

CHAPTER 1

INTRODUCTION

The aim of this thesis is to trace the development of the copper industry during the years between 1760 and 1820. It considers the importance of the two component industries, mining and the smelting, and their interrelationships. In so doing it will reflect upon the impact on the mining industry of the sources of copper ore, the regionalisation of the smelting industry, and changing technology. Whilst the treatment will be to a large extent chronological, the following questions will be specifically addressed:

- What output was achieved from the Cornish mines in terms of quantity and value? What profits were made in the industry by the mining companies, the mineral lords, the merchants, and the adventurers? What was the relationship with the production of tin in the county?
- Was the introduction of the Boulton and Watt improved steam engine advantageous or otherwise in the Cornish mining industry? How were the development and manufacturing costs incurred by Boulton and Watt recovered?
- Why was Anglesey so influential? How did Williams achieve his domination? What level of output was achieved from the two Anglesey mines?
- Why was the Cornish Metal Company (CMCo) founded? How was it constituted? Was it effective in countering the threat from Anglesey? How was it rescued from total failure? What were the causes of its failure?
- How did the mechanism of eighteenth century ore sales, the ticketings, differ from other sales methods? What was meant by the much used terms, 'standard'

- and 'returning charge'? How did the 'standard' differ from the price of copper?
- What tendency, if any, was there towards collusion amongst the owners of the South Wales smelters in the eighteenth century prior to the emergence of the Anglesey mines, and the CMCo in to the market, also following the formation of the Birmingham copper companies, and finally as a result of the establishment of John Vivian and Sons and other new smelting companies in the early nineteenth century?

The thesis comprises six chapters. Chapter 1 sets out the aims, outlines the content of the individual chapters, reviews the literature and provides an overview of the industry.

In Chapter 2 the fundamentals of the geology, geography, mineralogy and metallurgy applicable to the copper industry are briefly examined, thereby identifying the reasons for the locational distribution of the two sectors of the industry, mining and smelting. The chapter concludes with a superficial description of the technology applicable to the extraction of ore from the ground, and its conversion to copper.

Chapter 3 examines the copper mining industry, with the emphasis placed on its development in Cornwall. Following a brief introduction the organisation, management and labour of a typical mining company is discussed, in which the various classes of investors, (the 'adventurers'), managers, ('purser' and 'captains'), and labourers ('tributers', 'tut-workers' and 'dressers') are identified, and their functions described. The chapter continues with an examination of the role of Boulton and Watt in Cornwall, and the influence of Watt's improved steam pumping engines. Particular emphasis is placed on the unique payment methods formulated by Watt for the supply of these new engines. The chapter concludes with a discussion on the productivity and profitability of the industry. Mineral statistics for the period 1760 to 1820 are presented. Overall profitability as well as that of individual mines is examined, as is the return on investment received by the adventurers, and the profits gained by the mineral lords. The role of the adventurers who

were also merchants supplying that mine is similarly examined. The chapter concludes with a discussion of the emergence of the Anglesey mines, and the rapid rise to a position of dominance in the copper industry of the mines' manager, Thomas Williams.

Chapter 4 treats in a similar fashion the emergence of a separate smelting industry. Following an initial examination of the essential fundamentals for efficient copper smelting, the industry's regional developments are examined. It is shown that in most cases these fundamentals were not available in the majority of the regions, resulting in the centralisation of smelting resources in the valleys of South Wales. The chapter concludes with a discussion of the evolution of the industry in South Wales, stressing the fact that only in that region were the primary requirements of smelting best satisfied.

Chapter 5 examines the market for copper ore. Following an initial assessment of the consumption of copper by manufacturers and exporters, the chapter continues with an analysis of the mechanism for the sale of ore. Particular emphasis is placed on the definition of the terms 'standard' and 'returning charge'. A major characteristic of the marketing of ore was the collusion amongst the Welsh smelting companies, frequently alluded to, but rarely explored. This thesis attempts to rectify this shortcoming. To this is added an examination of the impact on the industry of the monopoly of the copper trade exercised by Thomas Williams, the cartel of the Cornish mine owners following the formation of the CMC_o, and the monopolistic activities of Boulton and Watt, elements which interact as attempts were made to control the market in ore. The chapter concludes with an examination of the impact on the smelting industry which resulted from the formation of the Birmingham copper companies, and the rise of a new generation of South Wales operators following the decline in the influence of Thomas Williams.

Chapter 6 contains the concluding remarks. It provides a summary of the subject

matter raised in the preceding chapters, particularly as it relates to the questions raised in Chapter 1.

PRIMARY SOURCES AND SECONDARY LITERATURE

The copper industry in the nineteenth century has been examined in depth in the theses of Toomey and Newell.¹ Toomey concentrated on the activities of one firm, John Vivian and Sons, founded in the early nineteenth century, and located in the Swansea Valley. The value of his thesis was the evidence which it contained of the shift away from mining and towards smelting taken by a number of Cornish mine owners. Newell's thesis took a much broader approach, analysing both the productivity of the copper industry in Britain and internationally in the nineteenth century. His analysis of the copper ticketings formed the basis for a similar analysis of ticketing data in the eighteenth century.

There are no comparable works which deal in depth with the copper industry in the long eighteenth century. The only publication to come close to this goal was Harris,² notwithstanding the emphasis on Thomas Williams, it being a biography of the Anglesey entrepreneur. Harris provides a graphic picture of Williams' role in dominating the copper industry, and establishing a business empire which rivalled any other enterprise of the period in its scope and wealth. As such it provided the source for much of the content in this thesis on the industry in Anglesey, its associated companies, and the dominance of Williams in the second half of the eighteenth century.

The most comprehensive contemporary statistical source available is the appendices to the 1799 report of the Parliamentary enquiry into the industry.³ Although reference to this report has been made by a number of historians,⁴ it has, without exception, been on a largely qualitative basis. Whilst of limited duration, concentrating on the fourth quarter of the eighteenth century, it does provide a detailed insight into the economics of the

industry. The opportunity has therefore been taken to examine a selection of this data, much of which provides evidence allowing conclusions to be drawn which run counter to many drawn on the statistics of the industry in the nineteenth century. The major deficiency of the report is the absence of information respecting the smelting industry.

Even though the majority of the report's appendices deal with the output of copper ore, the data is limited to a narrow time period, and contains little relating to the production of copper. Here primary sources are of great help, although there is no complete run of annual figures, and gaps in the series remain. The earliest data set for the output from the Cornish mines is to be found in Pryce,⁵ with figures for ore production from the first year of public sales in 1726 up to 1777. William Pryce was a mine doctor which gave him excellent access to the Cornish industry and his *Mineralogia Cornubiensis* remains the foremost contemporary source for the industry in Cornwall, and invaluable in the development of this thesis. The next data set of any importance was that of Sir Charles Lemon, read before the Statistical Society of London on 19 March, 1838.⁶ This encompassed the years 1771 to 1837, and included, in addition to the quantity of ore raised, the copper content, its value and the price per ton of the copper it contained. These two formed the basis for all subsequent data.⁷ Output from the Anglesey mines presented a much bigger problem. Williams guarded closely his business activities, ore was not put on public sale, but smelted from within his own resources. The output for a small number of years was found in a number of sources.⁸ Where no data was available resort was made to interpolation.

Whilst the technology in working the mines, opening new levels, extracting and dressing the ore changed little in the eighteenth century, major changes were introduced in the drainage of the mines allowing exploration at ever greater depths. Pryce figures amongst the earliest sources which describe the introduction of the steam engine, but was

quickly followed by an ever increasing volume of technical literature.⁹ The records of Boulton and Watt made a significant contribution to the literature of both the steam engine and the industry in Cornwall, much that is relevant to this thesis being reproduced over the years.¹⁰

The history of the mining industry in Cornwall has attracted the fullest attention. In addition to the work of Pryce, contemporary studies included Borlase and Thomas. The emphasis in the former's work was on natural history, whilst the latter provided a comprehensive survey of the mines of the central district.¹¹ Most useful of the general histories of the industry was that of Rowe.¹² Hamilton Jenkin's works¹³ made a material contribution to the industrial and social history of the mining industry in Cornwall, as was the collection of letters written by an ancestor and edited by him.¹⁴ Barton's slim volume¹⁵ on the history of the copper industry in Cornwall and Devon remains the only work dedicated solely to the industry, but was superficial, concentrating on the nineteenth century.

The history of the Anglesey mines has received detailed study from both an economic and an industrial perspective. Harris remains the pre-eminent source, but invaluable statistics were to be found for the nineteenth century in Hunt. Other useful studies of the Anglesey industry were those of Cockshutt, Hope and Rowlands,¹⁶ all of which supplemented that contained in Harris.

Without Joan Day's studies of the copper and brass industries in Bristol little would be known of that city's contribution.¹⁷ Her coverage is comprehensive from the beginning of the eighteenth century through to the late nineteenth. Following the move of the smelting industry to South Wales, literature relating to the industry's history becomes more extensive. The earliest work was that of Grant–Francis, an excellent qualitative

introductory text commencing with the introduction of smelting at Neath in the reign of Elizabeth I.¹⁸ No further work appears until 2000, in which year Rees published a study of the industry.¹⁹ In common with many works concerning the copper industry, Rees deals mainly with developments in the latter stages of the industry, particularly the nineteenth century. Prior to this detail is sparse. This was followed in the same year by Hughes' study of the Swansea Valley, a comprehensive industrial and archaeological history.²⁰ It proved extremely useful in arriving at a chronology of the smelting industry in South Wales, in particular the origin of the individual smelting companies. Both Percy and Hunt provided invaluable information regarding the metallurgy and technology involved in the smelting of copper.²¹ An invaluable primary source was the Vivian Archive in the National Library of Wales.²² This furnished invaluable documentary evidence of the industry's development in Cornwall and South Wales.

With regard to consumption, much can be gleaned from the previously cited references. Smiles was a source for the material relating to Boulton's activities respecting the coinage. The papers of Sir Joseph Banks in the State Library of New South Wales were extremely pertinent to coinage, and the economics of copper in general.²³ Much of the data respecting sheathing was drawn from three principal sources. Details of the ships of the Royal Navy were extracted from W M James,²⁴ whilst the application of copper in the mercantile fleet was derived from the articles of Harris and Rees.²⁵ Quantitative data in respect of consumption in the manufacturing trades is sparse. This must be due in part to commercial confidentiality, but more likely, particularly in regard to the Birmingham trade by the consumption of copper by a large number of small enterprises.²⁶ Data relating to exports was drawn from the 1799 Report.

OVERVIEW

The mining of copper ore in Cornwall originated as an extension of tin mining,

following the discovery of extensive deposits of copper rich minerals, as the mines developed in depth. These deposits, closely associated with the granite structure of the county, became the premier source of copper in Britain throughout the eighteenth and nineteenth centuries. On only one occasion was the position of the Cornish mine owners challenged, when in the third quarter of the eighteenth century considerable quantities of low grade ore were discovered on the island of Anglesey,. This was successfully exploited by the local entrepreneur, Thomas Williams. His success was such that not only did he develop a consortium of companies encompassing all aspects of the industry, but ultimately assumed responsibility for the marketing of copper produced from Cornish ore. For the best part of four years he controlled the British copper industry. In this he supplanted the earlier collusive association of the South Wales copper smelting companies.

Copper smelting became concentrated in South Wales during the second quarter of the eighteenth century, following a shift from Bristol and the Forest of Dean. Attempts to smelt the ore in the vicinity of the Cornish mines met with little success, only one company surviving into the nineteenth century. The South Wales companies expanded to become the dominant force in the industry, suppressing any competition, until the emergence of the Anglesey mines. To counter the established South Wales companies, Williams commenced smelting on Anglesey, in Lancashire, and later in South Wales. In 1785 the CMCo was formed. This company, floated to complement the Anglesey trade in copper, bought the ore produced in the Cornish mines, arranged for its smelting by a co-operating group of smelter owners, and thereafter marketed the copper. It co-operated closely with Williams, allowing him to defeat the activities of the associated Welsh companies and ultimately achieve his monopoly. The CMCo ceased trading in 1792, but Williams remained influential up to 1800, the same year that James Watt's patent respecting the improvements made by him in steam engine technology terminated.

Initially Watt's patent was of considerable benefit to the Cornish mine owners. As a result of the greatly improved thermal efficiency of the Watt pumping engine, the mine owners could develop their mines to the ever increasing depths essential to increase output. Initially welcomed, relations turned sour between the mine owners and the manufacturers of the engines, Boulton and Watt. This resulted from the means established for the payment of these engines, coupled with the suppression of any opposition to Watt's patent.

Demand for copper rose sharply in the closing quarter of the eighteenth century and early nineteenth century. The accompanying price rise caused an outcry amongst the Birmingham manufacturers, this despite the fact they had formed their own copper smelting companies during the 1790s, as a counter to Williams' empire. But petition to Parliament and subsequent inquiry did little to bring relief to the manufacturers. Causes were complex, large exports, new markets generated by Williams, rising consumption in copper sheathing by both the Royal and merchant navies, and the production of a new copper coinage. The increase in demand for copper was not helped by declining output from the Anglesey mines, which could not be quickly replaced by increased output from Cornwall. This situation prevailed until 1815, when following the cessation of hostilities, demand and with it price, fell sharply. By the beginning of the nineteenth century the South Wales smelter companies had reasserted themselves, once again colluding to control both the supply of ore and the price of copper. At the same time Cornish mining underwent a significant revival to become the primary source of copper ore in the country and the world for the best part of the next 60 years.

The structural differences between the the Cornish mining and South Wales smelting industries could not have been more marked. In Cornwall the vast majority of

the numerous mining companies were small organisations, with very limited capitalisation. The speculative nature of mining tended to make for a short life. Given a return to more optimistic trading conditions new companies were quick to take up old leases and resume operations. The South Wales companies could not have been more different. Highly capitalised, they relied on a continuous supply of ore to feed their multiple arrays of furnaces. Both these factors required a high initial investment, and assured sales. This resulted in the smelter companies being generally economically stable and long lived, and few in number. With limited markets, protectionism was high, and new entrants were not encouraged. With the concentration in South Wales it was not difficult to manipulate the market for copper ore and metal. It is against this background that this thesis examines the copper industry for the years 1760 to 1820.

NOTES

- ¹ Toomey, R R. *Vivian and Sons, 1808 – 1924*. ((Thesis submitted to the University of Wales for the degree of Doctor of Philosophy, August 1979. Subsequently published by Garland Publishing, New York, USA; 1985). Newell, E. 'The British Copper Ore Market in the Nineteenth Century, with particular reference to Cornwall and Swansea', (PhD thesis, Nuffield College, Oxford; 1988).
- ² Harris, J R, *The Copper King*, (University Press, Liverpool; 1964).
- ³ Lord Hawkesbury, 'Report from the Committee appointed to Enquire into the State of the Copper Mines and Copper Trade of this Kingdom, *House of Commons Committee Reports X*, 7 May 1799, 651 – 728. Hereinafter referred to as the 1799 Report.
- ⁴ Hamilton, H. *The English Brass and Copper Industries to 1800*, (First published 1926, 2nd ed., Frank Cass, London; 1967). Levy, H. *Monopoly and Competition*, (MacMillan and Co, London; 1911).
- ⁵ Pryce, W, *Mineralogia Cornubiensis*, London, (1778)
- ⁶ Lemon's paper is included in the essays in Burt, R, *Cornish Mining*, (Augustus M, Kelley, New York; 1969)
- ⁷ Example of which are Hunt, R. *British Mining*, (Crosby, Lockwood and Co, London; 1887). Mitchell, B R, *Abstract of British Historical Statistics*, (CUP; 1962), and Schmitz C J, *World Non-ferrous Metal Production and Prices 1700 – 1976*, (Frank Cass & Co, London; 1979).
- ⁸ Harris, J R. (1964). Hunt, R. (1887). Rowlands, J. *Copper Mountain*, (Anglesey Antiquarian Society, Llangefni; 1966). Sir Joseph Bank's Papers, Section 16, Series 84, National Library, New South Wales, Australia. <www.slsw.gov.au/Banks/index.html> (31 August 2002).
- ⁹ Farey, J. *A Treatise on the Steam Engine*, (London; 1827, reprinted by David and Charles; 1971), Pole, W. *A Treatise on the Cornish Pumping Engine*, (John Weale, London, 1844), being but two examples. A more modern treatment can be found in Tunzelmann, G N. von, *Steam Power and British Industrialisation to 1860*, (Clarendon Press, Oxford; 1978)
- ¹⁰ Fox, H. 'Boulton and Watt', *The Seventy-seventh Annual Report of the Royal Cornwall Polytechnic Society*, New Series, 1, 2, (1910), 311 – 328. Fox, H. 'Boulton and Watt', *The Seventy-eighth Annual Report of the Royal Cornwall Polytechnic Society*, New Series, 1, 3, (1911), 524 – 539. Smiles, S. *Lives of the Engineers, Boulton and Watt*, (Murray, London; 1874). Tann, J. *The Selected Papers of Boulton & Watt*, vol 1, (MIT Press, Cambridge, Massachusetts; 1981).
- ¹¹ Borlase, W. *The Natural History of Cornwall*, (Oxford; 1758, reproduced in facsimile by E & W Books, London; 1970. Thomas, R. *Report on a Survey of the Mining District of Cornwall from Chasewater to Camborne*, (London; 1819).
- ¹² Rowe, J. *Cornwall in the Age of the Industrial Revolution*, (University Press, Liverpool; 1953).
- ¹³ Jenkin, A K H. *The Cornish Miner*, (George Allen & Unwin Ltd, London; 1927). Jenkin, A K H. *Mines and Miners of Cornwall*, 16 vols, (Various publishers; 1961 – 70).
- ¹⁴ Jenkin, A K H. *News from Cornwall*, (Westaway, London; 1951).
- ¹⁵ Barton, D B. *The History of Copper Mining in Cornwall and Devon*, (The Bookshop, Truro; 1961).
- ¹⁶ Cockshutt, E. 'The Parys and Mona Copper Mines in the Island of Anglesey', *Archaeologia Cambrensis*, 114, (1965), 87 – 111. Hope, B D. *A Curious Place, The Industrial History of Amlwch (1550 – 1950)*. Moelfre Anglesey; 1994). Rowlands, J. (1966).
- ¹⁷ Day, J. *Bristol Brass: The History of the Industry*, (David and Charles, Newton Abbott; 1973). Day, J. 'The Costers: Copper Smelters and Manufacturers', *Transactions of the Newcomen Society*, 47, (1974/76), 47 – 58.
- ¹⁸ Grant-Francis, G. *The Smelting of Copper in the Swansea District*, 2 ed, (Henry Sothorn & C, London; 1881).
- ¹⁹ Rees, R. *King Copper, South Wales and the Copper Trade, 1584 – 1895*. (University of Wales Press, Cardiff; 2000).

²⁰ Hughes, S. *Copperopolis, Landscapes of an Early Industrial Period in Swansea*, (RCAHMW, Cardiff; 2000).

²¹ Percy, J. *Metallurgy – Fuel; Fire-clays; Copper, Zinc; Brass, etc.*, (John Murray, London; 1861).

Hunt, R. (ed), *Ure's Dictionary of Arts, Manufactures, and Mines*, (Longmans, Green & Co; 1867).

²² The Vivian Papers, Parts 1 to 3, 1982, National Library of Wales, <www.llgc.org.uk:81/ISYSquery/IRL8ED0.tmp/79/doc> (31 August 2002).

²³ Sir Joseph Bank's Papers, Section 16, Series 84.

²⁴ James, W M. *The Naval History of Great Britain*, 6 volumes, (Richard Bentley, London; 1837. Reprinted by Conway Maritime Press, London; 2002).

²⁵ Harris, J R. 'Copper and Shipping in the Eighteenth Century', *Economic History Review*, 19, (1996), 550 – 568. Rees, G. 'Copper Sheathing – An Example of Technological Diffusion in the English Merchant Fleet', *Journal of Transport History*, 2nd series, 1, 2, (1971), 85 – 94.

²⁶ Berg, M. *The Age of Manufacturers 1700 – 1820*, (Fontana Press, London; 1985). Hutton, W. *An History of Birmingham*, (First published 1783, Reprinted by EP Publishing Ltd, Wakefield; 1976).