain to any inexperienced reader the processes involved in these activities.

This is a well written history of this "curious place", which was dominated by the Parys mines. There are informative drawings and photographs throughout the text. The author has clearly taken great care in his research and has produced an interesting and enjoyable book. I do, however, have some reservations about the picture of the Amlwch smelter on the rear jacket. This seems to be based on a nineteenth century woodcut which has one man raking the slag from an ore furnace while another waits to tap the 'metal'. What the workmen on the jacket are doing stirring up the slag, which will shortly be taken to the tip, I cannot imagine.

Peter Hutchison

'The Labyrinth of Flames': Work and Social Conflict in Early Industrial Merthyr Tydfil by Chris Evans. *Cardiff, University of Wales Press, 1993. 212x140mm. xiv+237pp. 11 figs and plates. ISBN 0-7083-1159-8. No price stated.*

In this compact, but extremely well-researched monograph, Dr Chris Evans examines the labour and social processes at work in Merthyr Tydfil between about the 1760s and 1815. The book takes its title from a visitor's description of the Cyfarthfa ironworks at Merthyr in 1799, by which time south Wales had emerged as the leading iron producing region in the UK, accounting for nearly a third of the country's output. At the centre of the region was the parish of Merthyr, the 'metropolis of ironmasters'. Ideally situated for an iron industry that was to be based on coke smelting and Cort's puddling process, its growth was unprecedented, with the population expanding from 7,700 in 1801 to 17,400

in 1821. Dominated by its great ironworks – Dowlais, Cyfarthfa, Penydarren and Plymouth Merthyr was at the technological and economic forefront of the industry.

The main theme of the book is how labour was organised within these great ironworks, and how the ironmasters devised strategies to assert their authority over a disparate and independent workforce. The social impact of industrialisation is also explored in an attempt to present a rounded picture of the dynamics of Merthyr society. Using a wide range of primary business records, such as the Dowlais Company papers, an insight is provided into an eighteenth and early nineteenth century 'corporate' town.

As one would expect, the basis of ironmaking was largely empirical, with workers being 'bred up' to the trade of smelting and puddling. The author starts with a detailed look at the ironworkers' world, describing the technology in a clear fashion and exploring such subjects as labour mobility, the reaction to new technology (such as Cort's process), workplace dangers and the development of a 'fellowship' amongst ironworkers in this closed and often secretive domain. Next he examines the development of a professional managerial layer in the large works, which appeared early in Merthyr due to the influence of outside capital and the sophistication of the new technology. The Gilpins at Penydarren and the Woods at Cyfarthfa and Penydarren are cited as examples of this class of managers, who could occasionally (like Sir John Guest) themselves become owners – the dominating figures in the Merthyr iron industry. Amongst the ironmasters, the outstanding personality was Richard Crawshay (1739-1810), 'Moloch the Iron King', noted for his energy and ruthlessness in driving forward the fortunes of the Cyfarthfa works. Samuel Homfray (1762-1822), the master of Penydarren, was almost as ambitious and belligerent, and was regarded by contemporaries as 'a very dangerous person' to know. These men were conservatives, Anglican in their worship and Tory in their sympathies; with an evolving trade identity fostered especially by Crawshay; and powerful enough to repulse government plans to tax pig iron in 1806.

Yet Evans, as he carefully dissects Merthyr society, shows that the development of its iron industry was never simply the triumph of capital over labour. The head long expansion of the industry and the shortages of skilled workers meant that this was an industry even the masters could never entirely control. Notions of how work was to be conducted and how authority was to be legitimised had been many generations in the making: often they had been developed in older iron-producing centres. In the furnaces, the nature of the technology

and the prevalence of sub-contracting meant that the owners could only have their way with a mixture of blandishments, cajolery, threats and appeals to a fellowship of ironworkers that embraced both master and men. Moreover, the intense concentration of manufacture in such a small locality brought its own problems. Bitter rivalry developed between ironworks, especially over such matters as mineral rights; while the indigenous hill farmers resented the ecological impact of iron making. The coincidence of the region's spurt of economic growth with the Revolutionary movements in France and America also fostered radicalism in Merthyr, which could draw on its own roots of religious Dissent. The result, in the author's words, was a 'distinctly fractured urban identity', which later allowed antagonisms between the workers and ironmasters to erupt in conflict in the nineteenth century, notably during the Merthyr Rising in 1831.

This is a well-written and nicely produced study of the business of iron manufacture, which amply demonstrates the importance of considering the broad social and cultural context of technology. The complexity of the portrait Evans paints precludes a grand conclusion, though he makes a final sound point: Merthyr can only be properly understood in a national framework – one that takes in the Severn Valley and the metallurgical industries of the Bristol region.

Geoffrey Tweedale

John Bedford and the Ironworks at Cefn Cribwr

by Philip Riden. *Published by the author, 1992.*

viii + 148pp. 3 plates, 10 figs. ISBN 0 9503299 75. £7.95 (+85p postage), available from 38 Park Place, Cardiff CF1 3BB.

Research and publication on the 18th and 19th century iron industry has emphasised the successful and the innovative. Philip Riden has written in this journal of those which failed ('Some unsuccessful blast furnaces of the early coke era' *Historical Metallurgy* 26 (1992), 36-45). In this book he provides a comprehensive account of one of these, set up by John Bedford near Bridgend, Glamorgan, on land which he came from Birmingham to purchase in 1770. Skilled as a japanner, with a family background in the secondary metal trades, Bedford saw an opening for the development of the ore and coal resources of west Glamorgan. His writings show a curiosity about the innovations of his time, a period when the industry was evolving ways of using mineral fuel not only for smelting but more particularly for the conversion of pig to wrought iron. Bedford was not himself an innovator, but his papers show that he was familiar with the general thrust of change, of which

Cort's process is the best known but certainly not the only approach to the problem of developing a successor to the finery.

Putting the new technology into practice and adapting it to the ores and coals available on or near his lands, on any sound financial basis, turned out to be beyond Bedford's capabilities, encumbered as he was with excessive levels of borrowing. A master of hyperbole, his descriptions of his achievements purported to show a successful integrated ironworks, claims which the author demonstrates to have been false. The works failed, and Bedford withdrew from the business in 1791, shortly before his death. There were a series of successors, to the middle of the 19th century, but all found the local ores sparse and of a quality poorer than those from deposits further north. That each phase of management lasted as long as it did appears to lie in the other resources of the Cefn Cribwr lands, notably the clays used at the brickworks which outlasted the ironworks.

The author examines and comments on each of the

operators of the ironworks, and he is successful in conveying the aura of unreality which surrounds Bedford's affairs. Somehow he was able to attract finance on the basis of his claims, although the more hard-headed, notably the Board of Ordnance, were not taken in. Indeed it is hard to see how Bedford survived as long as he did, and it would be of interest to know what income he derived from the other resources of his estate.

A good deal survives of the structures built by Bedford, and particularly of the changes made by his successors. The consolidation of the buildings by Ogwr District Council provided the occasion for research in the Bedford papers in the National Library of Wales, which have provided much of the material for this book. The standard of production is excellent and the author has done well to grasp the problem of publication which a book of this size and content is apt to pose. In fact, the significance of Bedford's enterprise, on the periphery of the main developments in iron production, is more than local, and adds balance to the historiography of the industry.

David Crossley