Preface

This thesis presents some of the conclusions of a much larger research programme into the history of the iron industry in England and Wales. Throughout most of the period with which it is concerned, England and Wales were politically and economically united, and need to be treated as whole. Accordingly references in this thesis to England and the adjective (English) often include Wales.[1] Preparation of this thesis has occupied most of my time for over six years. However this time was preceded by about eight years of research with a view to producing a book (or books) on the iron industry, and also by another decade and more of intermittent research (as a hobby). In that research, I have sought to compile a brief history of every blast furnace, forge, steel furnace, slitting mill, and tinplate works, and of certain other kinds of iron mill operating in the 16th to 18th centuries, and to determine as far as possible its ownership, size and trading relationships. I intend to publish the results of those eight years research in a series of books probably entitled *Iron in the North*, *Iron in the Midlands*, and *Iron in the West*. The first of these exists as a reasonably complete typescript comprising several introductory chapters on different aspects of the industry, followed by a series of regional chapters, each describing the industry in that region, with gazetteer of the ironworks in it. The regional chapters (with gazetteers) for the other two volumes exist as drafts, but still need revision in the light of further research. The latest texts of these are on the accompanying CD-ROM. This body of work forms the background to this thesis.

In this thesis I have avoided citing to the two incomplete volumes, but occasional citation of *Iron in the North* has been necessary. Furthermore, in referring to certain works (such as boring mills for musket barrels) for which there is no adequate published account, I have had to cite the principal (rather than all) sources for each works. On other occasions, I have cited a published description of a particular works, even though I actually know rather more about that works than its author. This is because I have almost invariably been back to the original sources and made my own assessment of them, sometimes finding additional details that were not noted by a previous author or whose significance he failed to appreciate. The only exception to this is where the originals are not currently available, for example in the case of the documents of the Duke of Rutland and Lord Forester. Further details of this research and the methods employed appear in Appendix 1.

Acknowledgements

A particularly important source has been records of the sale and purchase of pig iron and certain other commodities. The two most important sources for this are the accounts of the Foley and Knight families, who were ironmasters in the Midlands. For permission to investigate the former (and also other documents in his

[1]. In these days of devolution this no doubt seems offensive to the Welsh, but the Welsh border had little legal or economic significance after 1536, and this usage accords for example with that of Parliamentary draftsmen, as reflected in the Interpretation Acts.

family archive), I am most grateful to A.T. Foley esq. of Stoke Edith. This is certainly one of the most important archives in Britain concerning the iron industry. I must also thank the Duke of Devonshire and the Trustees of the Chatsworth Settlement and Lord Lumley for permission to examine archives in the estate offices at Chatsworth and Sandbeck; St. Johns College, Cambridge for access to certain College deeds; Christchurch College, Oxford for access to the Evelyn documents; His Grace the late Duke of Norfolk E.M., C.B., C.B.E., M.C., the Earl of Wharncliffe, S.W. Fraser esq., His Grace the Duke of Beaufort, and Earl Baldwin of Bewdley for permission to refer to their family archives, respectively Arundel Castle Manuscripts, Wharncliffe Muniments, and Spencer-Stanhope manuscripts in Sheffield Archives and Bradford Archives, the Badminton Documents in the National Library of Wales, and the Baldwin Deposit in Worcestershire Record Office; and the family of the late Janet Butler for access to her notes. I have at various times had advice from a considerable number of people, whom I have met or corresponded with at various times in the course of my research. Among these, I must make particular mention of Brian Awty, Eric Alexander, John Barney, Mrs G. Bedingfield, David Cranstone, Peter Crew, Karin Dannehl, Chris Evans, Mrs H. Eaton, Neville Flavell, Jeremy Greenwood, the late John Harris, Jeremy Hodgkinson, Peter Hutchinson, Stafford Linsley, Jeff Morris, Philip Riden, Barrie Trinder, and Howard Ussher. I name them in alphabetic order, not that of merit, as their respective contributions have differed greatly. In some cases, this has consisted of drawing my attention to particular archives. In others, they have helped me understand the implications of documents, for example by drawing on their particular knowledge of technology or local history. In several cases the assistance has been mutual. Nevertheless, this thesis is my own work, and I remain solely responsible for any errors in it.

I have also greatly appreciated help I have received from archivists and librarians in many institutions, who have pointed me to archives, answered some quite challenging questions about them and their creators, and otherwise helped me in my research. These include university librarians and archivists in Oxford, Cambridge, Durham, Birmingham, Wolverhampton, Manchester, Nottingham and Hull Universities; archivists at the County Record Offices for almost every county in England and Wales, especially those for Carmarthenshire, West Glamorgan, Glamorgan, Gwent, Somerset, Wiltshire, Gloucestershire, Warwickshire, Worcestershire, Herefordshire, Shropshire, Staffordshire, Cheshire, Lancashire, Northumberland, Tyne & Wear, Durham, North Yorkshire, East Yorkshire, Lincolnshire, Nottinghamshire, Derbyshire, Leicestershire, Northamptonshire, Cambridgeshire, Norfolk, Suffolk, Hertfordshire, Berkshire, Hampshire, Surrey, West Sussex, East Sussex, and Kent; archivists at Record Offices or archive departments in Bristol, Dudley, Birmingham, Lichfield, Ruthin, Hawarden, Carlisle, Whitehaven, Barrow in Furness, Kendal, Hull, Bradford, Leeds, Wakefield, Sheffield; and archivists and librarians at the Public Record Office, House of Lords Record Office, Corporation of London Record Office, Guildhall Library, British Library, Science Museum Library, Ironbridge Gorge Museum, National Library of Wales, National Library of Scotland, Scottish Record Office, Borthwick Institute at York, National Maritime Museum at Greenwich; and Local Studies Libraries in Southwark, Greenwich, Gateshead, Wakefield, Barnsley, Rotherham, Derby, Walsall, Sandwell, and Cardiff; and those at several other institutions, which I have forgotten to mention or have only

visited briefly and with less productive results. My friend Carl Wright has very kindly drawn the plan for chapter 7, as my draftsmanship is not good enough. Last, but by no means least, I must thank Professor Malcolm Wanklyn, my director of studies at Wolverhampton University, who has been my guide and critic in the course of the six years that I have spent in researching and writing this thesis, and also David Goda for checking the methodological validity of my statistical work.

Methodology

I also owe thanks to the developers of modern computer technology, without which the calculations undertaken in the latter part of this thesis would hardly have been possible. The software used in each case has been the spreadsheet program Excel (1997 version), produced by Microsoft Corporation. In several cases, the scale of the calculations has necessitated programming in Visual Basic, rather than the use of its built-in calculation facility. Chapter 5 of this thesis presents a large scale accounting exercise concerning Coalbrookdale and the early data-processing stages of this are driven by macros which copy and paste information and then summarise it. The computations for chapter 6 (estimating English iron production) have involved essentially the same calculation with differing input data almost 90,000 times for forges and even more times for furnaces, again using macros. Both this and chapter 7 (on overseas trade) depend ultimately on interpolation. This is (with occasional exceptions) merely the simplest linear interpolation. Further detail of this is given in appendix 8.

Since the rounding off of estimated figures is liable to exaggerate errors, estimated data has not usually been rounded in statistical tables and appendices. To that extent, the convention has not been followed that measured or estimated figures should only be shown with a number of digits that reflects their reliability. Thus estimates given in tables and appendices may spuriously appear to have an accuracy that they do not possess. However, estimates quoted in the text have usually been rounded in the conventional way. Growth rates quoted in the text are exponential rates, calculated with an Excel function, 'logest'. 'Long term growth rates' have often been measured over 21 years. For example, the long term growth rate for a statistical series at 1744 is calculated from the computed estimates for the period 1734 to 1754. Similar shorter term rates are generally measured in like manner over five or seven years. All charts and most tables have also been prepared using Excel. The data has been smoothed in some charts, particularly in relation to 18th century trade statistics, using a running average measured over several years.

Weights and Measures

The units of money, weight, distance and capacity are those in use at the time discussed. Due to the effects of inflation, it is almost pointless to try to convert 16th, 17th, and 18th century currency into modern money. Indeed the relative values of different commodities have changed so much that any attempt to do so is as likely to confuse as to clarify the position. Weight was measured in tons and hundredweight (*cwt.*). The British ton and metric tonne are similar in size (but not quite equal). However there was more than one kind of ton in use in the iron industry, and it is not always clear in accounts which is meant. A ton normally meant a short ton of 2240 pounds (*lb.*) (with a hundredweight of 112 *lb.* and a quarter of 28 *lb.*). However, for some purposes a ton

meant a long ton of 2400 *lb.* (with 120 *lb.* to the *cwt.* and 30 *lb.* to the quarter).[2] For certain commodities, tons were of other sizes: for example, a ton of pig iron was often 20.25 *cwt.* to allow for sand adhering to the pigs, and a ton of blooms made by finers was 22 *cwt.*, because this ought to produce a ton of bar iron. This is inevitably confusing, and little attempt has been made to distinguish one kind of ton from the other. It has been assumed in making calculations of consumption per head in chapters 6 and 7 that a ton consisted of 2240 *lb.* If this is incorrect, the absolute figures calculated will be a little too low, but the overall trend of growth will remain correct. Nevertheless sales of iron to consumers were almost certainly short tons. Russian weights were in poods of about 36 *lb.* Swedish weights were measured in shippounds (*Slb.*) of about 300 *lb.* Accordingly, 7.5 *Slb.* staple-weight (*stapelstadtvikt*) were approximately equal to one ton shortweight. It is fortunately not necessary to refer to the subdivisions of these foreign weights nor (usually) to the other Swedish systems of weights.

Cordwood for making charcoal was measured in cords. A standard cord consisted of sticks four foot long piled in a stack eight foot long and four foot high making 128 cubic feet or about 98 cubic metres. However cords of other sizes are also known. Charcoal was measured in loads or dozens (which were identical). A (wain) load consisted of 12 sacks each holding one quarter or 8 strikes (or bushels). A bushel is 8 gallons or 36.25 litres. Iron ore (also called 'mine') was also usually measured in loads or dozens (also called blooms), but in this case the load was 12 bushels (or strikes), but in some places a greater (or lesser) number of bushels were allowed for each load presumably due to the poorer (or better) quality of the ore. These measures of capacity were convenient means of measuring large quantities of material. However the weight of a load of ore or a load of charcoal would vary somewhat according to how densely packed the material was, that is according to how much air was left in the interstices between the granules of charcoal or ore. Thus the shaking together of charcoal in the course of being transported resulted in sacks that were full on departure appearing less than completely full on arrival. Several of these measures will be discussed in more detail later in this thesis. English money was a bullion-based coinage, based on a pound (£) of 20 shillings (*s.*), each of 12 pence (*d.*). The smallest coin was a farthing (¼*d.*). The guinea was a gold coin, whose value had settled by the 18th century at 21*s.* Where financial calculations have been undertaken, currency (and other quantities) have often been decimalised and the results expressed as decimals, rather than being converted back to £.*s.d.* and so on. Finally, whole centuries (and parts of them) are referred to as such; periods described in the style '1600s' refer only to decades.

£1 = 20 shillings (*s.*) =240 pence (*d.*)

1 bushel = 36.25 litres.

1 mile= 1.86 km

1 yard = 3 feet = 36 inches = 0.919 metres.

1 ton = 20 *cwt.* = 80 quarters = 2240 *lb.* = 1015.9 kg.

Long weight: 1 ton = 20 *cwt.* = 2400 *lb.* = 1088.4 kg.

1 Swedish *Slb.* staple-weight = 300*lb.* = 136 kg.

1 Russian pood = 36 *lb.* = 16.34 kilograms.

---

[2]. I have not come across the American short ton of 2000 *lb.* in contemporary material.