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Davies, Thomas Eric

The Ironmasters, Ironworks and People of the North West Monmouthshire Area, 1780 to 1850.

Thomas Eric Davies
B.Sc. M.A. A.I.A. C.Stat. MBCS. C.ITP.

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Summary.

This thesis describes how the industrial revolution arrived in the North West Monmouthshire area in the form of a coke based iron industry in the late eighteenth century and how this iron industry grew in the first half of the nineteenth century such that the district became one of the major iron producing areas of Britain. Over this period there was a transformation of the area from thinly populated farmlands into an industrial area consisting of a number of ironworks and associated coal and iron ore mines with towns emerging around the iron manufacturing centres.

The catalysts for the developments described above were a group of industrialists who came to the area mostly with experience of the iron industry elsewhere. The thesis describes how these industrialists and their successors dealt with an array of difficulties over the period. These difficulties included poor communications, shortages in capital at times and fluctuations in demand for iron products. The ironmasters also had to attract and retain their workforces. The thesis explains how the ironmasters dealt with changes in technology and how they improved productivity such that iron output increased considerably over the period. It will be shown that the consequence of the development of a vibrant iron industry in the area was that the population of these iron districts grew at a truly dramatic rate.

Two points should be mentioned on the approach taken to the thesis. Firstly an attempt has been made to see the events that occurred in the context of the time and locality hence there has been considerable concentration on nineteenth century writers and especially on local newspapers. Secondly much information is presented in tabular form in keeping with the background of the author.

Declarations and Statements.

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

The thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by footnotes giving explicit references and a bibliography is appended.

I give my consent for my thesis, if accepted, to be available for photocopying and for inter-library loan, and for the title and summary to be made available to outside organisations.

Word Count. 58,761

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Abbreviations.

GRO	Gwent Record Office, Cwmbran.
NLW	National Library of Wales, Aberystwyth.

Chapter 1. Introduction.

1.1 The British Industrial Revolution.

As Pat Hudson reports in *The Industrial Revolution*, current interpretations of the industrial revolution in this country usually are of the view that 'less happened, less dramatically than was once thought'.[1] The rates of economic growth in the classic period of the industrial revolution, 1760-1830, have recently been reduced by historians[2] and, as Hudson adds, 'Perhaps it is more important in defining the industrial revolution to stress the sustained nature of the economic growth which the period initiated rather than the speed'.[3] The point is further amplified by Joel Mokyr who believes that the classic period of the industrial revolution should be regarded as one of incubation rather than one of rapid growth 'in which the groundwork to future growth was being laid'.[4] Throughout the eighteenth century and especially from about the middle of the century changes were taking place in many aspects of society, industrial, commercial, and social. In addition to major changes within established industries such as the cotton and iron production industries new industries of all sorts were appearing on the scene. These new industries ranged from the production of day-to-day items to new types of industries such as fashion and life assurance. Hence the industrial revolution is now seen as much more fundamental than just growth rates, technological advances and the factory system.

Despite this wider view of the industrial revolution it cannot be denied that the industrial revolution period saw a dramatic growth in major or staple industries such as iron and cotton manufacture with the iron industry in the country experiencing

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[1] Pat Hudson, *The Industrial Revolution*, London, 1992, p 1.
[2] Joel Mokyr, 'Accounting for the Industrial Revolution' in Roderick Floud and Paul Johnson, (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, p 1.
[3] Hudson, *The Industrial Revolution*, p 2.
[4] Mokyr, 'Accounting for the Industrial Revolution', p 14.

growth rates well in excess of the more modest general rates now assumed by historians.[5] In fact Joel Mokyr believes that the growing role of coal and iron was the key characteristic of the industrial revolution,[6] the vital technological breakthrough being Abraham Darby's discovery in about 1713 that coal in the form of coke could be used instead of charcoal to fuel blast furnaces for the production of pig iron.[7] Although coke was not used generally for this purpose until about 1750[8] the consequences for South Wales were quite dramatic as the South Wales coalfield was seen as an attractive proposition for entrepreneurs wishing to enter iron manufacturing, the area also having ample supplies of iron stone, limestone and water from the numerous rivers of the region, all ingredients essential for a vibrant iron producing industry. Consequently coke-fired blast furnaces were erected in South Wales after mid century with Merthyr being the main centre for the iron industry.

1.2 The Industrial Revolution and the North West Monmouthshire Area.

In the 1770s the North West Monmouthshire area was relatively deserted without even a small village, largely consisting of farms scattered around the hillsides. However by the 1830s and 1840s the area was well populated with an array of towns emerging around a vibrant iron industry that was responsible for approaching fifteen percent of the pig iron output of the whole country in 1830. The general aim of this thesis is to explain how this remarkable train of events came about.

The study is centred on an area to the east of Merthyr, where minerals were as abundant as in the Merthyr district and with the geography necessary for a coke fired iron industry to be developed. The area is a relatively small region of approximately ten miles west to east by about three to four miles north to south, stretching from

[5] Mokyr, 'Accounting for the Industrial Revolution', pp 1-4 and Table 3.1 of this work.
[6] Mokyr, 'Accounting for the Industrial Revolution', p 18.
[7] H. Scrivenor, *History of the Iron Trade*, London, 1854, p 56.
[8] H. Scrivenor, *History of the Iron Trade*, p 84.

Tredegar and Sirhowy in the west just a short distance from the Glamorgan border, to Clydach and Blaenavon to the east with Ebbw Vale, Beaufort and Nantyglo in between. The north part of the area is within the old boundary of Breconshire. The region, known to locals in the early nineteenth century as 'The hills', is located at the heads of the Sirhowy, the Ebbw Fawr, the Ebbw Fach, and the Afon Lwyd river valleys, includes much of the Clydach river valley and appears to have been ideal for the development of coke fired furnaces. Although only twenty miles from the nearest port, Newport, the area ranges from about 900 to nearly 1,500 feet above sea level and the nearest market town was Abergavenny which is to the east about ten miles from Ebbw Vale.

That the area under study was relatively deserted prior to 1780 can be seen from the detail of Thomas Kitchin's Map of Monmouthshire, dated 1748, Map 1.1. The only village anywhere near the study area is Blaenau Gwent, incorrectly named 'Llanyhangel' on Kitchin's map, situated below the site of the Nantyglo ironworks. The nearest substantial town, the market town of Abergavenny, can be seen in the upper centre of the map.

In this thesis it is argued that the industrial revolution in the North West Monmouthshire area as represented by the coke based iron and the associated mineral extractive industries based on and around the Sirhowy, Tredegar, Ebbw Vale, Beaufort, Nantyglo, Clydach and Blaenavon ironworks arrived late in the context of the British industrial revolution timescale and that the eventual emergence for such an iron industry in the area depended on the arrival of entrepreneurs from Merthyr and other areas of the country.

Map 1.1 Detail of Thomas Kitchin's map of Monmouthshire 1748

Once established these ironworks experienced substantial growth and it is further argued that these ironworks were remarkably successful as a group and that iron output in the region expanded dramatically through the first half of the nineteenth century. It will be maintained that the success of these ironworks and the growth experienced was due to the skill, nature and access to capital of the ironmasters and their approach to a range of factors, these factors being technological, economic, demographic and social.

Over the decades the ironmasters attracted huge numbers of unskilled workers to the area with the consequence that the population of the area grew at a truly exceptional rate for this period in history almost entirely because of the needs of the ironworks and the associated mineral industries. This rate of population growth was sustained over the period of the study and credit must be given to the ironmasters for attracting and accommodating such vast numbers of people. The masters built large

numbers of houses around their works usually in rows such that gradually an array of new towns evolved, the location of the ironworks often dictating the layouts of these towns.

1.3 The approach adopted to the thesis.

The role of the industrialists or ironmasters is the key issue in this dissertation and throughout attempts are made to understand the approaches adopted by the ironmasters to the great variety of issues that faced them establishing the ironworks, supervising the growth and, by and large, the success of the works through to the middle of the nineteenth century. As such a main aim of the study has been to try to understand the issues as they appeared at the time.

Once the ironworks were established the ironmasters sought to expand their businesses and to achieve this aim they had to face a variety of economic, technological, business and personnel matters. Attempts have been made to isolate the main issues in these categories and to analyse how the ironmasters dealt with such issues and, where possible, establish how successful they were. In order to try and understand how the ironmasters dealt with the issues identified it was found necessary to introduce a degree of technical detail in each case. For example to understand how the masters faced the wide fluctuations in demand for iron in the first half of the nineteenth century it was necessary to understand the underlying economic and political factors that affected demand. Similarly when discussing how the ironmasters dealt with technological changes it was necessary to look at the technological issues themselves in some detail including key issues such as iron ores. The attitude of the ironmasters often depended on their particular circumstances and to understand why they may have acted differently from ironmasters in other regions, a technical

knowledge of many of the aspects of ironmaking was found desirable, including identification of the differences across the country in mineral resources.

Although the study is centred on a relatively small area geographically attempts have been made to put the findings of the research into a wider context, locally, regionally or nationally. For example iron output growth rates and population growth rates are compared with national rates and those for selected regions. Many other similar attempts at putting the findings in context are made. In addition attempts have been made to see the progress of the industrial revolution in the area, as represented by the coke-fired iron industry, in the context of the British industrial revolution as a whole with the general conclusion that the industrial revolution in the North West Monmouthshire area occurred slightly later than in certain other districts. Again, where possible, themes that are of particular interest to current historians that appear relevant to the study are identified and commented upon and where findings differ from current historians' views these differences are discussed. The study area in this period in history is probably best known in the context of the Chartists' march on Newport or for the activities of the 'Scotch Cattle', groups of men who frightened certain local people and caused damage to property in times of industrial strife.[9] However in order to keep the work within the prescribed word count limit, work done on these issues had to be omitted and consequently industrial relations matters have been excluded from the thesis entirely.

1.4 The sources.

Original sources were essential to this project but because of the approach taken contemporary secondary sources were also vital. Unfortunately no comprehensive documents relevant to any of the ironworks exist for the whole period

[9] *Monmouthshire Merlin*, 14 June 1834, 18 September 1841, Scotch Cattle, (and many other reports).

to 1850 and very few documents survive at all for some of the works of the group. However some very useful documents have survived, the most comprehensive being for the Ebbw Vale Company in the early part of the period. For this ironworks there are four books extant, a memorandum book for 1796 to 1819, a letter book for 1824 to 1827 and company journals for the years 1791 to 1796 and 1814 to 1815. There are also many leases and other legal documents extant. It is possible to get an appreciation of how an ironworks was run on a day-to-day basis in the early part of the period under study from these Ebbw Vale documents. For the later part of the period there is the Blaenavon Minute Book from 1836 which gives an excellent view of the working of an early joint stock company within the iron industry. There are also some documents extant for other ironworks such as Clydach and Abersychan for selected years and there are the published works such as *The Dowlais Iron Company Letters 1782-1860*[10] and *The Letterbook of Richard Crawshay 1788-1797.*[11] The former of these works was particularly important as it covered the whole period concerned. There are other early documents held at the Gwent Record Office (GRO) the most voluminous being leases of land to ironmasters and by ironmasters to other parties. Also in existence are a few wills of ironmasters and many miscellaneous documents of some relevance, the most useful being the sale documents of various ironworks and the collection of documents on Samuel Baldwin Rogers at Newport library.

The other main original source documents used in this project were contemporary newspapers, principally the *Monmouthshire Merlin* which commenced publication in 1829 and the *Monmouthshire Beacon* which dates from October 1837. A thorough study of these newspapers was found to be extremely productive for most chapters as it contained a multitude of items of relevance to aspects of the study

[10] Madeleine Elsas (ed.), *Iron in the Making: Dowlais Iron Company Letters 1782-1860*, Glamorgan County Council, 1960.
[11] Chris Evans (Calendared by), *The Letterbook of Richard Crawshay 1788-1797*, Cardiff, 1990.

including items on the iron industry and trade, locally and for the country, items on ironmasters and particular ironworks, and much detail on the people of the 'Hills of Monmouthshire'.

Much use was also made of contemporary or near contemporary published secondary sources. Of a historical nature the most useful were John Lloyd's *The Early History of the Old South Wales Ironworks (1760-1840)* published in 1905,[12] William Coxe's *An Historical Tour in Monmouthshire* published in 1801,[13] H. Scrivenor's *History of The Iron Trade* published in 1854[14] and Samuel Smiles' *Industrial Biography: Iron Workers and Tool Makers*, published in 1884.[15]

For more technical information reference was made to contemporary works by established writers on metallurgy including John Percy's *Metallurgy: Iron and Steel* published in 1864,[16] William Truran's *The Iron Manufacture of Great Britain* published in 1855[17] and works by David Mushet.[18]

The area under study is not devoid of good local histories for some of the towns. For Tredegar there are Evan Powell's *History of Tredegar*, written in 1884 and published in 1902,[19] and Oliver Jones' *The Early Days of Sirhowy and Tredegar* written in 1969.[20] There is also an early unpublished history of Tredegar written by David Morris in 1862 titled 'The History of Tredegar From the Beginning of the Iron Works up to the present day'.[21] Ebbw Vale's historian, Arthur Gray-Jones wrote his

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[12] John Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, London, 1906.
[13] William Coxe, *An Historical Tour in Monmouthshire*, London, 1801.
[14] H. Scrivenor, *History of the Iron Trade*, London, 1854.
[15] Samuel Smiles, *Industrial Biography: Iron Workers and Tool Makers*, London, 1884.
[16] John Percy, *Metallurgy: Iron and Steel*, London, 1864.
[17] William Truran, *The Iron Manufacture of Great Britain*, London, 1855.
[18] David Mushet, *Papers on Iron and Steel, Practical and Experimental*, London, 1840; *Report on Victoria Iron Works and Mining Grounds*, Bath, 1841.
[19] Evan Powell, *History of Tredegar* (Subject of a competition at Tredegar Chair Eisteddfod, 25 February 1884), Newport, 1902.
[20] Oliver Jones, *The Early Days of Sirhowy and Tredegar*, Tredegar, 1969.
[21] David Morris, The History of Tredegar from the Beginning of the Iron Works up to the present day, (unpublished), Winning entry in the Eisteddfod of the Cymrodorion of Tredegar in 1862.

book, *A History of Ebbw Vale* in 1970[22] and the curators of the Ebbw Vale Steelworks Archive compiled and edited their excellent study of the iron and steel industry in the town titled *Ebbw Vale 'The Works' 1790-2002*.[23] Part 1 of this book 'Essays on the early industrialisation of the valley and urban area of Ebbw Vale' is based on an unpublished M.A. thesis by F. J. Ball, a local historian who produced other published and unpublished work on Ebbw Vale. There is also an unpublished history of Nantyglo and Blaina written by David James in about 1950[24] and to obtain an idea of the area prior to the advent of the coke fired iron industry there, and consequently the industrial revolution, reference can be made to Edmund Jones' *The History of Aberystruth*, published in 1779.[25]

For the demographic work required for chapter 6 extensive examinations were made of the enumerators' returns for the 1851 national census for selected zones within the study area. The 1841 census although used was found inappropriate for most purposes as places of birth were not supplied, only county of birth.

There are a number of excellent twentieth century secondary sources within the general subject area and these were used to obtain a general understanding of the iron industry in Britain and in South Wales in the industrial revolution period. Works such as those of Alan Birch,[26] Laurence Ince,[27] Michael Atkinson and Colin Baber,[28] A. H. John,[29] J. R. Harris,[30] J. B. Lowe,[31] Chris Evans,[32] John P. Addis[33] and Barrie

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[22] Arthur Gray-Jones, *A History of Ebbw Vale*, Risca, Monmouthshire, 1970.
[23] B. Caswell, J. Gaydon and M. Warrender (edited and compiled.), *Ebbw Vale 'The Works' 1790-2002*, Ebbw Vale, 2002.
[24] David James, History of Nantyglo and Blaina, Gwent County Library, Approximately 1950 (unpublished).
[25] Edmund Jones, *The History of Aberystruth*, 1779, Facsimile edition, J. E. Owen (ed.), 1988.
[26] Alan Birch, *The Economic History of the British Iron and Steel Industry 1784 to 1879*, London, 1967.
[27] Laurence Ince, *The South Wales Iron Industry 1750-1885*, Merton, 1993; *Neath Abbey and the Industrial Revolution*, Stroud, 2001.
[28] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History*, Cardiff, 1987.
[29] A. H. John, *The Industrial Development of South Wales 1750-1850*, Cardiff, 1950.

Trinder[34] amongst others, were excellent for this purpose and the outstanding work of Philip Riden and John. G. Owen, *British Blast Furnace Statistics 1790-1980*,[35] was essential for the study. Finally, attention was given to themes relevant to the study and concerning the industrial revolution period that interest current and recent historians.

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[30] J. R. Harris, *The British Iron Industry 1700-1850*, Basingstoke and London, 1988.
[31] J. B. Lowe, *Welsh Industrial Workers Housing 1775-1875*, Cardiff, 1977.
[32] Chris Evans, *'The Labyrinth of Flames' Work and social conflict in early industrial Merthyr*, Cardiff, 1993.
[33] John P. Addis, *The Crawshay Dynasty*, Cardiff, 1957.
[34] Barrie Trinder, *The Darbys of Coalbrookdale*, Chichester, 1974; *The Industrial Revolution in Shropshire*, Chichester, 2000.
[35] Philip Riden and John G. Owen, *British Blast Furnace Statistics 1790-1980*, Cardiff, 1995.

Chapter 2. The Start of the Industrial Revolution in the North West Monmouthshire Area c.1780-1810.

2.1 Introduction.

The early industrial revolution in Monmouthshire was based on the development of coke-fired ironworks and the associated mineral extractive industries. The sale coal industry did not truly come into its own until the latter half of the nineteenth century. A limited and somewhat scattered charcoal iron industry existed in the Monmouthshire area before and in the eighteenth century but as it will be shown this did not lead directly to coke based iron manufacture.

It will be argued in this chapter that these industries were developed later than might have been expected in view of the facts that domestic demand for iron increased dramatically in the eighteenth century and the North West Monmouthshire area possessed the geological and geographical requirements for the development of a major iron industry following the substantial technological advances that took place in the early and middle of the eighteenth century. Hence it is argued, with reasons, that the industrial revolution itself was delayed in the region.

It will further be argued that despite all the favourable factors that existed for iron making developments to occur in the area, major iron works were not set up until the arrival of a group of in-coming entrepreneurs or industrialists. Local Welsh businessmen were not involved and the major landlords generally took a more passive role. These incomers as a group had many characteristics in common with industrialists in general in the early British industrial revolution and it is further argued that the approach taken by these industrialists regarding the business and physical structure of the ironworks in their early life greatly contributed to the success of the businesses.

2.2 The Proto-Industrial Revolution in the North West Monmouthshire Area.

In the late Middle Ages and up to the seventeenth century in Britain wrought iron, that is malleable iron, had been produced in a single and laborious process known as a bloomery, the fuel being charcoal. In some areas of the country such as Lancashire and Scotland iron was still manufactured by this method in the eighteenth century.[1] Although the blast furnace was introduced into Britain around 1500 AD[2] the bloomery method was only gradually replaced by the blast furnace but by the late seventeenth century this latter method was generally adopted and hailed the production of wrought iron by the two stages indirect process. That is pig iron was produced in a blast furnace still fuelled by charcoal followed by a forge stage that converted the pig iron into wrought iron.[3] There was one key difference between these two methods. The bloomery process resulted with individual blooms of wrought iron being produced and hence the process was discontinuous. The indirect process however meant that the blast furnace was a continuous process[4] and output of pig iron was much improved. So in Britain in what is usually referred to as the proto-industrial revolution period,[5] the decades prior to the middle of the eighteenth century, pig iron was made from charcoal fired blast furnaces and wrought iron by a discontinuous or two stage process.

In fact in England and Wales in 1740 there were only 59 such charcoal fired blast furnaces well distributed around the country as shown in Table 2.1.This picture contrasts dramatically with the situation in the sixteenth and seventeenth centuries when there were many more charcoal furnaces in the country. In the table Sussex had

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[1] J. R. Harris, *The British Iron Industry 1700-1850*, Basingstoke and London, 1988, pp 11-13.
[2] Harris, *The British Iron Industry 1700-1850*, p 11.
[3] Harris, *The British Iron Industry 1700-1850*, pp 12-13.
[4] Harris, *The British Iron Industry 1700-1850*, pp 13-14.
[5] Pat Hudson, 'Industrial Organisation and Structure', Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, pp 29-36.

only ten charcoal fuelled furnaces in 1740 though this county had the largest number of furnaces at that time. However in the previous two centuries there were over one hundred charcoal furnaces in the Weald, the majority of which were situated in Sussex. There were also over eighty forges in the Weald in these two centuries. This indicates the extent of the decline in the charcoal based iron industry in Britain by 1740 and this must have been at least in part due to deforestation[6] though J. R. Harris thinks that shortages of water was a more common problem[7] in the particular area.

Table 2.1 Iron Furnaces in England and Wales in 1740

	No. of Furnaces	Tons		No. of Furnaces	Tons
Brecon	2	600	Monmouthshire	2	900
Glamorganshire	2	400	Nottinghamshire	1	200
Carmarthenshire	1	100	Salop	6	2,100
Cheshire	3	1,700	Staffordshire	2	1,000
Denbighshire	2	550	Sussex	10	1,400
Derbyshire	4	800	Warwickshire	2	700
Gloucestershire	6	2,850	Worcestershire	2	700
Herefordshire	3	1,350	Yorkshire	6	1,400
Hampshire	1	200			
Kent	4	400	Total	59	17,350

Source. H. Scrivenor, *History of the Iron Trade*, London, 1854, p 57.

As can be seen from the Table 2.1 the largest area of production was Gloucestershire with its ironworks in the Forest of Dean. Here, however, like Sussex, there was a dramatic fall in importance of this area as at the end of the seventeenth century almost half of Britain's total iron production was achieved in the Forest.[8] From the table also it can be seen that whilst iron was made in South Wales it was on a relatively small scale and the production for England and Wales as a whole was well below the country's needs as imports of iron greatly exceeded exports as shown in Table 2.2.

[6] Henry Cleere and David Crossley, *The Iron Industry of the Weald*, Leicester, 1985, pp 306-8.
[7] Harris, *The British Iron Industry 1700-1850,* p 24.
[8] Harris, *The British Iron Industry 1700-1850*, p 18.

As Table 2.1 shows both Glamorgan and Monmouthshire had 2 charcoal fired furnaces in 1740 and there is evidence that there were other ironworks in the district prior to the first coke-fired furnace in the Monmouthshire area in about 1779. The two charcoal furnaces in the county included in the table were probably those at Pontypool and at Tintern[9] both a fair way from the area under study. Richard Hanbury set up an ironworks at Pontypool in 1580 and this works continued to be run by the Hanbury family as a charcoal fuelled one into the coke era and is believed to be one of the last charcoal fuelled works to be operated in South Wales.[10] The Tintern works also ran from the sixteenth century and the Hanbury family were involved here as well at times.[11] There were also seven charcoal forges in Monmouthshire including four run by the Harford partnership,[12] which was later to be involved in both the Nantyglo and Ebbw Vale ironworks. The Harford family was a Bristol firm of merchants. A forge, in the eighteenth century and after, was the name given to a works or section of a works that converted pig iron to wrought iron.

There is evidence of charcoal fuelled ironworks nearer to the area under study. It is known that there was a forge at Llanelly in Breconshire quite near to the place where the coke fired furnaces were later to be erected at Clydach near the end of the eighteenth century. The Hanburys were also associated with this early forge at Llanelly.[13] There was a forge at Glangrwyney near Crickhowell that was owned by Walter Watkins who later had an involvement in the initial development of the coke-fired furnaces at Pen-y-Cae that is Ebbw Vale.[14] There was also an early charcoal

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[9] *Monmouthshire Merlin*, 20 July 1844, The Monmouthshire Iron Trade.
[10] Laurence Ince, *The South Wales Iron Industry 1750-1885*, Merton, 1993, p ix; Chris Barber, *Eastern Valley, The Story of Torfaen*, Llanfoist, 1999, pp 25-6.
[11] Barber, *Eastern Valley, The Story of Torfaen*, p 25.
[12] Rev. J. Evans and John Britton, *A Topographical and Historical Description of the County of Monmouth*, London, 1807, p 34.
[13] Arthur Gray-Jones, *A History of Ebbw Vale*, Risca, Monmouthshire, 1970, p 37.
[14] Gray-Jones, *A History of Ebbw Vale*, p 41.

fired ironworks in the Sirhowy valley at Pont Gwaith Yr Haern located about three to four miles downstream from Tredegar and probably erected in the 1730s.[15] In addition to these ironworks, late eighteenth century maps of Monmouthshire record 'Brynore iron and coal mines' close to where the town of Tredegar was later to be developed.[16]

Hence nationally the charcoal iron industry in Britain was at low ebb immediately prior to the onset of the industrial revolution. Locally there was a scattered charcoal fuelled iron industry including works near Tredegar and Clydach. Although the charcoal ironworks of Britain at this time were small concerns the works were generally organised on a capitalist basis with the owners or ironmasters employing a small number of men at each works. For example there were only three or four men working at Pont Gwaith yr Haern with each worker expected to be an all-rounder able to carry out a number of the activities associated with iron manufacture at one site with the required minerals being brought to the site.[17] This approach is unlike the domestic method of the early cotton industries of the North before the factory system came into being there. In this case the work was generally done within the family at home, unsupervised.[18] With the charcoal furnaces run on a capitalist basis and with the discovery of the use of coke for fuelling the blast furnaces it might be thought that the proto-industry that existed in the Monmouthshire area would have led to the industrial revolution proper in mid century but this was delayed until around the 1780s.

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[15] Evan Powell, *History of Tredegar* (Subject of a competition at Tredegar Chair Eisteddfod, 25 February 1884), Newport, 1902, pp 21-2.
[16] John Cary, Map of Monmouthshire, Strand, 1787.
[17] Oliver Jones, *The Early Days of Sirhowy and Tredegar*, Tredegar, 1969, pp 24-5.
[18] J. T. Ward, *The Factory System*, Newton Abbot, 1970, p 38.

2.3 Requirements for the Development of a Coke Based Iron Industry.

A number of factors were necessary for the industrial revolution to take off in a particular area resulting in a major industry. In the context of the iron industry these factors were economic, geographical and geological and there also had to be the catalysts, the people who initiated the enterprises. Finally there had to be a ready workforce. This section identifies these key factors for the iron producing industry around the mid eighteenth century in Britain and examines if the North West Monmouthshire area had all these factors.

As Pat Hudson has pointed out the existence of a proto-industry in a region did not necessarily mean that an industrial revolution proper would develop there.[19] However the existence of a proto-industry must point to the possibility that major industrial developments might take place later if only because some of the factors for both levels of industry would be common.

The principal economic requirement was the existence of a demand for iron products. Demand for iron domestically increased dramatically during the eighteenth century as can be seen from Table 2.2, which shows imports of iron increasing over the century. Entrepreneurs must have been conscious of the opportunities for improving domestic supply. Domestic supply was also favoured considerably in the late eighteenth century because of the tariffs imposed on foreign imports by the government.[20]

The catalyst for the onset of the industrial revolution in the iron industry was Abraham Darby's successful use of coal in place of charcoal in the smelting of iron

[19] Hudson, 'Industrial Organisation and Structure', pp 32-4.
[20] Chris Evans, Owen Jackson and Goran Ryden, 'Baltic iron and the British iron industry in the eighteenth century', *Economic History Review,* LV, 4 (2002), p 645.

Table 2.2 Comparison of Iron Imports and Exports – England and Wales.

IMPORTS	
Years	**Average Tons**
1711-1718	15,642
1729-1735	25,501
1750-1755	34,072
1761-1776	48,980
EXPORTS	
1711-1718	4,365
1729-1735	5,334

Source. H. Scrivenor, *History of the Iron Trade*, London, 1854, pp 58.

ore in about 1713. Darby found that by using coal in the form of coke he could produce pig iron but the method was not widely used until around 1750 probably because Darby's early coke pig iron had higher silicon content than charcoal pig iron.[21] Darby's innovation was not the only improvement. There were also developments in the production of the blast for the furnaces. In the early eighteenth century the charcoal furnaces were blown by leather bellows driven by water power but later in the century blowing machines came into use such as those of Isaac Wilkinson who used cylinders operated by a water wheel and then machines built by John Smeaton that had three cylinders and pistons again driven by water wheels.[22] Later still, in the last quarter of the century came the first use of steam engines such as those of Bolton and Watt, to drive the blast.[23] J. R. Harris states that by 1790 steam power was widely employed for production of the blast[24] and this had obvious advantages over water power, not being dependent on fast flowing rivers and streams but of course water was still required for the engine itself. However the use of steam power for the blast though obviously desirable was not a key factor for the industrial revolution to take off within the iron industry in South Wales. The general use of

[21] Harris, *The British Iron Industry 1700-1850,* pp 32.
[22] Ince, *The South Wales Iron Industry 1750-1885*, pp 10-11.
[23] Harris, *The British Iron Industry 1700-1850,* p 35.
[24] Harris, *The British Iron Industry 1700-1850,* p 35.

steam engines to generate the blast was delayed considerably in South Wales as will be explained later in this chapter.

The extent that coke fired furnaces had replaced charcoal fired ones is demonstrated in Table 2.3 based on pig iron production in 1788.

Table 2.3 Pig-iron output in England and Wales from charcoal fired and coke fired furnaces, 1788.

	Charcoal Furnaces			Coke Fired Furnaces		
	No. of Furnaces	**Tons at each**	**Total in each county**	**No. of Furnaces**	**Tons at each**	**Total in each county**
Breconshire				2	800	1,600
Carmarthenshire	1	400	400			
Cheshire				1	600	600
Cumberland	1	300	300	1	700	700
Derbyshire	1	300	300	7	600	4,200
Glamorganshire	3	600	1,800	6	1,100	6,600
Gloucestershire	4	650	2,600			
Lancashire	3	700	2,100			
Merioneth	1	400	400			
Monmouthshire	3	700	2,100			
Shropshire	3	600	1,800	21	1,100	23,100
Staffordshire				6	750	4,500
" 3 expected furnaces				3	800	2,400
Sussex	2	150	300			
Westmoreland	1	400	400			
Yorkshire	1	600	600	6	750	4,500
Total	24		13,100	53		48,200

Source. Scrivenor, *History of the Iron Trade*, pp 86-7.

In 1788 pig iron produced from coke-fired furnaces was between three and four times that from charcoal furnaces.

While recognising that the use of coke was the key change for the blast furnaces there is debate over the degree to which this was behind the increased productivity. The gains in productivity by the use of coke might have been largely due to falling coal prices, alternatively it might have been more to do with the technological improvements.[25] It is certainly true that charcoal prices rose in the middle of the eighteenth century whilst coke prices tended to fall thereafter[26] but the

[25] Harris, *The British Iron Industry 1700-1850*, p 37.
[26] Harris, *The British Iron Industry 1700-1850*, p 34.

use of coke also seemed to allow larger blast furnaces to be built[27] that would have improved productivity. It would seem both factors worked in the favour of coke usage.

For an iron industry to be developed in a British coalfield other minerals needed to be available. In addition to a ready supply of ironstone or iron ore, limestone was needed for use as a flux in the blast furnaces and other minerals such as clay were needed for brick making. The main geographical requirement is for the ironworks to be sited near a river or fast running stream. Water was required to provide power for the blast in the smelting furnace and for many ancillary reasons. The works should also be sited not too distant from a port.

That the North West Monmouthshire area possessed the key mineral and geographical requirements for the emergence of large iron producing concerns was stressed by Archdeacon Coxe, writer of the famous book *An Historical Tour in Monmouthshire.* Coxe visited the Blaenavon and Nantyglo area in 1801 and stated,

> About forty years ago the iron works suddenly revived, from the beneficial discovery of making pig iron with pit coal, instead of charcoal, which was soon afterwards followed by the improvement of manufacturing even bar iron by means of pit coal: hence a district, which contained such extensive mines of iron ore and coal, prodigious quantities of limestone, and numerous streams of water, could not fail of becoming the seat of many flourishing establishments.[28]

The discovery alluded to by Coxe was that by Abraham Darby who had used pit-coal in the blast furnace in the early years of the eighteenth century though it was not until

[27] Ince, *The South Wales Iron Industry 1750-1885*, p 9.
[28] William Coxe, *An Historical Tour in Monmouthshire*, London, 1801, pp 229-30.

the second half of the century that pit-coal was in general use in blast furnaces in the country.[29] Coxe also wondered how the mineral treasures of the area had been so long neglected despite the fact that iron had been made in the area for centuries on a small scale.[30] The slow progress in the county was also commented on in the *Monmouthshire Merlin* which observed that for several years after the introduction of the use of pit coal (in the form of coke) very little progress was made.[31]

Thus the North West Monmouthshire area had the basic physical requirements, an abundance of coal for conversion into coke, ironstone and limestone and the rivers and streams needed for waterpower. Coal and ironstone were the important minerals compared with limestone and the last mentioned had no effect on the siting of the blast furnaces.[32] The further ingredient needed for the ironworks was clay that would have been used to make bricks some of which would be needed to line the blast furnaces. There is evidence of an abundance of clay in the Nantyglo area as there are a number of entries in the Ebbw Vale Memorandum Book 1796-1819 indicating that clay and bricks were brought from Nantyglo to the works at Ebbw Vale.[33] A further point in favour of the development of iron working in the area was the nearness to the surface of the veins of ore and coal enabling the mining of the minerals to be carried out cheaply. As Michael Atkinson and Colin Baber point out between ten and twelve tons of coal, ironstone and limestone were needed to produce one ton of pig iron in 1800 and hence the nearness and accessibility of the raw materials exerted a strong pull on the location of the industry and in South Wales seams of both coal and

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[29] Scrivenor, *History of the Iron Trade*, pp 56, 84.
[30] Coxe, *An Historical Tour in Monmouthshire*, pp 228-9.
[31] *Monmouthshire Merlin*, 20 July 1844, The Monmouthshire Iron Trade.
[32] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History*, Cardiff, 1987, p 17.
[33] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819.

ironstone outcropped at the surface along the Northern rim of the coalfield.[34] Furthermore, not all the coalfields of the country had large deposits of ironstone, for example the North Eastern and Lancashire fields,[35] and the carbon content of the coal in some of the coalfields was less than that in South Wales coal.[36]

Having the necessary minerals reasonably accessible and adequate supplies of water was not enough in itself as the land on which ironworks might be erected had to be obtainable. In other words the landowners had to want their lands to be used and the minerals on and under these lands exploited. The principal landowners of the area were inclined to support these ventures as will be explained in the section 2.5.

The technological improvements in the mid and late eighteenth century iron industry point to two other key requirements for a successful entry into this industry. The need for large amounts of capital cannot be understated and a full discussion on the financing of the iron industry in the North West Monmouthshire area is given in Chapter 5. The iron industry in this period although requiring substantial capital was still labour intensive and an adequate supply of labour was also a prime requirement. The area under study was very thinly populated in the late eighteenth century but as will be demonstrated in Chapter 6 a workforce was obtainable from the surrounding regions. The vast majority of the workforce for the Monmouthshire works were thus immigrant workers and later, descendents of these immigrants. It is likely that immigrants having opted to come to the area for work would be more amenable to new work processes.

The final and most important factor was the catalyst to the venture that is the person or persons responsible for the initiation of the whole enterprise. Such a person had to have access to the necessary capital and have the vision to plan the enterprise

[34] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, pp 4-5.
[35] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 5.
[36] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 37.

taking into account all the problems and difficulties that existed in setting up a new industry often in previously unexploited localities. A great deal of discussion has taken place as to the necessary requirements of an entrepreneur or industrialist in the early industrial revolution whatever the industry being considered. Paul Mantoux believed that the distinctive quality of an industrialist was that of an organiser and although the industrialist need not have been an inventor he must have been aware of technical innovation.[37] A most influential work on this subject is *The First Industrialists* written by Francois Crouzet and published in 1985. Crouzet defines an industrialist as the head of a large concern in which he has a significant financial interest and is actively involved in management. He adds that the meaning of 'large' will vary according to the area and type of industry.[38] In the early industrial revolution an ironmaster running an ironworks consisting of one or more blast furnaces and employing forty or more men would be regarded as an industrialist.

It is clear then that Crouzet sees the industrialist of the early industrial revolution as the key figure in the undertaking and one who is deeply involved in the enterprise, almost certainly on a day to day basis and therefore based at the site for much of his time. As such the industrialist would carry out a variety of functions and not just that of management. For example he would probably be involved in the marketing of his products and possibly also in the accounting for the business. In fact he would deal directly with a whole variety of aspects of the operation of the company's business either on his own or in association with active partners and he would be likely to at least share in the responsibility for negotiating contracts for the sales of products, for the purchase of supplies, equipment and raw materials and for work done by skilled and unskilled workers. The above discussion is intended to

[37] Francois Crouzet, *The First Industrialists*, Cambridge, 1985, p 10.
[38] Crouzet, *The First Industrialists*, p 1.

illustrate how vital the industrialists or entrepreneurs were for the onset of the industrial revolution in general and for the start of the developments in the South Wales coke fired iron industry in particular.

Of all the industrialists of the early British industrial revolution the ironmasters were the first group to emerge prior to the last third of the eighteenth century.[39] Possibly the most notable were the Darbys of Coalbrookdale in Shropshire, a true dynasty founded in the seventeenth century.[40] Nearer to the study area is Merthyr and it was here that the Crawshay dynasty was established. Richard Crawshay, the first of the dynasty, hailed originally from Yorkshire, the son of a farmer[41] he made his way initially in London at a firm of iron merchants run by Robert Moser. Crawshay was a partner by 1772.[42] Later he moved to Merthyr and at Cyfarthfa he was a pioneer of the use of Henry Cort's puddling and rolling process. He is credited with the improvement of the process in practice by making modifications to the puddling furnace.[43] Possibly the other best known ironmaster dynasty in South Wales was that of the Guests of Dowlais. John Guest came to Merthyr in 1763 after experience of ironmaking in Shropshire. In Merthyr he spent a few years developing and working with Isaac Wilkinson (1695-1784) at the Plymouth works in Merthyr before he became involved at Dowlais, becoming a partner in 1782 after spending some time as manager.[44]

Of course the iron industry was just one of the industries of the early British industrial revolution and there were key entrepreneurs or industrialists at the heart of these other industries as well. One example is Sir Richard Arkwright who is at least

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[39] Crouzet, *The First Industrialists*, p 26.
[40] Barrie Trinder, *The Darbys of Coalbrookdale*, Chichester, 1974, p 21.
[41] Chris Evans (Calendared by), *The Letterbook of Richard Crawshay 1788-1797*, Cardiff, 1990, p ix.
[42] GRO. D.43. M250 (4801). 5 June 1772, Articles of Partnership Crawshay & Moser.
[43] Evans, *Letter book of Richard Crawshay 1788-1797*, pp xiii-xv.
[44] Chris Evans, *'The Labyrinth of Flames' Work and social conflict in early industrial Merthyr*, Cardiff, 1993, pp 15-16, 61-2.

partly credited with the development of the Midlands cotton industry.[45] Crouzet points out however that these industrialists were not a homogeneous group as cotton masters and ironmasters were themselves quite different from each other and both groups tended to lead much larger integrated units compared with the other industries.[46] Crouzet went further with his analyses of the industrialists of the industrial revolution and produced tables illustrating the background occupation of these industrialists. He found that over 40 percent of these industrialists had had backgrounds already in industry and nearly 20 percent had been merchants of one kind or another. Few were from the upper, professional or working classes or from the land.[47]

Entrepreneurs did not appear in the North West Monmouthshire area until the last two decades of the eighteenth century despite all the favourable factors for a coke fired iron industry to be developed there. Their arrival formed a 'second wave' of industrialisation in the region, the first being that in the Merthyr area commencing in the late 1750s and the following two decades. It is not surprising therefore that some of the incoming industrialists to the study area had gained experience of the iron industry as proprietors or senior employees of enterprises in Merthyr[48] though the earliest industrialists to the area mostly came from the Midlands, London and Bristol.[49]

These incoming entrepreneurs who were responsible for the initial and early development of the iron works of the North West Monmouthshire area display a similar profile to that established for industrialists nationally by Crouzet but with an even greater stress on industry, in their case the metal industry.

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[45] Ward, *The Factory System*, p 50.
[46] Crouzet, *The First Industrialists*, p 36.
[47] Crouzet, *The First Industrialists*, pp 147-50.
[48] Evans, *The Letterbook of Richard Crawshay 1788-1797*, pp 179-96.
[49] Jones, *The Early Days of Sirhowy and Tredegar*, pp 29-30; GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, 16 Oct 1779; GRO. D.7.15. Lease, Earl of Abergavenny and Hill, Hopkins and Platt, 30 Nov 1789.

Crouzet in his analyses of the occupations of founders of businesses in the industrial revolution found that 41.8 percent nationally had had industrial occupations and 19.6 percent had been merchants and traders, no other occupation group being prominent. Crouzet's sample was relatively large, analysing the occupations of 316 founders of large concerns in Britain in the period 1750 to 1850. A similar analysis has been carried out in this thesis for the founders and industrialists of the North West Monmouthshire area in the early industrial revolution period and although the sample sizes are small a clear pattern emerges. 75 percent of the founders of ironworks businesses in the area had industrial backgrounds almost entirely within the iron industry while as many as 80 percent of industrialists (including founders) had such industrial backgrounds. These percentages are much higher than the national average and point to a particular situation in that the Monmouthshire industrial developments were a second wave in the region. The results of Crouzet's analyses and those of the Monmouthshire founders and industrialists are shown in Table 2.4.

Table 2.4 A comparison of the occupations of founders and industrialists of ironworks of the North West Monmouthshire area with founders for the country as published by Francois Crouzet for 1750-1850.

	National Total %	**National Metal Concerns %**	**N.W. Mon Founders**	**N.W.Mon Founders %**	**N.W.Mon Industrialists**	**N.W.Mon. All Industrialists %**
Upper class	2.5	2.7				
Professional	2.5	3.6	1	8.3	1	6.7
Merchants and traders	19.6	12.6	2	16.7	2	13.3
Industry	41.8	43.2	9	75.0	12	80.0
The land	4.1	8.1				
Working class	9.8	17.1				
Miscellaneous	3.8	4.5				
Total	100.0	100.0	12	100.0	15	100.0

Source of Crouzet's data. Crouzet, *The First Industrialists*, pp 147-150.
Sources for Monmouthshire Industrialists: Evans, *The Letterbook of Richard Crawshay 1788-1797*, pp 179-96; Jones, *The Early Days of Sirhowy and Tredegar*, pp 29-30;
GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, 16 Oct 1779; GRO. D.7.15. Lease, Earl of Abergavenny and Hill, Hopkins and Platt, 30 Nov 1789; John Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, London, 1906, pp 140-92.

2.4 The Coming of the Industrialists to the North West Monmouthshire Area. 1778-1811.

J. R. Harris has commented on the lack of local enterprise in South Wales in the early industrial revolution[50] and this was certainly true in the North West Monmouthshire area. Despite ironworks being developed in the Merthyr area just a few miles to the west there was little development if any in the study area in the 1760s and for most of the 1770s. Generally it seems that the owners of the scattered charcoal fired furnaces in Monmouthshire did not wish or were not able to take advantage of the new opportunities given to the area by the coke fired furnace process, the abundance of minerals and ready water supplies. The one exception was the Harford partnership which had a number of charcoal forges in South Wales[51] and was later to be involved in both the Nantyglo and Ebbw Vale ironworks. The reason most of the owners of local charcoal furnaces failed to progress to coke fired works was probably a lack of capital. A. H. John has stressed this lack of local sources of capital in South Wales as a whole[52] and this seems to have opened the door to others who had access to capital.

The nineteenth century local historian, Evan Powell, writing in 1884, stated that a gentleman named Mr. Kettle, from Shropshire, erected a furnace at Sirhowy. Powell believed that this furnace was initially fired by charcoal but later by coal. The ironworks eventually failed and then the land was leased to a group of businessmen.[53] Oliver Jones, in *The Early Days of Sirhowy & Tredegar* disputes Powell's assertion that Kettle built a furnace in the 1750s and believes that Sirhowy ironworks started

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[50] Harris, *The British Iron Industry 1700-1850*, p 72.
[51] Evans and Britton, *A Topographical and Historical Description of the County of Monmouth*, p 34; Chris Evans, 'Global Commerce and Industrial Organisation in an Eighteenth Century Enterprise: The Melingriffith Company', *Welsh Historical Review* No. 20, (2000-1), pp 416-19.
[52] A. H. John, *The Industrial Development of South Wales 1750-1850*, Cardiff, 1950, p 23.
[53] Powell, *History of Tredegar*, pp 22-3.

with the 1778 lease of landowner Charles Henry Burgh.[54] In fact a certain John Kettle was a Birmingham industrialist in the 1730s, known principally for steel manufacturing[55] and there could be a connection between this man or a relative of his and Sirhowy but the likelihood is that even if an ironworks existed there in the 1760s it was not coke fired.

Hence industrialists began to set up a coke fired iron industry in the area in the last few years of the 1770s and within just over twenty years all seven of the ironworks forming the main focus of this study were set up or at least initiated. However there were variations in the patterns of the development of these ironworks.

The first wave of ironworks development came in 1778 and 1779 with the establishment of the Sirhowy and Beaufort works at the heads of the Sirhowy and Ebbw Fawr rivers respectively. The initial entrepreneurs of Sirhowy ironworks were businessmen, three from London involved in the tea and grocery trade and one from York, a merchant.[56] They must have recognised the potential of the area and it is possible that Thomas Atkinson, the York merchant, may have been the leading figure as it is believed that he was at one time in the iron trade at Ulverton in Lancashire.[57] However Tredegar's historian, Oliver Jones, believed that Atkinson had spent many years in South Carolina and so he may have made capital from the slave trade.[58] Changes in the partnership at Sirhowy came in 1794 when all but William Barrow of the original partners left and two new men joined. Matthew Monkhouse, a nephew of Atkinson and a cleric, and Richard Fothergill, who was a master builder from Clapham, London, became partners and the main ironmasters, Barrow leaving a few

[54] Jones, *The Early Days of Sirhowy and Tredegar*, p 29.
[55] Evans, Jackson and Ryden, 'Baltic iron and the British iron industry in the eighteenth century', p 653.
[56] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 145.
[57] Gray-Jones, *A History of Ebbw Vale*, pp 38,40.
[58] Jones, *The Early Days of Sirhowy and Tredegar*, p 30.

years later.[59] Beaufort ironworks was established by the Kendalls, a family of businessmen, individually based in Cheshire, Lancashire or Shropshire according to the lease they took out with the Duke of Beaufort.[60] John Lloyd stated that one of the Kendalls, Edward, was especially able and was the managing partner[61] and Ebbw Vale historian, Arthur Gray-Jones, believed that the Kendalls had owned ironworks in Derbyshire, Scotland and one near Machynlleth.[62] In fact the Kendall family had interests in the iron industry as early as 1714 when an Edward Kendall was one of the principals in the Kemberton furnace in Shropshire.[63]

As neither the original Sirhowy partners nor the Kendalls apparently had any previous association with this particular region of South Wales it is impossible to say what actually prompted them to set up business in the area. It is possible that there was a link between the two groups as Gray-Jones thought that the Kendalls had a connection with the works at Ulverton in which Atkinson, of the Sirhowy works, had been greatly involved.[64] If this was the case it could explain why these two ironworks were initiated so near and at almost the same time. It would seem that there might have been contact between Atkinson and the Kendalls on the move to the area.

The pattern of incoming businessmen from England who recognised the opportunities in the area continued at Blaenavon as three businessmen from the West Midlands established an ironworks there in 1789. Thomas Hill was from Stourbridge in Worcestershire, Thomas Hopkins was from Rugeley in Staffordshire and Benjamin Platt from Great Witley also in Worcestershire. It is believed all three were involved

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[59] Jones, *The Early Days of Sirhowy and Tredegar*, p 33.
[60] GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, land plus power to erect ironworks etc. 16 Oct 1779.
[61] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 178.
[62] Gray-Jones, *A History of Ebbw Vale*, p 38.
[63] Barrie Trinder, *The Industrial Revolution in Shropshire*, Chichester, 2000, p 25.
[64] Gray-Jones, *A History of Ebbw Vale*, pp 37-8.

in the iron trade and Hill's family had been connected with the trade for some time.[65] John Lloyd believed that Thomas Hill was a man of wealth 'as he was spoken of in that regard by the firm of Harvey (Harford), Partridge and Company' and he considered Thomas Hopkins 'a man of means'.[66] In fact Hill had one of the largest shareholdings in the Monmouthshire Canal enterprise[67] which adds weight to Lloyd's assertion of his wealth. The Hill family and to some extent the Hopkins family continued to be involved at Blaenavon for many years.

The establishment of the remaining four works was somewhat different from that at Sirhowy, Beaufort and Blaenavon in that the industrialists who came to Clydach, Nantyglo, Tredegar and Ebbw Vale all had experience at ironworks nearby. The entrepreneurs who set up the Clydach ironworks, situated in the gorge very close to the river Clydach, in the mid 1790s were Edward Frere and Thomas Cooke both of whom had worked under Richard Crawshay at Cyfarthfa in Merthyr.[68]

Nantyglo ironworks, not initially a success, was set up in 1792 by a partnership of the Blaenavon entrepreneurs who held the lease of the land on which the Nantyglo works was to be erected and the firm of Bristol merchants, Harford, Partridge and Co.[69] The Harford family had long been involved in the iron trade and their works included Melingriffith in Glamorgan.[70] They were a rare example of ironmasters in the region who made the successful transition from charcoal fired ironworks to larger scale coke ones.[71] A dispute arose between the two sets of

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[65] Sir Joseph Bradney, *A History of Monmouthshire, Volume 1 Part 2b, The Hundred of Abergavenny (Part 2)*, London, 1992, pp 399-400 (originally published in 1907).
[66] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 161.
[67] 'A List of the Proprietors and Committee of the Monmouthshire Canal Navigation', Reginald Nichols (ed.) *Monmouthshire Medley*, Volume 3, Pontypool, 1978, pp 37-43.
[68] Evans, *The Letterbook of Richard Crawshay 1788-1797*, p 124.
[69] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 166-7.
[70] Evans, 'Global Commerce and Industrial Organisation in an Eighteenth Century Welsh Enterprise: The Melingriffith Company', pp 419 on.
[71] Ince, *The South Wales Iron Industry 1750-1885*, p 27.

partners at Nantyglo and the works stopped after only one year of iron production.[72] It was not until 1811 that the future of Nantyglo ironworks was secure when Joseph Bailey and Matthew Wayne appeared on the scene. Joseph Bailey was the nephew of Richard Crawshay of Cyfarthfa ironworks and he had left Yorkshire for Merthyr on hearing of the success of his uncle at Cyfarthfa. Joseph worked his way up at Cyfarthfa showing great steadfastness and perseverance. However when the old ironmaster died Bailey realised that William Crawshay, the grandson of Richard, would restrict his scope at the Cyfarthfa works and so he looked to pastures new. Joseph had been a beneficiary in Richard Crawshay's will and thus he was able to buy his way into the Nantyglo concern. Matthew Wayne, although lacking the enterprise of Bailey was regarded as a fine man and had been furnace manager under Richard Crawshay.[73]

The active Tredegar partners Richard Fothergill, Matthew Monkhouse and Samuel Homfray, were also partners at other nearby ironworks. Fothergill and Monkhouse were partners at the Sirhowy ironworks in 1800 though they had not been original partners at that works, while Samuel Homfray was from Penydarren ironworks in Merthyr. It was Homfray, who, as son-in-law of the major landowner of the site, Sir Charles Morgan, was able to get a favourable lease.[74] The fourth and fifth partners at Tredegar were London merchants, William Thompson and William Forman. The Tredegar partnership was thus one of the strongest in the region financially, backed by Homfray who made his money at Penydarren and the two

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[72] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 166-7.
[73] Charles Wilkins, *The History of the Iron, Steel, Tinplate and Other Trades of Wales*, Merthyr Tydfil, 1903, pp 73-6.
[74] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 140-2; David Morris, The History of Tredegar from the Beginning of the Iron Works up to the present day, winning entry in the Eisteddfod of the Cymrodorion of Tredegar in 1862, p 1.

wealthy London businessmen, Thompson and Forman.[75] These three men and certain of their descendents were to have long associations with the Tredegar works.[76]

The establishment of the Ebbw Vale ironworks, just a relatively short distance down the Ebbw Fawr River from Beaufort, differed from that of all the above works in that there was the involvement of a Welsh iron producer. Walter Watkins of Dan y Graig, Breconshire, had a forge at Llangrwyney (now Glangrwyney) near Crickhowell and, assisted by Charles Cracroft, a capitalist, Watkins established a furnace at Ebbw Vale in 1786.[77] Gray-Jones gives as the reason for Watkins' decision to start making pig iron at Ebbw Vale the fact that the Beaufort ironworks had built a forge and hence used their own pig iron for this forge. Previously Beaufort had supplied Watkins' forge at Llangrwyney with pig iron.[78] Watkins soon sought a partner with experience of coke blast furnaces and a partnership was set up on 3 April 1789 between Jeremiah Homfray, one of the Homfray brothers of Penydarren ironworks in Merthyr, and Watkins and Cracroft as ironmasters.[79] This partnership was short lived and in 1791 Homfray became the owner of Ebbw Vale ironworks supplying pig iron to Watkins at Llangrwyney and a few months later Homfray was joined in partnership by Harford, Partridge and Company, Homfray having a one third share and the Harford, Partridge Company having two thirds. The capital was to be £7,000 and Homfray was to reside on site and be the superintendent of the works. This arrangement lasted until 1796 when Homfray assigned all his interests to Harford and Co. for £500 paid in £100 instalments.[80]

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[75] Powell, *History of Tredegar*, p 38.
[76] Philip Riden and John G. Owen, *British Blast Furnace Statistics 1790-1980*, Cardiff, 1995, p 28.
[77] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 151.
[78] Gray-Jones, *A History of Ebbw Vale*, p 41.
[79] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 151.
[80] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 152.

Hence it is clear from the above brief account of the establishment of the ironworks of the North West Monmouthshire area that the role of the incoming industrialists was vital. It is significant that the vast majority of these industrialists had had experience of ironmaking elsewhere before embarking on the Monmouthshire enterprises and this might be a reflection on the perceived difficulties and complications that applied for the construction and operation of larger scale ironworks in the region. For example the ironworks were relatively isolated, situated at the heads of the valleys close to the moors of Llangynidr and Llangattock. Communication was a major problem and there were no turnpike roads in the area. The ironmasters had to construct roads or railroads from the quarries and mines to the ironworks. There were no villages nearby and so the ironmasters had to build houses for the incoming workers. These difficulties and many others such as want of capital would have put off less determined men.

Map 2.1 Detail of 'A New Map of the County of Monmouth' by C. Smith. 6 January 1804.

The location of the ironworks at the heads of river valleys is clearly shown in Map 2.1, a detail of the 1804 map of the Monmouthshire by C. Smith. The map was first issued in 1801 and this probably explains the absence of the Tredegar ironworks which was being constructed at that time. The Clydach ironworks is not shown but was located on the Clydach River that flows west to east below the village of Llanelly in the upper right of the map.

2.5 The Role of the Landlords.

The key role in the development of coke-fired ironworks in the North West Monmouthshire area was that of the incoming industrialists but the role of the major landlords in these developments is less clear. There were three major landlords in the area, the Duke of Beaufort, the Earl of Abergavenny and the Morgans of Tredegar Park near Newport. There were other landlords or freeholders involved, particularly in connection with the Sirhowy and Ebbw Vale works, but these had relatively small holdings and did not rival the huge lands owned by the three mentioned above.

Much of the land in the east of the North West Monmouthshire area was owned by the Earl of Abergavenny and it was on this land that the Blaenavon and the Nantyglo ironworks were erected.[81] Most of the land in the north part of the area, in the old county of Breconshire, was the property of the Duke of Beaufort and it was on this land that the Beaufort and the Clydach ironworks were built [82] while much of the land in the west on which the Tredegar works was erected was owned by the Morgans of Tredegar Park.

From a study of the early leases between these landlords and the industrialists there seems little doubt that the landowners were keen to have their lands exploited for

[81] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 161.
[82] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 178-80.

the minerals on and under them and they were happy for ironworks and associated constructions to be built as required. Some leases even allowed for rivers to be diverted[83] and they usually gave the ironmasters the power to sublease parts of the land leased to them, to farmers and others at rents higher than they themselves paid thus granting the ironmasters built in profits.[84] Further, these early leases often failed to include the payment of royalties on the amounts of minerals used or the amounts of iron produced.[85] Full details of the leases are given in Table 5.1 in Chapter 5.

It seems therefore that the major landlords were most keen to assist the industrialists in all ways including the granting of favourable lease terms though they also took a wide view of their responsibilities under these leases. They sought to protect their other tenants, local people and the environment in general as evidenced by various clauses in the leases. For example they often put controls on the price that the ironmasters could charge tenants and other local inhabitants for coal[86] and some of the leases insisted on new trees being planted when existing trees had to be felled.[87]

Considering the national picture for ironworks developments Alan Birch says that it is impossible to establish whether it was the entrepreneurs or the landowners who were principally responsible for the industrial activity.[88] In the North West Monmouthshire area it is clear that the landowners were keen to have their minerals exploited and ironworks built on their lands but it is difficult to know if they ever took the initiative with these developments. What is certain is that no major landowner ever became a partner in any of the early coke fired ironworks of the North West Monmouthshire area. Nevertheless some of the landlords insisted via the leases that

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[83] GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, 16 Oct 1779.
[84] GRO. D.397.1669. Leases, Duke of Beaufort and Messrs. Kendall, 28 Dec 1801.
[85] GRO. D.7.15. Lease, Earl of Abergavenny and Hill, Hopkins and Platt, 30 Nov 1789.
[86] GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, 16 Oct 1779.
[87] GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, 16 Oct 1779.
[88] Alan Birch, *The Economic History of the British Iron and Steel Industry 1784 to 1879*, London, 1967, p 179.

certain sums had to be expended by the industrialists. In the original lease for the Beaufort ironworks in 1779 the Duke of Beaufort insisted that the sum of one thousand pounds had to be spent on a good iron furnace within eighteen months of the date of the lease[89] and Sir Charles Gould Morgan went much farther in the agreement for the Tredegar ironworks developments by stating that at least £40,000 had to be spent on the works on or before 29 September 1809.[90] Morgan also insisted that use had to be made of his wharf at Newport for the transportation of iron[91] and so he had additional reasons to hope that the venture would succeed.

Thus there may just be hints that both the Duke and Sir Charles might have taken the initiative but on the evidence available it still seems unlikely that the major landowners took the initiative with the ironworks developments. They did not become partners in the ironworks ventures and they might have been deterred by the huge costs involved and the complications associated with such ventures. The favourable lease terms they offered the ironmasters also suggests that in these early years the landowners did not fully appreciate the value of the minerals on and under their lands. Had they done so they might have been more likely to invest directly in the ironworks partnerships as they did invest in other industrial enterprises in the region such as the Monmouthshire Canal. Sir Charles Morgan played a leading role in the planning of the canal and invested in it.[92] In this Sir Charles was typical of the major landowners of Britain in the industrial revolution period as they are believed to have been sensitive to investment opportunities such as the canals and turnpike roads. In fact British landowners are thought to have been entrepreneurially minded.[93]

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[89] GRO. D.397.1664. Lease, Duke of Beaufort and Messrs. Kendall, 16 Oct 1779.
[90] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840),* p 141.
[91] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840),* p 140.
[92] John Elliott, *The Industrial Development of the Ebbw Valleys*, 1780-1914, Cardiff, 2004, p 131.
[93] Eric J. Evans, *The Forging of the Modern State: Early Industrial Britain 1783-1870*, Harlow, Essex, 2001, pp 135-6.

The conclusion therefore must be that while the role of the major landowners in the developments of the ironworks of the North West Monmouthshire area was certainly important, even enabling, it was not the key role which was that of the industrialists. The landlords wanted the ironworks to succeed but they were cautious with regard to these developments. They did not possess the experience of setting up ironworks in new areas and they were content to give the industrialists the facilities and the freedoms to make their enterprises successful.

2.6 The Business Development of the Ironworks in the Years to 1810.

The approach the industrialists took with regard to the physical and business structure of the ironworks in the early years is examined in this section and it is claimed that the structure adopted greatly contributed to the success of the works in their early life with the one exception of the Nantyglo works. This works failed after just one year in operation but this failure was due to a dispute between the partners and not due to the structure of the business. Although all the ironworks in the group were set up within twenty years there is a surprising variation in the way they developed in this early period and with the pace of the developments.

The capital structure of the early ironworks was the partnership usually consisting of between two and five partners. This contrasted starkly with other major business developments in the area such as the Monmouthshire Canal which had a large number of shareholders including local landowners and ironmasters,[94] developments such as canals were probably seen as less risky and less complicated than the more localised ironworks. The iron works partnerships usually centred on one or two principal masters such as Edward Kendall at Beaufort, Joseph and Crawshay Bailey at Nantyglo, the Hills and Hopkins of Blaenavon and the Harfords at Ebbw

[94] 'A List of the Proprietors and Committee of the Monmouthshire Canal Navigation', pp 37-43.

Vale and it is this concentration of control and enterprise that was the key to the early success of the ironworks. John Addis stated that the early ironmasters had an attitude of self-sacrifice and frugality that enabled them to face difficult times and situations courageously[95] and this must have been the case with the early ironmasters of the area such as Edward Kendall, Thomas Hill, Thomas Atkinson and the Harfords.

With regard to the physical structure of the early ironworks the key issue for the ironmasters was the siting of the blast furnaces. Invariably blast furnaces in this period were sited close to rivers or streams in order to utilise waterpower to generate the blast. The geographic layout of the area, a succession of relatively narrow valleys, meant that the furnaces could be built into banks near the rivers and this made the charging of the furnaces with ore, coke and limestone relatively straightforward. The siting of blast furnaces into banks was not a feature limited to coke furnaces however as the technique was started in the earlier charcoal phase of iron smelting.[96]

The use of steam power is often associated with the early industrial revolution within the iron and other industries but there is evidence that its use generally in blast furnaces was delayed in the North West Monmouthshire area. However a Boulton and Watt steam engine was installed to power the blast of the second furnace at Sirhowy in the late 1790s[97] and a Boulton and Watt blowing engine was in use at Blaenavon from the end of the eighteenth century.[98] The blast for the initial furnace at Beaufort was driven by a great bellows powered by a water wheel[99]and waterpower was still being used at Clydach well into the nineteenth century. A watercolour by Thomas

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[95] John P. Addis, *The Crawshay Dynasty*, Cardiff, 1957, p 155.
[96] Harris, *The British Iron Industry 1700-1850*, p 14.
[97] G. N. von Tunzelman, *Steam Power and British Industrialisation to 1860,* Oxford, 1978, pp 56, 93-4; Geoffrey Hill and Gordon Green, *Industrial Locomotives of Gwent*, London, 1999, p 85.
[98] Jeremy Knight, 'The Blaenavon Iron and Coal Company 1836-1864, A Victorian Joint-Stock Venture', *Bulletin of the Board of Celtic Studies 1980*, Volume 28, Part 4, (May 1980), p 640.
[99] Gray-Jones, *A History of Ebbw Vale*, p 39.

Barker dated 1808 shows the blast driven by water power[100] and although there was a Trevethick engine at Clydach in 1825[101] the sale document produced when the business was put up for sale in 1833 stated that the blast for the blast furnaces was supplied by a Bolton and Watt engine nearly new and by a blowing machine worked by a water wheel.[102] Hence Clydach seems to have been late in adopting a steam engine for powering the blast and even then was still supplementing this with waterpower. However for the other works in the group the timing of the introduction of steam engines to power the blast is difficult to assess. Certainly a steam engine had been erected at Nantyglo prior to its sale to Joseph Bailey and Matthew Wayne in 1811 as the works was described then as consisting of two furnaces, one steam engine, workmen's houses, buildings etc. plus mines, veins, quarries etc. for minerals[103] and the steam engine was to power the blast as there was no forge at Nantyglo at that time. Even at Tredegar the situation is not clear despite the involvement there of Samuel Homfray of Penydarren who had a particular interest in steam engines. Tredegar's historian, Evan Powell, believed that a steam engine was acquired for the blast around 1802 from the Neath Abbey works and had to be conveyed via sea to Newport and then to Abergavenny, presumably by canal, and finally on to Tredegar across the hills. However Powell adds that this engine was known as number 2 and he deduced that the number 1 engine, presumably also acquired for the blast, was one developed by Richard Trevithick, the engineer at Penydarren.[104] Powell was writing in 1884 and it is clear from parts of his work that he was relying sometimes on local oral sources.

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[100] Thomas Barker, Clydach Ironworks, A water colour painting, 1808, in John Van Laun, *The Clydach Gorge*, Abergavenny, 1979, p 8.
[101] NLW. Maybery MSS 3431/3432, 18 June 1825.
[102] GRO. D.591.19.384. Particulars of freehold and leasehold estate comprising the Clydach Iron Works, South Wales, 17 July 1833.
[103] GRO. D.7.12. Lease, Thomas Hill, Samuel Hopkins and Joseph Bailey, Matthew Wayne, 25 March 1811.
[104] Powell, *History of Tredegar*, pp 25-7.

Nevertheless Trevithick was working for the Homfrays at Penydarren developing engines so it is quite possible that Samuel Homfray acquired a Trevithick engine as early as 1802. The issue at Tredegar is further complicated by the fact that the list of stationary steam engines produced by the Neath Abbey Iron Company, given in Appendix two of *Neath Abbey and the Industrial Revolution* by Laurence Ince, does not include any before 1806 and none at all for Tredegar in the early part of the nineteenth century.[105]

From this discussion it can be said that the commencement of coke fired furnaces in the North West Monmouthshire area was not dependent on the use of steam engines to power the blast and water power was the main force for this purpose. Steam engines were used for the blast at some early furnaces but it is likely that other steam engines recorded in the period might have been used elsewhere at the ironworks site such as at the forge, driving the rolling mill. The late introduction of steam power for the blast in general does not in any way suggest that the industrialists of the area were not innovative. Steam engines must have been expensive and there was the further complication of transporting them from their place of manufacture to the hills of the area, quite a difficult task. The ironmasters were certainly justified in making the maximum use of the fast flowing rivers next to their furnaces in this early period.

The ironworks of the area had all been established by the first years of the nineteenth century but they did not develop at similar rates thereafter. The increases in iron output year by year can be seen as an indicator of the pace of development. Harry Scrivenor in his *History of The Iron Trade* written in 1854 gives tables of iron carried on the Monmouthshire canal. Scrivenor had been a manager at the Blaenavon Ironworks in the early 1840s after it had become a joint stock company but it appears

[105] Laurence Ince, *Neath Abbey and the Industrial Revolution*, Stroud, 2001, Appendix Two.

he did not stay very long[106] and went on to write about the iron industry. Scrivenor's figures are not actual output totals but they do give a good idea of the production at the respective ironworks. Below is an extract from one of his tables.

Table 2.5. Iron carried on the Monmouthshire Canal in the early 19th century. (tons).

Year	Blaenavon	Beaufort	Clydach	Ebbw Vale	Tredegar	Nantyglo
1804	8,490	2,950	1,266	2,890	-	-
1806	6,594	3,989	1,599	3,252	3,124	-
1808	7,163	4,004	963	1,553	5,529	-
1810	12,254	3,948	1,372	2,758	7,696	-
1812	14,579	3,995	1,774	4,648	7,862	1,168

Source. H. Scrivenor, *History of The Iron Trade,* London, 1854, pp 127.

From the table it can readily be seen that whilst all the works apart from Nantyglo grew in the early years of the nineteenth century some grew much quicker than others. Blaenavon and Tredegar grew quickly whilst Clydach in particular grew slowly. As can be seen, the Nantyglo works was not operating right up to 1810. The use of iron carried down the canal is somewhat misleading in this early period because it masks output of pig iron sent to other works in the area. As will be shown below some of the works sent much of their pig iron to other local works especially Cyfarthfa and so such output would not be expected to be included in Scrivenor's figures. As the century progressed this practice diminished and Scrivenor's figures become a better guide. Scrivenor seems to have included Sirhowy in his 'Sundry persons' column as he has not shown them separately.

The different pace of development of the ironworks in the group must have been at least in part related to the amount of capital available in these early years. Blaenavon was undoubted aided by the generous lease terms they had and the vast extent of the minerals resources on and under the lands they leased. The Tredegar

[106] GRO. D.751.356. The Blaenavon Iron and Coal Company Minute Book.

works had a group of partners that included Samuel Homfray of the Penydarren works at Merthyr and Ebbw Vale had the resources of Harford and partners, the successful Bristol merchants who had other iron forges and tinplate interests in South Wales. Clydach however had no such financial resources as indicated by the fact that Frere and Cooke, the ironmasters there, had to borrow £10,000 from their former boss, Richard Crawshay of Cyfarthfa, to build a mill in 1805.[107] This point is probably also relevant for Nantyglo that had failed in the mid 1790s once Harford and Co. left. The works did not really start up properly until 1811 when Joseph Bailey and Matthew Wayne from Cyfarthfa bought the works.

Although the pace of development of the group in terms of output was diverse the progress of the works towards total integration was generally slow. An ironworks could be regarded as fully integrated if the enterprise extended from extraction of minerals, through to the production of pig iron via blast furnaces and finally on to the manufacture of wrought, that is malleable iron, in the form of bars by means of puddling furnaces and rolling mills. However that a particular works was not fully integrated in the early period need not be a criticism of the ironmasters. In the early years, most of the ironworks of the area did not have forges, a forge meaning puddling furnaces and rolling mills, the facilities for making wrought or bar iron and later rails from pig or refined iron. Pig iron, whilst sometimes used by the ironworks themselves, or sold, as castings, was more often sold directly to neighbouring works such as Cyfarthfa or Penydarren in Merthyr and some might have been sent to smaller forges in the neighbourhood. For example Ebbw Vale sent pig iron to Walter Watkins' forge at Llangrwyney early on and was still sending pig iron there as late as 1817. It also sent iron to other forges and in 1796 it was supplying Bassaleg forge with finers metal

[107] John van Laun, *The Clydach Gorge*, p 9.

(refined iron).[108] One works of the group, the Beaufort ironworks, appears to have had a forge early on as Gray-Jones, Ebbw Vale's historian, believes that a forge was built there as early as 1785.[109] It is not known if this forge was run using Cort's puddling process, 1785 does seem too early for this. Probably they were using the potting and stamping process initially and switched to Cort's method later. There is no evidence that a forge was set up in any of the other works in the group until the nineteenth century. As stated above Clydach built its first mill in 1805 and Blaenavon was even slower. Its forge and mill, at Garnddyrris, a few miles from the blast furnaces, was not built until 1817.[110] Ebbw Vale also seems to have built its forge late as it was certainly selling pig iron to Penydarren in 1796.[111] Tredegar had its first forge in 1807 and Tredegar's historian, Evan Powell, described the opening of the forge and mill that year as a red letter day in the history of the town.[112] Joseph Bailey and his partner, Matthew Wayne, set about planning the Nantyglo works as an integrated concern once they took control of it in 1811 and it is believed that forges and new furnaces were erected in a very short period of time.[113]

Hence all the works in the group had become fully integrated concerns by 1817 apart from Sirhowy which appears never to have had a forge. The industrialists of the area had good reason to delay making their concerns fully integrated. Cort's puddling and rolling process was only just getting established following the eventual success with the procedure at Cyfarthfa and Penydarren and it would have seemed more cost effective for the Monmouthshire works to supply these two Merthyr works

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[108] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819; GRO. D.2472.3. Ebbw Vale Company Journal 1791-6; GRO. D.2472.4 Ebbw Vale Company Journal 1814-15.
[109] Gray-Jones, *A History of Ebbw Vale*, p 41.
[110] Chris Barber, *Exploring Blaenavon Industrial Landscape World Heritage Site*, Llanfoist, Abergaveny, 2002, p 23.
[111] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819.
[112] Powell, *History of Tredegar*, pp 30-1.
[113] David James, History of Nantyglo and Blaina, Gwent County Library, Approximately 1950, (unpublished), p 10.

with pig iron in the early period rather than develop their own forges. They might also have been deterred by the fact that it was not until the 1790s that independent forges in South Wales became reconciled to the use of coke pig iron in their works in large proportions. For example the Melingriffith forge used predominantly charcoal pig iron in the 1780s even importing some from New Jersey, USA, but by the mid 1790s they were using substantial amounts of charcoal pig and coke pig together with some finers metal.[114]

Therefore it is fair to say that the industrialists of the North West Monmouthshire area made the most of the favourable factors such as the nearness of a plentiful supply of water and the abundance of minerals in the early structure of their businesses. Some delayed incurring costs such as those associated with the acquisition of steam engines at least for a time and the ironmasters deemed the construction of forges non-essential in the early years though they moved to fully integrated concerns later. These approaches and the consequent savings in costs might have helped them meet the expense associated with improvements in communications within the area.

2.7 Why the Industrial Revolution was late in the North West Monmouthshire Area.

Once Abraham Darby had demonstrated that coal, in the form of coke, could be used as fuel in the blast furnaces to smelt iron ore the coalfields of Britain became potential areas for the development of large-scale iron production. The Darby family was based in the Coalbrookdale district in Shropshire and so it is no surprise that when the iron industry in the country really took off in the 1750s the Shropshire coalfield was in the forefront of the developments. Coke fired blast furnaces also sprang up in Lancashire, South Wales and in Scotland. In fact Shropshire men had an

[114] Chris Evans, 'Global Commerce and Industrial Organisation in an Eighteenth Century Welsh Enterprise: The Melingriffith Company', pp 420-2.

involvement in certain such developments in Merthyr in South Wales and in Lancashire.[115] However despite the ideal geological and geographical criteria that existed in the North West Monmouthshire part of the South Wales coalfield for the development of coke fired furnaces none were erected there until the last two decades of the eighteenth century.

In Shropshire in and on the periphery of the coalfield the population had been rising in the first half of the eighteenth century even before the rapid expansion of the iron industry which started there in 1755, there being many existing villages in the vicinity of the River Severn.[116] The situation there was quite unlike that of the North West Monmouthshire at the time, an area that had no village of any size within it. The Coalbrookdale area also benefited from the Severn as a form of transport, the river being a navigable one.[117]

In South Wales, in Merthyr for example, coke-fired ironworks were erected in the mid eighteenth century. The Dowlais works was established in 1759, the Plymouth works in 1763 and Cyfarthfa in 1765 with the last of the four Merthyr works, Penydarren following in 1784.[118] Merthyr Tydfil however was a pre-existing village that is it was in existence well before the establishment of the ironworks of the 1750s and 1760s. Thomas Kitchin's map of Glamorgan dated from the 1760s has the village of 'Merthyr Tydvil' placed by the River Taff with a road to Cardiff close by.[119] J. R. Harris states that there was an involvement by the local mineral owners in Merthyr but

[115] Barrie Trinder, *The Industrial Revolution in Shropshire*, 2000, pp 38-9.
[116] Trinder, *The Industrial Revolution in Shropshire*, p 4.
[117] Trinder, *The Industrial Revolution in Shropshire*, p 8.
[118] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History, Cardiff, 1987,* p 6.
[119] Thomas Kitchin, A New Map of Glamorganshire, c.1760s.

that the key figures were the entrepreneurs, in this case men like Isaac Wilkinson, Anthony Bacon, John Guest, Richard Crawshay and the Homfrays.[120]

It has already been established that the industrial revolution did not take off in the North West Monmouthshire area until entrepreneurs arrived on the scene from other areas and thus the reason why this area was developed later than in Merthyr must rest with the entrepreneurs. They must have been more attracted to the Merthyr area. There are a number of reasons why they may have preferred Merthyr such as the presence there of an existing village which could have been used as an initial base and as a source of labour. The North West Monmouthshire area was very thinly populated in the third quarter of the eighteenth century and despite its mineral wealth the area would have been less well known than Merthyr with its road and river links to the coast at Cardiff. The mineral owners may also have played a role at Merthyr[121] and possibly acted as catalysts whereas the landowners of the Monmouthshire area seem to have taken only a passive interest being content to lease their lands but never becoming partners in the ironworks companies. The other factors in the North West Monmouthshire situation were the almost total absence of a workforce and the poor communications that existed there, Kitchin's map of Monmouthshire dated about 1748 shows no roads at all in the north west of the county.[122] Hence if the entrepreneurs were faced with a direct choice between the Merthyr area and North West Monmouthshire the absence of a road in the latter might have been critical.

With the above factors applying therefore it is not surprising that the industrial revolution in the form of a major coke fired iron industry arrived in the North West Monmouthshire area later than other areas such as Merthyr and Shropshire. As some of the industrialists who eventually set up iron works in the area had already been

[120] Harris, *The British Iron Industry 1700-1850*, pp 54-5.
[121] Harris, *The British Iron Industry 1700-1850*, pp 54-5.
[122] Thomas Kitchin, A New Map of Monmouthshire, 1748.

involved in the Merthyr iron industry the developments in North West Monmouthshire could be regarded as a second or later phase of the industrial revolution in the east of the South Wales coalfield.

2.8 Conclusion.

The North West Monmouthshire area had all the geological and geographical features necessary for the industrial revolution to have taken off in the form of the development of a major coke fired iron industry in the mid eighteenth century following the technological advances that had been made in the iron industry by that time. However such an iron industry did not emerge until a group of industrialists from outside took an interest in the area. The profiles of these industrialists were not untypical of industrialists of the British industrial revolution but a distinctive feature was the high proportion who had had previous experience of the iron manufacturing industry. Iron manufacturing anywhere absorbed large amounts of capital but this was especially so in a remote area with no infrastructure and no local workforce and these incoming industrialists managed to obtain sufficient funds to establish their ironworks.

It must be assumed that as the small scale and scattered charcoal iron industry that existed in Monmouthshire did not lead on to the development of major coke furnaces the owners of these charcoal furnaces did not have the capital or entrepreneurial drive to take their businesses to the next level. It also appears that whilst the landowners of the area played an important role they did not wish to become directly involved in iron manufacturing possibly deterred by the sheer complexities of setting up such industries in remote areas.

The entrepreneurs were therefore the key to the introduction of the industrial revolution to North West Monmouthshire and the relatively cautious approach they

took with regard to the physical and business structure of their companies undoubtedly contributed to the steady early success of the enterprises.

Finally it has been demonstrated that the arrival of the industrial revolution into the North West Monmouthshire area was later than might have been expected and that its eventual arrival could be regarded as a second or later phase of the industrial revolution in the north east of the South Wales coalfield. It is significant that even as late as around 1800, maps of the area still referred to localities as furnaces or works not towns or villages. S. Smith's map of Monmouthshire of 1804 records 'Sorrwy' Furnace, Beaufort Works, 'Ebwy Vale' furnace, 'Nant y Glo' Furnace and 'Blaen Avon' Furnace. Clearly the industrial revolution in the area was still at its infancy.

Illustration 1 A view of the Blaenavon Ironworks c.1800.

Source. William Coxe's *An Historical Tour of Monmouthshire, Part the second,* published in London in 1801. The engraving is adjacent to page 228.

Chapter 3. Demand for Iron Products, the Reactions of the Ironmasters and the Growth of the Iron Output in the North West Monmouthshire Area. - First Half of the Nineteenth Century.

3.1 Introduction.

This chapter is especially concerned with the demand for iron products in the British iron industry in the first half of the nineteenth century. The demand for iron fluctuated such that in general nine separate periods can be identified, these periods being of boom, depression or relative depression and of a mixed or uncertain nature. The fifty-year period was also one of steady decline in iron prices with minor peaks and troughs, again a particular problem for the industrialists.

The effects of the contrasting economic periods on the iron industry of the study area are discussed together with the reactions of the ironmasters, locally and nationally, to the differing circumstances. Unfortunately data in the first quarter of the century is relatively limited but relevant information is much more abundant in the second quarter. The main original sources of data used in the section on demand are the Ebbw Vale Memorandum Book of 1796 to 1819, the Ebbw Vale Letter Book of 1824 to 1827, the Blaenavon Minute Book, *The Dowlais Iron Company Letters 1782-1860* and local newspapers especially the *Monmouthshire Merlin*. This newspaper has been used extensively with the intention of seeing the changing economic circumstances from the perspective of the local ironmasters.

The chapter also includes a discussion of the growth of iron output of the ironworks of the area. However before discussing the growth of iron output in this period it is necessary to take account of the changing view of the industrial revolution itself. The industrial revolution is now seen by some economic historians as broadly

based.[1] For example more stress is now being put on the role of commerce and financial services and it is now claimed that the largest fortunes made in the period were made by bankers and landowners not by the major industrialists of the cotton or the iron industries.[2] Even where technological change was considerable it did not apply in all regions of the country[3] but this does not mean that areas largely untouched by major industrial developments were any less involved in the industrial revolution as it is now perceived.

Thus an element of caution is necessary when discussing an area of the country that apparently experienced dramatic industrial growth before making a claim that consequently the area truly was exceptional for the industrial revolution period. However it is claimed that the North West Monmouthshire area was exceptional in that its growth of industrial output was in an area thinly populated prior to the industrial revolution and this meant that the ironmasters faced a whole range of problems in addition to those related to demand. Many of the industrialists in other areas and in other industries may not have faced some of these difficulties. It is for this additional reason that it is claimed that in general the ironmasters of the area were themselves exceptional.

With regard to source data the principal modern publication containing pig iron output data is Philip Riden and John G. Owen's *British Blast Furnace Statistics 1790-1980.*[4] There were no annual official returns of iron output until 1854 and so the estimates given by Riden and Owen were assembled from private surveys. There were sufficient numbers of these surveys for Riden and Owen to produce output figures for

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[1] Eric J. Evans, *The Forging of the Modern State, Early Industrial Britain 1783-1870*, Harlow, Essex, p 129.
[2] Evans, *The Forging of the Modern State, Early Industrial Britain 1783-1870*, pp 129-30.
[3] Pat Hudson, *The Industrial Revolution*, London, 1992, p 101.
[4] Philip Riden and John G. Owen, *British Blast Furnace Statistics 1790-1980,* Cardiff, 1995.

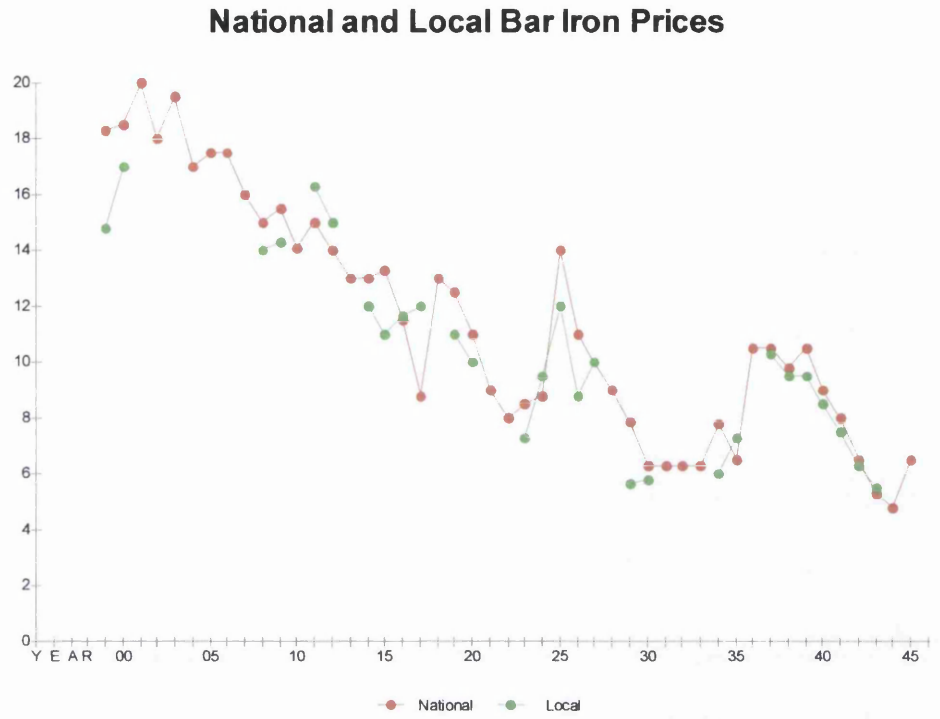
17 individual years from 1788 to 1852 inclusive.[5] Table 1.1 of their volume displays output of pig iron for Great Britain and for thirteen regions, South Wales being one of them. Hence there are no separate entries of iron output for Monmouthshire or for any individual ironworks in this publication. However there is a comprehensive source of iron output data for Monmouthshire and individual ironworks therein, Harry Scrivenor's *History of The Iron Trade* published in 1854.[6] Fortunately Scrivenor gives more detailed information about the counties of Monmouthshire and Glamorgan than other areas though his data for these counties was not actual iron output but iron sent down the Monmouthshire and Glamorgan canals. Scrivenor gives data for the Monmouthshire ironworks for years 1802 to 1840[7] and for Glamorgan ironworks for the years 1817 to 1840.[8]

3.2 The Economic Factors affecting the Iron Industry of the North West Monmouthshire area c.1800-1850.

This section outlines how the demand for iron fluctuated over the first half of the nineteenth century and how the local ironmasters attempted to deal with these changes in demand. The section also examines the principal effects of the demand movements on the local iron industry and highlights the main changes and developments that resulted. The fluctuations in demand for iron products and the continual trend towards lower prices within the British iron industry in the period 1799 to 1845 are seen clearly in Figure 3.1

[5] Riden and Owen, *British Blast Furnace Statistics 1790-1980,* pp ix to xxi.
[6] H. Scrivenor, *History of The Iron Trade,* London, 1854.
[7] Scrivenor, *History of The Iron Trade,* pp 127, 258.
[8] Scrivenor, *History of The Iron Trade*, pp 126, 257.

Figure 3.1



Sources. National prices, Alan Birch, *The Economic History of the British Iron & Steel Industry 1784 to 1879*, London, 1967, p 230. The sample of local prices (i.e. South Wales prices) shown were assembled from various original sources. Prices are in pounds per ton for the years 1799 to 1845.

Russia and Sweden had been the main exporters of bar iron until late in the eighteenth century when the Baltic War of 1788 harmed exports from these countries to the obvious benefit of the new British producers.[9] The British Government also aided British manufacturers by the imposition of duties on imported iron, the rate of such duties increasing steadily through the first quarter of the nineteenth century.

Table 3.1 Duties on Foreign iron 1782-1825 (per ton).

1782-1795	£2. 16. 2d
1796	£3. 1. 9d
1797	£3. 4. 7d
1798-1802	£3. 15. 5d
1803	£4. 4. 4 ½d
1804	£4. 17. 1d
1805	£5. 1. 0d
1806-1808	£5. 7. 5 ¾d
1809-1812	£5. 9. 10d
1813-1818	£6. 9. 10d
1819-1825 (British ships)	£6. 10. 0d
(foreign ships)	£7. 18. 6d

Source. Scrivenor, *History of The Iron Trade*, p128

[9] Chris Evans (ed.), *The Letter book of Richard Crawshay 1788-1797*, Cardiff, 1990, p 24.

By 1800 all seven of the group of ironworks of the North West Monmouthshire area under study were working concerns or, in the case of Tredegar ironworks, their establishment had been initiated. Hence these works were ready to take advantage of the generally favourable period for the iron industry to around 1815. Although a lack of information makes it difficult to measure the degree of this favourable period in the British iron industry during the Napoleonic Wars there is enough evidence to confirm that the period was generally one of boom with the price of bar iron remaining over thirteen pounds per ton.[10] As for the country as a whole 131 new blast furnaces were built in Britain between 1796 and 1810[11] and competition from abroad was falling away such that by the end of the Wars in 1815 imports of foreign iron were quantitatively insignificant.[12]

Although this early period was favourable for the iron industry the local ironmasters nevertheless found it necessary in January 1809 to meet at Newport and agree to support the price of iron fixed at the recent Gloucester meeting of British ironmasters. They were keen to keep the price at £14.5.0d per ton and agreed not to sell to any commission house who they thought would sell below this price.[13] Two years later the local ironmasters agreed again at Newport to fix their price for tram plates.[14] These examples indicate that the ironmasters soon found it desirable to work together on occasions when, as a group, they felt their businesses would suffer. In fact there are records of ironmasters' meetings held in South Wales to discuss prices from

[10] Alan Birch, *The Economic History of the British Iron & Steel Industry 1784-1879*, London, 1967, pp 20-1.
[11] Riden and Owen, *British Blast Furnace Statistics 1790-1980*, Tables 2.1 to 2.13.
[12] Roger Burt, 'The extractive industries', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860,* Cambridge, 2004, pp 430-1.
[13] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, 13 January 1809.
[14] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, 2 January 1811.

1808 through to the 1820s.[15] The meetings were attended by the ironmasters themselves, almost a prerequisite for decisions to be made at this time. The ability of the ironmasters to work together for particular purposes even though they were also competitors was to be a major characteristic of the relationship between the local ironmasters throughout the first half of the nineteenth century.

Unfortunately for the British iron industry the years following the end of the Napoleonic Wars saw a depression in the industry as the price of English merchant bar iron fell from £13.5.0d per ton in 1815 to as low as £8.15.0d in 1817.[16] This change in economic climate was reflected in the Ebbw Vale Company's current account, which more than halved from 1814-15 to 1816-17.[17] It was in this period that perhaps the most dramatic change in the ownership of one of core ironworks took place. The Sirhowy ironworks had been run jointly with Tredegar ironworks since the construction of the latter. The Sirhowy lease was due for renewal in 1818 but some years earlier the Harford partnership of Ebbw Vale ironworks had acquired the Sirhowy lease. A dispute arose over new lease terms and the result was that ownership of the Sirhowy works transferred to the Ebbw Vale partners.[18] Communication between the two works, Ebbw Vale and Sirhowy, was difficult in this early period such that in 1832 the Ebbw Vale Company was forced to construct a tunnel through the mountain connecting the Sirhowy works with Ebbw Vale.[19] This dispute over the

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[15] Madeleine Elsas (ed.), *Iron in the Making: Dowlais Iron Company Letters 1782-1860*, Glamorgan County Council, 1960, pp 1-17; GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819; GRO. D.2472.2. Ebbw Vale Letter Book 1824-1827.
[16] Birch, *The Economic History of the British Iron and Steel Industry 1784-1879*, p 230.
[17] F. J. Ball, Essays on the History of Ebbw Vale. Volume 1 Industrialisation, Ebbw Vale, 1971, (unpublished), pp 233-4.
[18] Arthur Gray-Jones, *A History of Ebbw Vale*, Risca, 1970, p 49; Oliver Jones, *The Early Days of Sirhowy and Tredegar*, Tredegar, 1969, pp 46-9; John Lloyd, *The Early History of the Old South Wales Ironworks (1760-1840)*, London, 1906, p 149; Ebbw Vale Works Archive, Document No. 146, Deed of Assignment of Sirhowy Iron Works to the Harford Company, 14 November 1822.
[19] Oliver Jones, 'The Sirhowy-Ebbw Vale Tunnel' in *Presenting Monmouthshire, The Journal of Monmouthshire Local History Council*, No. 31, (Spring 1971), pp 21-5.

Sirhowy works was the only major one between the ironworks of the area throughout the first half of the nineteenth century.

The uncertainty for the iron trade continued in 1819, when the ironmasters nationally vigorously opposed a tax on coal at the pithead which they saw as a tax on iron[20] and it was not until 1824 that there was evidence of a substantial improvement in the iron market. The meetings to fix prices continued but it seems that the meetings were rarely attended by all the relevant ironmasters though on balance it does seem that decisions made were generally followed but it is possible that by the middle or late 1820s meetings aimed at fixing prices became less successful. As early as 1818 William Crawshay of the Cyfarthfa ironworks in Merthyr had unilaterally dropped his price for bar iron at Cardiff from £12 to £11 and the meeting held at Merthyr on 9 May 1818 simply agreed to follow him[21] and it was reported in the Ebbw Vale Memorandum Book on 28 June 1824 that regular quarterly meetings of the Trade had been abandoned though an entry for 12 July of the same year stated that '...the usual Quarter day meeting of the iron trade took place yesterday at Newport at which such a small number of the Trade attended...'.[22] It is likely that as the industry grew and particular ironmasters became more powerful that the regular meetings began to lose significance at least for price fixing. There is evidence of co-operation between ironmasters of different regions and this was done sometimes via letters. For example W. Pinton, chairman of the Staffordshire Ironmasters wrote to Guest and Company of Dowlais on 2 March 1818 indicating that an advance of 15/- a ton on bar iron and 25/- per ton on rods had been declared in Staffordshire but then abandoned because there

[20] Elsas, *Dowlais Iron Company Letters 1782-1860*, Minutes of the Meeting of the Iron Trade of South Wales, at Castle Inn, Merthyr, 26 January 1819, pp 215-6; *Monmouthshire Merlin*, 20 February 1819.
[21] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, 9 May 1818.
[22] GRO. D.2472.2. Ebbw Vale Letter Book 1824-1827, 28 June 1824, 12 July 1824.

was no corresponding advance at Cardiff and London.[23] This period from 1815 to 1823 or very early 1824 could be seen as an uncertain one with the price of iron falling to as low as £8 per ton in 1822.

The situation was to change in 1824 and demand for iron was high such that the Ebbw Vale ironworks for example was turning down orders for pig iron.[24] The ironmasters there even had to refuse to sell pig iron to such customers as David Mushet, the eminent metallurgist at Coleford.[25] The price of merchant bar iron nationally reached a peak of £14 in 1825 and in June the Ebbw Vale Company had to inform the Neath Abbey Iron Company that they had no foundry pig iron to spare.[26] This refusal or inability to sell pig iron was partly because the local ironworks by this time were specialising in the production and sale of wrought iron in the form of bars. Therefore in times of high demand for iron generally works like Ebbw Vale were using most of the pig iron they produced for their own purposes, that is largely for the manufacture of bar iron.

It was in this favourable economic period that ironworks were established further down the valleys from the core group of works of the study. In the Ebwy Fach valley below Nantyglo, Coalbrookvale ironworks was set up in 1823 and the Blaina ironworks in 1825. While in the Afon Lwyd valley below Blaenavon, the Pentwyn ironworks was established in 1825. In addition, the Bute works was established in the same year near the existing Rhymney ironworks on the Glamorgan/Monmouthshire

[23] Elsas, *Dowlais Iron Company Letters 1782-1860*, W. Pinton, Chairman of Staffordshire Ironmasters to Guest and Company, Dudley, 2 Mar 1818.
[24] GRO. D.2472.2. The Ebbw Vale Letter Book 1824-1827.
[25] GRO. D.2472.2. The Ebbw Vale Letter Book 1824-1827, 4 September 1824.
[26] GRO. D.2472.2. The Ebbw Vale Letter Book 1824-1827, 17 June 1825.

border in the nearby Rhymney valley.[27] This rush of new works led to the possibility that an oversupply situation would result at the next fall in demand.

The products sold in this boom period were still mainly bar iron products, the production and sales of wrought iron rails had still not yet generally got under way. The Ebbw Vale Company sold bar iron in a variety of shapes and sizes plus items such as nail rods and cable bolts.[28]

The price of iron declined gradually after 1825 and by the early 1830s iron prices were at their lowest level of the century so far. Some ironmasters, such as William Crawshay of Cyfarthfa ironworks in Merthyr, were strong enough financially to apply a policy of stocking of iron when demand fell[29] but most of the ironmasters of the region did not have this luxury and would had to have considered cutting supply and/or reducing prices further. Crawshay was often out of step with the other ironmasters on the north east part of the South Wales coal field and in 1830 he refused to sell bar iron below £6 whilst others, such as the Baileys of Nantyglo and the British Iron Company at Abersychan continued to sell at £5 10s.[30] Undoubtedly Crawshay was greatly assisted by the Crawshay family's London merchant house which could take iron from Cyfarthfa in depressed times.[31]

This period was difficult for the Monmouthshire ironmasters although it saw the start of the production of wrought iron rails and the Ebbw Vale Company obtained contracts in 1828 to supply these rails for the Stockton and Darlington Railway.[32] One of the main customers of the Monmouthshire ironmasters was the Monmouthshire

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[27] Riden and Owen, *British Blast Furnace Statistics 1790-1980,* pp 1-31 and John Priyeane's Map of the Ironworks and Collieries in the Counties of Monmouth and Glamorgan, Newport, 1843
[28] GRO. D.2472.2. The Ebbw Vale Letter Book 1824-27, Letter to Samuel White, Waterford, 24 August 1824, Price list.
[29] John P. Addis, *The Crawshay Dynasty*, Cardiff, 1957, pp 71-5.
[30] Addis, *The Crawshay Dynasty*, p 75.
[31] Addis, *The Crawshay Dynasty*, p 21.
[32] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History,* Cardiff, 1987, p 67.

Canal Navigation Company who advertised regularly for supplies of tramplates.[33] Despite regular orders of these types the iron trade remained in a depressed state and in February 1831 some of local ironmasters complained to the proprietors of the Monmouthshire Canal company about their tonnage rates claiming that 'those who are embarked in iron & coal concerns painfully feel, not only that they are deriving no profit therefrom, but that their capitals are dwindling away'.[34] Some contemporary writers however thought that the ironmasters themselves had contributed to the depression by extending the supply excessively such that prices were forced down.[35] There is some evidence for this for in 1824/5 there were around 185 furnaces in blast in Britain, the pig iron price being about £3.13.0d. However in August 1832 there were as many as 252 furnaces in blast and the pig iron price was lower at about £2.17.0d.[36]

In August 1831 the Staffordshire ironmasters wanted to reduce production provided the South Wales producers would do likewise but on this occasion it appears they feared that William Crawshay I of Cyfarthfa and Crawshay Bailey of Nantyglo ironworks might not go along with the plan.[37] Some of the ironmasters, those amongst the strongest financially and possibly amongst the most single minded, were reluctant to cooperate with these supply cutting schemes. A letter written by Crawshay's son, William Crawshay II, confirmed this as he stated that his father and Bailey felt strong enough to act independently if they saw fit.[38] Another example of this independence of mind seems to be indicated in a letter from a Staffordshire ironmaster to J. J. Guest

[33] *Monmouthshire Merlin*, 6 June 1829, 17 April 1830, 23 April 1831, 19 May 1832, 1 December 1832.
[34] *Monmouthshire Merlin*, 12 February 1831, Letter to the proprietors of the Monmouthshire Canal from Thomas Prothero.
[35] *Monmouthshire Merlin*, 29 October 1831 and 28 September 1832.
[36] *Monmouthshire Merlin*, 29 September 1832, The Iron Trade.
[37] Elsas, *Dowlais Iron Company Letters 1782-1860*, Michael Grazebrook to J. J. Guest, Worcestershire, 26 July 1831, p 9.
[38] Elsas, *Dowlais Iron Company Letters 1782-1860*, William Crawshay Junior to J. J. Guest, Cyfarthfa, 23 Sept 1831, p 9.

of Dowlais when he wrote 'We are also informed that your house in particular is guilty of adding to the great mischief already existing in Wales, viz of increasing your establishment by building 4 new furnaces at the present moment'.[39]

The economic climate for the iron industry in the country did not improve during the next few years and in August 1832 a deputation of iron masters from the Staffordshire and Shropshire districts had an interview with Earl Grey and Lord Althorp at the Treasury on the subject of the depressed state of the iron industry. The ironmasters blamed the government's attempts to enforce the restoration of the gold standard to the ancient basis of £3.17.10½d per ounce.[40] In 1833 some European governments were seen in some quarters as adding to the difficulties for British iron manufacturers by increasing import duties on British iron, the biggest complaint being against the Hanoverian Government's imposition of £3.6.0d per ton on imported iron.[41] There were orders for malleable iron rails in 1833 such as those for the Bodmin and Wadebridge railway and the Stanhope and Tyne Rail Road Company and there were orders at Liverpool for rails for the United States.[42] It was not the lack of orders that was the problem in 1833 but the 'ruinous price' as the trade saw it.[43] Probably with the aim of improving the demand situation the local ironmasters themselves took a positive role in some of the railway enterprises, most of the Monmouthshire and Merthyr ironmasters being on the committee to plan for a railway from South Wales to Gloucester to join with projected lines from Bristol to London.[44]

The effects of this continued period of uncertainly and low iron prices were felt in the North West Monmouthshire area. In January 1833 the Beaufort ironworks

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[39] Elsas, *Dowlais Iron Company Letters 1782-1860*, Bagnall & Sons (John and Thomas Bagnall) to Guest, Gold Hill Iron Works, West Bromwich, Staffs, 4 April 1835.
[40] *Monmouthshire Merlin*, 11 August 1832.
[41] *Monmouthshire Merlin*, 9 March 1833.
[42] *Monmouthshire Merlin*, 9 February 1833, 18 May 1833, 27 April 1833.
[43] *Monmouthshire Merlin*, 9 March 1833.
[44] *Monmouthshire Merlin*, 19 October 1833.

was sold to the Baileys, ironmasters of the neighbouring Nantyglo works for £45,000[45] indicating that Messrs. J. and C. Bailey were in a relatively strong financial position compared with some of the other ironmasters. In July of the same year the Clydach ironworks was put up for sale though the sale was unsuccessful.[46] The original ironmaster of the Clydach works, Edward Frere, had left the works the previous year after more than thirty years with the company leaving John Powell as the active proprietor.[47] The Blaenavon ironworks proprietors also felt it necessary to put the company on the market in November 1833[48] though the company was finally sold as a joint stock company[49] a few years later.

The Rhymney ironworks was up for sale in May 1835[50] and like Blaenavon it became a joint stock company after it was sold. Railway activity continued to increase during the year such that in November there was concern at railway speculation in the country.[51] By the end of 1835 the market had become buoyant especially the export market with many orders having been received by British manufacturers for railroad iron from Europe, the United States and elsewhere abroad.[52] The improved situation for manufacturers continued throughout 1836 with domestic demand for rails, chains and carriages prominent adding to foreign demand especially that from the United States.[53] This year saw the flotation prospectuses for the Blaenavon ironworks, the Varteg ironworks and that for the Monmouthshire Iron and Coal Company that is the

[45] GRO. D.397.1679. Sale of Beaufort Ironworks to J. and C. Bailey, 17 January 1833.
[46] GRO. D.591.19.384. Particulars of freehold and leasehold estate comprising the Clydach Iron Works, South Wales, 17 July 1833.
[47] GRO. D.591.23.46. Clydach Ironworks, 19 January 1832.
[48] GRO. D.7.194. Sale document, Blaenavon ironworks, 22 November 1833.
[49] Joint stock iron companies are discussed in Chapter 5.
[50] *Monmouthshire Merlin*, 23 May 1835.
[51] *Monmouthshire Merlin*, 21 November 1835.
[52] *Monmouthshire Merlin*, 19 December 1835, 26 December 1835, The Iron Trade.
[53] *Monmouthshire Merlin*, 3 September 1836, The Iron Trade.

Victoria ironworks[54] which was situated a mile or two south of Ebbw Vale. As earlier, it appears that the local iron industry was expanding its supply side in boom times.

The boom however was short lived and by the end of 1836 the market was less certain such that some ironmasters in South Wales, Shropshire and Staffordshire reduced their production of iron in an attempt to maintain prices.[55] In South Wales dramatic action was agreed at Newport and the ironmasters decided to reduce production by 20 percent. To achieve this they agreed to blow out furnaces and reduce production on the remaining ones until the 20 percent figure was attained. The plan was to last for one year. This agreement had the effect that the largest ironworks such as Dowlais and Cyfarthfa had to blow out three furnaces while the Ebbw Vale/Sirhowy and the Nantyglo/Beaufort groups had to put two out of action with the remainder of the works closing down one furnace each.[56] There can be little doubt that this agreement held as it accepted that one ironmaster would inspect the books of another to ensure that the agreed reduction had been done. Samuel Homfray of the Tredegar ironworks was requested to arrange for these measures to be carried out and a copy of the agreement was to be sent to the respective chairmen of the Shropshire, Staffordshire, Scottish and North Wales ironmasters' meetings.[57] The Blaenavon directors reported to their shareholders that this agreement to reduce production by 20 percent and the consequent blowing out of one furnace had caused a loss of up to £800.[58] To illustrate how this exceptional agreement was to be followed through, Table 3.2 shows how the ironmasters agreed each particular ironworks in South Wales was to conform to the agreement by shutting down furnaces.

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[54] *Monmouthshire Merlin*, 28 May 1836, 23 July 1836, 20 August 1836.
[55] *Monmouthshire Merlin*, 10 December 1836, 7 January 1837, The Iron Trade.
[56] Elsas, *Dowlais Iron Company Letters 1782-1860*, Meeting of Ironmasters, King's Head, Newport, 3 December 1836. pp 12-13.
[57] Elsas, *Dowlais Iron Company Letters 1782-1860*, Samuel Homfray to Guest Lewis and Co, 4 April 1837, p 13.
[58] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book, 15 Sept 1837.

Table 3.2. Agreement of the ironmasters of South Wales to reduce their production of pig iron. Schedule of furnaces to be blown out. (to be carried out on or before the 15th December 1836).

Ironmasters.	**Ironworks.**	**No. of Furnaces To be blown out.**
Thomas Forman	Penydarren, Merthyr	1
Samuel Homfray	Tredegar, Monmouthshire	1
Thomas Guest	Dowlais, Merthyr	3
Summers Harford	Ebbw Vale and Sirhowy	2
William Wood	Abersychan, Monmouthshire	1
L.Powell	Clydach, Breconshire	1
Thomas Hill	Blaenavon, Monmouthshire	1
James Hunt	Pentwyn, Monmouthshire	1
J. Russell	Blaina, Monmouthshire	1
W.Crawshay	Cyfarthfa, Merthyr	3
R.Fothergill	Aberdare, Glamorgan	1
G.S.Kenrick	Varteg, Monmouthshire	1
Thomas Foreman	Rhymney	1
J. & C. Bailey	Nantyglo and Beaufort	2
R. & C. Hill	Plymouth, Merthyr	1
John Crane	Yniskedwyn, Glamorgan	1

Source Elsas, *Dowlais Iron Company Letters 1782-1860*, Minutes of Ironmasters' Meeting, King's Head Inn, Newport, 3 December 1836. Four other ironworks including the Coal Brook Vale works near Nantyglo and the Neath Abbey Company were to reduce their production by 20 percent.

In May 1837 the *Sheffield Mercury* reported that the iron market was still basically uncertain[59] but by August demand had picked up so much that it was reported in Newport that 'The demand for iron of all descriptions made in this neighbourhood has become unprecedently great: so much so that many of the makers have determined to close their order-books and reject orders at any price'.[60]

The demand for iron mostly in the form of rails for domestic and foreign customers, particularly from the United States,[61] held up and prices were generally maintained at around £10 per ton for bar iron across the country during 1838 to 1840. Despite the relatively sound position of the coke iron trade the remaining charcoal iron industry in Monmouthshire continued its decline and the Abbey Tintern Iron and

[59] *Monmouthshire Merlin*, 13 May 1837, The Iron Trade, from *Sheffield Mercury*.
[60] *Monmouthshire Merlin*, 26 August 1837, The Iron Trade.
[61] *Monmouthshire Merlin*, 28 September 1838.

Wire Works was put up for sale in February 1838.[62] In March 1839 tenders were invited by the Severn and Wye Railway and Canal Company and by the end of this year the iron trade was viewed as an exception to the general state of stagnation that affected other branches of British industry.[63] It was in this relatively favourable period that three further ironworks were erected in Monmouthshire. The Golynos works below Blaenavon, the Cwm Celyn works below Nantyglo and the Victoria works below Ebbw Vale were all established in 1839.[64]

The situation in the iron industry deteriorated in 1841. The Blaina and Cwm Celyn ironworks were to be formed into a joint stock company and there were periodic sales of shares in the concern in this year. The depression had affected the nearby Coalbrookvale ironworks though in February 1841 a proposed sale of the works was cancelled as the ironmasters had managed to pay the amount of the execution and distress order placed on the company.[65] In October the committee set up to look into the affairs of the British Iron Company, that is Abersychan ironworks, produced a plan to dissolve the company and replace it with a newly formed one[66] and in the following month the Victoria ironworks was put up for sale.[67] 1841 was thus a troublesome year for the Monmouthshire iron trade and by October the price of bar iron had fallen to £7 per ton.[68]

1842 was also a very difficult year for the ironmasters if not worse than the previous year and another agreement to reduce production was put into effect. The directors of Blaenavon ironworks reported to the shareholders in April that only four

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[62] *Monmouthshire Beacon,* 24 February 1838.
[63] *Monmouthshire Merlin*, 28 December 1839.
[64] Riden and Owen, *British Blast Furnace Statistics 1790-1980,* pp 1-31 and John Priyeane's *Map of the Ironworks and Collieries in the Counties of Monmouth & Glamorgan*, Newport, 1843.
[65] *Monmouthshire Merlin*, 6 February 1841.
[66] *Monmouthshire Merlin*, 2 October 1841.
[67] *Monmouthshire Merlin*, 6 November 1841.
[68] *Monmouthshire Merlin*, 2 October 1841, Metal Prices.

furnaces were in blast in accordance the resolution passed by the ironmasters.[69] The core study group of ironworks fared better than the newer works in that in March of 1842 31 of 38 furnaces were in blast in the former compared with only 17 out of 30 in blast amongst the newer Monmouthshire ironworks.[70] In South Wales as a whole only 112 of the 162 blast furnaces were actually in blast in this month and the Yorkshire and Derbyshire ironmasters agreed to reduce production in May.[71] It is probably this agreement made by ironmasters right across England, Wales and Scotland to reduce production by 25 percent that a few of the most powerful ironmasters such as William Crawshay of Cyfarthfa, Crawshay Bailey of Nantyglo and J. Dixon in Scotland failed at least in part to comply with.[72] Nevertheless it appears that the ironmasters went from relatively informal attempts to reduce production in times of falling demand to quite precise agreements where the reduction percentage was stated. It seems also that there was a vetting arrangement in place to ensure compliance even if one or two of the big ironworks were excluded from time to time. It demonstrates a remarkable degree of co-operation often right across Britain though the agreements were essentially voluntary with no system of sanctioning defaulters, as far as one can tell. Further it does seem that agreements to reduce production did work at least at times. The *Monmouthshire Merlin* of 7 January 1832 reported that at the impending quarterly meeting of the ironmasters an advance in price was anticipated and that this expected advance in price originated entirely from a decrease in the production and not from any alteration in state of the demand.[73]

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[69] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book, 22 April 1842.
[70] *Monmouthshire Merlin*, 12 March 1842.
[71] *Monmouthshire Merlin*, 12 March 1842, from *Mining Journal.*
[72] Elsas, *Dowlais Iron Company Letters 1782-1860*, Harford, Davis and Co. from Bristol to Sir John Guest, January 1842, p 14.
[73] *Monmouthshire Merlin*, Saturday 7 January 1832.

Shutting down furnaces was a major exercise for the ironmasters and inevitably when demand fell and especially when it fell suddenly they would have been left with stocks of iron that would have had the effect of further depressing the price. The concentration on bar iron by the South Wales ironmasters introduced a further hazard as stocks of iron built up as bar iron, that is wrought iron sold in bars, is more prone to rusting than pig iron and rusting would depress the price more.[74] It would not be surprising therefore that the ironmasters would be most reluctant to hold on to these stocks waiting for better times. The ironmasters' inclination would have been to get rid of surplus iron as soon as they could apart, possibly at times, for one or two of the soundest manufacturers financially.[75]

The price of bar iron continued to fall as the depression deepened in 1842 and in June the *Monmouthshire Merlin* reported distress amongst the people of the hills of North Monmouthshire and reported 'The Abergavenny workhouse has its full complement of paupers and the neighbouring iron masters, with the exception of the Messrs. Bailey [of Nantyglo ironworks] are discharging their workmen continually and those remaining are little better than half employed'.[76] The price of bar iron stabilised in the second half of the year at around £5.10.0d per ton.[77] The Victoria ironworks was put up for sale again in August 1842[78] and production had been suspended at the Varteg ironworks near Blaenavon as in January 1843 engines, machinery, coal and mine (iron ore) trams and other items were advertised for sale.[79] The *Mining Journal* in February 1843 reported an eminent ironmaster as describing

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[74] Addis, *The Crawshay Dynasty*, p 72.
[75] Evans, *The Letterbook of Richard Crawshay 1788-1797*, Richard Crawshay to William Stevens and William Crawshay, 1 September 1791, p 115; Elsas, *Dowlais Iron Company Letters 1782-1860*, George Brewer to J. J. Guest, Coalbrook Vale, Shropshire, 23 September 1831.
[76] *Monmouthshire Merlin*, 11 June 1842.
[77] *Monmouthshire Merlin*, 23 July 1842, 24 December 1842, 7 January 1843.
[78] *Monmouthshire Merlin*, 20 August 1842.
[79] *Monmouthshire Beacon*, 7 January 1843, Varteg Iron Works, Sale by Mr H .M .Partridge.

the current price of iron as ruinous, adding 'at the present time, almost any description of iron may be purchased at less than its cost to the manufacturer'.[80] Bar iron prices reached as low as £5.5.0d in the spring of 1843 and in June a potential disaster hit the people of North West Monmouthshire with the failure of the Harford, Davies Partnership proprietors of the Ebbw Vale and Sirhowy ironworks. The *Monmouthshire Merlin* commented on 16 June 1843 that the ruinous state of the iron trade in Britain that had already marked the failure of some ironworks in other areas has now finally taken its toll on the population of 'the Hills' with the stoppage of the Sirhowy and Ebbw Vale works.[81] The failure of these two works would have been a disaster for the area with about 3,400 people employed and nearly 11,000 persons dependent on these concerns. Fortunately it was decided at the bankruptcy court at Bristol, on the advice of Samuel Homfray of the Tredegar ironworks, himself a magistrate, that the works should be carried on as usual.[82] The creditors of the Ebbw Vale Company met in August and agreed to press for the works to continue until a further decision might be arrived at,[83] the works thus being saved.

The leading article in the *Monmouthshire Merlin* in July 1843 put a lot of the blame for the present troubles at the door of the Government by keeping the corn laws to the benefit of the landlords to the detriment of their tenants, by laying an export duty on coal and by rejecting offers of free trade with America so losing trade of 100,000 tons of iron.[84] Also in July 1843 the *Mining Journal* published an article with suggestions on how the iron industry might widen demand in this depressed time for the industry. The main suggestion was for an institution to be set up representing the

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[80] *Monmouthshire Merlin,* 4 February 1843, from *Mining Journal.*
[81] *Monmouthshire Merlin,* 16 June 1843, Failure of Messrs. Harfords and Davies.
[82] *Monmouthshire Beacon,* 24 June 1843, The Bankruptcy of the Ebbw Vale and Sirhowy Iron Company.
[83] *Monmouthshire Beacon,* 19 August 1843, Bankruptcy of Harford, Davies and Co.
[84] *Monmouthshire Merlin,* 1 July 1843, Leader article.

iron industry in Staffordshire, South Wales and Scotland aimed at publicising the many uses to which iron was and could be put.[85]

In the second half of 1843 the depression began to ease slightly despite the fall in the price of bar iron to £4.10.0d per ton in July and a deputation from the South Staffordshire ironmasters indicated at a meeting with the Sir Robert Peel, Mr Gladstone and other ministers in the same month that they had no option but to cut the wages of their colliers further.[86] An article in *The Times* newspaper however put the blame for the troubles in the iron trade firmly on the ironmasters of the country for over production and 'gambling competition for speculative advantage'.[87] The *Monmouthshire Beacon* saw the iron trade of mid 1843 as a competition between South Wales, Staffordshire and Scotland and believed that with its existing contracts South Wales should survive in the long run better than Staffordshire.[88] Fortunately the bar iron price recovered to £5.5.0d per ton by October and the Stafford iron trade reported demand as sound in the same month but an expected further advance in price failed to materialise by the end of the year.[89]

1844 was a year of consolidation for the ironmasters as bar iron prices and demand for iron improved a little but it was not until the end of the year that the situation began to change appreciably. The situation for the people of North West Monmouthshire was poor in the early part of the year with the Ebbw Vale and Sirhowy works being put up for sale by the assignees in January to be followed in the same month by the Cwm Celyn and Blaina ironworks.[90] These latter works were

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[85] *Monmouthshire Merlin*, 22 July 1843, Suggestions to ironmasters on increasing the demand for iron, from *Mining Journal.*
[86] *Monmouthshire Merlin*, 29 July 1843, The South Staffordshire Iron and Coal Trade, from a *Times* Correspondent.
[87] *Monmouthshire Beacon*, 22 July 1843, reproduced article from *The Times.*
[88] *Monmouthshire Beacon*, 12 August 1843.
[89] *Monmouthshire Merlin*, 4 November 1843, 11 November 1843, Present state of Staffordshire Iron Trade, 16 December 1843, The Iron Trade.
[90] *Monmouthshire Merlin*, 13 January 1844, 27 January 1844.

eventually bought by Mr Stodhart of Bath and other shareholders.[91] There was some very welcome news in March when it became known that the famous family of the Darbys of Coalbrookdale in Shropshire had bought the Ebbw Vale and Sirhowy ironworks as going concerns[92] fully justifying the decision taken in the previous year to continue both works. A shortage of ironworks firemen in late April indicated that a recovery of some sort applied and in July it was reported that the ironworks of Monmouthshire had obtained orders for rails from German businessmen in addition to further rail orders for the United States.[93] The price of bar iron was still around £5.15.0d to £6.5.0d per ton in the country through the second half of the year when in November there was an explosion of railway prospectuses hitting the press.[94]

1845 was a year of increasing prices and demand such that the price of bar iron nationally moved from around £6-10-0d to £6-15-0d in January to around £10 to £11 by the end of the year.[95] The year was one of extensive railway activity with the consequent demand for rails[96] though the ironworks of England and Wales were facing increased competition from the Scottish companies especially for sales of pig iron. In June of the year there were 99 blast furnaces in Scotland with another twelve under construction.[97] The successful Nantyglo ironworks launched one the largest sheet rolling machines in South Wales in January at a cost of at least £25,000[98] indicating the determination of the ironmasters to make the most of the better climate for the iron industry. In fact the industry was so buoyant in the region at this time that all stocks would be used up together with new production to satisfy orders already

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[91] *Monmouthshire Merlin*, 27 July 1844.
[92] *Monmouthshire Merlin*, 30 March 1844; Ebbw Vale Works Archive, Document number 225, 11 November 1845.
[93] *Monmouthshire Merlin*, 27 April 1844, 6 July 1844, 27 July 1844.
[94] *Monmouthshire Merlin*, 10 August 1844, 2 November 1844, 23 November 1844.
[95] *Monmouthshire Merlin*, 4 January 1845, 18 January 1845, 11 October 1845, 29 November 1845.
[96] *Monmouthshire Merlin*, 13 September 1845, 25 October 1845.
[97] *Monmouthshire Merlin*, 5 July 1845, The Scotch Pig Iron Trade.
[98] *Monmouthshire Merlin*, 11 January 1845.

taken.[99] The Railway Department in Whitehall announced that they had approved a number of railway developments in South Wales[100] and the price of bar and rail iron reached around £8-10-0d to £9 by March 1845.[101] In the second half of the year railway prospectuses were still being published at a fast rate[102] indicating a huge demand for rails but the price of iron did not rise dramatically suggesting considerable stocks were still in existence or there was great competition from other iron producing regions of the country.

The following year started on an optimistic note with the strong possibility that British iron companies would have much greater access to the French markets for sales of rails there and with 2,400 miles of railways having received the Royal Assent in Britain in the last session it was felt that pig iron prices should advance in the Spring.[103] However in March an article in the *Mining Journal* indicated that anthracite coal was being used by an American works using hot blast to make pig iron and warned British makers of the possible competition that might result.[104] In general 1846 was a prosperous year for British manufacturers with bar iron prices holding at between £9 and £10 per ton. The *Monmouthshire Merlin* reported further complaints about the duties imposed by the French government on imported iron,[105] the Midlands ironmasters reported that American orders were holding up[106] and domestic demand was steady with further railway prospectuses published.[107]

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[99] *Monmouthshire Merlin*, 18 January 1845.
[100] *Monmouthshire Merlin*, 15 February 1845, Railways.
[101] *Monmouthshire Merlin*, 15 March 1845, Metal Prices.
[102] *Monmouthshire Merlin*, 20 September 1845, 27 September 1845, 25 October 1845, 22 November 1845.
[103] *Monmouthshire Merlin*, 10 January 1846, The Prospects of the Iron Trade for 1846, from a writer to the *Mining Journal*.
[104] *Monmouthshire Merlin*, 28 March 1846, The Iron Trade – England and America, from *Mining Journal*.
[105] *Monmouthshire Merlin*, 26 September 1846.
[106] *Monmouthshire Merlin*, 12 December 1846, reports from Birmingham.
[107] *Monmouthshire Merlin*, 14 November 1846.

It was reported in January 1847 that England (and Wales) would need to supply iron for 12,314 miles of rails based on railroads now contemplated, 7,494 miles of which were for this country[108] and so the year commenced favourably for the ironworks of Britain. Bar iron prices held up generally well during the year averaging around £10.0.0d in the early months to around £9.10.0d to £9.15.0d near the end of the year when prices started to decline ending the year at £8.15.0d per ton of bar iron.[109] The Monmouthshire ironworks were still not working to capacity in this year with around 84 percent of the furnaces in blast, on average.[110] The advances in prices of provisions for the work people had for some time been a real difficulty for the working classes and in February the ironmasters of the Beaufort works, Messrs. Bailey, granted an addition of 10 percent to their men as a result of this problem.[111] However 1847 saw a number of strikes mostly involving colliers[112] and in anticipation of such strike action by the workpeople the ironmasters of South Wales met to discuss and adopt measures of mutual protection against the strikers.[113]

The decline in national iron prices continued in 1848 such that in January the trade in South Staffordshire and Shropshire was seen as in a depressed state. 58 blast furnaces out of 137 were out of blast in that part of the country and the iron trade was being compared to the last major depression of 1843 when 69 blast furnaces out of 141 were not running.[114] The national prices fell steadily from around £8-10-0d in January to around £6-15-0d per ton for bar iron late in the year[115] and some areas were again threatened by strikes as the ironmasters attempted to lower the men's wages as

[108] *Monmouthshire Merlin*, 9 January 1846.
[109] *Monmouthshire Merlin*, Metal prices, weekly reports.
[110] Riden and Owen, *British Blast Furnace Statistics 1790-1980*, pp 1-31.
[111] *Monmouthshire Merlin*, 13 February 1847.
[112] *Monmouthshire Merlin*, 17 April 1847, 8 May 1847, 12 June 1847.
[113] *Monmouthshire Merlin*, 3 April 1847.
[114] *Monmouthshire Merlin*, 8 January 1848, 15 January 1848, The Iron Trade.
[115] *Monmouthshire Merlin*, 8 January 1848, 11 November 1848, Metal prices.

the prices fell. Tredegar was hit by a strike in February as the depression deepened.[116] It is clear that the iron trade was badly affected by the depressed state of the railway market at this time.[117] There was however some good news from Tredegar in mid 1848 as the new mill being launched there would provide work for an extra 1,000 people[118] once trade improved. The price of bars in Wales was as low as £5-5-0d in December and the year ended on a bad note with 300 colliers and miners being laid off at Rhymney ironworks due to the depression in the iron trade.

1849 was an even worse year for the iron manufacturing companies of Britain. Early in the year the Welsh and Scottish iron makers seemed to have fared rather better than the West Midlands manufacturers and it was reported in February that the Welsh houses had taken up the major share of large orders taken at Liverpool.[119] In March an improvement was expected and some leading houses announced an advance in price of bar iron of £1 but there was also concern expressed that any increase in production could be improvident.[120] By May it was clear that the supposed improvement was not real and stocks were accumulating at some ironworks in the country with bar iron prices around £7-10-0d nationally. There was concern at the uncertainty that existed in the home railway markets and at the depression of foreign trade being experienced.[121] The South Staffordshire masters were concerned that the Welsh houses were selling well below the nominal rates and they resolved to lower their prices but they did not wish to enter into 'ruinous competition' with other districts such as South Wales and Scotland.[122] Bars were being sold at as low as £5 per

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[116] *Monmouthshire Merlin*, 19 February 1848.
[117] *Monmouthshire Merlin*, 21 October 1848, Quarterly Meeting of the West Midlands Ironmasters in Wolverhampton.
[118] *Monmouthshire Merlin*, 17 June 1848, Tredegar Ironworks.
[119] *Monmouthshire Beacon*, 17 February 1849.
[120] *Monmouthshire Beacon*, 3 March 1849, The Iron Trade.
[121] *Monmouthshire Beacon*, 5 May 1849, 19 May 1849, The Iron Trade.
[122] *Monmouthshire Beacon*, 7 July 1849, 14 July 1849, from *Aris's Birmingham Gazette*.

ton in July although there was a slight improvement by August and in September it was reported that there was a fall in production by Welsh manufacturers partly as a consequence of the cholera epidemic in the region.[123] The Staffordshire ironmasters were concerned to get their costs nearer to those of other iron districts such as South Wales, Scotland and the North of England.[124] The Monmouthshire ironworks were operating at about 80 percent capacity throughout the year, on average.[125] The average price of bar iron nationally was about £5.15.0d late in the year and the uncertain conditions continued throughout 1850.[126]

There are two main features that emerge from this account, the continual fluctuations in the level of demand for iron and the overall reduction in the price of iron over the fifty-year period. The fluctuations in demand for iron must have been a major headache for the ironmasters of the country as a whole, the Monmouthshire ironmasters being no exception. The demand changes were generally due to factors both domestic and foreign, in particular variations in demand for ordnance in the early years and rails in the second quarter of the century. Wrought iron rails overtook bar iron as the main product for the Monmouthshire ironworks for much of the 1830s and 1840s and therefore the local ironmasters were particularly vulnerable to the peaks and troughs of the railway industry. As soon as the ironmasters increased supply to meet increasing demand the market would turn around and they would be left in an oversupply situation. They were then faced with the options of either keeping stocks which was the less favoured option or selling at lower prices. In fact most local ironmasters probably did a mixture of both plus immediate action to cut supply and/or

[123] *Monmouthshire Beacon*, 21 July 1849, The Iron Trade, from *Aris's Birmingham gazette*, 4 August 1849, The Iron Trade, 18 August 1849, The Iron Trade, 22 September 1849.
[124] *Monmouthshire Beacon*, 22 September 1849.
[125] Riden and Owen, *British Blast Furnace Statistics 1790-1980*, pp 1-31.
[126] *Monmouthshire Beacon*, 20 October 1849, The Iron Trade, 11 May 1850, The Iron Trade, from the Wolverhampton Chronicle, 15 June 1850, The Iron Trade, 17 August 1850, The Iron trade, from *Aris's Birmingham Gazette*.

wages with the consequent adverse affect on the employees. Nevertheless it is to the credit of the local ironmasters who ran their businesses successfully that they were able to live with this perpetually uncertain state of affairs and with the general trend of falling iron prices over the whole period.

The ironmasters made attempts to deal with falling demand by acting together on the supply side. Furnaces were blown out on agreed bases and output cut by set percentages. There seems to have been considerable success with these joint actions even if certain ironmasters failed to cooperate at times if they felt strong and independent enough. In the first quarter of the nineteenth century the local ironmasters also attempted to control prices by joint action but with less success as some ironmasters were weaker financially and needed to sell their iron as soon as possible. Later in the period the ironmasters worked together for mutual protection against strikes in times of falling markets when workmen opposed wage reductions by threatening strike action.

It is possible however that the ironmasters contributed to some extent to the demand problems by creating over supply situations. The new ironworks and additional furnaces tended to be erected in good times creating over supply situations when demand fell. This result would be expected but the lack of diversification in the South Wales iron industry must have contributed to the problems for the local ironmasters when demand for bar iron and rails fell, with so much concentration on these products. However any criticism of the ironmasters for this should be qualified in that they acted for the benefit of not only themselves but for their local communities by providing extra employment.

A clear picture of the fluctuations in demand for British iron can be seen in Table 3.3 below which gives the prices of English merchant bar iron for every year for

the period 1799 to 1845. Although there was a downward trend in iron prices nationally throughout the period, the depressions of 1816-17, 1821-24, 1830-33 and in particular that of the early 1840s are clearly visible.

Table 3.3 Prices of English Merchant Bar Iron 1799-1845

Year	£	Year	£	Year	£
1799	18.25	1817	8.75	1835	6.5
1800	18.5	1818	13.0	1836	10.5
1801	20	1819	12.5	1837	10.5
1802	18	1820	11.0	1838	9.75
1803	19.5	1821	9.0	1839	10.5
1804	17	1822	8.0	1840	9.0
1805	17.5	1823	8.5	1841	8.0
1806	17.5	1824	8.75	1842	6.5
1807	16.0	1825	14.0	1843	5.25
1808	15.0	1826	11.0	1844	4.75
1809	15.5	1827	10.0	1845	6.5
1810	14.10	1828	9.0		
1811	15.0	1829	7.85		
1812	14.0	1830	6.25		
1813	13.0	1831	6.25		
1814	13.0	1832	6.25		
1815	13.25	1833	6.25		
1816	11.5	1834	7.75		

Source. Birch, *The Economic History of the British Iron & Steel Industry 1784-1879*, p 230.

3.3 The growth in iron output of the ironworks of the North West Monmouthshire area c.1800 to 1850.

Many of today's historians view economic growth rates in the industrial revolution period as more modest than hitherto believed and in addition they believe that Britain was highly commercially developed prior to the industrial revolution.[127] In fact recent estimates of the rates of annual growth of industrial production are around 3 percent or just over this for period 1800 to 1830 and much lower than this for the period 1760 to 1800.[128] However in the context of the iron industry in Britain such modest growth rates seem quite at odds with the reality for this industry. Table 3.4 below clearly shows that the national growth rate for iron output in the first fifty years of the nineteenth century exceeded 3 percent considerably. The table also demonstrates the variations in the growth of iron output across the regions of the country with Scotland and Staffordshire exceeding the national performance, South Wales being close to the national average and the Shropshire and the Yorkshire/Derbyshire regions performing below the national growth rate.

Pig iron output in South Wales grew from 72,900 tons in 1805 to 666,000 tons by 1852 representing an annual growth rate of 4.8 percent over the forty-seven year period. In this section an attempt will be made to isolate what part of this growth was due to the ironworks of the North West Monmouthshire area. Unfortunately there are no comprehensive sources of iron output for individual ironworks in the first half of the nineteenth century but there are figures for individual ironworks for three particular years, 1796, 1823 and 1830. The figures for 1796 were supplied by the ironworks as part of their campaign against William Pitt's plan to tax coal at the

[127] Joel Mokyr, 'Accounting for the Industrial Revolution', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume I Industrialisation, 1700-1860*, pp 1-2.
[128] Mokyr, 'Accounting for the Industrial Revolution', pp 3-4.

pithead[129] while the figures for 1823 and 1830 were prepared at the request of the Government.[130] The figures for these three years are presented in Table 3.5.

Table 3.4 Estimates of pig iron output for selected years ('000 tons) and annual growth rate % between the years shown for the period 1805 to 1852.

	Britain		**South Wales**		**Shropshire**		**Staffs**		**Yorks & Derby**		**Scotland**	
Year	**Pig Iron**	**% p.a.**	**Pig Iron**	**% p.a.**	**PIg Iron**	**% p.a.**	**Pig Iron**	**% p.a.**	**Pig Iron**	**% p.a.**	**Pig Iron**	**% p.a.**
1805	250		72.9		55.0		48.5		36.6		22.8	
		3.4		5.2		0.3		5.8		0.7		0.4
1823	455		182.3		57.9		133.6		41.3		24.5	
		5.8		6.2		3.4		6.8		1.8		6.3
1830	677		277.6		73.4		211.6		46.9		37.5	
		7.0		5.6		1.1		6.2		7.1		20.2
1839	1,249		453.9		80.9		364.4		86.8		196.6	
		11.8		11.3		2.3		17.4		0.2		22.6
1840	1,396		505.0		82.8		427.7		87.0		241.0	
		-4.5		-3.2		-2.7		-9.0		-8.0		-0.3
1843	1,215		457.4		76.2		322.0		67.8		238.6	
		13.3		11.5		3.8		4.6		24.5		22.7
1847	2,000		706.7		88.4		385.8		162.8		540.0	
		6.2		-1.2		6.3		16.1		-1.6		7.5
1852	2,701		666.0		120.0		815.0		150.0		775.0	
1805 to 1852		5.2		4.8		1.7		6.2		3.0		7.8

Source Pig iron output figures from Riden and Owen, *British Blast Furnace Statistics 1790-1980*, Table 1.1

Table 3.5 Pig iron output for the ironworks of the North West Monmouthshire area, 1796, 1823 and 1830.

Ironworks.	**1796**	**1823**	**1830**	**%Growth p.a. 1796-1823**	**% Growth p.a. 1823-1830**
Blaenavon	5,460	16,882	13,843	4.3	-2.8
Beaufort	1,560	5,243	7,276	4.6	4.8
Clydach	1,820	5,200	10,190	4.0	10.1
Nantyglo		17,750	23,883		4.3
Sirhowy and Ebbw Vale	1,820 1,560	20,425	26,020	6.9	3.5
Tredegar		16,385	18,514		1.8
Totals (core group)	12,220	81,885	99,726	7.3	2.9
South Wales	41,000	182,325	277,643	5.7	6.2

Source. Scrivenor, *History of The Iron Trade*, pp 96, 134.

[129] Scrivenor, *History of The Iron Trade*, p 94.
[130] Scrivenor, *History of The Iron Trade*, p 131.

The figures supplied for 1796 in Table 3.5 are clearly estimates and can only be used as a guide but the table does give an idea of the rate of growth of output of the core group of ironworks in the South Wales context. The very high growth figure for the core group for the period 1796 to 1823, whilst quite correct, is of course inflated by the fact that Nantyglo and Tredegar did not contribute to the output for 1796 but did so for 1823. It is important to recognise this feature when examining growth rates for particular industries as growth rates are usually calculated for areas, counties, regions or countries and as such will be inflated in times of growth as new companies emerge in the period under examination.

The core group made up approximately 30 percent of the South Wales output of pig iron in 1796, 45 percent in 1823 and 36 percent in 1830 indicating how important the area was in terms of the South Wales iron industry. However just considering the core group of ironworks in the North West Monmouthshire area understates the importance of the area in the first half of the nineteenth century. The other ironworks, mostly established lower down the valleys from the ironworks of the main group under study, should also be included. A list of these later works is given in Table 3.6 plus their approximate year of establishment and their location.

Table 3.6 List of ironworks established in the North West Monmouthshire area after 1800.

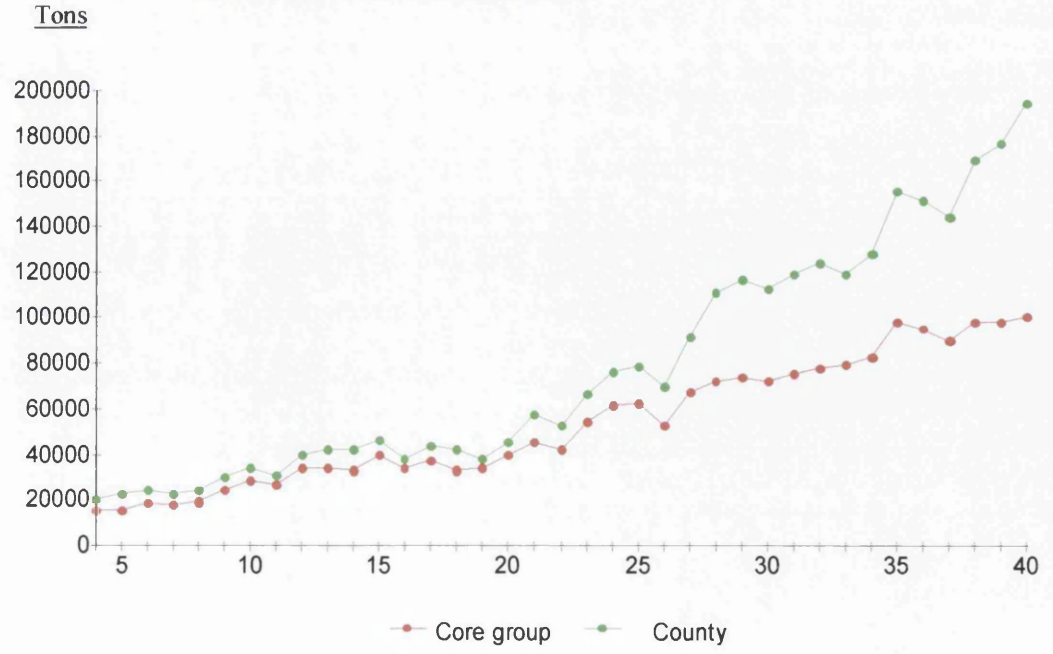
Ironworks	**Year of establishment (approximate)**	**Location.**
Rhymney	1805	Rhymney valley, Monmouthshire/Glamorgan border
Varteg	1805	Afon Lwyd valley, below Blaenavon
Coalbrookvale	1823	Ebwy Fach valley, below Nantyglo
Blaina	1825	Ebwy Fach valley, below Nantyglo
Bute	1825	Rhymney valley, Monmouthshire/Glamorgan border
Abersychan (British Iron Co.)	1825	Afon Lwyd valley, below Blaenavon
Pentwyn	1825	Afon Lwyd valley, below Blaenavon
Golynos	1839	Afon Lwyd valley, below Blaenavon
Cwm Celyn	1839	Ebwy Fach valley, below Nantyglo
Victoria	1839	Ebwy Fawr valley , below Ebbw Vale

Source. Riden and Owen, *British Blast Furnace Statistics 1790-1980*, pp 1-31 and John Priyeane's *Map of the Ironworks and Collieries in the Counties of Monmouth & Glamorgan*, Newport, 1843.

If the newer works are included in the figures for 1823 and 1830 the ironworks of the area represent approximately 53 percent and 52 percent respectively of the South Wales total output of pig iron, a remarkable percentage for a relatively small district geographically and one where the output of pig iron was almost insignificant in the 1770s.

Concentrating on pig iron output however gives a misleading picture of the development of the iron industry in the area for, as has been stressed, the staple products of the area once the ironworks had become integrated works were bar iron and, later in the period, wrought iron rails. The growth in iron output, pig and wrought, for the core group of ironworks and for the ironworks of the county of Monmouthshire can be represented approximately by the following graph using Harry Scrivenor's data of pig and wrought iron sent down the Monmouthshire canal. (See Table 3.6 below).

Figure 3.2 Iron output of the core group and of the county of Monmouthshire (tons) for the years 1804 to 1840 inclusive.



Source. Scrivenor, *The History of the Iron Trade*, pp 127, 258.

Harry Scrivenor's data published in his *History of the Iron Trade*, is of quantities of iron sent down the Monmouthshire Canal and its linking tramroads for the years 1802 through to 1840. These totals which represent movements of iron do not differentiate between pig iron and wrought iron and they must also be an understatement of the actual iron production at each works particularly in the earlier years prior to the time when the works of the group had become integrated. It is noticeable that Scrivenor left out the Sirhowy works as a separate entity probably because this works only produced pig iron that was largely transferred to other works in the area and generally not sent down the canal. Scrivenor's figures also do not include iron sold locally by any of the works as castings nor do they include castings used by the ironworks themselves. Despite these reservations Scrivenor's data does provide a means of assessing how the various works grew individually over the years and as such they do offer a way of comparing output performance in general. The fluctuations from year to year are considerable and hence it is prudent to include the full data supplied by Scrivenor.

A general point is that the Table 3.7 shows a gradually increasing share of output by the later works in the county. For example in 1810 the core group of ironworks were responsible for 82 percent of the iron sent down the Monmouthshire canal but by 1840 this percentage had fallen to just under 52 percent as iron manufacturing spread through the district.

Table 3.7 Iron carried down the Monmouthshire canal and associated tramroads (tons).

Year	Blaen -avon	Beaufort	Clydach	Ebbw Vale	Tred -egar	Nanty -glo	Total for Group	Total for County
1804	8,490	2,950	1,266	2,890			15,596	20,474
1805	7,262	4,605	1,455	1,012	956		15,290	22,431
1806	6,594	3,989	1,599	3,252	3,124		18,558	23,994
1807	6,042	3,947	1,196	2,209	4,138		17,532	23,019
1808	7,163	4,004	963	1,553	5,529		19,212	24,551
1809	9,848	3,566	1,136	786	9,105		24,441	29,741
1810	12,254	3,948	1,372	2,758	7,696		28,028	34,070
1811	12,377	3,910	872	2,633	6,643	77	26,512	30,459
1812	14,579	3,995	1,774	4,648	7,862	1,168	34,026	40,020
1813	13,562	3,204	2,174	5,939	7,597	1,855	34,331	41,822
1814	12,438	3,146	1,472	4,752	9,131	2,292	33,231	41,838
1815	14,002	3,767	2,999	4,953	9,225	4,684	39,630	46,207
1816	11,773	3,146	2,658	2,949	7,499	6,160	34,185	38,443
1817	11,080	2,104	3,162	3,127	10,350	7,242	37,065	43,407
1818	13,868	2,100	3,947	2,476	8,258	7,325	32,877	42,012
1819	11,203	2,124	3,788	1,907	7,140	7,934	34,096	37,709
1820	12,221	3,132	3,397	3,605	8,211	8,826	39,392	45,462
1821	11,811	2,962	3,876	6,041	9,923	10,460	45,073	57,290
1822	9,307	3,786	4,225	5,960	8,102	10,906	42,286	52,432
1823	15,115	4,269	3,651	8,613	9,903	12,723	54,274	66,564
1824	15,782	5,347	3,617	10,101	11,444	15,134	61,425	76,320
1825	13,261	7,091	3,748	10,325	11,012	16,536	61,973	78,800
1826	10,204	6,028	3,660	10,297	10,962	11,512	52,663	69,783
1827	10,701	5,914	4,107	14,403	13,837	18,059	67,021	91,618
1828	12,411	5,701	5,183	15,479	14,341	19,032	72,147	110,918
1829	12,366	6,896	6,967	16,959	13,349	17,433	73,970	116,531
1830	13,051	5,065	6,771	18,133	12,303	17,115	72,438	112,647
1831	13,839	5,150	6,231	18,778	13,340	17,866	75,204	119,165
1832	10,819	6,052	6,542	19,740	13,304	21,333	77,790	124,207
1833	11,885	7,512	7,252	19,226	12,323	21,007	79,205	118,924
1834	10,620	9,808	6,261	20,228	12,858	22,594	82,369	127,554
1835	13,309	12,976	7,618	25,392	13,909	24,957	98,161	155,317
1836	11,863	14,567	7,640	23,120	12,133	25,384	94,707	151,408
1837	12,765	11,145	7,081	22,475	12,641	23,981	90,088	144,277
1838	13,762	10,903	9,283	23,579	15,526	25,263	98,316	169,367
1839	12,426	10,505	9,606	25,342	14,861	24,945	97,685	176,346
1840	14,302	10,049	10,038	24,199	15,288	26,662	100,538	194,661

Source. Scrivenor, *The History of the Iron Trade*, pp 127, 258. The County totals include all ironworks that transported iron down the Monmouthshire Canal and include Clydach and Beaufort.

Using Scrivenor's data it is possible to make a broad assessment of the relative performances of the individual ironworks of the core group using output as a measure of success. Only one of the works actually failed following initial establishment that is the Nantyglo works. Although originally established in the 1790s there are no entries for shipments until 1811, the year that Joseph Bailey and Matthew Wayne took over the works. So despite the works being sited in an ideal location and in an area of abundant mineral resources as evidenced by the large number of leases and other

documents held at the Gwent Record Office it still took the arrival of particular entrepreneurs to make the works run successfully. To assist a performance comparison of the core group of ironworks a table of average individual growth rates has been assembled from Scrivenor's data. In order to minimise the effect of individual year fluctuations, growth rates have been calculated for each five-year period taking the average of three years data at the start and three years data at the end of each five years. For example the average growth for say 1820 to 1825 was calculated from the average of years 1819, 1820 and 1821 to the average of years 1824, 1825 and 1826.

Table 3.8 Average individual growth rates per annum (measured across five year periods) for the ironworks of the North West Monmouthshire group for the period .

Years	Blaenavon Inc Garndyrris	Beaufort	Clydach	Ebbw Vale	Tredegar	Nantyglo	Group Totals	County Totals
1804-1806 to 1809-1811	9.1	0	-4.8	-2.9	30.8	-	9.8	7.1
1809-1811 to 1814-1816	2.1	-2.5	16.1	15.4	2.0	274.6	6.3	6.1
1814-1816 to 1819-1821	-1.6	-4.0	9.2	-1.8	0	15.7	2.1	2.1
1819-1821 to 1824-1826	2.2	17.6	0	21.6	5.7	9.7	8.2	9.9
1824-1826 to 1829-1831	0	-1.5	12.6	11.9	3.1	4.0	4.7	9.1
1829-1831 to 1834-1836	-1.8	16.9	1.5	5.0	0	6.8	4.4	4.5
1834-1836 to 1839-1840	2.3	-3.8	6.5	1.6	3.1	1.2	1.6	5.1
Overall 35 year Growth rate p.a. 1804-1806 to 1839-1840	1.7	2.8	5.6	6.9	5.9	7.4	5.3	6.2

Note. The overall growth rate for Nantyglo was calculated over 25 years.

The ironworks of the core group and of the county yield growth rates well over three percent for most of the period of Table 3.8 with overall growth rates of 5.3 percent and 6.2 percent respectively. The overall growth of the county ironworks

was always likely to be higher than that of the core group because the latter were generally established concerns at the beginning of the period whilst the growth figures for the county as a whole were aided by new works being set up in the period. This factor also affects the growth performance of the individual works as an increase in growth is to be expected following an increase in capacity say by the erection of new blast furnaces or new puddling furnaces and rolling mills. Nevertheless some analysis of actual individual ironworks performance is possible from the table.

The performance of the Blaenavon works is demonstrably the worst of the group despite its early high growth rate. The works suffered negative or zero growth in three of the five-year periods and it is no surprise that the works was put up for sale in 1833. It is also significant that the sale document puts somewhat more emphasis on the coal and iron mines than on potential profits from the ironworks. That lack of capital was the main problem is confirmed by the following statement in the sale document, 'The price of iron has been lately improving, and to any firm of Capital who might feel disposed to enter with spirit into a concern of this Magnitude and Importance, there can be no question that an immense and increased Annual Income may be derived'.[131] A full discussion on capital and the joint stock iron companies of the area is given in Chapter 5.

The Beaufort ironworks is the other ironworks with a relatively disappointing overall growth rate, only 2.8 percent over the thirty-five year period. The works had an oscillating pattern of growth, showing negative or zero growth in four of the seven five year periods but dramatic growth in two, one of which, 1830-35, was the period when the works was taken over by the Baileys of Nantyglo and their influence on Beaufort is clearly demonstrated.

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[131] GRO. D.7.194. Sale particulars of Blaenavon Iron and Coal Mines (with ironworks etc.), 22 November 1833.

The other ironworks all had excellent overall growth rates for the thirty-five year period ranging from 5.6 percent for the Clydach ironworks to 7.4 percent for the Baileys' Nantyglo. Nantyglo's growth rate for 1811 to 1815, 274.6 percent, while accurate, is clearly an accident of the fact that the works did not really start production consistently until 1811. Nantyglo also was the only works to show positive growth in every five-year period once it had truly started, all the other works showed zero or negative growth in at least one five year period. In fact, whilst the group and county growth rates, though variable, are at least reasonably consistent, the individual ironworks' growth rates show remarkable fluctuations, often inconsistently, some showing high growth rates in the same five year period as other show negative growth. For example whilst most of the works followed the national trend in the 1820 to 1825 period with substantial growth, the Clydach ironworks managed no growth at all. This degree of inconsistency in performance among the ironworks of the group points above all to varying quality of management, instability of management and ownership and access to capital.

3.4 Conclusion.

The economic climate for the development of ironworks in the North West Monmouthshire area was generally favourable in the first half of the nineteenth century. All the ironworks of the group developed in the war period when demand for iron was likely to be high and the developments were further assisted by political advantages such as government assistance due to imposition of duties on foreign imports of iron, such duties steadily increasing as the first quarter of the century progressed. The British iron industry also benefited from the effects of the Baltic wars and the new ironworks of the study area also benefited from the experience gained at nearby Merthyr. As for other industries the iron industry must have benefited also

from the general developments in the legal, financial and commercial fields that were a feature of the British industrial revolution.[132]

The period following the end of the Napoleonic Wars in 1815 to the middle of the century saw demand for iron in Britain fluctuate considerably. The local ironmasters attempted to deal with these demand changes by joint and individual actions. At times they worked together to cut the supply side with considerable success but for most of the time each ironmaster acted according to their own circumstances.

The local ironmasters' concentration on bar and rail iron made them vulnerable to the swings in the fortunes of the railway industries. The vast majority of the iron produced in the study area was sent via Newport to other areas and it is likely that relatively little was sold or used locally hence the local population had no real role in the commercial side of the iron business unlike say other more consumer orientated industries. As such they had no opportunity to affect demand for iron when externally the demand was low.

However it is possible that the ironmasters contributed to their own problems to a limited extent by increasing the supply side too rapidly in boom times for the industry. It is difficult to criticise them for this however as their expansion plans were generally to the benefit of the local populations in the further provision of employment.

The second major economic feature of this period in the iron industry in Britain and in the North West Monmouthshire area was the trend for falling prices with the consequent squeeze on potential profits. Despite the problems over fluctuating demand and the trends of falling prices it is argued that the levels of

[132] C. Knick Harley, 'Trade: discovery, mercantilism and technology', in Floud and Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume I Industrialisation, 1700-1860*, Cambridge, 2004, p 190.

growth attained by the local ironworks in an area mostly devoid of proto-industry, local population and communications prior to the arrival of the industrial revolution, is exceptional and that this warrants considerable credit to the ironmasters. The variability in growth rates between the ironworks of the group displayed in Table 3.8 are almost certainly attributable to different qualities of management and different approaches to all the various technological, organisational and business factors that were at play throughout the period. The following three chapters study in detail how the local ironmasters achieved these growth rates with respect to technology matters, to the provision of adequate capital and finally with respect to the recruitment of labour.

Chapter 4 Technological factors facing the ironmasters of the North West Monmouthshire Area 1800 to 1850.

4.1 Introduction.

It is argued in this thesis that the ironmasters were the key elements in bringing the industrial revolution to the North West Monmouthshire area with the development, growth and success of a major iron industry. It is further argued that growth and success depended on the ironmasters confronting a range of factors and issues; technological, business, organisational and personnel issues, major and relatively minor in importance, and that the growth and success of the ironworks was not due to any one factor such as a major technological advance. In this sense there is a sharp difference between the iron industry in this district and that in Scotland where the discovery and successful use of hot blast in the blast furnaces there resulted in a huge surge in output of iron such that Scotland's share of British pig iron production went from under 6 percent in 1830 to nearly 16 percent nine years later.[1] The introduction of hot blast in furnaces in South Wales had no such dramatic or immediate outcome.

Innovations were of course vital in the industrial revolution period but innovation does not just mean major technological change but can also mean continuous adaptation of technological processes and developments in organisational structures and in business processes.[2] This chapter looks at the whole range of technological and technologically related factors that faced the ironmasters in the first half of the nineteenth century and at the approach the ironmasters of the area took to these issues.

The chapter looks at the technological changes that were evident in the iron industry in Britain in the first half of the nineteenth century. Unlike the eighteenth

[1] Philip Riden and John G. Owen, *British Blast Furnace Statistics 1790-1980,* Cardiff, 1995, p lxv.
[2] Pat Hudson, 'Industrial organisation and structure', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume l Industrialisation, 1700-1860,* Cambridge, 2004, p 46.

century, the technological innovations in the first half of the nineteenth century with the possible exception of hot blast were more modest and generally involved slight or gradual improvements in techniques or methods.

The approach of the local ironmasters to technologically related issues is examined, possibly the main point of importance being their attitude to hot blast with an explanation of why it was not introduced with the same urgency as the Scottish masters. The use of hot blast was related to the use and value of particular ores and the whole subject of iron ores is discussed in detail separately in the chapter. Iron does not exist as such in nature but exists only in the form of chemical compounds such as ferric oxide or ferric carbonate and the importance of iron ores in a study of the iron industry cannot be understated.

The role of the inventors is also analysed in the chapter and how this role related to that of the ironmasters. J. R. Harris believes that there is more research needed to examine the role of the ironmasters as innovators[3] and it will be contended in this section that the ironmasters tended to take advantage of inventors in the study area and nationally. In the context of the British iron industry as a whole the main inventors whose work affected the industry greatly in the first half of the nineteenth century were Henry Cort, who is credited with the invention of the puddling and rolling process, Joseph Hall who is known for his work in connection with the introduction of 'wet puddling', and James Beaumont Neilson, inventor of the hot blast process, but in the area under study the most prominent inventor was Samuel Baldwin Rogers who is best known as the inventor of the cast iron bottom to the puddling furnace in about 1818. A clear pattern emerges with regard to the long term fortunes of these inventors in that they rarely obtained appropriate reward for their discoveries.

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[3] J. R. Harris, *The British Iron Industry 1700-1850*, Basingstoke and London, 1988, p 73.

As the local inventor, particular attention is given to the life of Samuel Rogers of Nantyglo. No discussion on the inventors of the period in the iron industry would be complete without mention of David Mushet. Mushet was an expert metallurgist who regularly gave advice to ironmasters and is probably best known as the discoverer of the blackband ironstone in 1801. Although not used greatly until after Neilson's hot blast process came into use, blackband, in conjunction with hot blast, contributed dramatically to the success of the Scottish iron industry from the 1830s, with great credit due to Mushet,[4] a Scot himself. The chapter ends with a brief discussion of the reasons for the technological changes introduced by the ironmasters.

4.2 Blast furnaces.

There were two fundamental technological innovations in the British iron industry in the eighteenth century, the use of coke in the blast furnace used widely after mid century following its introduction by the Darby family of Shropshire and the production of malleable iron using the puddling and rolling process patented by Henry Cort in 1784. There were no innovations in the industry in the first half of the nineteenth to match these but there were substantial technological improvements in the manufacture of iron in this period.

With regard to the smelting process the most obvious way to raise output of pig iron was to build additional blast furnaces and this was done by most of the ironmasters in most regions of the country in the first half of the nineteenth century. Table 4.1 shows the numbers of blast furnaces in existence in the main iron manufacturing regions of Britain together with the numbers of ironworks.

[4] Fred. M. Osborn, *The Story of the Mushets*, London et al., 1952, pp 13-26.

Table 4.1 Blast furnaces in Britain, 1805 to 1852.

Year	South Wales		Shropshire		South Staffs and Worcestershire		Yorks & Derbyshire		Scotland	
	No. of Works	Furnaces Built	No. of Works	Furnaces Built	No. of Works	Furnaces Built	No. of Works	Furnaces Built	No. of Works	Furnaces Built
1805	26	46	19	42	22	39	26	46	12	27
1823	23	72	16	38	43	84	24	41	8	22
1830	34	113	20	48	56	123	24	45	10	27
1839	41	127	14	34	53	126	22	45	18	55
1843	42	168	15	36	52	129	20	48	21	98
1847	46	193	15	34	57	139	25	58	24	130
1852	48*	197	14*	40	64	159	26*	61**	27*	144

Source. Riden and Owen, *British Blast Furnace Statistics 1790-1980*, Table 2.1.
*1849 **1854

From the table it can be seen that the ratio of blast furnaces to the number of ironworks rose throughout the first half of the century. This ratio went from 1.9 and 2.3 in 1805 and 1823 respectively to 3.3 and 3.4 in 1847 and 1852 clearly indicating that the ironmasters saw the building of new furnaces as a primary, though expensive, way of increasing output.

The most obvious method of increasing output of pig iron was the building of an extra furnace at a particular ironworks site and the ironmasters of the North West Monmouthshire area ironworks certainly did this as can be seen from Table 4.2.

Table 4.2 Numbers of blast furnaces at the ironworks of the North West Monmouthshire group.

Year	Blaenavon	Beaufort	Clydach	Ebbw Vale	Sirhowy	Tredegar	Nantyglo	Total for Group
1805	4	2	2	2	2	2	2	16
1810	5	2	2	1	2	4	2	18
1823	5	3	2	3	3	5	5	26
1825	5	4	3	3	4	5	7	31
1830	5	4	3	3	3	5	7	30
1839	5	6	4	3	4	5	8	35
1841	5	6	4	4	5	7	7	38
1843	5	8	4	4	4	7	8	40
1847	5	7	4	4	5	7	8	40
1854	5	7	4	4	5	8	7	40

Source. Riden and Owen, *British Blast Furnace Statistics 1790-1980*, pp 1-31.

Compared with the approximate industry average numbers of furnaces per ironworks as demonstrated from Table 4.1 it is clear that the ironworks of the group were larger

concerns even in 1805 with an average of 2.3 furnaces per works as compared with 1.9 for the country. This average increased to 3.7 by 1823 (2.3 for the country) and reached 5.7 furnaces per works in the late 1840s and early 1850s (3.3 to 3.4 for the country). Hence the ironworks of the group were larger concerns than the national average throughout the first half of the nineteenth century and the greater tendency to expand and build additional furnaces is an indication that there was more of an inclination to reinvest profits in their businesses than in some other regions of the country.

Prior to the general use of hot blast the usual method of improving the yield per furnace was to build larger ones.[5] The height of furnaces tended to increase and, whilst there were regional differences, the average height of blast furnaces prior to 1832 was in the region of 35 to 40 feet, those built after this date tended to be higher.[6] It is believed that there was a tendency for the Welsh furnaces to be larger than those of their competitors in the Midlands as the latter generally required better quality pig iron, more of their iron going to foundries.[7] The Welsh ironworks could thus produce a larger volume of pig iron of slightly lower quality per furnace as the vast majority of Welsh pig iron went to forges for the production of malleable iron. The extra refining done in the puddling furnaces meant that pig iron used in forges need not be of the quality of that used in foundries where no further refining process was normally carried out. Although the Welsh furnaces were not particularly taller than those of other areas they may have been of greater capacity due to extra width and a generally wider shape. By the 1850s some of the furnaces in the study area had capacities

[5] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History*, Cardiff, 1987, p 43.
[6] H. R. Schubert, 'Extraction and Production of Metals: Iron and Steel', in Charles Singer, E. J. Holmyard and A. R. Hall (eds.), *A History of Technology Volume IV The Industrial Revolution c1750-1850*, Oxford, 1958, pp 111-4.
[7] A. H. John, *The Industrial Development of South Wales 1750-1850*, Cardiff, 1995, p 155.

greater than 5,000 cubic feet.[8] For example the Number 3 furnace at Ebbw Vale had a capacity of 5,890 cubic feet, the Number 2 furnace at Cwm Celyn had a capacity of 5,360, the Number 1 furnace at Blaenavon, 5,540 and the planned Number 3 furnace at Cwm Celyn was to have a capacity of 16,560 cubic feet.[9]

Probably the major technological innovation in the first half of the nineteenth century was the application of hot blast to the blast furnace. The inventor of the hot blast process was James Beaumont Neilson who took out a patent in 1828 and in the following year the method was employed at the Clyde ironworks.[10] The key advantage with the successful use of hot blast was that much less fuel was required than with the cold blast process to produce the same amount of pig iron[11] and the method was particularly important in Scotland as raw coal could be used and the Scottish coals had never made good coke.[12] This point was well made in a letter to Thomas Evans of the Dowlais Ironworks in Merthyr in September 1831 'Have you heard they are making pig iron in Scotland from raw coal by the hot air blast. If you could do this in all the iron districts you would be able to spare half your colliers'.[13]

However there were differing opinions amongst experts of the day as to whether the hot blast procedure was a truly great invention. David Mushet certainly thought so and in the context of the creation of wealth he thought the hot blast process might rank with that of Arkwright for cotton spinning.[14] John Percy, the great nineteenth century writer on metallurgy, did not regard the procedure as a great invention in the sense that there was no intricately complicated process or machinery

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[8] John Percy, *Metallurgy: Iron and Steel*, London, 1864, pp 559-64.
[9] Percy, *Metallurgy: Iron and Steel,* pp 559-64.
[10] Schubert, 'Extraction and Production of Metals: Iron and Steel', pp 109-11.
[11] Percy, *Metallurgy: Iron and Steel*, p 425.
[12] Schubert, 'Extraction and Production of Metals: Iron and Steel', pp 109-11.
[13] Madeleine Elsas (ed), *Iron in the making: Dowlais Iron Company Letters 1782-1860,* Glamorgan County Council, 1960, p 60-1, Thomas Bell to Thomas Evans, Newcastle, 3 September 1831.
[14] Percy, *Metallurgy: Iron and Steel*, p 396.

involved and 'without wishing in the smallest degree to distract from the spirit to which Mr Neilson is justly entitled, I may nevertheless express my opinion that the hot blast was a lucky hit rather than an invention properly so called'.[15] William Truran, another metallurgist of the mid nineteenth century who had worked under J. J. Guest at the Dowlais works as engineer, was even more sceptical about the merits of the hot blast process. Writing in 1855 Truran believed that writers on the process had greatly exaggerated its effects. He thought that Mushet, in his claims about the savings of fuel, had failed to take account of the improvements that had taken place over the years in the iron industry, including those that had involved savings in fuel. Truran also questioned the claims that the hot blast process had permitted the application of certain types of coals, such as anthracite, to the blast furnace that had been believed inappropriate earlier. He claimed that the key to the use of such coals was the density of the blast, whether this blast was cold or hot. However Truran did concede that hot blast was about 12 percent superior to cold.[16] Mushet, apparently, was greatly involved in the proving of the use of anthracite[17] and the use of this type of coal in the blast furnace benefited other regions of the country as well as the Scottish region, and ironworks sprang up in the anthracite areas such as in the more western part of the South Wales coalfield.[18] For example, George Crane, the manager or proprietor of the Yniscedwin iron works near Swansea, commented that while his early attempts to use anthracite had not worked, he found that by availing himself of Mr Neilson's hot blast patent he had completely succeeded in the application of anthracite to the smelting of ironstone and ore. Crane further stated that he had used a cupola blast furnace for

[15] Percy, *Metallurgy: Iron and Steel*, p 397.
[16] William Truran, *The Iron Manufacture of Great Britain*, London, 1855, pp 85-7.
[17] Samuel Smiles, *Industrial Biography: Iron Workers and Tool Makers*, London, 1884, p 147.
[18] Laurence Ince, *The South Wales Iron Industry 1750-1885*, Merton, 1993, p 3.

these experiments which he had patented, and he was now preparing to use the method in his three blast furnaces.[19]

Whether the hot blast process was strictly a great invention or not and accepting that its effects might have been somewhat exaggerated by Mushet and others, there can be no doubt that the process did affect the Scottish iron industry quite dramatically and over a relatively short space of time. There can also be no doubt about its long-term effect on the iron industry of not just Scotland but of Britain as a whole, the process being adopted eventually throughout the country. Percy believed that some of the resistance to it was due to the misguided view of most ironmasters when cold blast dominated the industry that the blast needed to be as cold as possible, a view arrived at because it was generally known that production of iron was higher in winter. Percy states that although this latter state of affairs was true it was nothing to do with the temperature of the atmosphere but a result of different levels of moisture in the air in summer than in winter.[20]

As the discoverer of blackband ironstone, David Mushet was especially interested in the hot blast process and its suitability to be used in conjunction with blackband. Mushet claimed that the output per furnace with blackband and cold blast never exceeded 60 tons per week whilst a furnace with the same ore could produce 50 percent more iron if hot blast was used.[21] New fields of blackband were discovered in Scotland in the mid 1830s and most of the large ironworks there used the ore in conjunction with other ores or on its own and this, according to Mushet, contributed greatly to the rapid expansion of the Scottish iron industry in this decade.[22]

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[19] *Monmouthshire Beacon,* 20 January 1838, Smelting of iron ore with anthracite or stone coal, Article by George Crane of Yniscedwin iron works.
[20] Percy, *Metallurgy: Iron and Steel,* p 397.
[21] David Mushet, *Papers on Iron and Steel, Practical and Experimental,* London, 1840, p 127.
[22] Osborn, *The Story of the Mushets,* pp 25-6.

With regard to the inventor himself, Neilson does not seem to have benefited greatly. Neilson was short of capital and required partners and as a result he retained for himself only three-tenths of the value of the royalties from his invention. In addition there was litigation and it was some years before Neilson's rights were established and although he had had to cede more that two-thirds of the profits of his invention he did retain sufficient to have a comfortable life thereafter.[23]

It has already been established how this innovation improved the Scottish iron industry but hot blast did not have the same effect in South Wales. The advantageous qualities of the bituminous coal affected the apparent need to rush into the use of the hot blast process as it was questionable whether the savings in fuel would even offset the royalty payments for its use.[24] The ironworks of the study area were certainly slow to introduce hot blast. For example the Beaufort and Blaenavon ironworks had not introduced its use in 1832 and 1833 respectively[25] and Tredegar was just experimenting in its use in 1835.[26] Table 4.3 gives the number of furnaces in the area utilising hot and cold blast in July 1839.

The Sirhowy and Ebbw Vale works had most of their furnaces using hot blast by 1844[27] though it is believed that the Blaenavon works continued to use cold blast in at least one of its furnaces longer than any other ironworks in Wales.[28] Neilson's patent expired after 1842[29] and it is probably no coincidence that most of the works of the area seemed to have adopted hot blast in the 1840s probably assessing that the

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[23] Smiles, *Industrial Biography: Iron Workers and Tool Makers,* pp 149-59.
[24] Alan Birch, *The Economic History of the British Iron and Steel Industry 1784-1879*, London, 1967, p 185; Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 19.
[25] GRO. D.397.1677. Letter to C. Bailey re. Valuation of Beaufort ironworks 1832; GRO. D.7.194. Sale/Auction Document for Blaenavon, 22 November 1833.
[26] Evan Powell, *History of Tredegar*, (Subject of Competition at Tredegar Chair Eisteddfod, 25 February 1884), Newport, 1902, pp 49-50.
[27] GRO. D.749.508. 18 April 1844, Sirhowy and Ebbw Vale Auction Particulars.
[28] Arthur Clark, *The Story of Monmouthshire*, Volume 2, Monmouth, 1979, pp 77-8.
[29] Smiles, *Industrial Biography: Iron workers and tool makers*, p 157.

Table 4.3 Furnaces with cold or hot blast in July 1839.

Ironworks	Furn-aces erected	Hot Air	Cold Air	Out Of Blast
Nantyglo & Beaufort	14	10	4	
Ebbw Vale & Sirhowy	7	3	4	
Blaenavon	5	-	5	-
Tredegar	5	-	5	
Clydach	4	-	4	
Pontypool	3	2	1	1
Pentwyn & Golynos	5	3	2	-
Abersychan	6	-	4	2
Varteg	5	4	1	-
Coalbrook Vale	3	--	3	
Blaina & Cwm Celyn	2	-	2	
Victoria	2	-	-	1
Rhymney & Bute	6	2	4	
Dowlais	15	5	10	
Penydarren	7	-	6	1
Cyfarthfa	14	-	12	2
Hirwaun			-	
Plymouth	7	-	7	
Aberdare	6	2	4	
Pentyrch	2	-	2	

Source. *Monmouthshire Beacon,* 6 July 1839, Monmouthshire works are listed first followed by Dowlais and other works in East Glamorgan.

savings in fuel more than justified the capital cost of the change once royalty payments were not a factor.

If the Welsh ironmasters were slow to move to hot blast compared with some other regions they were among the first, if not the first, to cap successfully the furnace tops and were to the forefront of developments to capture and reuse the waste gases from the blast furnaces. The installation of the cup and cone device in about 1850 to the top of the furnaces was credited by John Percy to George Parry of the Ebbw Vale works[30] though it is believed by certain current historians that the method was collectively invented.[31] Percy believed that Parry had derived the idea of this method from material published by Mr. Jessop who had worked at the Butterley and Cognor Park ironworks in Derbyshire. The main result was the retention of heat and an even

[30] Percy, *Metallurgy: Iron and Steel*, pp 470-1.
[31] Hudson, 'Industrial organisation and structure', p 46.

distribution of the charge of the minerals.[32] There is no evidence whatsoever that furnaces were capped in this period with environmental considerations in mind, the process was carried out for purely economic reasons.

Related to the capping of furnaces was the capture and reuse of the hot furnace gases. For example in the 1850s at the Number 1 furnace at Ebbw Vale, the hot waste gases from the furnace were captured and reused to heat the hot blast stoves.[33] There was a similar process being installed at the Blaina ironworks a few miles down the Ebbw Fach valley from Nantyglo. The ironmaster at Blaina, Mr Levick, claimed that this application of the blast furnace waste gases to heat the hot blast ovens and steam boilers saved the equivalent of around 600 tons of coal a week.[34] Mr Percy was impressed by these innovations at Ebbw Vale and Blaina:

> At Blaina and Ebbw Vale I saw the application of the waste gases of the blast furnaces carried out to perfection. I have never witnessed any metallurgical operation with more pleasure than that of these hot-blast stoves; and I have felt no small degree of commiseration for ironmasters who still pursue the old plan of using solid fuel, such as coal-stack, however cheaply it may be obtained.[35]

Hence the South Wales ironworks and in particular the works of the North West Monmouthshire area were not slow to build additional blast furnaces and introduce innovations to blast furnace processes when such innovations were seen as cost effective at the particular time.

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[32] Percy, *Metallurgy: Iron and Steel*, pp 470-1.
[33] Percy, *Metallurgy: Iron and Steel*, pp 366-7.
[34] Percy, *Metallurgy: Iron and Steel*, pp 366, 410; Charles Wilkins, *History of the Iron, Steel and Tinplate Trades*, Merthyr, 1903, pp 292-3.
[35] Percy, *Metallurgy: Iron and Steel*, p 410.

4.3 The Refining processes.

With regard to the refining side of iron making the fundamental breakthrough was the successful use of Henry Cort's puddling and rolling process in the late eighteenth century. The puddling process was perfected at Merthyr with Richard Crawshay of Cyfarthfa credited with much of the experimenting whilst Samuel Homfray of the Penydarren works completed matters by suggesting that the puddling furnaces should be charged with finers' metal rather than pig iron. Hence pig iron from the blast furnace was processed in a finery furnace prior to the puddling stage. Although Cort took out his patent for the puddling and rolling process in 1783 and 1784[36] it was not until the early years of the nineteenth century that the ironworks of the study area were integrated organisations. It should be mentioned that it was the Shropshire ironmasters in the late eighteenth century who led the way in establishing the integrated structure for coke fired ironworks and the Welsh industrialists and those of other regions followed their example.[37] For the remainder of the pre-steel industry period the local ironworks concentrated on the manufacture of malleable iron by their own puddling furnaces and rolling mills by Cort's processes and later modifications of these processes. In fact the puddling process became so identified with South Wales compared with other regions that it became known as the 'Welsh Method'.[38]

The other iron producing districts of Britain made similar use of Cort's method also with improvements as time went on. However Cort died in poverty as he was ruined financially in 1790 as a result of the death of the father of his partner who had been financing Cort in exchange for Cort's patent. Cort himself died in 1800 having received virtually nothing for his work in the form of royalties. His family took

[36] Percy, *Metallurgy: Iron and Steel*, p 629.
[37] Barrie Trinder, *The Industrial Revolution in Shropshire*, Chichester, 2000, p 40.
[38] Trinder, *The Industrial Revolution in Shropshire*, p 47.

legal action but it seems that William Crawshay of Cyfarthfa claimed that they had not entirely followed Cort's plans and Samuel Homfray of Penydarren and later Tredegar ironworks, thought that the process was not original, the use of finer's metal in the puddling furnace being the key to the success of puddling. The issue was further complicated by James Cockshutt, Richard Crawshay's partner at Cyfarthfa, who wrote attributing the process to Cort and claiming that Crawshay would not have agreed to pay 10 shillings a ton for patent rights if he had not accepted Cort's rights. It appears however that Cort did not receive royalties from Crawshay.[39] On the subject of puddling it should also be mentioned that Peter Onions of Merthyr took out a patent in 1783 and Percy accepted that a method of puddling was described in it but the method still required a blast unlike Cort and it was the latter's method that was generally followed.[40]

As with the iron smelting processes there were no further dramatic technological advances in refining in the first half of the nineteenth century though there were a few substantial improvements to these processes. Under Cort's process the base of the puddling furnace was of sand but apparently Crawshay experimented with the use of an iron bottom to the puddling furnace as early as 1789 but did not continue with it.[41] It was not until 1818 that an iron bottom was successfully used instead of a sand one in the puddling furnace. The inventor was Samuel Baldwin Rogers later of the Nantyglo ironworks. The iron bottom which was water cooled had a much longer life than sand based ones and was cleaner. Rogers claimed that his invention improved the weekly yield of iron produced in the puddling furnace by two

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[39] Percy, *Metallurgy: Iron and Steel*, pp 629-39; Smiles, *Industrial Biography: Iron Workers and Tool Makers*, pp 116-25.
[40] Percy, *Metallurgy: Iron and Steel*, pp 638-39; Smiles, *Industrial Biography: Iron Workers and Tool Makers,* pp 115-16.
[41] Chris Evans (calendared by), *The Letterbook of Richard Crawshaw 1788-1797*, Cardiff, 1990, p 34, Richard Crawshay to James Cockshutt, 1 January 1789; Birch, *The Economic History of the British Iron & Steel Industry 1784-1879*, pp 40-1.

or three times[42] however this does appear a little optimistic in a commercial sense in view of the labour intensive nature of the puddling process.

Rogers was born in Chepstow in 1778 and before the age of twenty he owned a bookshop in the town but unfortunately he was forced to move on by creditors.[43] He moved to Pontypool and though it is not known how he became interested in chemistry or metallurgy he certainly worked at a laboratory in Pontypool in 1815[44] and it is believed he moved to an ironworks at Pontymister in 1815 or 1816 as furnace manager.[45] It was while he was at Pontymister that Rogers made and announced his discovery, the use of the iron bottom to the puddling furnace, and this discovery ensured he would be remembered in the history of iron making. He did not patent his invention probably because of lack of funds and offered it freely to various ironmasters in South Wales but initially only Richard Harford of the Ebbw Vale works adopted the procedure, other masters followed later and it came into general use.

Rogers was a determined writer of pamphlets and treatises, and in about 1832, he started working at J. and C. Bailey's Nantyglo ironworks where he was able to make a number of improvements, much of his work there being concerned with the use of raw materials.[46] In and prior to 1838 he was involved in analyses of iron ores and other minerals and in the planning and erecting new coke ovens and in 1844 he published a note on 'The use of a new Flux for iron-making, generally or particularly, is herein recommended to the notice and patronage of the iron-masters of

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[42] Percy, *Metallurgy: Iron and Steel*, p 652.
[43] *Famous People of Blaenau Gwent*, Blaenau Gwent Borough Council, 1989, p 109.
[44] Newport Library, pqm 330 012, Samuel Rogers, Advertisement for *Genuine Westphalian Essence* prepared by Samuel Rogers, Newport, 1815.
[45] T. G. Grey-Davies, 'Iron-Bottom Rogers' in *Presenting Monmouthshire,* No. 12 (Autumn 1961), Monmouthshire Local History Council, 1961, pp 23-4.
[46] Grey-Davies, 'Iron-Bottom Rogers' in *Presenting Monmouthshire,* No. 12 (Autumn 1961), p 26.

Monmouthshire and South Wales'.[47] These are just a few examples of the work he did while he was at Nantyglo and while still there he seems to have carried out analyses of minerals for other ironmasters,[48] such was the way the ironworks of Monmouthshire freely communicated and helped each other at this time.

Rogers was a man of great vision well ahead of his time and he produced pamphlets on a variety of issues. The late nineteenth century Welsh historian, Charles Wilkins, when writing of Rogers, said of his ideas of 1815 for railways that 'had his ideas been practically adopted, the earlier and more methodic development of the mineral district would unquestionably have been brought about'.[49] In 1845 Rogers produced a pamphlet on 'An Early Victorian Severn Bridge' that was to be magnificent, toll-free and built of stone[50] and in 1841 he published a letter on 'A new mode of supplying London, and other populous places,-and also, the "Great Western" and other railway companies with GAS'.[51] Rogers also devised a 'New and exceedingly beneficial system of Commerce' in 1848[52] indicating that his range of interests was practically unbounded. Rogers lived to an old age and after he died on 5 September 1863 he was buried in the churchyard at Llanfoist, near Abergavenny[53] though unlike his former boss, Crawshay Bailey, whose monument in the same

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[47] Newport Library, qm 330 672, Letter from S. Rogers to Thomas Brown, Cwm Celyn ironworks, 20 October 1838.
[48] Elsas, *Dowlais Iron Company Letters 1782-1860*, Letter from S. Rogers to Samuel Homfray (of Tredegar ironworks), copy to Dowlais ironworks, Nantyglo, Monmouthshire, 6 June 1844, pp 203-4, Letter regarding Rogers' analysis of Abersach ironstone (blackband).
[49] Charles Wilkins, *History of the Iron, Steel and Tinplate Trades*, pp 213-16.
[50] Newport Library, pm 425.3 625.1, *Memorandum relative to a Magnificent Toll-free Stone Bridge across the River Severn between The New Passage in Gloucestershire and The Black-Rock in Monmouthshire,* Abergavenny, 1845.
[51] Newport Library, M160 665.7, S. B. Rogers, Mineral and Metallurgical Chemist, Nantyglo, *A Letter to the Coal Owners and Workers of Coal Mines in Monmouthshire, and certain parts of Glamorganshire and to the Directors and Shareholders of Gas Light Establishments, situate on a route extending from Cardiff to London, via Gloster, etc. (and others) On a new mode of Supplying London, and other populous places, -and also, the "Great Western" and other railway companies with GAS.*
[52] Newport Library, qm 330 672, Samuel Baldwin Rogers, *Outline of a NEW and exceedingly beneficial SYSTEM OF COMMERCE, etc., to be established generally throughout the United Kingdom, under legal, and if possible, Royal authority*, Nantyglo, 14 October 1848.
[53] Grey-Davies, 'Iron-Bottom Rogers', pp 29-30.

churchyard is grand and very prominent, visible immediately one enters the churchyard, Rogers' grave is unmarked.[54]

The next substantial improvement to the puddling process was an innovation introduced by Joseph Hall known as 'wet puddling'. The procedure, which took some years to perfect in the second half of the 1820s and much of the next decade, involved a further change to the bottom of the puddling furnace. Hall lined the bottom of the furnace with cinder and with solid oxidised compounds of iron, which in contact with pig iron released carbonic acid, which escaped giving the appearance of boiling. The process was also known as 'pig boiling'. Hall's process, which he developed at the Bloomfield ironworks in Staffordshire, contributed greatly to the improved position of the Staffordshire iron industry.[55]

Hall got little reward for his invention even failing to secure a patent. Hall did obtain a patent for a further improvement to the bottom of the puddling furnace, the application of tap-cinder, but made little financially from this procedure either.[56] Unfortunately there is no evidence to indicate when the ironworks of the study area adapted their puddling furnaces with this innovation but as the production of wrought iron was their main activity it can be assumed that the process was soon taken up in the area.

Although the puddling process which was based on coal as fuel was the general method of producing malleable iron in South Wales in the first half of the nineteenth century the ironmasters were still cautious individuals and would not readily give up an older method entirely unless this was clearly beneficial to them. Thus the Clydach ironmasters were still making finished iron using charcoal blooms

[54] Grey-Davies, 'Iron-Bottom Rogers', p 30.
[55] Percy, *Metallurgy: Iron and Steel*, pp 669-70 and Birch, *The Economic History of the British Iron and Steel Industry 1784-1879*, pp 152, 191.
[56] Percy, *Metallurgy: Iron and Steel*, pp 670-1.

as much as by the puddling process as late as 1825 for in the four week period from 21 May to 18 June of that year they made an average of 18 to 19 tons of malleable iron by each process.[57] This is not to suggest that the ironmasters of the area were not continually striving to improve their puddling procedures. The Tredegar works took out a patent in connection with puddling probably in 1824 and the Ebbw Vale Company were quick to point out to Tredegar that their own plan resulting from their trials was not an infringement of the Tredegar patent.[58] The Clydach Company also took out a patent in 1841 aimed at improving their puddling procedures[59] and probably there were many more attempts to improve the puddling methods than the above examples.

William Neale Clay took out patents in which he set out a method of producing wrought iron direct from ore, that is without the smelting process in blast furnaces. Clay's approach was one which used rich haematite ore mixed with powdered charcoal, coke or other carbonaceous matter in a reverberatory furnace. This type of furnace is one, like a puddling furnace, in which the ore is separated from the fuel to stop the reintroduction of impurities into the reduced metal. Clay's method also required a further process in a balling furnace and trials were made at a small forge near Glasgow and on a larger scale at Liverpool.[60]

John Percy, writing in 1864, stated that Clay's process and that of other attempts to produce malleable iron directly in a reverberatory or puddling furnace even if successful in practice were not viable commercially. Percy made no mention of such a process being in operation at Nantyglo.[61]

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[57] NLW. Maybery MSS 3421-2, Make reports at Clydach Ironworks May/June 1825.
[58] GRO. D.2472.2. The Ebbw Vale Letterbook for the years 1824-1827, Letter to Tredegar Co., Bristol, 31 July 1824.
[59] NLW. Maybery MSS 348, April 1841, Clydach Ironworks Patent.
[60] Percy, *Metallurgy: Iron and Steel*, pp 330-1.
[61] Percy, *Metallurgy: Iron and Steel*, pp 330-5.

However the Nantyglo works, the most successful of the works in the group in the 1830s and 1840s, was in the news in the early 1840s both for improvements made in the production of malleable iron and in connection with the blackband ironstone. The blackband ironstone first identified by David Mushet in 1801 in Scotland was found to exist in substantial amounts in the neighbourhood of Beaufort in about 1838, confirmed personally by Mushet in a letter to the *Monmouthshire Merlin.*[62] Blackband ironstone was very rich in carbonaceous matter and it was reported in December 1843 that Clay's process had been adopted at Nantyglo using blackband ironstone to make malleable iron directly in a reverberatory furnace, with success.[63] S. B. Rogers, famous for inventing the iron bottom for the puddling furnace as recorded above, took great exception to this report and wrote to the *Monmouthshire Merlin* strongly asserting that the process being carried out at Nantyglo using blackband ore directly in the puddling furnace 'is neither a piracy, nor an imitation of Mr Clay's or any other man's patent or invention'. Rogers claimed that Nantyglo's method was new in principle and practice and that it could herald a new era in iron manufacture.[64]

Truran in his book, *The Iron Industry of Great Britain* published in 1855, stated that 'The Beaufort blackband was thus converted into malleable iron (without smelting the ore in a blast furnace), though after a few experimental trials the operation was discontinued'[65] and so it appears that the process described by Rogers was not carried out for any length of time or was commercially viable. Percy suggests that some users of this type of process modified it and included pig iron with the carbonaceous ore[66] and this may have been done at Nantyglo.

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[62] *Monmouthshire Merlin*, 14 January 1843, Letter to *Monmouthshire Merlin* from David Mushet.
[63] *Monmouthshire Merlin*, 23 December 1843, Nantyglo, Clay's Process.
[64] *Monmouthshire Merlin*, 6 January 1844, S. B. Rogers' letter of 26 December 1843.
[65] Truran, *The Iron Manufacture of Great Britain*, p 165.
[66] Percy, *Metallurgy: Iron and Steel*, p 331.

With the concentration on malleable iron production it is no surprise that the ironworks of the group were to the forefront of rolling mill developments and with the use of steam engines to drive the rolls. The Tredegar ironworks had only one rolling mill engine in 1821 but had increased this number to four by 1862[67] and the records of steam engines built by the Neath Abbey works and supplied to the works of the group show that they were regular buyers especially for their rolling mills.[68] Tredegar was one of the first works to introduce a guide mill in 1834[69] and the works built a huge new mill in 1849, the opening of which in March that year was an occasion of much celebration.[70] The Baileys of Nantyglo ensured that their works remained in the forefront of rolling mill developments and in January 1845 it was reported that one of the largest sheet rolling machines in South Wales had been set up at the works[71] and a year later the *Monmouthshire Merlin* reported with regard to Nantyglo that 'above 8,000 tons of rolled iron were made in this stupendous manufactory within the last month'.[72] In fact John Lloyd, the nineteenth century historian, believed that the Baileys had sought to acquire the Beaufort ironworks in 1833 to get access to more pig iron for the new mills they were developing for the rail age that was dawning at that time.[73]

There were also improved procedures to the rolling mills themselves such as the introduction of reversing mills[74] which increased the throughput of iron rolled considerably and in August 1844 it was reported that *The Times* newspaper had noted

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[67] David Morris, The History of Tredegar from the Beginning of the Iron Works up to present day, Unpublished, Winning entry in the Eisteddfod of the Cymrodorion of Tredegar in 1862, p 21.
[68] Laurence Ince, *Neath Abbey and the Industrial Revolution*, Stroud, 2001, Appendix 2 (Stationary steam engines built by the Neath Abbey Iron Company).
[69] Morris, The History of Tredegar from the Beginning of the Iron Works up to present day, p 21.
[70] *Monmouthshire Beacon*, 17 March 1849, Tredegar, Opening of the new mill at the Tredegar Iron Works, Grand Demonstration.
[71] *Monmouthshire Merlin*, 11 January 1845, Nantyglo Iron Works.
[72] *Monmouthshire Merlin*, 3 January 1846.
[73] John Lloyd, *The Early History of the Old South Wales Ironworks (1760-1840)*, London, 1906, p 174.
[74] Aubrey Byles, *The History of the Monmouthshire Railway and Canal Company*, Cwmbran, 1982, p 5.

that 'The application of electricity, to supersede several of the expensive processes, has, it is stated, been tried in the Welsh and Derbyshire furnaces with satisfactory result'.[75]

In summary it is clear that following their decision early in the nineteenth century to concentrate on bar iron products, and later these products plus railway iron, the works of the group were heavy investors in puddling furnace developments, in rolling mills and associated steam engines, with the Baileys often leading the way.

4.3 Steam engines and locomotives.

Economic historians debate the true effect of steam power in the British industrial revolution in the second half of the eighteenth century and first half of the nineteenth century,[76] some historians believing that the benefits of steam power in the industry revolution have been overstated.[77] In general the opinion is that the use of steam power only became a major factor in the economy of the country during the second quarter of the nineteenth century. G. N. von Tunzelman wrote in his book *Steam Power and British Industrialisation to 1860*, 'steam power did not start the industrial revolution but opened up vastly expanded production possibilities'.[78]

In the context of the North West Monmouthshire area iron industry there is evidence that the impact of steam power may indeed have been exaggerated to some degree and the continued use of waterpower underestimated. In chapter 2 it was demonstrated that the use of steam engines to power the blast in blast furnaces was in general delayed and it seems that some of the ironworks of the group were not using

[75] *Monmouthshire Merlin,* 24 August 1844, Application of electricity to improving the manufacture of iron.
[76] Joel Mokyr, 'Accounting for the Industrial Revolution', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860,* Cambridge, 2004, pp 12-16.
[77] Kristine Bruland, 'Industrialisation and technological change', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860,* Cambridge, 2004, pp 142-5.
[78] G. N. von Tunzelman, *Steam Power and British Industrialisation to 1860,* Oxford, 1978, pp 4-7.

steam engines for blowing purposes before the 1820s. The ironmasters were pragmatic and were happy to use water-power for, or to assist in, the blast if the flows of nearby rivers or streams were strong enough to supply this power. In general, though, the ironworks of the group were heavy users of steam engines by the second quarter of the nineteenth century for various uses in addition to powering the blast, for example for powering the rollers and for winding and pumping machines at pits and mines.[79] It could be argued that steam engines were more important for the development and expansion of puddling and rolling processes than they were for the production of the blast in blast furnaces.[80] This must be the case for South Wales with the concentration there on bar iron but was probably also the case throughout the country.

If there were some reservations over the introduction of stationary engines amongst some of the local ironmasters in the early years of the nineteenth century there was no such hesitation over the introduction of locomotives in the second quarter of the century. The Tredegar ironmaster, Samuel Homfray led the way by purchasing one of Stephenson's engines in 1828.[81] The intention was to use the locomotive to carry iron from the Tredegar works right down to the docks at Newport[82] and the locomotive, named 'Britannia', succeeded in this on 17 December 1829. The Tredegar Company had a second locomotive in service in about 1832 and a further nine by mid century. All these locomotives were for use on tramroads.[83] Homfray's early interest in locomotives must in some way have resulted from that of his father, also Samuel Homfray, who had connections with the first Trevithick locomotive run early in the century when he was at Penydarren. That Samuel Homfray

[79] Ince, *Neath Abbey and the Industrial Revolution,* Appendix 2 (Stationary steam engines built by the Neath Abbey Iron Company).
[80] von Tunzelman, *Steam Power and British Industrialisation to 1860*, p 99.
[81] W. Scandrett, *Old Tredegar Volume 1*, Newport, 1990, pp 85-6.
[82] *Monmouthshire Merlin,* 26 Dec 1829, Tredegar Ironworks.
[83] Geoffrey Hill and Gordon Green, *Industrial Locomotives of Gwent*, London, 1999, pp 115-16, 154.

I had a detailed and technical understanding of steam engines was demonstrated by the correspondence between himself, William Smith and Richard Trevithick in the years 1804-1806.[84]

The Harfords of Ebbw Vale and Sirhowy ironworks were not far behind Homfray and on 2 February 1831 they applied for permission to connect their Newport wharves by tramroad to the Monmouthshire Canal Navigation tramroad at Ynysnewydd Bridge near Newport for the use of a locomotive of their own.[85] The Ebbw Vale Company ran their first two locomotives, 'Lark' and 'Industry', in 1832 or 1833 with a third by about 1836.[86] The Ebbw Vale sale document of 1844 stated that the company had five tramroad locomotives at that time.[87] Other ironmasters in the area were not slow to follow Homfray's example and the Blaina ironworks were operating a locomotive over the canal tramroads from about 1830 and the Baileys of Nantyglo and Beaufort ironworks were having a locomotive built for them in 1832[88] and a locomotive was recorded on the Beaufort to Llangattock line connecting to the canal wharf at Llangattock from about 1840.[89] These examples indicate how keen the local ironmasters were to improve their transport facilities once locomotives were established.

Hence with regard to the use of stationary steam engines the conclusion must be that in general the ironmasters of the group were heavy users from about the 1820s onwards for a variety of purposes when they felt that the introduction of steam power would improve the efficiency of their enterprises. While it was still cost effective to

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[84] Joan M. Eyles, 'William Smith, Richard Trevithick and Samuel Homfray: Their Correspondence on Steam Engines, 1804-1806', *Transactions of the Newcomen Society*, Volume XLIII, (1970-71).
[85] Hill and Green, *Industrial Locomotives of Gwent,* p 91.
[86] Hill and Green, *Industrial Locomotives of Gwent*, p 94.
[87] GRO. D.749.508. Ebbw Vale and Sirhowy Ironworks Auction, 18 April 1844.
[88] Elsas , *Dowlais Iron Company Letters 1782-1860*, R Jones to J. J. Guest, Birmingham, 11 August 1832, p 182.
[89] Hill and Green, *Industrial Locomotives of Gwent*, p 141.

use waterpower for particular tasks, for example to power the blast, they were content to continue to utilise this source of power in addition to steam. Water was still a vital commodity for the ironmasters whether they still used waterpower or not as evidenced by the Ebbw Vale Company's excuses to customers in August 1825 when they blamed the delay in an order for iron on the dry weather.[90] The rather conservative approach of the ironmasters to the use of steam power before 1820 is not out of line with that of other industries in the British industrial revolution[91] and this slight conservatism must be judged in the light of the normally ample supply of water in the hills of Monmouthshire. The local ironmasters however were far from conservative with the introduction and use of locomotives on the tramroads and it appears that the use of locomotives for the transport of iron to Newport or for the transport of minerals to the ironworks was general in the area by the 1840s.

4.4 Iron ores.

The coalfields of Britain became possible sites for the development of iron industries in the second half of the eighteenth century following the successful use of coke in the blast furnaces, provided an ample supply of iron ore was readily accessible. In the early parts of the period under study, from 1780 to approximately the 1820s, the ironmasters of the study area did not have any major difficulties over ores but from around 1830 and in particular following the use of hot blast in the blast furnaces in other areas, they became much more concerned about the whole issue of ores and some ironmasters started to import ores and use mixtures of imported and local ores in their blast furnaces. This was not because of any shortage of local ores, as will be explained below, and whilst most of the ironmasters of the area strove to deal

[90] GRO. D.2472.2. The Ebbw Vale Letter Book 1824-1827, Geo Eaton and Sons, Bristol, 16 August 1825.
[91] Bruland, 'Industrialisation and technological change', p 145.

with their iron ore issues, one particular partnership, that of the Baileys of Nantyglo and from 1833, Beaufort, had a stroke of fortune in the discovery on their lands of blackband, a particularly valuable ore.

In Britain iron ores found in substantial amounts can be classified into three broad groups as in Table 4.4.

Table 4.4 The Iron Ores of Britain

Ores	**% Iron**	**Areas where the ores are found in greatest quantities**
Red Haematite	c.70% when pure	Lancashire, Cumberland
Brown Haematite	c.60% when pure	Forest of Dean
Argillaceous ores, Clay-band ironstone, Carbonaceous ores.	Usually 30-40% but sometimes less.	Coal fields of Britain

Source. Percy, *Metallurgy: Iron and Steel*, pp 197-202; William Truran, *The Iron Industry of Great Britain*, p 5. Other ores such as magnetite are not found in great quantities in Britain.

Iron does not exist freely in nature but only in chemical compounds with oxygen and sometimes other elements such as carbon. Magnetite, chemical formula Fe_3O_4, although an important ore is not common in Britain whilst Red Haematite, the anhydrous ferric oxide, Fe_2O_3, and Brown Haematite, hydrated ferric oxide, are rich in iron compared with argillaceous ores such as those found in the South Wales coalfield. These latter ores are really ferrous carbonate, $FeCO_3$ or $FeO.CO_2$, and are found in mixtures with clays and other earthy material and contain only 30 to 40 percent metal at best.[92] Iron, unlike most metals, has a variable valency which explains its ability to exist in chemical compounds in different proportions to other elements.

Hence the local ores, or ironstones as they are known, of the Monmouthshire area were relatively low in iron content. This was demonstrated by the famous metallurgist, David Mushet when he produced a report in 1841 on the Victoria

[92] Percy, *Metallurgy: Iron and Steel*, pp 197-202

ironworks, situated slightly lower down the Ebwy Fawr valley than the Ebbw Vale works. The owners of Victoria ironworks, The Monmouthshire Iron and Coal Company were considering selling the works and asked Mushet to produce a report on it. Mushet established that a large problem for the company was the cost of its pig iron production. He concluded that because of the 'poverty of the Iron-Stone used in the Furnaces' it was taking nearly 5 tons of ironstone to make a ton of pig iron. Mushet analysed samples of the different ironstones available to the company on their sites and found that one of the main ironstones used in the furnaces had an average of only 10 percent metal. The company had access to ironstones having around 30 to 40 percent iron and he advised the company to use only these in the furnaces.[93] That Mushet was able to come to this straightforward conclusion does tend to suggest that the ironmasters of this works did not analyse accurately the iron content in the ores they were using themselves.

This relatively low iron content in Welsh mine that is iron ore extracted in South East Wales, was clearly a matter of concern to the ironmasters though it was not until the 1870s that imported ores with higher iron content were used in furnaces in anything like the same volumes as local ores.[94] Right up to the middle of the century at least and probably much later local ores were still in abundant supply[95] though it is likely that in some areas access was becoming more difficult as ore levels were deeper. Possibly competition from other regions caused the ironmasters most concern especially from Scotland where the advent of hot blast and the fact that they had

[93] David Mushet, *Report on Victoria Iron Works & Mining Grounds*, Bath, 1841.
[94] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 32.
[95] GRO. D.591.19.384. Sale particulars of the Clydach ironworks, 17 July 1833; GRO. D.7.194. Sale/Auction document for Blaenavon, 22 November 1833; GRO. D.43.6328. Sale particulars of Rumney Iron Works and estates, 17 July 1835; GRO. D.751.356. Blaenavon Minute Book, 2nd Meeting of the Shareholders 15 September 1837; GRO. D.749.508. 18 April 1844, Auction particulars, Ebbw Vale and Sirhowy.

supplies of the blackband ironstone, a carbonaceous ore rich in carbon,[96] resulted in the Scottish ironmasters being able to produce their pig iron more cheaply than the ironmasters of South Wales.[97] David Mushet pointed out in 1840 that some ironmasters had experienced difficulties in producing good iron from mixtures of ores in their blast furnaces[98] however it is known that a number of the ironworks of South Wales were importing ores from Barrow and Ulverston in the North of England from 1825,[99] and it must be assumed that they had managed to use mixtures of imported and local ores at least to the extent that their furnace yields were improved. There is direct evidence of the importation of ores by certain Monmouthshire ironmasters. The Harfords of Ebbw Vale, for example, were importing foreign ores as early as the 1820s[100] and the huge Dowlais ironworks in Merthyr was importing large volumes of haematite ore in the 1840s.[101] The Abersychan and Victoria ironworks were using mixtures of ores in the 1840s for the Abersychan accounts for the month ending 21 September 1844 show that 8,488 tons of local ore was used in the furnaces together with 2,469 tons of imported red ore (haematite) and the Victoria accounts for the four weeks ending 25 March 1848 show that 2,173 tons of local ironstone was used in their furnaces with 394 tons of imported ore.[102]

However there is no evidence in the Blaenavon Minute Book[103] that the company used any appreciable amounts of imported ores in the 1836 to 1849 period and it is likely that there were other works that also had huge reserves of local ores

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[96] Truran, *The Iron Manufacture of Great Britain*, p 5.
[97] *Monmouthshire Merlin*, 6 May 1843, Latest Current Prices of Metals, Pig iron in Wales 70s per ton, Pig iron in Clyde, 45shillings per ton.
[98] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 34.
[99] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 96.
[100] GRO. D.2472.2. Ebbw Vale Letter Book 1824-7, Letter to E. Frere & Co. Clydach, 6 December 1825.
[101] Elsas, *Dowlais Iron Company Letters 1782-1860*, pp 95-6, Letter from Henry William Schneider to Thomas Evans, Ulverston, 14 July 1842 and p 98, Copy of Contract, Dowlais Co. and Messrs. Tulk and Ley, 22 January 1846.
[102] GRO. D.454.939. Abersychan Iron Work Accounts.
[103] GRO. D.751.356. Blaenavon Minute Book.

like Blaenavon that used only local mineral resources. In some cases it might have been the particular products that affected the decision whether to use imported ores or not. Ironworks specialising in the production of wrought iron rails might have wanted to use haematite ore as it was believed that pig iron from this ore allowed greater control over the product than was possible using only Welsh ironstone.[104]

In conclusion it would seem that the ironmasters again took a pragmatic approach over the use of ores in their blast furnaces. Where they had extensive supplies of ore that were reasonably easy to extract they may have been more likely to use solely local ores but where the costs of producing pig iron from local ores that were relatively low in metal content was a problem for them the ironmasters were more likely to experiment in the use of mixtures of local ores and imported ores, usually haematite. When mixtures of local and imported ores were used in the blast furnaces the largest portions in the mixtures were still likely to be the local ores and so local ores remained the main source of iron throughout the period. In some cases ironmasters might have used haematite ores for the production of iron required for manufacturing particular products such as rails. In all circumstances the ironmasters were striving to improve their productivity even calling in consultants such as David Mushet if they had become worried about the cost effectiveness of their operations.

That the ironmasters of the North West Monmouthshire area were all concerned about the efficiency of their enterprises cannot be doubted but the element of luck often played a part as well. David Mushet discovered the blackband ironstone in Scotland at the start of the nineteenth century and later this ore plus the invention of the hot blast process meant that output of the Scottish ironworks expanded rapidly. Blackband ironstone was clay-like in appearance and existed in coal measures. It

[104] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, pp 34-5.

could contain up to around 40 to 50 percent iron oxide and the coaly matter in the ironstone was such that it could be worked with hot blast with much less addition of coal.[105] Until around 1838 blackband ironstone does not appear to have been discovered at least in any workable volumes in the study area but it was reported in the *Monmouthshire Merlin* that blackband ironstone was first smelted at the Bailey's Beaufort works in August 1838 but abandoned.[106] The newspaper reported an article from *The Cambrian* two weeks later that stated that Messrs. Bailey had discovered the vein or seam known as 'Mushet's Blackband' and introduced the subject saying that 'a great sensation has been created in this part of the principality'.[107] However it appears that Messrs. Bailey believed that they had been working blackband for the past twenty or twenty-five years, a belief that was not shared by the Mushet family. The issue seems to have been settled in a letter written by Robert Mushet, David's son, from Coleford, Gloucestershire, on 10 January 1843. It seems that the Baileys had been using an ironstone for many years which was 'black stone' and not the true carboniferous blackband. However Mushet confirmed that the recent blackband identified in 1838 at Beaufort was indeed the true blackband discovered by David Mushet in 1801.[108] Hence the Baileys had the great fortune to have large quantities of this valuable ironstone on their lands, an ironstone that maybe did not contain as high a proportion of metal as haematite but one that required much less fuel especially with hot blast. The Baileys used their blackband in their attempts to obtain malleable iron directly from the ore in the puddling furnace.[109] The Baileys of Nantyglo and Beaufort were undoubtedly the most successful of the ironmasters for many years but it would

[105] Smiles, *Industrial Biography: Iron Workers and Tool Makers*, pp 145-6; Percy, *Metallurgy: Iron and Steel,* pp 202-3.
[106] *Monmouthshire Merlin*, 17 December 1842.
[107] *Monmouthshire Merlin*, 31 December 1842.
[108] *Monmouthshire Merlin*, 14 January 1843, Letter to the Editor of the *Monmouthshire Merlin* from Robert Mushet, Coleford, 10 January 1843.
[109] *Monmouthshire Merlin*, 23 December 1843, Nantyglo, Clay's Process.

be incorrect to attribute this success over their rival ironmasters largely to their supplies of blackband. As Mushet pointed out they did not have supplies of true blackband until the end of the 1830s and they were greatly successful in the decades prior to that.

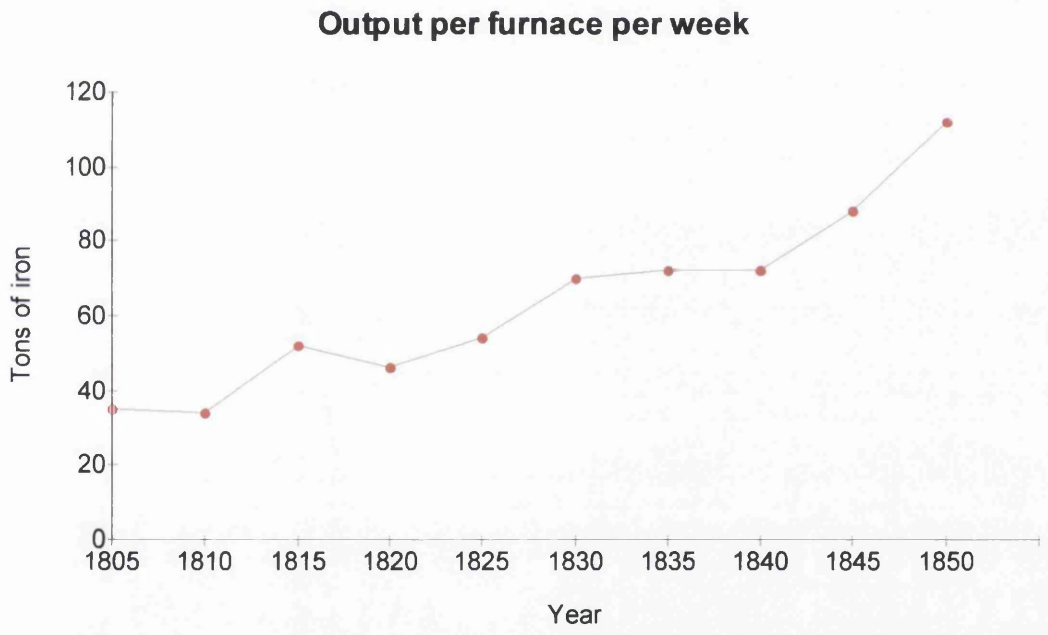
4.5 Conclusion.

It has been claimed in this chapter that the ironmasters of the North West Monmouthshire area strove to improve the efficiency of their enterprises throughout the period and, in the context of technology, that they achieved such improvement by dealing with a variety of issues in a pragmatic manner. To increase output they were prepared to build extra furnaces when this seemed appropriate possibly a little more readily than ironmasters in some other areas, a good indication of their will to reinvest in their businesses. There is evidence also to support the view that the Monmouthshire ironmasters were eager to innovate if this was cost effective, some taking out patents on occasions. They displayed this pragmatic approach to technological matters in their attitude to hot blast and to steam power as they did to other innovations and in the second quarter of the nineteenth century they strove to overcome the difficulties associated with the relatively low iron content in local iron ores by various means according to their own particular circumstances with regards to the quality of their mineral resources and ease of access. There are indications that some of the ironmasters may have occasionally delayed implementing particular innovations to avoid royalty payments and the evidence clearly shows that the British inventors of the iron industry as a group failed to benefit either in recognition in their lifetime or financially through royalties in the manner that might have been due to them.

In the context of technological issues it has been argued that the ironmasters of the North West Monmouthshire area helped to achieve increases in output and

improvements in productivity by a series of incremental improvements rather than via any one major technological change. One objective way to demonstrate this substantial and steady progress would be to measure how much the efficiency of their blast furnaces changed over the years. In other words a good objective measure of at least the smelting side of the businesses would be to assess the output of pig iron per furnace where data allows. Unfortunately the data available makes it possible only to give a general indication of the trends.

Figure 4.1. An indication of the improvements in efficiency of the furnaces of the ironworks of the North West Monmouthshire Area.



Source H. Scrivenor, *History of The Iron Trade*, London, 1854, pp 127, 258; Riden and Owen, *British Blast Furnace Statistics 1790-1980*, pp 1-31 plus other random sources. Note that the resulting figures have been smoothed so that five year estimates can be obtained.

Over the period there is every reason to suppose that the improvements in producing finished iron via puddling and rolling processes followed a similar trend.

This approach of gradual improvements in technological processes adopted by the Monmouthshire ironmasters with more generalised knowledge was common in

Britain compared with the continent where science was further developed.[110] There is however no substantial evidence that the ironmasters of the study area strove to introduce technological changes with the prime aim of reducing labour. In fact when new and technologically advanced mills were built it was a reason for the whole area to celebrate, hardly an indication that the people felt their jobs were threatened by the new developments. The ironmasters wanted their works to succeed and only made changes when they believed their businesses would benefit fairly quickly.

The approach of the ironmasters to technological change in general was therefore essentially a pragmatic one. When there were clear advantages in investing in new furnaces or new processes they were not slow to invest but when they saw economic advantages in continuing with existing procedures they did not rush into the latest technological innovations. The approach coupled with the advantages that the district had in terms of geography and geology contributed to the overall success of the works of the area. However by the 1830s some of these advantages began to slip away. The discovery of the hot blast process was a particular benefit to the Scottish iron producers and the relatively low iron content in local ores meant that ores richer in iron were being imported to the area in increasing quantities.

[110] Pat Hudson, *The Industrial Revolution*, London, 1992, p 24.

Chapter 5 Capital and capital structures of the ironworks of the North West Monmouthshire Area.

5.1 Introduction.

The most important business issue facing the ironmasters of the area and in fact all the ironmasters of the country was the supply of capital to set up the businesses in the first place, to ensure that the necessary innovations could be funded thereafter and finally to ensure that the enterprises had sufficient funds to deal with situations caused by the frequent fluctuations in demand for iron, that is to ensure that they had sufficient working capital. It has been generally accepted that the iron industry of Britain required a higher level of capital investment than say the copper or the coal industries[1] and shortages of capital were problems for some of the ironmasters at times and undoubtedly held these companies back when compared with some of the others. There are two forms of capital needed for any industrial enterprise, fixed and working capital, and in the industrial revolution period it is generally accepted that working capital was the more important of the two but within the iron industry fixed capital was also a major element.[2]

The various sources of capital available to the ironmasters are discussed in turn. All the ironworks of the core group were partnerships until the Blaenavon Company became a joint stock company in 1836 and the partnership itself was the main source of fixed capital. Each partner, whether an active partner or a silent partner, had to bring capital to the company although not necessarily in equal proportions. A second source of fixed capital was a legacy under a will and there are examples of this within the group.

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[1] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History*, Cardiff, 1987, pp 46-7.
[2] M. D. Matthews, 'Small and medium enterprise in the eighteenth century: financing local enterprise in south-west Wales', *National Library of Wales Journal*, 32:4 (2002), p 447.

The reinvestment of profits was the main source of working capital and the financial factors affecting the profits of the ironworks, other than sales of iron and payments of wages, are discussed. Such items included payments of rents for land leased, payments of royalties on minerals used and miscellaneous profits such as those from company shops and sales of coal.

Loans or mortgages served to provide both fixed and working capital especially for the weaker companies financially. Loans were granted within the iron communities, especially in the earlier period, whereas incidences of loans from banks tended to increase as the period progressed. The role of the banks in the area is discussed together with that of local solicitors who often played a key part in arranging supplies of capital.

The final source of finance to be discussed is that provided by the joint stock company capital structure. Although the Blaenavon Company was the only one of the core group of companies to convert to this structure before 1850 some of the newer ironworks of Monmouthshire were either set up as joint stock companies or were converted to this capital structure. An account is given of the experience of joint stock iron companies in the area.

These two alternative capital structures within the iron industry, that is the partnership and the joint stock company, will be compared in the chapter and an assessment will be made as to which was the more appropriate structure for the South Wales iron industry in the first half of the nineteenth century.

5.2 Partnerships.

Apart from the Blaenavon Company from 1836 all the ironworks of the core group were partnerships into the second half of the nineteenth century. The partnership was the main source of fixed capital for the ironworks concerns, the

number of partners in each enterprise being just a few individuals. Each concern had one, occasionally two, active partners sometimes supported financially by one or more silent or sleeping partners who provided capital but who were not directly concerned in management. As such, this method of funding was quite different from that of other major industrial developments in the same district such as in the funding of canals early in the period and funding of railways later. The Monmouthshire canal in 1792 for example had a very impressive list of promoters including the Duke of Beaufort, William Barrow and Co. of Sirhowy iron works, John Cockshutt of Cyfarthfa ironworks, Sir Charles Gould Morgan of Tredegar Park near Newport, the Hanburys of Pontypool, the Harfords of Nantyglo ironworks, Ebbw Vale ironworks and Bristol, Samuel Hopkins and Thomas Hill of Blaenavon ironworks, Jonathan Kendall of Beaufort ironworks, and many others.[3] Hence major landowners did invest in canal developments but they were never partners in any of the local group of ironworks.

The active partners in the ironworks concerns were largely industrialists who had already accumulated capital in the iron industry elsewhere, in the West Midlands or in the Merthyr area. The exceptions were the Harfords, a family of Bristol merchants with other iron interests in South Wales such as at the Melingriffith works[4] and the initial partners at Sirhowy were merchants in the tea trade.

The capital invested in the ironworks by the early partners in the late eighteenth century was relatively modest. The Sirhowy partnership had a capital of slightly less than £12,000 in 1795[5] and in the same year the Beaufort ironworks had capital of £16,000. At Beaufort ironworks the leading partner, Edward Kendall

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[3] Sir Joseph Bradney, *A History of Monmouthshire, Volume 5, The Hundred of Newport*, Madeleine Gray (ed.), Cardiff and Aberystwyth, 1993, p 37.
[4] Chris Evans, 'Global Commerce and Industrial Organization in an eighteenth-century Welsh enterprise: The Melingriffith Company, *Welsh History Review* 20, (2000-1), pp 416-17.
[5] John Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, London, 1906, pp 147-8.

supplied £8,500, Jonathan Kendall, £6,500 and Joseph Latham, £1,000.[6] This pattern of unequal shareholdings was not uncommon. The capital was even less in the Ebbw Vale concern in 1792 after the Harford, Partridge partnership joined Jeremiah Homfray at Ebbw Vale. The capital was only £7,000, two-thirds supplied by the Harford partnership and one-third by Homfray.[7]

The initial Blaenavon ironworks partners in 1789 were Thomas Hill, a banker from Stourport, Thomas Hopkins and Benjamin Platt, both industrialists from the West Midlands with previous experience of the iron industry.[8] Thomas Hill must have been a wealthy man in this period as he had one of the largest holdings in the Monmouthshire Canal Navigation Company with 74¼ shares of £100 each.[9]

The Union Ironworks Company at Rhymney on the Monmouthshire-Glamorgan border had a capital of only £4,000 when it was established in the early years of the nineteenth century. There were four partners each investing £1,000 but they agreed to invest a further £6,000 when required again in equal amounts.[10]

The development of Tredegar ironworks in around 1800 was partly financed by Samuel Homfray who had made a success of the Penydarren ironworks in Merthyr with his brother, Jeremiah. At Penydarren the brothers had financial support from Richard Forman, a London merchant, as they were not thought to be wealthy men when this works was set up in 1784.[11] Samuel Homfray and the two ironmasters from Sirhowy, Matthew Monkhouse and Richard Fothergill, had the financial support of London merchants, William Thompson and William Forman when they set up the

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[6] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 180.
[7] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 152.
[8] A. H. John, *The Industrial Development of South Wales 1750-1850*, Cardiff, 1995, p 25.
[9] 'A List of the Proprietors and Committee of the Monmouthshire Canal Navigation', Reginald Nichols (ed.), *Monmouthshire Medley,* Volume 3, Pontypool, 1978, pp 37-43.
[10] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 130.
[11] John, *The Industrial Development of South Wales 1750-1850*, p 33.

Tredegar ironworks in 1800.[12] The landowner, Sir Charles Morgan possibly reacting to the modest initial capital at some of the other ironworks of the group insisted that the five partners at Tredegar spend at least £10,000 in erecting the works. Morgan remained concerned that the works should develop quickly and a covenant stated that by 29 September 1808 the partners must invest a sum of at least £40,000.[13] In fact the original capital was £30,000, very substantial for the date.[14]

Despite the relatively modest amounts of initial capital in some of the ironworks further investment was required as the works sought to expand. For example the capital at Tredegar ironworks had grown such that in 1817 it was £100,000 and the partners sought to increase the capital by a further £20,000 by allowing profits to accumulate.[15] It was by allowing profits to accumulate that Richard Crawshay saw the capital at Cyfarthfa works in Merthyr rise dramatically from £14,369 in 1790 to £103,908 only eight years later.[16] The capital at the Beaufort ironworks had risen from £16,000 in 1795 to £36,000 by 1816 and the works was valued at £45,000 when it was sold to the Baileys of Nantyglo in 1833.[17] The capital at Ebbw Vale had reached £62,440 in 1820-1 and it is also suggested that as much as £250,000 had been expended on the Blaenavon ironworks by 1816.[18] Possibly because of the continuing need for further finance there were regular changes within some of the partnerships. By 1794 William Barrow was the only survivor of the original four partners at Sirhowy and he left the firm in 1797 and the Ebbw Vale partnership changed twice in its first ten years.

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[12] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 140.
[13] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 141.
[14] John, *The Industrial Development of South Wales 1750-1850*, p 34.
[15] John, *The Industrial Development of South Wales 1750-1850*, p 35.
[16] John, *The Industrial Development of South Wales 1750-1850*, p 43.
[17] B. Caswell, J. Gaydon, M. Warrender (edited and compiled.), *Ebbw Vale 'The Works' 1790-2002*, Ebbw Vale, 2002, p 48; GRO. D.397.1679. Sale of Beaufort Ironworks to the Baileys, 17 January 1833.
[18] John, *The Industrial Development of South Wales 1750-1850*, pp 35-6.

The early life of the Nantyglo works however was the most unusual of all. Thomas Hill of Blaenavon ironworks decided to break off the Nantyglo part of the lands he had leased from the Earl of Abergavenny and in 1791 sought to set up a new partnership for this works with Harford, Partridge and Company of Bristol. A formal deed of partnership was agreed on 30 April 1792, each side to pay half of the cost of erecting the ironworks. The manager of the new works was to be Richard Summers Harford. Apparently Messrs. Hill and Company believed that their share of the cost of the works should not exceed £10,000 but by 1793 the Harford partnership had already expended £16,831 compared with Hill's contribution of £10,483. Much correspondence took place between the two sides without agreement and on 27 January 1795 Messrs. Harford and Co. decided to lay off the miners and to put the furnaces in blast only to run down the stocks of iron ore that had been mined by that date. The Harfords obtained legal advice from Lincolns Inn, the advice confirming their right to use the proceeds of the sales of pig iron to offset their over supply of capital to the partnership. The works were stopped in 1796 and it appears that the Harfords gave up the interest in the Nantyglo works around 1800 presumably accepting a settlement from Hill. Hill made a further attempt to start up the works with new partners but this apparently came to little.[19] The Nantyglo works did not really take off until Thomas Hill and his then partner, Samuel Hopkins, son of one of the original Blaenavon partners, sold the Nantyglo works to Joseph Bailey and Matthew Wayne in 1811.[20] It must be assumed that Thomas Hill's reluctance to invest more heavily in the Nantyglo concern was a shortage of capital. He had lost both his original partners at Blaenavon, both had died before or during his dispute with the

[19] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 165-70.
[20] GRO. D.7.12. Lease of Nantyglo Iron Works, Hill and Hopkins to Bailey and Wayne, 25 March 1811.

Harfords and he might have felt vulnerable with respect to capital for his main concern, the Blaenavon works.

After this early period there was more stability within the partnerships. The senior active partner at Tredegar for a large part of the first half of the nineteenth century was Samuel Homfray II, son of one of the founder partners and Messrs. Joseph and Crawshay Bailey retained ownership of the Nantyglo ironworks well past mid century. The Ebbw Vale partnership involved the Harford family from 1791 right through to 1843 when the partnership went bankrupt. There were other partners from time to time but one or more members of the Harford family were always the active partners. Similarly the Clydach partnership had stability of management with just two different managing partners throughout the first half of the nineteenth century though this works was known to be short of capital continually.[21]

Barrie Trinder in *The Industrial Revolution in Shropshire* states that, in addition to the capital raised within the iron industry and from merchants as in South Wales, capital was also raised in Shropshire from the local coal industry.[22] There is little evidence of any sizeable amounts of capital raised by this source in the study area. The coal industry was always subsidiary to the iron industry in the study area at least until the mid nineteenth century.

5.3 Legacies under wills.

A source of capital that arose from time to time was a legacy under a will. The iron districts were close communities with family connections sometimes across different ironworks as well as within a unit with generations of the same family. The most prominent such family was the Crawshay family of Cyfarthfa ironworks in Merthyr. The first in the generation of Crawshays was Richard Crawshay who, by the

[21] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 192.
[22] Barrie Trinder, *The Industrial Revolution in Shropshire*, Chichester, 2000, p 38.

time of his death in 1810, had amassed a fortune. Amongst the many beneficiaries under Crawshay's will were his son William, Benjamin Hall, of the Rhymney ironworks and Joseph Bailey, later of Nantyglo. Apart from certain specific bequests to family and others the whole Cyfarthfa business was to be divided between these three in proportions of three-eighths, three-eighths and two-eighths respectively. However Bailey elected to sell his interest in the Cyfarthfa works to the other two and left for Nantyglo in 1811. John Lloyd stated that Joseph's brother Crawshay Bailey was one of the witnesses of Richard Crawshay's will and, if this was so, he could not have been a beneficiary of the will himself.[23] However John Addis in *The Crawshay Dynasty* wrote that Crawshay Bailey received £1,000 under the will.[24] Matthew Wayne, who was Joseph's initial partner at Nantyglo, was also given a modest legacy under the will.[25] Benjamin Hall was the executor of the will. He was Richard Crawshay's son-in-law having married Crawshay's daughter, Charlotte, in 1801. In addition to the three-eighths share in the Cyfarthfa enterprise Hall and his wife were also left the residue of Crawshay's estates,[26] the clear implication being that Crawshay was much closer to Hall than to his own son, William, at the time he drew up his will. Hall had been a partner with Crawshay in the Union ironworks at Rhymney but he died in 1817 aged only 39.[27]

As would be expected the main beneficiaries under the wills of the ironmasters of the area were their sons. There were three generations of Thomas Hills associated with the Blaenavon ironworks. The first Thomas Hill, one of the founder partners, bequeathed most of his assets to his two sons, Thomas and Waldron and his grandson,

[23] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 65-7.
[24] John P. Addis, *The Crawshay Dynasty*, Cardiff, 1957, p 13.
[25] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 65.
[26] Chris Evans (calendared by), *The Letterbook of Richard Crawshay1788-1797*, Cardiff, 1990, p 185.
[27] Addis, *The Crawshay Dynasty*, p 13.

Thomas.[28] Thomas Hill II left the bulk of his assets to his son, Thomas Hill III though he also made generous provision for his daughters.[29] Unfortunately both the first and second Thomas Hills died within a few years of each other in the 1820s. The first Thomas Hill must have been related to one of the other founding partners, Thomas Hopkins, as the latter's son, Samuel left his fourth part and other interests in the Blaenavon concern to his cousin, Thomas Hill. This will was dated 13 April 1813. Samuel also made generous provision for his sister, Sarah,[30] well known for her work amongst the poorer people of the Blaenavon area especially with regard to the provision of a school. Thus the Hill family together with the Hopkins family early in the period, managed to keep the Blaenavon concern largely to themselves from the inception of the works right through to 1836 when the company became joint stock. Thomas Hill III was still involved after this being one of the directors of the new company.[31]

When Samuel Homfray of Penydarren ironworks and later Tredegar ironworks died in May 1822 he left his shares to his sons, Samuel, of Tredegar ironworks and Watkin.[32] Similarly Frederick Levick, ironmaster of Blaina ironworks bequeathed his share in the partnership by leaving three shares to Frederick Levick, two shares to George Levick, two shares to Thomas Levick and the final share to Robert Simpson.[33]

There was a similar history of family control at another of the earliest ironworks of the group, Beaufort, though the picture there was more complicated than at Blaenavon. Two of the founder partners were the brothers, Edward and Jonathan Kendall. Edward was the managing partner and in his will of 16 December 1793, he

[28] GRO. D.751.295. Will of Thomas Hill, Will proved in London, 2 June 1825.
[29] GRO. D.751.295. Will of Thomas Hill, 1 April 1824.
[30] GRO. D.591.23.109. Will of Samuel Hopkins of Blaenavon, 13 April 1813.
[31] GRO. D.751.356. Blaenavon Company Minute Book.
[32] GRO. D.917.316. Homfray Partnership documents, 15 December 1824.
[33] GRO. D.397.916. Abstract of the will of Frederick Levick of Wain Wern Co. Monmouth, 25 September 1855.

bequeathed the bulk of his estate to his son, Edward on the occasion of his twenty-fourth birthday. Edward also willed that his son 'be brought up to the iron trade' and that his concerns in Scotland, Breconshire and Monmouthshire should be carried on until his son was able to take over at the age of twenty four.[34] Kendall therefore not only left the bulk of his estate to his son but ensured that his son would continue with his iron making concerns. The will of Kendall's brother Jonathan is even more intriguing. Jonathan left the bulk of his assets to his wife, Mercy, while she was alive. Mercy was to have his interests and share in the Beaufort ironworks as well as his share of the profits of the concern. However on her death Jonathan's interests were to pass to his nephew, Edward Kendall.[35] However Jonathan added a codicil to this will following the death of his brother, Edward. By this codicil he removed his nephew, Edward as a main beneficiary on the grounds of the fortune he had been given following his father's death. Instead Jonathan promoted the interest of the eldest son of his brother-in-law, John West. William Henry West was to benefit on the death of Mercy Kendall and he was 'to be brought up to the iron trade', become a manager in the works with a salary of £100 per annum and be entitled to a small share in the profits. West would inherit Jonathan's share of the business once Mercy died.[36] Jonathan's wishes came about and William Henry West became one of the partners of the Beaufort ironworks with Edward Kendall II and William Hibbs Bevan, the son-in-law of Edward Kendall I.[37]

Hence quite a large amount of capital was circulated over the period within the ironworks families and within the ironworks communities as a result of legacies under wills of relatives. It is clear that the managing partners sought to keep control within

[34] GRO. D.397.1667. Will of Edward Kendall, 16 December 1793.
[35] GRO. D.397.1670. Will of Jonathan Kendall, 10 April 1805.
[36] GRO. D.397.1670. Codicil to the will of Jonathan Kendall.
[37] GRO. D.397.1074. 1 May 1824; GRO. D.397.1675/9. Documents showing the co-partners of Beaufort Ironworks.

their families as much as possible, in some cases declaring in their wills that the beneficiaries whilst below certain ages were to be raised up into the industry to ensure they would follow in their ancestors' shoes. There are just a few cases where beneficiaries were not related but were employees. One example is the case of Matthew Wayne who received a modest legacy under the will of Richard Crawshay.[38] Wayne had been a bookkeeper and a manager at Cyfarthfa ironworks under Richard Crawshaw in the period from 1791 to 1810.[39]

5.4 Reinvestment of profits and financial factors affecting profits.

The numbers of partners of the ironworks companies of the area never exceeded a small number of individuals and so it appears that acquiring extra capital by increasing the numbers of partners was not a policy favoured in general by the principal partners. They wished to keep the control of their concerns to themselves as much as possible. The greatest source of additional capital was the reinvestment of profits.[40] The majority of the working capital of the ironworks came from this source and in a few cases profits reinvested were allowed to accumulate over the years providing a strong capital structure for these particular companies. This section also discusses the sources of profits for the ironworks companies, the financial factors affecting profits and how the profits might have been distributed.

Unfortunately only a very limited amount of source information on the profits made by the local ironworks companies has survived but it is safe to assume that majority of the profits made would have arisen through sales of iron and iron products. However profits were made from other sources in addition. The majority of the coal mined by the ironworks companies in the district would have been used for the works themselves with possibly relatively small supplies sold locally. However by

[38] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, pp 65-7.
[39] Evans, *The Letterbook of Richard Crawshay,* p 195.
[40] John, *Industrial Development of South Wales 1750-1850*, p 40; Addis, *The Crawshay Dynasty*, p 158.

the 1840s some of the iron companies were shipping coal as well as iron. In the Merthyr area there is no evidence that the sale of coal was a substantial factor in the profits of the ironworks there in the late 1830s as none of the four Merthyr ironworks were sending any substantial amounts of coal down the Glamorgan canal in 1838.[41] However in the early 1840s Samuel Homfray of the Tredegar ironworks company was sending coal as well as iron down the Monmouthshire Canal Company's tramroads for shipment at Newport.[42] Later in the same decade the Ebbw Vale Company shipped relatively modest amounts of coal down to Newport, however in both these cases the amounts of coal sent down the canal were very small compared with that shipped by dedicated coal mining companies. For example in October 1847 the Ebbw Vale ironworks company sent down 301 tons of coal whereas Thomas Powell of the Gaer, a coalmaster, sent down 6,845 tons in the same month.[43] Crawshay Bailey of the Nantyglo ironworks seemed to have been one of the first ironmasters to recognize the value of coal deposits independently of iron making and he invested accordingly.[44]

The local ironworks also made some profits from sales in the company shops. Although all the ironworks companies ran shops the level of profits from them were never likely to be large but might have helped the ironmasters in bad years. An example is the Clydach Company which made a profit of £571 from its shop in the year ending 31 March 1824.[45]

Further sources of income for the ironmasters were rents from the lands they had acquired either leasehold or freehold. There are examples where the ironmasters leased or subleased land to farmers and others. They sometimes subleased mineral

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[41] *Monmouthshire Beacon*, 6 July 1839, Iron and Coal sent down the Glamorganshire canal from 1 January to 31 December 1838.
[42] *Monmouthshire Beacon*, 10 December 1842, 18 February 1843, 6 March 1844.
[43] *Monmouthshire Beacon*, 6 November 1847, Coal sent down the Monmouthshire Canal tramroads, October 1847.
[44] E. Phillips, *Pioneers of the Welsh Coalfield*, Cardiff, 1925, pp 70-2.
[45] NLW. Maybery MSS. 363, Clydach Iron Company, Year ending 31 March 1824.

lands to other ironmasters. The Blaenavon Ironworks subleased land to the Nantyglo ironworks[46] and to the Varteg ironworks company.[47] Similarly the Beaufort ironworks company subleased land to the Clydach ironworks.[48] The Ebbw Vale Company acquired much freehold land, as this company had not leased large tracts of land from one major landowner. There are records of this company leasing land to farmers, tradesmen and workmen.[49] The Baileys of the Nantyglo works were major acquirers of land and leased mineral and building land to other ironmasters and farmlands to local farmers.[50]

All the costs associated with the manufacture of iron had to be taken off the sale proceeds. These costs included wages to all employees, costs of extraction and purchase of minerals, all maintenance costs of capital equipment, building and maintenance costs of workers' houses, building of roads and transportation costs of all sorts especially the costs of transporting iron to the docks at Newport, commissions to agents and many other costs. Occasionally the ironmasters were faced with costs made necessary because of unusual circumstances. The Ebbw Vale Company found it necessary to build a tunnel through parts of the hill between Sirhowy and Ebbw Vale to move iron and minerals between the two works after the Ebbw Vale Company acquired the Sirhowy works in 1818. The tunnel was not completed until the early 1830s. Similarly the Blaenavon works built a tunnel to connect its furnaces with Pwll Du and on by railroad to the company's forge at Garnddyrys. However the two major financial drains on profits were interest payments on loans and rents payable on the

[46] GRO. D.7.12. Lease of Nantyglo iron works, Hill and Hopkins to Bailey, 25 March 1811.
[47] GRO. D.751.356. Blaenavon Company Minute Book, 12th Shareholders Meeting, 26 April 1844.
[48] GRO. D.397.1671. Deed of Copartnership between Messrs. Kendall and Bevan, 12 August 1816. Lists underlease of Clydach Ironworks at £780 per annum as an asset.
[49] Ebbw Vale Works Archive, Document 129. Lease, 20 March 1813 and others; GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, 23 January 1800, Agreement between Richard S. Harford of the Ebbw Vale Company and John Davies for the latter to rent the Duffryn farm.
[50] GRO. D.397.20.19. November 1825, Lease J. and C. Bailey to Leah Needham (widow) of Beaufort Iron Works; GRO. D.397.834. 4 July 1849, Lease of mineral land, J. and C. Bailey to Robert Cruttwell and others; GRO. D.397.1659/1660. Farmlands, cottages etc. leased by J. and C. Bailey.

major leases of land on which the ironworks were built and from which the minerals were extracted. Loans are discussed in the next section.

The lands on which the ironworks and their associated mineral resources lay were leased from major landowners in most cases and the rental and lease terms were issues of considerable concern to most of the ironmasters, the rents being a real drain on working capital. The issue of the lease terms was a matter where luck played a part. The early ironmasters of the region, that is those of the Merthyr area, were fortunate in that the landlords did not fully appreciate the value of the minerals on their lands and consequently the lease terms were sometimes very favourable to the ironmasters. The Dowlais Company for example had to pay just £31 per annum, the clearest example of a landowner not realizing the value of the minerals on and under his land when the lease was granted. However when J. J. Guest, the Dowlais ironmaster, entered into negotiations with the then Marquis of Bute for renewal of the lease in March 1848 the Marquis not only knew the value of his minerals but resented the 'princely fortunes' Dowlais had made under the old lease.[51] The core group of ironworks of the North West Monmouthshire area had started up somewhat later than their Merthyr counterparts and the lease terms for the Monmouthshire masters were considerably less favourable as can be seen in Table 5.1 where the lease terms are given through the first half of the nineteenth century.

Of the earliest Monmouthshire iron companies the Sirhowy works appears to have had the easiest lease though the Tredegar works and the Beaufort works also had fairly light terms. The Clydach and the Nantyglo ironworks were at a disadvantage as

[51] *Monmouthshire Merlin*, 11 March 1848, The renewal of the lease of the Dowlais Iron Works.

Table 5.1. Lease terms in the early nineteenth century

Ironworks	Year works founded	Duration of lease	Terms of lease in the period 1800 to1850.
Dowlais, Merthyr	1763	to 1862	£26 p.a. plus £5 p.a. to previous lessee
Plymouth, Merthyr	1763	to 1862	£60 p.a.
Cyfarthfa, Merthyr	1765	to 1864	£100 p.a. (plus £5,000 p.a. and 15s per ton until 1814)
Pendarren, Merthyr	1784	to 1883	£140.8.0 p.a. plus 6 ½d per ton on coal paid to Dowlais
Sirhowy	1778	to 1818	£134.9.0 p.a. Sirhowy ironworks was acquired by Ebbw Vale in 1818, the latter having acquired the Sirhowy freehold earlier.
Beaufort	1779	to 1878	£406 p.a. plus 2s for each dozen of ironstone used
Blaenavon	1789	to 1810	£1,300 p.a.
		to 1869	£5,200 p.a. plus £500 a year for each additional blast furnace over nine furnaces.
Ebbw Vale	C1790		See note below
Clydach	C1800		£780 p.a. plus 9d per ton of coal not used by Clydach, all payable to the Beaufort ironmasters.
Tredegar	C1800	to 1899	£300 p.a. for 5 years then £500
Nantyglo	1790s reopened 1811	1811 to 1859	£2,050 p.a. plus £750 p.a. for each extra furnace in blast over the two that existed in 1811. The Baileys were granted a lease directly from the Earl of Abergavenny from 1855 rental £3,000 p.a.
Abersychan (British Iron Co.)	C1825	1827 on	£400 p.a. ground rent, £2,000 (£3,000 from 1829) mineral rent plus a royalty of 7/6d on each ton of pig iron used plus an extra 1/3d on refined iron.
Varteg	C1805		£2,600 p.a. payable to Blaenavon
Cwm Celyn & Blaina	1839 1825	After merger in 1841	£3,450 p.a. plus 6s per ton up to 10,000 tons of iron then 5s per ton.

Sources. Lloyd, *Early history of the old South Wales ironworks (1760-1840)*; Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, pp 21-5; Alan Birch, *The Economic History of the British Iron & Steel Industry 1784 – 1879,* London, 1967, p 114; GRO. Lease documents.
Note. The Ebbw Vale Company held no one major lease but acquired a number of freehold and leasehold tracts of land.

they had sub-leases each paying rental to other ironworks. The terms experienced by the later works established lower down the valleys such as the Varteg, Abersychan, Blaina and Cwm Celyn ironworks were more severe and no doubt contributed to the fact that all these works were up for sale at some stage in their existence.

That payment of rents under leases was an important cost to the ironmasters is demonstrated by the example of the Blaenavon Company when in 1837 they

considered the site for a new works. The site was chosen on freehold land to avoid any additional rents to the Earl of Abergavenny as under their existing lease they would be charged an extra rental of £500 p.a. for each new furnace at the old site.[52] The Blaenavon directors were also most concerned at the loss of £2,600 per annum rent after the Varteg Company failed in 1843.[53] The payment of royalties, or galeages as they were termed, was also of major concern to some companies such as the Abersychan ironworks situated a few miles lower down the valley from Blaenavon. This company was so concerned about the effect of royalties that they wrote to some neighbouring ironmasters seeking details of the galeages paid by them presumably to see if their own burden was in line with that of others.[54] The British Iron Company that had become the New British Iron Company was the owner of the Abersychan works and the severe rent and royalty terms of the ironworks must have contributed to the failing company's predicament. The Abersychan ironworks was bought up by the Ebbw Vale Company in 1852 for the trifling sum of £8,500 which was more than covered by the stock left on the site.[55]

Rents and royalties on minerals or iron manufactured as illustrated in Table 5.1 were thus major concerns for the ironmasters and undoubtedly had an impact on the cash flow situations within their accounts. However it is possible to identify the element of luck in the context of these leases. The later ironworks had the disadvantage of dealing with landowners who had a better idea of the value of their minerals. Some ironworks were even so lucky as to benefit from sub-leases where newer ironworks had to pay rents to ironmasters holding the first lease and not directly

[52] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book, 2nd Meeting of the Shareholders, 9 March 1837.
[53] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book, 12th Meeting of the Shareholders, 26 April 1844, at No.4 Pancras Lane, London.
[54] GRO. D.454.939. Correspondence and notes, accounts etc. associated with Abersychan Ironworks especially galeages 1843-1850.
[55] Caswell, Gaydon, Warrender, *Ebbw Vale 'The Works' 1790-2002*, p 194.

to the landowner. With regard to royalty payments associated with the use of patented processes, the ironmasters appear to have escaped the payment of large amounts. The most well known patent was the puddling and rolling process of Henry Cort. However it is not certain if the South Wales ironmasters ever paid any royalties to Cort.

In profitable years the actual amount reinvested in the ironworks companies would also depend on the amounts taken out of profits by the partners for their own use. In unprofitable years the partners would have had to stand the losses. It is impossible to assess the proportions ploughed back into the businesses compared with that taken out but it is certain that the more successful of the ironworks managed to do both over quite long periods. For example the Nantyglo works was the most successful of the group after the Bailey brothers took over yet Joseph Bailey acquired extensive lands and estates such as Glan-Usk near Crickhowell, his principal estate and residence. However with regard to investing in their own businesses, Messrs. Bailey, as they were known, had a reputation for keeping their works running even in bad times. This is summed up in the following comment that was part of a speech made at a public meeting held in the Nantyglo area in January 1855, in the context of trade depressions, 'But at Nantyglo the works were carried on with the greatest regularity whether the iron was made at a profit or loss, and the workmen were constantly employed at a rate of wages, at least that enabled them to support themselves and their families'.[56] It is likely that in most cases and for most years the majority of any profits made were ploughed back with the ironmasters taking the smaller share. This appears to be confirmed by the steady growth rates of the companies of the group, though at differing levels, and by the records of investment in

[56] *Monmouthshire Merlin*, 19 January 1855, Public Meeting – Workmen's Wages.

innovations such as steam engines from the Neath Abbey works.[57] Thus it is most likely that the amounts taken out of the businesses by the partners for their own use were related to the size of the profits made and to the success of the enterprise as a whole.

As regards the actual distribution of profits taken out of the businesses it was likely that these monies were paid in proportion to the shares held in the partnerships by the individual partners. This is clearly stated in the Blaenavon Articles of Partnership of 1827 between Thomas Hill and Waldron Hill both of Blaenavon, Charles Wheeley of Abergavenny and William Morgan also of Abergavenny, partners in the Blaenavon business at that time.[58]

So while it is likely that a sizeable proportion of the profits made by the ironworks of the group were actually reinvested in the businesses it is also likely that few of the companies of the North West Monmouthshire group, Nantyglo a possible exception, built up large capital accumulations such as at the Dowlais works in Merthyr.[59] This was due in no small part to the fluctuations in demand leading to similar fluctuations in profits and other sources of capital would have been required from time to time.

5.5 Loans.

Loans played an important part in the financing of some of the ironworks of the group both in terms of fixed and ordinary working capital. These ironworks were often low on capital and this section attempts to examine in detail the extent of the use

[57] Laurence Ince, *Neath Abbey and the Industrial Revolution*, Appendix 2 (Stationary steam engines built by the Neath Abbey Iron Company).
[58] GRO. D.591.3.217. Articles of Partnership, Blaenavon, 1822.
[59] Chris Evans, *'The Labyrinth of Flames', Work and social conflict in early industrial Merthyr Tydfil*, Cardiff, 1993, p 20.

of loans within the group.

The iron works communities were a close group and not surprisingly loans were sometimes granted by one ironmaster to another. The Clydach ironworks was usually short of capital[60] as evidenced by the fact that it was offered for sale in 1813 and again in 1833.[61] The Crawshays of Cyfarthfa made loans to the Clydach ironmasters, Edward Frere and Thomas Cooke, to enable them build a new forge and mill in 1810.[62] Frere and Cooke had worked under Richard Crawshay at Cyfarthfa, Frere in charge of the fineries in the early 1790s and Cooke as works manager in 1791-92.[63]

The Harford partnerships of Ebbw Vale ironworks seem to have obtained a succession of loans. In 1820 they had a loan of £30,000 possibly from Robert Thompson an ironmaster. The sum was raised on the security of the Ebbw Vale and Sirhowy ironworks and associated land.[64] The Ebbw Vale Company had a loan of £20,000 from William Crawshay II in 1826.[65] Crawshay's father William Crawshay I, criticised his son over this loan suggesting that he would have done better to have invested his money at the Crawshays' George Yard house in London.[66] Later the Harfords had a mortgage debt of £40,000 from J. and C. Bailey of Nantyglo ironworks.[67] The Harfords also had loans from their bankers.[68] It is not known if these loans were all outstanding simultaneously or if some were taken out to redeem others.

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[60] Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, p 192; NLW. Maybery MSS 349, Clydach ironworks, 1842-1846.
[61] John van Laun, *The Clydach Gorge*, Abergavenny, 1979, p 9; GRO. D.591.19.384. Particulars of freehold and leasehold estate comprising the Clydach Iron Works, South Wales, 17 July 1833.
[62] NLW. Maybery MSS. Letter from Robert Thompson (Abbey Tintern Works) to Walter Powell solicitor (Brecon), 27 November 1810.
[63] Chris Evans, *The Letterbook of Richard Crawshay 1788-1797*, pp 124, 128, 181, 184.
[64] Ebbw Vale Works Archive, Document 149, 1 December 1820, Deed to secure £30,000.
[65] Ebbw Vale Works Archive, Document 185, 27 January 1826, further legal charge to secure £20,000 from William Crawshay on the security of properties.
[66] Addis, *The Crawshay Dynasty*, p 156.
[67] Ebbw Vale Works Archive, Document 173, 15 May 1829 and 181, 23 March 1837.

It does not appear to have been difficult to obtain loans in this period and solicitors played a key role in arranging them. They are many examples of solicitors advertising potential loans in local newspapers, some of these loans being quite sizeable. For example the following advertisement appeared in the *Monmouthshire Beacon* of 8 February 1839:

> Money. £20,000; £10,000 and various smaller sums. Ready to be advanced on landed security at 4%. Apply post paid to GABB and SECRETAN, Abergavenny.[69]

There were no banks in Wales until the 1770s and 1780s but by 1815 there were four banks in Monmouthshire.[70] None were in the iron districts; the nearest banks at this time were in the market towns of Abergavenny and Brecon. Because of the shortage of banking facilities in this early period it is not surprising that the main sources of new capital were the partnerships themselves and loans on the security of property or land privately arranged within the iron communities.[71] As the century progressed some of the ironworks companies obtained credit and loans from the local banks. The Clydach ironworks company was assisted by Messrs. Wilkin and Co. of Brecon continuously and was usually in debt to the bank for amounts ranging from five to twenty thousand pounds.[72] The Ebbw Vale Company had loans from their bankers, Jones, Jones and Davies of Abergavenny. These bank loans reached £20,000 by the mid 1820s.[73]

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[68] Ebbw Vale Works Archive, Document 186, 28 September 1825, Loan of £14,000 from Jones, Jones and Davies, Abergavenny, Document 188, 1 May 1823, Loan of £6,000, from the same bank.
[69] *Monmouthshire Beacon,* 8 February 1839.
[70] R. O. Roberts, 'Financial Developments in Early Modern Wales and the Emergence of the First Banks', *Welsh History Review,* 16 (1993), pp 296, 303.
[71] M. D. Matthews, 'Small and medium enterprise in the eighteenth century: financing local enterprise in south-east Wales', p 447.
[72] John, *The Industrial Development of South Wales 1750-1850,* p 48; Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840),* p 192.
[73] Ebbw Vale Works Archive, Document 186, 28 September 1825, Loan of £14,000 from Jones, Jones and Davies, Abergavenny and Document 188, 1 May 1823, Loan of £6,000, from the same bank.

In 1825 during the banking crisis of that year the Ebbw Vale Company was one of the ironworks companies that had difficulty obtaining day-to-day finance from their bankers. The situation for the company did not improve over the following two years such that in 1827 Richard Summers Harford appealed to William Crawshay not to call in the loan the Ebbw Vale Company had from him.[74] In the 1830s and 1840s there was a strengthening of the local banking system in the area and the prospectus for the Monmouthshire Banking Company was published in June 1836. This joint stock bank was to have capital of £500,000 in £20 shares.[75] Further consolidation of the banks in the region took place on 16 July 1836 when the Cardiff and Glamorganshire Bank agreed to merge with the Monmouthshire Banking Company to form the Monmouthshire and Glamorganshire Bank.[76] It is believed that this bank formed a branch in Tredegar around this period.[77] Also around this time certain national and provincial banks moved into the region such as the West of England and South Wales Bank with branches at Newport, Merthyr and Cardiff and the National Provincial Bank with a branch at Cardiff.[78] A branch of this latter bank was to be opened in Brecon in March 1834.[79] It should be noted that in the 1830s and 1840s there were savings banks in Monmouthshire but generally these banks did not grant loans and the majority of the depositors' funds were invested with the Commissioners for the Reduction of the National Debt.[80]

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[74] Caswell, Gaydon, Warrender, *Ebbw Vale 'The Works' 1790-2002*, pp 51-2.
[75] *Monmouthshire Merlin*, 4 June 1836, Prospectus of the Monmouthshire Banking Company.
[76] *Monmouthshire Merlin*, 16 July 1836, The Cardiff and Glamorganshire Bank have agreed to merge with the Monmouthshire Banking Company to form the Monmouthshire and Glamorganshire Bank.
[77] Evan Powell, *History of Tredegar*. (Subject of Competition at Tredegar Chair Eisteddfod 24 Feb 1884), Newport, 1902, p 50.
[78] John, *The Industrial Development of South Wales 1760-1840*, p 52.
[79] *Monmouthshire Merlin*, 8 March 1834, National Provincial Bank to open a branch at Brecon.
[80] *Monmouthshire Merlin*, 23 January 1830, Monmouth Savings Bank, 30 January 1830, Chepstow Savings Bank, 1 January 1831, Monmouthshire Savings Bank, 24 January 1835, Abergavenny Savings Bank.

The Monmouthshire and Glamorganshire Banking Company provided a loan of £40,000 out of the purchase price of £77,000 so that the new partners of the firm Cruttwell, Allies and Company were able to take over the Blaina and Cwm Celyn ironworks near Nantyglo in May 1846.[81] This bank also supported some of the railway issues of 1843 and 1844 in the region such as the Newport and Nantyglo Railway and the South Wales Railway to Pembrokeshire providing a link by boat to the south of Ireland. The committee for the latter venture included Joseph Bailey of Nantyglo Ironworks, J. J. Guest of the Dowlais Ironworks and Anthony Hill of the Plymouth Ironworks in Merthyr. It appears that Messrs. Bailey had formed their own banks by this time as these two railway ventures were also supported by the bank of Messrs. Bailey and Co. and Messrs. Bailey, Morgan and Co respectively.[82]

From this discussion it can be seen that generally there were good opportunities for the ironmasters to obtain loans from different sources throughout the first half of the nineteenth century and the weaker companies financially certainly used these facilities. The loans in the early part of the period were often arranged within the iron communities but the banks soon took up the major role in granting financial support to the iron companies. The Bank of England itself made loans to some ironworks, particularly in South Wales[83] and the stronger of the iron companies such as Messrs. Bailey of Nantyglo went farther and set up their own banking concerns.

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[81] GRO. D.397.917. Deed of Partnership, 14 May 1846, Blaina and Cwm Celyn ironworks.
[82] *Monmouthshire Beacon*, 21 January 1843, Newport and Nantyglo Prospectus, 1 June 1844, South Wales railway to South of Ireland.
[83] Alan Birch, *The Economic History of the British Iron & Steel Industry 1784-1879*, London, 1967, p 209.

5.6 Joint stock companies.

In 1836 the first of the core group of ironworks converted from the partnership capital structure to joint stock company status. This was the Blaenavon Company and although most of the Monmouthshire ironworks remained partnerships through the middle of the nineteenth century five other ironworks of the county were set up or were converted to joint stock status in the first half of the century. These were The Monmouthshire Iron and Coal Company at Victoria near Ebbw Vale, the Varteg Company near Blaenavon, The British Iron Company at Abersychan, the Rhymney Iron Company and the Blaina and Cwm-Celyn Iron Company.

Following the unsuccessful attempt to sell the company in 1833 the Blaenavon Company partners decided to float the company as a joint stock concern and the prospectus of May 1836 stated that a capital of £400,000 was to be raised by issuing 8,000 shares of £50 each. It is significant that Thomas Hill, the previous ironmaster was to be one of the directors of the new company[84] suggesting shortages of capital were behind the conversion to joint stock status. By July 1837 the directors had still failed to make this target as 6,633 shares out of 8,000 had been allocated at that time. There might have been reluctance by investors to risk their money at this time because the liability of such companies was not yet limited. This protection for shareholders did not come in until 1855-56.[85] Eventually 8,000 shares were in issue as the directors reported in April 1841 that £45 (out of £50) had been called on 8,000 shares. However at the same meeting further capital was sought by an issue of 2,000 new £50 shares, this capital being needed partly to pay for the planned new furnaces, forges and mills and partly to repay earlier debentures. By April 1843 only 668 new shares out of 2,000 had been subscribed. A resolution seeking further capital was passed in April

[84] *Monmouthshire Merlin*, 28 May 1836, Prospectus, Blaenavon Iron and Coal Company, London, 23 May 1836.
[85] John, *The Industrial Development of South Wales 1750-1850*, p 53.

1845 this time by the means of an issue of scrip certificates of £25 each.[86] The conversion to joint stock company status does not seem to have improved the situation with regard to the raising of capital for Blaenavon ironworks and they had the extra problem of attempting to pay dividends to shareholders. They did pay dividends for a few years but soon found it impossible to maintain them. One of the main purposes of the conversion of the Blaenavon Company to joint stock status was presumably to fund the new furnaces, forges and mills but these developments did not appear until after the period under study, that is until well after 1850.

The *Mining Journal* reported in July 1855 that 'a most unsatisfactory, not to say extraordinary statement relative to the affairs of the Blaenavon Iron and Coal Company' had reached them. The report produced by a committee of investigation into the company contained an array of severe criticisms including the following: firstly there had been poor attendances at the London Board meetings, the committee even suggesting that some of the directors' fees should be returned to the company; secondly there was unproductive work on the company's freehold property in particular in connection with the three furnaces, the erection of which had been started in 1839, and on which £71,000 had been spent over the years and yet none were completed; thirdly the company had previously sub-leased land on which the Varteg ironworks now stood idle and was suffering dilapidation and plunder but the company was still paying rental for the land to the Earl of Abergavenny; and finally the committee also criticised the amount of money wasted on the mill and forge amongst other issues.[87] Harry Scrivenor who was appointed manager of the Blaenavon company in early 1841, staying only for a few years,[88] and who was the author of the

[86] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book.
[87] *Monmouthshire Merlin,* 11 July 1855, The Blaenavon Iron and Coal Company – its past management and future prospects, (from the *Mining Journal*).
[88] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book.

History of the Iron Trade, wrote to the *Monmouthshire Merlin* following this paper's publication of the *Mining Journal* report, giving 'three essentials to the successful operations of such a work –a London Board, consisting of men of business, with unity of action, a sufficient working capital, and a good manager at the works'.[89] It is probably no coincidence that in 1855, the year of the *Mining Journal's* unsatisfactory report, the Baileys of Nantyglo got themselves out of the sub-lease they had held with the Blaenavon ironworks since 1811.[90] This sub-lease involving an annual rental of £2,050 plus £750 for each additional furnace in blast[91] would have been valuable to Blaenavon providing the ironmasters there with a sound regular income every year but apparently they needed capital in 1855 possibly associated with the new works and forge that had been planned since the formation of the joint stock company in 1836.

The majority of the joint stock iron companies of South Wales were loss-making concerns in this period[92] and many of the problems identified at Blaenavon also affected these companies. The Monmouthshire Iron and Coal Company, owners of the Victoria works situated a mile or so down the Ebwy Fawr valley from the Ebbw Vale works, was established in 1836 but there were no furnaces running at Victoria two years later and although one furnace was blown in, in late 1838. David Mushet reported that £193,848 had been expended by 1841,[93] and the Victoria works was up for sale in the same year, the sale re-advertised the following year.[94]

The Varteg ironworks, situated lower down the Afon Lwyd River from Blaenavon, was converted to a joint stock company in 1836 but failed and in January

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[89] *Monmouthshire Merlin*, 18 July 1855, Letter to the editor. Blaenavon Iron and Coal Company.
[90] GRO. D.7.213. Marquis of Abergavenny and Nantyglo Company.
[91] GRO. D.7.12. Lease of Nantyglo Iron Works, Hill and Hopkins to Bailey 1811.
[92] Birch, *The Economic History of the British Iron and Steel Industry 1784-1879*, p 204.
[93] Caswell, Gaydon, Warrender, *Ebbw Vale 'The Works' 1790-2002*, pp 53-4.
[94] *Monmouthshire Merlin*, 20 August 1836, Monmouthshire Iron & Coal Company, also 5 May 1838, 24 November 1838, 6 November 1841, 2 April 1842 and 20 August 1842.

1841 there was a sale of the company's stock in trade.[95] In 1839 the Blaina and Cwm Celyn ironworks were consolidated into a joint stock company but these works also were up for sale in January 1844[96] and the concern seems to have reverted back to partnership structure.[97] The Rhymney Company seems to have fared reasonably until the mid 1840s, judging by the share price, but in November 1846 the directors stated that no dividends were payable, blaming labour costs, and the company sought authority to raise more capital to pay off a £40,000 mortgage.[98] If the experiences of these joint stock companies seem disappointing the British Iron Company and its works at Abersychan a few miles south of Blaenavon fared even worse. In May 1838 there was considerable apprehension following a House of Lords ruling against the company in favour of Mr Attwood who was in dispute with the company and who was awarded a considerable sum. Despite this the company felt able to grant a dividend of ten shillings in the pound on profits of £19,400 in December 1838. In 1841 a second investigation into the company's affairs recommended dissolution whilst action was taken against certain shareholders who were refusing to pay calls on their shares. The company was still trying to collect calls in 1842 and in July 1843 an action was taken in the Vice-Chancellor's Court over a £25 call. In August of the same year dissolution of the company was again proposed, the aim being to sell the interests and works with the formation of a new company that was to have share capital of £400,000. The new company was set up and in February 1845 it was reported to be profitable 'to some extent' though the defaulting shareholders from the original company were still being chased for outstanding calls as late as May 1846, the old company finally being

[95] *Monmouthshire Merlin*, 30 July 1836, Varteg ironworks, also 2 January 1841.
[96] *Monmouthshire Merlin*, 13 July 1839, Blaina and Cwm Celyn ironworks, also 30 January 1841 and 27 January 1844.
[97] GRO. D.397.917. Deed of partnership, Blaina and Cwm Celyn ironworks, 14 May 1846.
[98] *Monmouthshire Merlin*, 28 November 1846, Rhymney Ironworks, also 30 December 1846.

dissolved in April 1847. At the same time the new company was able to declare a dividend of 20 percent with a pick up in the market and orders pouring in.[99]

The capital of these joint stock companies as shown in Table 5.2 was quite substantial and cannot be regarded as the main reason for their apparently weaker performance than that of the works still run as partnerships in the years up to 1850. This weak performance was also reflected in the share prices which for Blaenavon, the British Iron Company and Rhymney had been £42, £9 and £36 respectively in August 1839 but by early 1844 Blaenavon's share price was below £10, Rhymney's £12 with no price being available for British Iron Company.[100] It must be assumed that the management structure of the early joint stock companies in the iron industry was, on average, much less successful than that of the companies still run as partnerships.

Table 5.2 Capital of the Joint Stock Iron Companies of Monmouthshire 1844.

Company	Capital (£)
Rhymney	650,000
Blaenavon	500,000
Blaina	320,000
Pentwyn	220,000
Victoria	170,000

Source Birch, *The Economic History of the British Iron & Steel Industry 1784-1879*, p 204.

The general conclusion to this discussion on the relative merits of ironworks partnerships and joint stock companies in the 1830s and 1840s seems clearly to point in favour of the former, at least at this time. The continuity of the partnerships, control often remaining within the same family for decades, and the skill of the main partners or ironmasters were critical in these difficult times. Assuming they had sufficient capital they could decide what they wanted to do themselves and do it immediately whether this be introducing a particular innovation or expanding their operation in

[99] *Monmouthshire Merlin*, 14 April 1838, British Iron Company, Also 5 May 1838, 19 May 1838, 8 December 1838, 17 July 1841, 2 October 1841, 5 February 1842, 8 July 1843, 5 August 1843, 12 August 1843, 2 September 1843, 23 November 1844, 8 February 1845, 30 May 1846. 5 September 1846, 10 April 1847.
[100] *Monmouthshire Merlin*, 3 August 1839, 6 January 1844, Share Prices.

some way. When the Tredegar Company and the Nantyglo works each decided to invest in new mills they just got on with it but the Blaenavon Company struggled for years with plans for new works, forges and mills without success. If loans were required to achieve some of their aims such loans seemed relatively easy to come by. One of the risks of partnerships was that the death of one of the partners might lead to a period of uncertainty[101] and no doubt this did arise on occasions but the active partners made every effort to allow control to pass smoothly to descendents or other relatives.

The joint stock iron companies of Monmouthshire were often unable to raise sufficient capital. The shareholders were eager to invest in good times but less so in bad times especially if dividends were suspended, hence the battles over calls. This desire for dividends displays a conservative attitude amongst the shareholders many of whom would have never seen an ironworks in their lives, the board meetings generally being held in London or Bath. There is also evidence that some of the joint stock companies were not well managed as committees of enquiry into the running of the companies were sometimes set up. Hence better management; freedom of action and generally better access to capital seems to have given the partnership ironworks of the study area the edge. The fact that the two great Merthyr iron companies, Cyfarthfa and Dowlais, remained partnerships until late in the nineteenth century[102] suggests that the partnership capital structure might also have been appropriate in other iron districts of South Wales in the first half of the nineteenth century.

[101] Jeremy Knight, 'The Blaenavon Iron and Coal Company, 1836-1864, A Victorian Joint-Stock Venture', *Bulletin of the Board of Celtic Studies* 1980, Volume 28, part 4 (May 1980), p 632.
[102] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 63.

5.7 Conclusion.

Although the iron industry and its associated mineral extractive activities were highly labour intensive a substantial amount of both fixed and working capital was always required for the works to function. In general the success of the ironworks of the area in the first half of the nineteenth century enabled the ironmasters to reinvest substantial proportions of their profits back into their businesses. The greater ratio of furnaces to works within the Monmouthshire core group of works compared with the national average as indicated in Tables 4.1 and 4.2 in Chapter 4 seems to confirm this. There is no evidence that particular ironmasters took untoward amounts of profits out of their companies leaving their businesses vulnerable. It appears that ironmasters, such as Messrs. Bailey who clearly did take out large amounts of money, did so because their companies were the most successful, generating the most profit. At times some of the ironworks of the area did suffer from shortages of capital that might have held back the progress of their businesses.

Table 5.3 Profits and losses at the Clydach ironwork, 1838 to 1850

	Profits (£)	Losses (£)
1838	111	
1839	4,032	
1840	2,994	
1841		2,926
1842		3,322
1843		6,737
1844		9,069
1845		1,535
1846	15,008	
1847	12,485	
1848	12,309	
1849		2,175
1850		5,275

Source. W. E. Minchinton, 'Brecknock and the Industrialization of South Wales', (ed.) D. J. Davies, *Brycheinog*, Volume 7 (1961), p 22.

The obvious example is the Clydach ironworks, a works that was up for sale more than once. Some of the problems of the Clydach ironmasters however might

have been due to its location in the fairly narrow Clydach gorge. Expansion would have been more difficult there as a result. The difficulties of the Clydach ironworks are illustrated in Table 5.3, the company's fortunes varying between profit and loss situations in the period 1838 to 1850.

The level of rentals payable by the ironworks companies on the land they leased was a concern for some of the ironmasters as high rents were a major drain on working capital. There was a considerable element of luck involved with the level of these rents, in general the later established ironworks had the harsher lease terms, and the ironmasters were always looking for freehold opportunities as they expanded their operations.

Loan capital was vital for some of the works such as Clydach and Ebbw Vale though there may have been some reluctance to rely on loan capital within the core group. The Blaenavon directors were intent on limiting debentures and other loans as the chairman reported to the shareholders on 6 April 1841 that the capital he hoped to raise from a new share issue was in part to redeem the debentures.[103] A. H. John stated that the Ebbw Vale Company in the period 1810 to 1842 was financed up to about one half by loans[104] and this reliance on loans and mortgages seems to have been a major factor in the eventual bankruptcy of the Ebbw Vale partners in June 1843. It was reported in July of that year that the Ebbw Vale partnership had unsecured debts of £349,000 whilst the available assets of the company were then only £93,000. There was also a further secured debt of £100,000 that included the £40,000 mortgage debt they had to Messrs. J. and C. Bailey of the Nantyglo works. The Ebbw Vale and

[103] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book, 7th Meeting of the Shareholders, 6 April 1841.
[104] John, *The Industrial Development of South Wales*, pp 46-7.

Sirhowy works had been valued in 1841 at £270,000.[105] The company was saved as the creditors agreed that the works should continue to run and in just over six months the company was running successfully again under a new partnership lead by Abraham Darby of Coalbrookdale.[106]

The partnership was still the most appropriate capital structure for ironworks of the area in the first half of the nineteenth century. Despite apparently having adequate share capital initially, the joint stock companies of Monmouthshire were not a success and they often found that shareholders were reluctant to pay calls or take up new share issues when times were difficult, making innovations and future developments hard to achieve. However the continuity of control and the better and simpler management structures of the partnership companies were probably as least as important as capital when comparing the success of the partnership companies with the relative failure of the joint stock ironworks companies in the period before 1850.

[105] *Monmouthshire Beacon*, 8 July 1843, The bankruptcy of the Harford, Davies partnership, reported from the *Bath Chronicle*, also *Monmouthshire Beacon*, 21 October 1843.
[106] *Monmouthshire Merlin*, 19 August 1843, Harford, Davies Company's Bankruptcy, 13 January 1844, Ebbw Vale and Sirhowy Ironworks for sale, 30 March 1844, Ebbw Vale and Sirhowy ironworks bought by Messrs. Darby of Coalbrookdale.

Chapter 6. The recruitment of the workforce and the population of the Iron Districts of the North West Monmouthshire Area.

6.1 Introduction.

Labour was a vital element in the growth and success of the ironworks of the North West Monmouthshire area and this chapter is a study of the workforce, how they were recruited and from where they originated. The consequence of the recruitment of large numbers of workers to the area over the first half of the nineteenth century was a dramatic growth in population. The rates of this growth in population are compared with those of other regions and districts of Britain. The rapid inward migration was a particular problem for the ironmasters in that they were responsible for providing housing for the workpeople. A summary is given of the types of housing built by the ironmasters in the early period and later, in the second quarter of the century.

In 1780 the North West Monmouthshire area was thinly populated. Edmund Jones writing in 1779 in his *The History of Aberystruth* believed that there were about 150 houses in the whole parish but some were uninhabited and some had only one or two people living in them. Jones felt therefore that there were not more than 500 people in the parish at that time, fewer than in earlier times.[1] There is no reason to suppose that the parts of the area under study in other parishes were any more thickly populated. In fact a maximum of only three place names usually appear on eighteenth century maps of Monmouthshire in the North West part of the county, Blaenagwent or Blaena Gwent, Bedwellty and Llanhilleth. All three were locations of parish churches, Bedwellty and Llanhilleth being well down the valleys and outside the study area geographically. Only Blaenagwent, the alternative parish name for Aberystruth, could

[1] Edmund Jones, *The History of Aberystruth*, 1779, Facsimile edition, J. E. Owen (ed.), 1988, p 60.

Illustration 2 A view of the Parish of Aberystruth c1830

Source. *South Wales Illustrated in a Series of Views,* (adjacent to) p 131. The book has no author or date stated. The engraving is from a drawing by Henry Gastineau with colouring added later.

be considered to be inside this area, the actual village and parish church being sited where the town of Blaina is today. See Illustration 2 for an early view of Aberystruth.

Hence, when the ironworks of the study area were established in the last two decades of the eighteenth century, there would not have been a pool of potential labour in the area apart from the relatively small number of farm labourers. The ironmasters therefore were presented with a labour recruitment problem at the start. This problem of labour recruitment would have continued well into the nineteenth century as the works expanded. The way the ironmasters dealt with the recruitment of managers, senior employees, skilled and unskilled workmen is examined together with an assessment of the extent of the employment of women and children. Unskilled

labour had to be attracted to the area and analyses have been produced to show the districts of the country from which the workforce originated. It will be demonstrated that the ironmasters attracted workers from near and afar. Many came from nearby farming areas, others from neighbouring Welsh counties and many from West Wales and the western counties of England. Attempts have also been made to indicate changes in the patterns of the inward migration of workpeople.

As a result of the inward migration of workpeople to the area over the whole period of the study there was a dramatic increase in the population. The extent of the increase is demonstrated and compared with that of other districts of the country, confirming that the growth of population in the study area was truly exceptional for Britain in the industrial revolution period. This growth was almost entirely due to the requirements of labour arising from the development of the ironworks and the associated mineral extraction industries as no other substantial industry existed there in the period.

The ironmasters had the responsibility for housing their workforce and the study follows the various patterns of housing developments that arose over the years. It will be shown that as the nineteenth century progressed the housing developments around the ironworks gave rise to an array of new towns, the actual position of the ironworks often dictating the layouts of the towns.

6.2 The workforce.

This section is a study of the workforce, of the status levels within the workforce and in particular how the differing levels of the workforce were recruited. Essentially there were three levels within the overall workforce of the ironworks companies. The highest level was the managerial level that included works managers, section managers such as furnace managers and senior people such as engineers. The

second level is that of the skilled workmen. This group includes puddlers, rollers, refiners, furnace keepers and others where considerable skill and experience was needed. There were also groups of artisans that could be included in this group. Examples of these are masons, blacksmiths and carpenters. The last group were the unskilled workers, a mixture of labourers and others who lacked the experience of the skilled workers and generally did more routine tasks. Women and children would be included in this group. Iron ore miners and colliers were numerous and also were skilled and unskilled though the distinction may not have been so clear as for iron workers. Where evidence permits an indication is also given of the salary or wage that applied to the particular category of worker at different times within the period of the study.

Industrial managers as such only really came into being from the mid-eighteenth century,[2] and in the early days of the ironworks of the area when the works were relatively small concerns the manager was often the active partner or a member of his family. In the period 1791 to 1796 Jeremiah Homfray was both one of the partners and the works manager of the Ebbw Vale ironworks company, his annual salary in 1793 being £150 per annum.[3] Ignoring external workers such as ore miners and colliers the numbers of men at the ironworks site in this period probably numbered in the region of 40 to 60.[4] The ironmasters worked closely with the workmen, often signing individual agreements. For example on 19 May 1796 the Ebbw Vale ironmaster, John Harford, agreed with George Jones that the latter would be employed by the works as a blacksmith for one year from the day the furnace was put into blast. Until this time Jones was to do whatever other work was allocated to

[2] Sidney Pollard, 'The Genesis of the Managerial Profession: the Experience of the Industrial Revolution in Great Britain', *Studies in Romanticism*, Volume IV Number 2 (Winter 1965), p 57.
[3] GRO. D.2472.3. Ebbw Vale Company Journal 1791-96, Entries for June 1793.
[4] GRO. D.2472.1. Ebbw Vale Company Memorandum Book 1796-1819. The estimate is based on the day labourer schedules for April 1796 and June 1796.

him. He was to receive a wage of twelve shillings a week rising to twenty four shillings when the furnace was in blast. In addition he was to receive a house and firing for which he was to be charged one shilling a week.[5]

The salaries of the early partner/managers seem modest but were probably competitive for relatively small industrial concerns in the last years of the eighteenth century.[6] The managing partners could improve their income by their share of profits not reinvested. This pattern of works management continued into the nineteenth century though the salaries tended to increase. In 1816 William Hibbs Bevan, son-in-law of the original Beaufort ironmaster, Edward Kendall, received £200 per annum as manager of the Beaufort ironworks and in 1825, Richard Summers Harford, the managing partner of the Ebbw Vale works, had his salary increased from £200 per annum to £300. At the same time younger members of the Harford family were also involved in the management of the company. Summers Harford had a salary of £200 in 1825, increased to £300 in 1830 and Charles Lloyd Harford had a salary of £200 per annum from 1824 until 1833.[7]

By the 1830s and 1840s the ironworks were large organisations with management structures approaching those of modern times. At the time of the boom in 1843 the huge Dowlais ironworks in Merthyr employed 7,300 persons and had a comprehensive managing team. In about 1845 Thomas Evans, the agent for sales was the highest paid receiving £1,000 per annum whilst the works manager, John Evans received £750 per annum. Amongst the other members of the team were the engineer,

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[5] GRO. D.2472.1 Ebbw Vale Company Memorandum Book 1796-1819, Agreement between John Harford for the Ebbw Vale Company and George Jones, blacksmith, 19 May 1796. There are numerous similar cases of individual agreements between the ironmasters and particular tradesmen or workers in the Memorandum Book.

[6] Pollard, 'The Genesis of the Managerial Profession: the Experience of the Industrial Revolution in Great Britain', p 61. Whereas managing partners and top managers in the largest firms had salaries of £300 to £1,000 per annum in 1750 to 1790 and £500 to £2,000 in 1790 to 1830 the salaries of typical managers in the same two periods were £50 to £100 and £100 to £250 per annum.

[7] F. J. Ball, Glyn Ebwy to Ebbw Vale, written in the 1950s, unpublished, p 74.

Samuel Truran who received a salary of £200 per annum, the mine agent, who received £200 per annum and the shipping agent who received the same sum.[8]

As the ironworks of the region were large concerns in the 1830s and 1840s the method of recruitment of managers and senior people became more open and not restricted to family and contacts of the partners as had generally been the case in the early years of the industrial revolution.[9] Advertisements for senior posts appeared in the local press. Examples of some of these advertisements are listed in Table 6.1.

These advertisements illustrate the dramatic change that had taken place in the iron industry since the early days of the industry in the late eighteenth century. In some cases there were plenty of applicants. When the Blaenavon directors advertised for a works manager on the retirement of the existing manager, James Askwell, on 1 January 1841, they had 120 applicants. The successful person was Harry Scrivenor who wrote the *History of the Iron Trade* published in 1841.[10]

Unfortunately information on the recruitment of skilled workers in the iron works is less prevalent. The introduction of Henry Cort's puddling and rolling process in the late eighteenth and early nineteenth centuries did not result in a decrease in skilled ironworkers compared with that under previous processes and skilled workers such as puddlers, ballers, refiners and rollers increased in number as the works expanded in the first half of the nineteenth century. It is estimated that as many as thirty to forty percent of the workforce were skilled in the large ironworks.[11] In the early days it is most likely that industrialists coming to the area from ironworks in

[8] John A. Owen, *A Short History of the Dowlais Ironworks*, Merthyr Tydfil, 1972, pp 23-4.
[9] Pollard, 'The Genesis of the Managerial Profession: the Experience of the Industrial Revolution in Great Britain', pp 62-3.
[10] GRO. D.751.356. Blaenavon Iron and Coal Company Minute Book.
[11] A. H. John, *The Industrial Development of South Wales 1750-1850*, Cardiff, 1950, p 59.

other regions of the country such as the West Midlands, brought some key workers with them.[12]

Table 6.1 Advertisements for managers and senior positions in South Wales Ironworks, 1830s and 1840s.

***Monmouthshire Merlin* Newspaper.**	**Advertisement.**
26 November 1831	Advertisement. To Furnace Managers and Engineers. Wanted – A steady respectable Man, to manage blast furnaces and fineries: also a good practical engineer who can make our drawings and fit up machinery in a proper and workmanlike manner. Applications (post paid) to be addressed to "X.Y.Z.", "Post Office, Newport, Mon, 23 November 1831."
10 January 1835	Wanted. – A respectable MAN who well understands his business, principally to take charge of superintending the Masters of the Levels and Patches, and generally to direct the working of the Iron Stone at an Iron Work in South Wales. A knowledge of both the Welsh and English languages will be indispensable.[13] The party must be capable of keeping a good account. Apply (post paid) to X, Y Box No. 11 Post Office, Swansea.
6 February 1836	Wanted. A Person to take charge of the Engines and Machinery of an extensive Ironwork. To be a competent person, a liberal salary will be given. Apply by letter (post paid) to A.Z. Post Office, Newport.
5 November 1836	To Mine and Coal Agents. Wanted. A person who has had some experience in Mining, to undertake the Superintendence of the Underground working at the Blaina iron works. It is requested that no person will apply who cannot produce the most satisfactory references to his sobriety and competence – Apply by letter to Thomas Brown, Blaina ironworks.
12 November 1836	Wanted. A steady young man as secondary clerk in an Ironmaster's office who writes a good hand and is capable of keeping general accounts. Apply at the Merlin's Office, Newport.
19 May 1838	To engineers. Wanted at an Iron Work in Monmouthshire – a practical engineer, competent to the erection of blast furnaces, and a Forge and Mill etc. on a large scale:: also the construction of Winding and Blowing engines and all the machinery used in Iron Works. - testimonials needed of their ability to make specifications for contracts and superintend their execution in masonry, carpentry and machinery. - Salary £200 p.a. and upwards with a house and coals.
28 December 1839	Wanted Principal Manager of Extensive Iron Works in the county Of Monmouthshire.
20 February 1841	To Furnace Managers. A good practical manager who can undertake the management of several blast furnaces (in Wales), may have a permanent engagement and good wages, on application to Mr Thomas Evans of Dowlais Works. None need apply who cannot give testimonials for sobriety, integrity and industry – Dowlais 15 February 1841.
1 May 1841	Coalbrook Vale iron works. Wanted – Furnace Manager who is capable to undertake the management of four blast furnaces – apply to T. LL. Brewer.

[12] Chris Barber, *The Story of Torfaen*, Abergavenny, 1999, p 127. It is believed that founders of the Blaenavon iron works, Thomas Hill and Thomas Hopkins came to the area with certain key workers and housed them in good quality cottages.

[13] William Coxe, *An Historical Tour in Monmouthshire*, London, 1801, p 248. In 1800 the area was predominantly Welsh speaking as Coxe attests when visiting the parish church in Aberystruth 'In this church the service is always performed in Welsh'; *Monmouthshire Merlin*, 18 September 1841, Tea party at Tredegar, the speeches were made in English and Welsh. Both languages were spoken in the area by the 1830s and 1840s. See Section 6.3, 'Where the workforce came from'.

It is also likely that skilled workers came to the Monmouthshire ironworks steadily throughout the study period from Merthyr, as the ironworks of this town were so close by.[14] In fact it is believed that the majority of skilled ironworkers were recruited within the neighbourhood of new ironworks set up in the country[15] and throughout the period there was a continual, if slow, transference of skilled workers from one ironworks in the area to another and, in fewer numbers from other iron districts of the country.[16] This latter situation would most likely have applied where special needs arose as a result of new processes rather than because of a shortage of labour.[17] Artisans such as smiths, carpenters and masons were more likely to have moved to the area from outside the neighbourhood as such skills were more widely dispersed around the country.[18] In the early years of the ironworks of the area there was considerable use of contracts presumably to lock in skilled men to the particular company. Contracts were used extensively at Ebbw Vale throughout the period of the Memorandum Book of 1796 to 1819[19] but according to A. H. John it is unlikely that the practice continued when the works were large concerns.[20]

There is no evidence that the ironmasters advertised for skilled workers in local newspapers[21] and the majority of the skilled ironworkers in the area, and probably in the country, became skilled after periods of unskilled work in the same ironworks. For example, young men worked with skilled puddlers for a number of

[14] Oliver Jones, *The Early Days of Sirhowy and Tredegar*, Tredegar, 1969, p 31. Jones believed that the majority of the workers in the early years at Sirhowy came from Merthyr.
[15] John, *The Industrial Development of South Wales 1750-1850*, p 60; Barrie Trinder, *The Industrial Revolution in Shropshire*, Chichester, 2000, p 82.
[16] David J. V. Jones, *Before Rebecca: Popular Protests in Wales 1793-1835*, London, 1973, p 71. Jones stated that some skilled workers were brought to South Wales from other iron districts including Scotland – attracted by wages of twenty five shillings a week.
[17] John, *The Industrial Development of South Wales 1750-1850*, p 62.
[18] 1851 census returns for Superintendent Registrar's District 578, Abergavenny, Registrar's District 5, Enumerator's District 11, Nantyglo. Analysis of places of birth of heads of households and lodgers who were artisans indicated that nearly two-thirds were born outside the neighbourhood.
[19] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819.
[20] John, *The Industrial Development of South Wales 1750-1850*, p 74.
[21] No such advertisements have been identified in the *Monmouthshire Merlin* in the period 1829 to 1850.

years until they themselves became skilled. To prove this point an analysis was carried out utilising the 1851 census enumerators' returns for a zone in the Nantyglo area,[22] identifying cases where sons living in the same household as their fathers had similar occupations. In the particular survey 116 households were identified where one or more sons of working age were living with their fathers. It was found that thirty-seven sons had followed similar skilled occupations to their fathers within the ironworks environment and thirty sons of miners or colliers had followed these occupations. In addition to sons of skilled workers following in the footsteps of their fathers there were also many cases of young skilled men born in the same area indicating that they probably had progressed from unskilled status to skilled status in the area in which they were brought up. Whether there were ever planned apprenticeship schemes or not these workers served their time under skilled men.

An index of average wages across the country published by B. R. Mitchell and Phyllis Deane in *Abstract of British Historical Statistics* indicates that wages improved little over the first half of the nineteenth century[23] and Pat Hudson stated that 'various quantitative studies have failed to prove the existence of any major increases in real incomes for the mass of the population before the 1820s'.[24] However recent studies have estimated that the cost of living declined by fifty-one percent between 1810/14 to 1849/51 and this has resulted in an assessment that the overall increase in real full-time earnings over the period of the study, 1780 to 1850, was just over 30 percent.[25] There is some evidence though that the money wages of skilled ironworkers, colliers and miners did increase over the period of the study. In the early

[22] 1851 census returns for Superintendent Registrar's District 578, Abergavenny, Registrar's District 5, Enumerator's District 11, Nantyglo.
[23] B. R. Mitchell and Phyllis Deane, *Abstract of British Historical Statistics*, Cambridge, 1962, p 343.
[24] Pat Hudson, *The Industrial Revolution*, London, 1994, p 31.
[25] Hans-Joachim Voth, 'Living standards and the urban environment', Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, p 273.

1790s furnace keepers were paid in the region of ten to thirteen shillings a week, they received about twenty one shillings in 1817, around thirty five shillings in the mid 1840s falling to under twenty seven shillings by 1850.[26] Skilled men in the forges and mills were paid by the ton and information on weekly wages is sparse. Records are available for the Abersychan ironworks in Monmouthshire for the years 1844 to 1850 and weekly rates for skilled forge and mill men are given in Table 6.2 together with the national average bar iron prices for comparison.

Table 6.2. Weekly wage rates for skilled forge and rolling mill men, Abersychan Ironworks, and the national average bar iron prices (per ton) for comparison. 1844-1850

	1844	**1845**	**1846**	**1847**	**1848**	**1849**	**1850**
Refiners	37/8	39/3	51/2	40/7	48/9	39/6	31/-
Puddlers	23/7	30/6	35/8	32/4	30/11	25/7	23/-
Ballers	26/2	32/7	45/1	38/8	31/7	23/-	18/-
Rollers	33/7	58/10	72/-	80/-	60/9	35/6	32/-
Bar iron price (£)	4. 15. 0.	6. 10. 0.	9. 10. 0.	9. 15. 0.	7. 0. 0.	6. 5. 0.	5. 17. 6.

Sources. Wage rates: Kim Colebrook, 'A History of the British Ironworks, Abersychan', *Gwent Local History Journal*, Volume 54, p 23. Average bar iron prices; B. R. Mitchell and P. Deane, *Abstract of British Historical Statistics*, Cambridge, 1962, p 192.

The figures in Table 6.2 show that in good years for the iron industry wage rates for these skilled workers were high but such rates invariably did not last and fell swiftly with falls in price of iron. The high degree of variability in the rates is due partly to the rates being for one company but it does indicate that for short periods at least skilled ironworkers experienced wage increases. Another factor that affects any view of real incomes is that certain workers in the iron industry had subsidised housing and coal for their fires. This benefit was particularly prevalent in the early period.[27]

The most comprehensive wage rate data available is for colliers and Table 6.3 indicates the progression of these wage rates through the first half of the nineteenth

[26] John A. Owen, *The History of the Dowlais Iron Works, 1790-1970*, Risca, Newport, 1977, pp 16, 23; Chris Evans (calendared by), *Letterbook of Richard Crawshay 1788-1797*, Cardiff, 1990, p 107; Madeleine Elsas (ed.), *Iron in the Making: Dowlais Iron Company Letters 1782-1860*, Glamorgan County Council, 1960, pp 3-4; Ball, Glyn Ebwy to Ebbw Vale, p 14.
[27] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, various contracts include provision of housing and firing.

century in the South Wales coal industry. Although not great, there was a general improvement in wages of colliers over the first half of the nineteenth century.

Table 6.3 Weekly wage rates for colliers in the South Wales Coal Industry.

Year	Wage	Year	Wage	Year	Wage
1796	12/-	1833	18/-	1840	21/- to 27/-
1801	15/-	1834	19/-	1841	25/-
1807	20/- to 30/-	1835	17/-	1842	19/-
1815	15/-	1836	16/-	1843	18/- to 24/-
1829	20/-	1837	22/- to 23/-	1845	c25/-
1831	20/-	1838	19/-	1850	c20/-
1832	17/-	1839			

Source. All years except 1815, 1845 and 1850, P. W. Evans, 'The History of Industrial Relations in the South Wales Coal Industry to 1912'- a thesis presented to the University of Wales, Ph.D. 1955; 1815 and 1845, Owen, *The History of the Dowlais Iron Works*, 1759-1970, p 23; 1850, Roger Burt, 'The extractive industries', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, p 435.

There were clearly two principal sources of unskilled labour for the ironworks and associated mines. These were young men, boys and occasionally girls and women, already living in the area and farm workers and others moving to the area. A detailed study of immigrants to the area is contained in Section 6.3 however analyses have been carried out for this section to assess the extent of employment of women, boys and girls in the study area.

To assess the pattern of female employment in the area and the extent that women were employed in the iron and mining industry the Nantyglo sample identified above was analysed for women aged 14 and over who were not classed as housewives in the 1851 census enumeration and the results are shown in Table 6.4.

Table 6.4 Jobs analysis – Females aged fourteen, fifteen, sixteen, seventeen and eighteen and over. Housewives excluded.
1851 Census, 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo)

Occupation	**14**	**15**	**16**	**17**	**18+**	**Totals**	**Average age**
Servants, house servants, maids etc.	6	2	3	5	21	37	22.3
Dressmakers	-	2	1	-	13	16	21.5
Housekeepers,	-	-	-	-	15	15	43.7
Washers, washer women	-	-	-	3	8	11	26.7
Annuitants	-	-	-	-	11	11	54.1
Labourers, out-door employment etc.	2	1	1	-	7	11	20.3
Working in a forge/iron works	-	-	1	1	8	10	19.5
Piling in an iron works	1	-	1	-	7	9	18.9
Relieved by parish	-	-	-	-	6	6	63.0
Hauliers etc.	-	1	-	-	3	4	20.0
Laundresses	-	-	-	-	4	4	31.0
Dependent on son	-	-	-	-	4	4	65.3
Miscellaneous industrial jobs	-	1	1	3	5	10	19.1
Miscellaneous non-industrial jobs	-	1	-	-	16	17	33.1
No job stated	6	7	6	4	52	75	
Totals	15	15	14	16	180	240	

Women were prohibited from being employed underground in mines under the 1842 Mines Act[28] and no women were recorded definitely working in collieries or mines but 33 women (13.8 percent) worked in physical industrial roles and a further 11 were classed as labourers (4.6 percent). The large number of women listed as having no job is also suspect as some of these women may have worked in manual jobs in the ironworks but possibly did not wish to admit this. The average age of these female industrial workers was low being around 19 with only a few 14 to 16 year olds employed in industry. The majority of the females who were employed were in 'female' jobs such as servants, dressmakers, housekeepers and washerwomen and the small number of women working directly in the iron industry probably meant that their role within the industry locally and in the activities of the workforce was unlikely to have been significant. However most of the women not classed as housewives were earning and therefore they must have made a useful contribution to the average family income.

[28] Roger Burt, 'The Extractive Industries', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, p 441.

Further analyses were carried out to see how many children appeared to be employed in the ironworks and associated industries. Again the target Nantyglo area was selected and 1851 census data again analysed for children aged seven to 13. Unfortunately the 1841 census enumerators' data could not be used because of the tendency of the enumerators to record ages to the nearest multiple of five years. Apart from establishing the numbers of children employed it was also decided to compare these results with numbers of children recorded in the census enumeration as 'scholars'. The Factory Act of 1833 restricted the hours that children aged between nine and thirteen could work to 48 in a week and in addition children were to attend school during working hours for not less than two hours a day.[29] This presented a difficulty with the reliability of the data. For example if children who worked also had to attend school for two hours a day there is the question as to what would be entered as the occupation in these circumstances. It was not possible to deal with this problem and so the occupation entered has to be taken at face value with obvious reservations.

The sample overall consisted of 179 boys and 154 girls aged seven to 13 and it was found that 38 percent of the boys were listed as working but only 6½ percent of the girls. Both figures appeared to be lower than might have been expected and it must be questioned whether there was a tendency to under record the fact that children were working with a corresponding overstatement of the numbers of children 'at home' and a considerable reluctance of parents to give any answer to the occupation question thus the large number of blank entries. It is also not clear how accurately the enumerators tried to establish the occupation of children compared with those of adults.

[29] E. Royston Pike, *Human Documents of the Industrial Revolution in Britain*, London, 1966, p 138-9.

Table 6.5 Jobs/school attendance analysis – Children aged seven to thirteen.
1851 Census, 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo)

Age	Boys				Girls			
	At work	Scholars	At home	Blank	At work	Scholars	At home	Blank
7	1	7	5	7	-	9	13	10
8	5	11	5	7	-	7	7	5
9	6	17	4	2	1	12	3	8
10	10	10	5	5	3	8	5	5
11	14	5	2	3	-	8	3	2
12	14	6	-	4	2	6	6	9
13	18	1	-	6	4	6	6	6
Totals	68	56	21	34	10	56	43	45

Seven of the ten girls with jobs were servants of one sort or another and only three had jobs indisputably industrial in nature. As for the boys Table 6.6 gives an analysis of the jobs undertaken as listed in the census.

Table 6.6 Boys job analysis.
1851 Census, 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo)

Occupation	Age							
	7	8	9	10	11	12	13	Total
Colliers, miners	1	3	2	5	1	2	3	17
Firemen, fire work	-	1	2	-	5	6	1	15
Working in forge	-	-	-	2	3	2	1	8
Hauliers	-	-	-	-	2	1	4	7
Puddlers, rollers	-	-	-	-	-	1	4	5
Labourers etc.	-	-	-	1	-	1	3	5
Miscellaneous ironworks jobs	-	1	2	2	3	1	2	11
Totals	1	5	6	10	14	14	18	68

As stated above it is likely that many more children were working than it appears from census data but even from the entries given it is clear that some boys as young as seven to nine were working in the ironworks and in the mines. However in the case of mines the children may not have been working underground but might have been employed on surface work. As would be expected only older boys worked in more skilled roles such as puddling. These results even taking occupations at their face value in the census data tend to reflect badly on the ironmasters of this area for even if they were not directly responsible for the employment of young children they should have set up procedures to check that children were not so employed.

Owing to the rather uncertain nature of some of the data for children's occupations in the census for Nantyglo a second area was studied for a comparison. The town of Tredegar was chosen for this second study and the sample consisted of 176 households in enumeration district 3 of Registrar's District 6 (Tredegar) of Abergavenny. The aim behind this second study was to test the suggestion made above that there was a clear tendency to avoid recording occupations of children and/or that the enumerators varied considerably in their attempts at establishing occupations for children. This should be seen in the context that blank occupation entries for men were rare in the 1851 census, only four percent for adult males in the Nantyglo target sample.

Although the Tredegar sample was small compared with the target Nantyglo sample, being only 130 children, the results were remarkable in comparison. Only eight of the children, all boys, were listed as having jobs and all these were 10 or over. Thus the Tredegar sample yielded only 6.1 percent of children having jobs (Nantyglo 23.4 percent). The percentages of seven to 13 year olds in school or at home were not dissimilar. 30.8 percent of Tredegar children were listed as scholars (Nantyglo 33.6 percent) and 17.7 percent of Tredegar children were described as 'at home' (Nantyglo 19.2 percent). However the percentages of blank occupation entries were quite different for the two areas. 45.4 percent of Tredegar entries were blank compared with only 23.7 percent for Nantyglo.

Table 6.7 Jobs/school attendance analysis – Children aged seven to thirteen.
1851 Census, 578 Abergavenny, 6 Tredegar, Enumeration district 3.

Age	All children			
	At work	Scholars	At home	Blank
7	-	10	4	5
8	-	9	3	9
9	-	3	3	10
10	2	10	2	8
11	1	4	2	8
12	2	4	6	13
13	3	-	3	6
Totals	8	40	23	59

The stark differences between the two samples in the numbers of children where entries for occupation were left blank could suggest either a greater reluctance amongst Tredegar parents to admit that their young children were working, or it could suggest that more young children were employed at Nantyglo, or that the enumerator was less thorough at Tredegar. With such an unsatisfactory conclusion to this particular problem it was decided that a third and quite different area was to be studied for the same issue. In this case a sizeable sample of households were studied in the vicinity of the Clydach ironworks in the county of Brecon.

Table 6.8 Jobs/school attendance analysis – Children aged seven to thirteen. 1851 Census, County of Brecon, Crickhowell, Clydach Village

Age	Boys				Girls			
	At work	Scholars	At home	Blank	At work	Scholars	At home	Blank
7	-	8	-	2	-	5	-	6
8	-	10	-	2	-	6	-	3
9	1	5	-	5	-	7	-	4
10	3	4	-	1	-	6	-	6
11	4	3	-	1	1	11	1	3
12	6	2	-	3	-	6	-	4
13	9	4	-	-	3	4	-	8
Totals	23	36	0	14	4	45	1	30

The results for Clydach at least seem to confirm that the enumerators did vary in their treatment of children's occupations in that virtually no children were described as 'at home' in this sample, only one out of a total of 153. At Clydach 23 boys were described as in work, mostly aged 10 to 13, this being 32 percent of boys compared with 38 percent boys in work at Nantyglo and only 11 percent at Tredegar. These results all seem quite incompatible. Whilst it is possible that differences in the management and in the practices at the three works may have some effect the differences found cannot be explained in this way. It is also possible that parents in Nantyglo felt more able to admit that their children were working and there might just have been more work there for children. All the above points coupled with the

inconsistency amongst the enumerators seem likely to have played some part in the substantial differences in the three samples.

Conclusions therefore from this work must be treated with much caution. However it is probably fair to claim that there was considerable employment of children in the area, probably more at Nantyglo and Clydach than at Tredegar. The numbers of the children working increased from relatively few at age seven to large numbers at ages 11 to 13. Boys were much more likely to be employed in the ironworks, in connection with mineral extraction or in haulage than the girls. Most of the girls in work were servants of one sort or another. It seems very likely that the numbers of children actually working were considerably understated in the 1851 census for the region. A sizeable minority of the children ages seven to thirteen were at school though for how long each day it is impossible to state nor is it known if these scholars also had outdoor work from time to time. It is likely that many did have such work. The Children's Employment Commission of 1842 produced analyses of children and young people at work in the study area. It was reported that there were 160 boys and 31 girls under thirteen employed at the Ebbw Vale and Sirhowy ironworks and associated mines. The corresponding figures for the Nantyglo, Tredegar and Blaenavon works were 131 and eleven, 179 and twelve and 148 and 37 respectively.[30]

In summary the patterns of recruitment of managers and senior employees, skilled workmen and unskilled workpeople were quite different. The principal partners or members of their family often filled the function of works managers early in the period and even later, works managers, section managers and senior employees or professionals were often recruited from within the ironworks local network.

[30] *Children's Employment Commission 1842.* Volume XV11, pp 594, 614, 621and 624.

However recruitment by advertisements became more common for management and senior roles. In the very early days some skilled men may have accompanied the industrialists to the area and in the early days and later some may have been recruited from outside the district for particular needs such as the implementation of new machinery. However the vast majority of skilled men were either recruited from within the neighbourhood of the particular works or by promotion from within. Many skilled men had followed the trade of their fathers. Wage rates of skilled ironworkers slowly increased over the period but with considerable fluctuations according to the prosperity of the various ironworks and the demand for iron at the time. Colliers' wages followed a similar pattern but with less fluctuation. In addition the position of the workers in the iron districts had improved further to some extent because of the fall in the cost of living in the 1830 to 1850 period.[31]

In the very early days unskilled workers were mostly recruited from the small pool of local farm workers. However the vast majority of unskilled labour was recruited from descendents of previous immigrants to the area or were themselves immigrants. It was established that late in the period about twenty percent of females aged fourteen and over were employed in an industrial capacity. Women classed as housewives were excluded from the analyses. Following various attempts to assess the numbers of boys and girls aged seven to thirteen who were working in an industrial capacity it was concluded that the 1851 census returns for the area were unreliable however it could be concluded that a considerable number of boys were so employed possibly in the region of thirty to forty percent. Only a small proportion of young girls were working in industry possibly around five or six percent.

[31] John, *The Industrial Development of South Wales 1750-1850*, p 83.

Pat Hudson poses the question whether whole families tended to work together in any sense in industrial districts.[32] The data above suggests that in the study area this might have arisen but was limited. Most of the women had 'female' jobs whilst relatively few were employed industrially where they might have worked with their husbands. As regards their children the analysis earlier indicating that many boys or young men followed the profession of their father does suggest that some families worked together though not usually including the mother. However as stated earlier the census data for the employment of children in the area was both variable by enumeration district and suspect in general and it might be that many more children at young ages worked with their fathers than it would appear from the analyses above.

6.3 Where the workforce came from.

The ironmasters manned their ironworks, mines and collieries with migrant workers and the descendents of these workers and it will be shown that they attracted people from both near and afar, from other industrial areas and from farming areas. In order to obtain a detailed picture of the patterns of migration the enumerators' returns for the 1851 census were studied for the same target area around Nantyglo and for the first analysis the birthplaces of heads of households were examined. Inevitably there were difficulties using the 1851 census data and compromises were necessary. Using a data set as late as 1851 is likely to give a picture of migration biased towards the later decades of the period of the study but none of the previous censuses gave details of places of birth. A further problem encountered was that at times the enumerators only inserted the county of birth. This did not present a difficulty except in the cases of Monmouthshire and Breconshire when more precise data was needed to establish if

[32] Pat Hudson, 'Industrial organisation and structure', in Floud and Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, pp 34-5.

the person was born locally. County only entries although recorded separately were included with 'Monmouthshire not local' and 'Breconshire not local' in Table 6.9 and this must have the effect of understating the true 'local' places of birth.

Table 6.9 Birthplaces of Heads of Households, 1851 Census, 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo).

	Numbers	**%**		**Numbers**	**%**
Local to the study area	54	13.4		54	13.4
Monmouthshire not local & Mon' unspecified	35	8.7	}		
Breconshire not local & Brec' unspecified	44	10.9	}	112	27.7
Glamorgan – Merthyr	33	8.2	}		
Glamorgan – other	43	10.6	}	43	10.6
Neighbouring English Counties					
- Herefordshire	15	3.7	}		
- Somerset	23	5.7	}	50	12.4
- Gloucester	12	3.0	}		
West Wales					
- Carmarthen	48	11.9	}		
- Cardigan	17	4.2	}	82	20.3
- Pembroke	17	4.2	}		
Mid/North Wales	17	4.2	}		
Midlands	18	4.5	}	44	10.9
West Country	9	2.2	}		
England – Other	5	1.2		5	1.2
Ireland	9	2.2		9	2.2
Unspecified birthplace	5	1.2		5	1.2
Total	404			404	

It was decided to use a fairly wide definition of 'local' places of birth as follows: The head of household was regarded as 'local' if his or her entry in the census was one of the following:

1. Any town or village in the North West Monmouthshire region (e.g. Tredegar, Sirhowy, Beaufort, Ebbw Vale, Trefil, Nantyglo, Brynmawr, Blaina, Clydach, Blaenavon, Garndyrrys, Varteg, Rhymney, Victoria and Abersychan.). The villages of Gilwern,

Llanfoist and Govilon were also included as they had direct working links with the ironworks because of the canal wharfs.

2. A place of birth listed as Bedwellty (parish) or Aberystruth (parish) unless the entry also included a village outside the area of study

3. A place of birth listed as one of the three Breconshire parishes of Llangynidr, Llangattock and Llanelly

Under the criteria listed above the nearby towns of Abergavenny, Crickhowell, Pontypool and Merthyr would not be regarded as local.

A fairly mixed picture emerges from Table 6.9. In 1851 only 13.4 percent of the heads of households were born locally, while the largest group of immigrants, 27.7 percent, were those coming from the most immediately neighbouring areas, other parts of Monmouthshire and Breconshire and the iron district of Merthyr. Thus the largest group of immigrants came partly from rural and partly from existing industrial areas.

Not surprisingly the next largest group (23 percent) came from neighbouring counties such as Glamorgan excluding Merthyr, Herefordshire, Somerset and Gloucestershire. Somerset though not neighbouring by land was certainly near across the Bristol Channel. These three English counties recorded lower than the national average growth in population in the period and it is clear that some men from the farming areas of these counties migrated to North West Monmouthshire. There was also considerable immigration from West Wales (20.3 percent), from Carmarthenshire in particular, and a not insignificant number of migrants (14.3 percent) came from districts farther away such as from the Midlands; some no doubt were industrial workers from the iron works in Shropshire and Staffordshire while others came from rural North Wales.

In general the migration pattern was mixed with workers coming to the area from existing industrial regions and from rural areas in Wales and neighbouring counties of England. As the ironworks and their associated mineral industries were practically the only sources of employment in the study area the immigrants must have been attracted by the wages on offer and the prospect or hope of continual employment. This must certainly be true of immigrants from rural areas while the picture was more complicated for workers already involved in the iron trade as there is evidence that there was a degree of movement between the ironworks of the district. It follows that some of the immigrants born in farming districts may well have worked in other industrial districts prior to working in the North West Monmouthshire area. The heads of households examined were predominantly men though where the heads of households were women, usually widows, they were still included.

A further feature of the households of the Nantyglo sample was that many of the households included boarders or lodgers and some included visitors. The presence of substantial numbers of lodgers in households was a feature of the industrial areas of South East Wales[33] and probably of Britain, and was of some concern to the ironmasters who had to provide housing for them. Some employers who rented out houses to particular workers under employment agreements were keen that these workers took in lodgers presumably because of the shortages of houses. The employers sometimes included clauses in employment agreements under which there were limits on the rents these tenants could charge lodgers.[34]

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[33] Harold Carter and Sandra Wheatley, *Merthyr Tydfil in 1851*, Cardiff, 1982, pp 32, 44. Like the study area there were many instances of lodgers in the industrial parts of Merthyr though in Merthyr the lodgers tended to be accommodated in households in which the main residents had low status occupations. This feature was not found in the Nantyglo sample as lodgers were fairly well distributed amongst households of low and higher status occupations.

[34] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, 13 April 1798 and others.

In the Nantyglo sample 404 households were examined and it was found that 130 of them had one or more boarders or lodgers, 32 percent of the households. However twenty-eight of the households had forty-one 'visitors', which complicates the issue. Some of these visitors might have been genuine visitors present for only a short time but it is likely that others were really lodgers but were classed as visitors if the head of the household or his wife knew the person previously, the term visitor being preferred to lodger in these circumstances. Others might just have been lodgers in the usual sense. With this uncertainty regarding the visitor category it was decided not to include them in the analysis of persons classed as lodgers or boarders. A further category was that of servants and it was found that 22 of the 404 households had non family servants though it could not be certain that residents classed as servants were actually servants in those particular households. The feature about these servants was that they were mostly female and born locally.

Table 6.10 below shows the birthplaces of the 209 persons clearly identified as lodgers or boarders in the sample area of Nantyglo, children classified as lodgers who were under ten years of age were excluded from the analysis. It would be expected that the pattern of immigration for lodgers would more closely resemble the overall pattern of immigration in the years immediately prior to the 1851 census on the assumption that lodgers would have arrived in the area later than the heads of households. However this pattern of immigration for lodgers was found to be quite similar to that for heads of households but with slightly fewer births local to the area, from nearby areas and from Glamorgan but with a somewhat higher proportion of births from neighbouring English counties, West Wales and farther afield in England and Ireland. However immigration of lodgers from the Midlands industrial areas

seems to have been lower. These results suggest a slight change in the pattern of immigration.

Table 6.10 Birthplaces of Lodgers 1851 Census
578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo).

	Numbers	%		Numbers	%
Local to the study area	24	11.4		24	11.4
Monmouthshire not local & Mon' unspecified	22	10.5	}		
Breconshire not local & Brec' unspecified	20	9.6	}	46	22.0
Glamorgan – Merthyr	4	1.9	}		
Glamorgan – other	16	7.7	}	16	7.7
Neighbouring English Counties					
- Herefordshire	12	5.7	}		
- Somerset	15	7.2	}	34	16.3
- Gloucester	7	3.3	}		
West Wales					
- Carmarthen	25	12.0	}		
- Cardigan	9	4.3	}	46	22.0
- Pembroke	12	5.7	}		
Mid/North Wales	4	1.9	}		
Midlands	2	1.0	}	13	6.2
West Country	7	3.3	}		
England – Other	10	4.8		10	4.8
Ireland	11	5.3		11	5.3
Scotland	1	0.5		1	0.5
Unspecified birthplace	8	3.8		8	3.8
Total	209	100		209	100

An attempt was made to see if the changes in the overall pattern of immigration suggested by the lodgers' analysis in Table 6.10 had in fact applied over the few decades prior to 1851. The returns from the 1851 census for the same Nantyglo enumerator's district were examined again and attempts were made to identify when heads of households came to the local area by examining the birthplaces of their children. 248 cases were found from the 404 heads of households where census information on their children allowed an informed estimate to be made of the approximate year of the arrival of the particular head. In order to identify more easily

trends from the relatively small sample the results have been presented for groups only in Table 6.11.

Table 6.11 Approximate dates of arrival in the area of Heads of Households 1851 Census 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo).

Birthplace	**Numbers**	**% of total sample**	**1846-1851**	**1840-1845**	**1830s**	**1820s and earlier**
Monmouthshire not local & Mon' unspecified	}					
Breconshire not local & Brec' unspecified	} 77	31.0	13	11	39	14
Glamorgan – Merthyr	}					
Glamorgan – other	} 30	12.1	0	6	14	10
Neighbouring English Counties						
- Herefordshire	}					
- Somerset	} 37	14.9	14	13	8	2
- Gloucester	}					
West Wales						
- Carmarthen	}					
- Cardigan	} 55	22.2	12	17	15	11
- Pembroke	}					
Mid/North Wales	}					
Midlands	} 35	14.1	5	8	17	5
West Country	}					
England – Other	5	2.0	1	1	1	2
Ireland	9	3.7	3	1	4	1
Total	248	100	48	57	98	45

It is important to stress the crudeness of this method and it could be criticised on many accounts but two trends are clearly demonstrated by the analysis. Workers born in nearby areas were less likely to migrate to the area in the 1840s than earlier whilst the opposite was the case for migrants from the neighbouring English counties of Herefordshire, Somerset and Gloucestershire. These results tend to support some of the findings for lodgers above, however migrants from West Wales appear to have arrived in relatively consistent proportions over the thirty years of the analysis. There

was an exodus of Irish immigrants to Britain in the 1840s[35] but from the analyses above only a fairly limited number of Irish immigrants appear to have moved to the study area by mid century. Five percent of the lodgers were classified as Irish.

Looking at the overall numbers in Table 6.11 suggests that the largest number of the heads of households came to the area in the 1830s. This is not surprising as this decade was one of maximum prosperity for the ironworks areas, the 1840s being much more uncertain. One of the weaknesses of this approach might have been that it masked those situations where workers arrived in the study area via intermediate locations or where they temporarily moved out again. However a brief study of this issue indicated such cases were not particularly numerous and are not likely to have had a major effect on the analyses.

The above discussion attempts to analyse where the immigrants the North West Monmouthshire area came from and when the came from the different regions of the country. Clearly the main reason they came was that they were attracted to the iron districts because of the prospect of higher wages.[36] Although the immigrants would be paid unskilled workers' rates when they arrived it might have been the attraction of the skilled workers' rates that appealed to them as labourers' wage rates were poor by comparison. Data on labourers' wages is not abundant. Labourers were sometimes paid by the day, especially early in the period, and it cannot be assumed that they had work each working day of the week[37] and so a daily rate is misleading as a measure of the weekly earnings of labourers. However some weekly rates are available. Richard Crawshay paid his labourers eight shillings a week in 1791[38] and Clydach ironworks labourers received twelve to fifteen shillings a week in the period

[35] Phyllis Deane and W. A. Cole, *British Economic Growth 1688-1959*, Cambridge, 1967, pp 10-11.
[36] John, *The Industrial Development of South Wales 1750-1850*, p 63.
[37] GRO. D.2472.1, Ebbw Vale Memorandum Book 1796-1819, Day labourers schedules.
[38] Evans, *Letterbook of Richard Crawshay 1788-1797*, p 107.

1800 to 1805.[39] If these figures are typical weekly rates for the area there was little progress in labourers' wages rates by the 1830s as Tredegar ironworks labourers were paid around eleven shillings six pence to fourteen shillings six pence in this decade.[40] Labourers at Abersychan received similar rates in the period 1844 to 1850 and so the labourers wage rates over the period were not very attractive compared to those of skilled ironworkers. In addition to the prospect of skilled workers' wage rates later it might also have been the possibility of more regular work that attracted the immigrants to the iron districts.

6.4 The growth in population of the area.

The North West Monmouthshire area was thinly populated when the industrial revolution was initiated in the district in the last two decades of the eighteenth century. Workers were attracted to the area in these early years and later as the ironworks expanded their operations. The result was that the population of the area increased throughout the first half of the nineteenth century at a dramatic rate. It is asserted that this continuing immigration to the area was the main reason for the spectacular increase in population growth and it will be demonstrated that other factors such as the female age at marriage were not sufficiently different from the national average to have played any substantial part in the excess population growth rates of the area.

Table 6.12 below gives the population of the parishes containing the ironworks under study for all the census years from 1801 to 1851. Merthyr has been included for comparison. The table also gives the population of the county of Monmouthshire, and for comparison, Glamorgan. Finally to put these figures into context for population

[39] John, *The Industrial Development of South Wales 1750-1850,* p 81.
[40] Jones, *The Early Days of Sirhowy and Tredegar*, p 86.

growth during the industrial revolution in Britain, figures are also given for England and Wales as a whole.

The parish of Aberystruth included the area in the immediate vicinity of the Nantyglo ironworks and that part of Ebbw Vale to the east of the River Ebbw Fawr, an area that included the Ebbw Vale furnaces and many of the rows of houses near them. The parish of Bedwellty included the town of Tredegar and its ironworks, the town of Ebbw Vale and that part of Ebbw Vale ironworks that lay to the west of the Ebbw Fawr River plus parts of the district around Sirhowy and Beaufort ironworks. The parishes of Llangynidr, Llangattock and Llanelly were largely rural Breconshire areas but Llangynidr included other parts of the district around Sirhowy ironworks, Llangattock parish included land on and close to Beaufort ironworks and parts of the town of Brynmawr and the parish of Llanelly included other parts of Brynmawr and the whole of the area around Clydach ironworks. Blaenavon, while not being a parish at this time, is included as one as it comprised parts of three old parishes, Llanfoist, Llanwenarth and Llanover Upper, clearly identified with Blaenavon, Pwll Du and Garnddyrys.

Table 6.12 Population of the parishes in which the iron works of the North West Monmouthshire area were located and regional and national populations for comparisons. (populations in '000s).

Parish	**1801**	**1811**	**1821**	**1831**	**1841**	**1851**
Aberystruth	805	1,626	4,059	5,992	11,272	14,383
Bedwellty	1,434	4,590	6,382	10,637	22,413	27,183
(Blaenavon)*	1,469	2,619	4,066	4,382	6,223	5,855
Llanelly	937	1,821	2,962	4,041	7,366	9,644
Llangattock	1,046	1,263	1,947	2,690	4,334	5,415
Llangynidr	775	1,126	1,345	1,440	2,775	3,246
Merthyr	7,705	11,104	17,404	22,083	34,977	46,378
Monmouthshire	45,568	62,105	75,801	95,126	134,368	157,418
Glamorganshire	70,859	85,067	102,037	126,612	171,188	231,849
England & Wales	8,872,980	10,164,000	11,978,875	13,897,187	15,913,829	17,928,000

Sources. Figures for the individual parishes have been obtained from *Summary Census Statistics for South East Wales 1801-51*, edited by Philip Riden.[41] Those for the counties of Monmouth and Glamorgan have been obtained from *Digest of Welsh Historical Statistics.*[42]

* The figures for Blaenavon for 1801 to 1831 include estimates.

[41] Philip Riden, *Summary Census Statistics for South East Wales 1801-51*, Cardiff, 1979.
[42] J. Williams, *Digest of Welsh Statistics, Population 1*, Cardiff, 1985, pp 17, 20.

From the population figures above it is clear that the areas surrounding the ironworks under study experienced dramatic population growth in the first half of the nineteenth century such that the percentage of the population of the three areas in Monmouthshire (Aberystruth, Bedwellty and Blaenavon) to the total population of the county went from 8.1 percent in 1801 to 30.1 percent in 1851, the increase being almost entirely due to the growth of the iron industry and associated mineral industries. Table 6.13 translates these population totals into growth rates.

Table 6.13 Population growth over each decade of the parishes in which the iron works districts of the North West Monmouthshire area were located. (Growth rate percent per decade plus growth rate percent for 1801 to 1851).

Parish	1801-11	1811-21	1821-31	1831-41	1841-51	1801-51
Aberystruth (Mon)	102.0	149.4	47.6	88.1	27.6	1,687
Bedwellty (Mon)	220.1	39.1	66.7	110.7	21.3	1,796
(Blaenavon)* (Mon)	78.3	55.3	7.8	42.0	-5.9	299
Llanelly (Brecon)	94.3	62.7	36.4	82.3	30.9	929
Llangattock (Brecon)	20.7	54.2	38.2	61.1	24.9	418
Llangynidr (Brecon)	45.3	19.4	7.1	92.7	17.0	319
Monmouthshire	36.3	15.6	24.5	41.3	17.2	245
Glamorganshire	20.1	19.9	24.1	35.2	35.4	227
England & Wales	14.6	17.9	16.0	14.5	12.7	102

Growth rates calculated from census data are crude or overall rates and do not reflect individual factors affecting population change such as fertility rates, mortality rates, and the age/sex structure[43] or immigration and emigration however they are a valuable indicator of the general growth rate of a population.

Table 6.13 shows that whereas the population of England and Wales went up by 102 percent in the fifty-year period from 1801 to 1851 the population of the parish of Aberystruth increased by 1,687 percent in the same period and that of the parish of Bedwellty by 1,796 percent. Table 6.14 below consolidates the Monmouthshire and the Breconshire parts of the area under study to give an even clearer picture.

[43] E. A. Wrigley, 'British Population during the 'long' eighteenth century', in Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, pp 59-60.

Table 6.14 Population growth over each decade of both parts of the iron works area and comparisons with other areas and nationally. (Growth rate per cent per decade plus growth rate per cent for 1801 to 1851.)

	1801-11	1811-21	1821-31	1831-41	1841-51	1801-51
Monmouthshire parishes Including study area.	138.3	64.2	44.8	89.9	18.8	1,178.9
Breconshire parishes Including study area	52.6	48.6	30.7	77.2	26.6	563.7
All parishes including Study area.	101.2	59.1	40.6	86.4	20.9	916.5
Neighbouring area of Merthyr	44.1	56.7	26.9	58.4	32.6	502
Monmouthshire	36.3	15.6	24.5	41.3	17.2	245
South West of England						66.9
West Midlands						99.7
England & Wales	14.6	17.9	16.0	14.5	12.7	102

Source. The figures for the South West of England and the West Midlands were obtained from *An Historical Geography of England and Wales* by R. A. Dodgshon and R. A. Butlin.[44]

The table demonstrates most clearly of all the dramatic increase in population in the area under study. England and Wales grew steadily in population in the first half of the nineteenth century, the population approximately doubling, but this growth is modest indeed compared with that in the area under study as has been demonstrated. In fact the national growth rate in population was highest in the period 1791 to 1831[45] and thus the peak in growth rate in the area under study was probably later and if so this adds to the suggestion that the industrial revolution arrived in the study area rather late. It is also significant that in the nearest region of England, the South West, the growth in population over the period 1801 to 1851 was well below the national average. This would appear to offer some support to the earlier findings that some men were leaving the South West of England.

It is now necessary to seek to explain why the population of the parishes that included the study area increased 916 percent in the first fifty years of the nineteenth century whilst that of England and Wales increased by only 102 percent. Clearly the

[44] R. A. Dodgshon and R. A Butlin, *An Historical Geography of England and Wales*, London, 1978, p 321.
[45] Wrigley, 'British Population during the 'long' eighteenth century', p 65.

main element in the increase in population in the area was immigration over the fifty-year period and descendents of immigrants born locally but it needs to be estimated if other factors were also involved in the excess increase over the national average. Looking at the growth in population of the country as a whole the debate has tended to involve a comparison of the effects of improving mortality[46] and increasing fertility, immigration into the country and emigration out of the country not appearing to have been major factors. Earlier it was thought that improving mortality rates during the industrial revolution period might have been the greater factor but recent work has tended to put more stress on fertility.[47] Fertility rates can increase for various reasons, the most important being a lowering of the age at marriage of women. In 1780-9 this was 24.0 in England but by 1830-39 the age at marriage of women had fallen to 23.1, not apparently a great movement but capable of accounting for a sizeable part of the increase in population in England.[48] Examination of local parish marriage records for the area is the obvious way of checking if the average age of women on marriage had followed the national trend or exceeded it but unfortunately actual ages were rarely recorded. The common method was simply to record ages as 'of full age' or 'minor' and so local parish records cannot be used. From 1837 all marriages had to be formally registered and the ages of the parties concerned were recorded but these records are only available individually on request. However it is possible to make rough estimates of ages at marriage of women from census data making assumptions using the age of the oldest recorded child. From this approach an estimate of the age at marriage could be obtained by taking this age as say one year less than the apparent age of the woman on the birth of the first recorded child. This method becomes increasingly unreliable the older the woman as in many cases the oldest child would

[46] Actuaries use the term 'improving' mortality which means lighter or reducing mortality.
[47] Wrigley, 'British Population during the 'long' eighteenth century', pp 65-9.
[48] Wrigley, 'British Population during the 'long' eighteenth century', pp 70-5.

have left home. Nevertheless restricting a sample to women up to age say 39 might give at least an indication of the general age of women at marriage though a particular problem is the high pre and post natal mortality rates of children. This point could mean that this approach will tend to overstate the age as only live children can be identified from census data. Because the enumerators often recorded ages incorrectly the 1841 census could not be used.

The same Nantyglo enumeration district identified earlier for the 1851 census data was analysed and it consisted of 404 households in which there resided 1,205 males and 992 females. This excess of males over females was a feature of the study area in general and would be expected of a new industrial area subject to huge immigration. For an analysis of women's ages at marriage 176 cases were found to fit the criteria described above where the data was clear and reasonable. An average age of 22.4 at marriage was found for this area.

For a comparison a smaller sample of 118 households in the vicinity of the Clydach ironworks was examined following the same rough approach and the average age at marriage obtained was 23.2. A further small sample of 70 households in the town of Brynmawr was examined and the average age at marriage for this group was found to be 22.4. Brynmawr was a mile or so from the Nantyglo ironworks and just a little farther from the Beaufort works. Based on these results the conclusion is that there might have been a reduction in the average age at marriage for the study area compared with the national average of 23.1. However it could be added that the excess of adult males in the local population, many of the excess being single lodgers, would act to reduce the birth rate per total population in the area.

It is believed also that stillbirth rates fell nationally during the industrial revolution period and it is suggested that the combined effect of this and of the fall in

the mean age at marriage for women might have accounted for a substantial part of the increase in population nationally during the period.[49] Data on stillbirths is not available for the area under study but it can be assumed that the stillbirth rate in a relatively new industrial area would be at least the national average. Hence if the local still birth rates were worse than the national average this would act to reduce the increase in population.

Finally there is the effect on fertility of economic circumstances. It has long been assumed that economic circumstances have had a powerful influence on marriage decisions.[50] As covered earlier in this work the iron trade tended to swing between boom and recession such that any temporary boost to fertility in boom circumstances would often be short lived.

From the above discussion it is argued that any increase in fertility in the area under study over the national rate was probably not sufficient to make a significant difference to the comparative population growth rates. With regard to mortality Table 6.15 shows that the gross mortality rate for the ten years 1841 to 1850 was higher in the districts in which all the ironworks of the group were situated, Abergavenny/Bedwellty and Crickhowell, compared with the national average. This excess mortality in the study area would act to reduce the population growth rate in the area compared with the national average population growth rate.

[49] Wrigley, 'British Population during the 'long' eighteenth century', p 71-5.
[50] Wrigley, 'British Population during the 'long' eighteenth century', p 76-8.

Table 6.15 A comparison of the mortality in the areas under study with other selected areas in Wales and with the country as a whole. Males and females. Period 1841-1850. (Deaths per 1,000 persons per annum)

Districts	**Deaths per 1,000 living Per annum**
National	22.35
Abergavenny/Bedwellty	25
Merthyr Tydfil	28
Crickhowell	27
Newport	24
Pontypool	23
Wrexham	23
Cardiff	22
Neath inc Aberavon	22
All other registration districts in Wales	<22

Source. *Supplement to the Forty-fifth Annual Report of the Registrar-General of Births, Deaths and Marriages in England*, London, 1885, pp iv, LXXXIVand LXXXV.

In conclusion it has been demonstrated that the population of the North West Monmouthshire area grew at a truly dramatic rate in the first half of the nineteenth century and that the increases in population were almost entirely due to immigration and descendents of the immigrants born locally. The natural increase in population in the area, that is population increase due to rises in fertility rates and improvements in mortality rates, was not a major factor when comparing local population growth rates with national rates. However as stressed earlier the growth rates calculated were crude rates that mask all individual factors including emigration. The detailed study of the *Monmouthshire Merlin* newspaper carried out for this thesis has revealed that advertisements encouraging local inhabitants to emigrate to the United States in particular, but also to Australia and Canada, appeared regularly in this newspaper. It must be assumed that many Monmouthshire people did emigrate in the 1830s and 1840s and that tends to make the crude population growth rates shown even more dramatic.

6.5 How the population was housed.

The provision of housing for the vast numbers of workers coming into the area was always a problem for the ironmasters. There was no workers' housing at all when the works were set up and the responsibility for housing fell on to the masters. It will be shown that even by mid century a vast number of the housing stock of the iron towns was still owned by them. The section also looks at the types of housing provided by the ironmasters over the period of the study and comments on how suitable the housing was. Finally the general layout of the housing in the embryonic towns is examined and it is suggested that in only one case was there any evidence of deliberate structural planning of the layout of the housing.

The ironmasters had the responsibility for housing the workforce and their families not just when the ironworks were first established but for many decades thereafter. In the early years relatively small numbers of houses were erected usually in close proximity to the furnaces but as the nineteenth century progressed and the numbers of the workforce grew so did the pace of housing developments. At Ebbw Vale the first houses were built in 1787 near the furnaces on the east side of the River Ebwy in the parish of Aberystruth but later the Harford partnership erected a number of rows of cottages on the Bedwellty side of the river such that by 1824 the Ebbw Vale company owned 103 cottages in this parish. The pace of house building increased further on the Bedwellty side and also on the Aberystruth side with the rows of houses known as Newtown.[51] By 1844 the Harford partnership owned 604 workmen's cottages in Ebbw Vale plus fourteen agents' houses and the same company owned 348 workmen's houses at Sirhowy together with ten agents' houses.[52]

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[51] B. Caswell, J. Gaydon, M. Warrender (edited and compiled), *Ebbw Vale 'The Works' 1790-2002*, Ebbw Vale, 2002, pp 122-6.
[52] Newport Library, px M280 672, Particulars of the sale of the Ebbw Vale and Sirhowy Iron Works.

Much the same pace of housing development arose at other ironworks within the group. At Blaenavon early housing such as at Stack Square was built right adjacent to the furnaces but by 1833 approximately 470 workmen's and agents' houses had been erected on the Blaenavon Company's freehold and leasehold land at Blaenavon, Garnddyris and Pwll Du.[53] The sale document for the Clydach Ironworks in 1833 also indicates that the company had built an array of houses around the furnaces, rolling mills, forge and on freehold land nearby.[54] In addition to building houses the ironmasters also had responsibility for the maintenance of their houses. As early as July 1796 the Ebbw Vale ironmasters made an agreement with a mason for him to repair the inside of some houses at Lower Hendre and to put up grates and make repairs to the roof.[55]

The need to house immigrant workers to the area meant that workpeople living in company housing were expected to offer accommodation to lodgers and the ironmasters at Ebbw Vale sought to limit the amount their tenant workmen could charge their lodgers. For example, George Jones was appointed by John Harford to work at the furnace and was granted a house and firing. However the agreement stipulated that Jones was not to charge a lodger more than nine pence a week or one shilling and sixpence a week should the lodger be married.[56]

With regard to the type of housing an early design was that at Office Row in Nantyglo built in 1793-95 by the Harfords, the ironmasters at the time. These houses were built into a bank and had three levels on the lower side but only two on the upper

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[53] GRO. D.7.194. 22 November 1833, Particulars of the sale of Blaenavon Iron and Coal Mines (including the iron works).
[54] GRO. D.591.19.384. 17 July 1833, Particulars of freehold and leasehold estate comprising the Clydach Iron Works.
[55] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, 17 July 1796, Agreement with David Jones, mason.
[56] GRO. D.2472.1. Ebbw Vale Memorandum Book 1796-1819, May 1796, Agreement between George Jones and John Harford for the Ebbw Vale Furnace Company.

side. There were two houses in each unit, the lower house having just two rooms and a larder whilst the upper house was of two floors and had four rooms plus a larder.[57] These types of houses can be seen clearly in Illustration 4, 'Nantyglo ironworks', on the left of the engraving. William Coxe, in his *An Historical Tour of Monmouthshire*, is probably describing this row of houses when he visited Nantyglo ironworks in the late 1790s and met Mr Hertford (Harford).[58] Similar houses were built at Ebbw Vale, some located very close to the furnaces and this type of house was still being built at Ebbw Vale in 1811 and shortly after, an example being the houses at the Gantre. Although these early houses usually had gardens there were no sanitary arrangements and water had to be carried to the houses from nearby springs.[59]

The most unusual houses in the area were those described by William Coxe as an 'ingenious contrivance' in the context of housing at Blaenavon. Dwellings were built into an arched railroad bridge by bricking up the arches. Coxe said that this was found necessary because of the increasing number of families at Blaenavon.[60] These houses are shown in Illustration 3 below.

Most of the houses of the area however were small terraced houses of one or two storeys. The smallest of the houses had just two rooms though such housing was relatively rare in the area except in Nantyglo where about 25 to 30 percent were of this type. Other houses had three rooms but the largest group of workers' houses were those with four rooms.[61] Examples of the smaller two room houses were those at Bayliss Row, Nantyglo, built about 1827. These houses had just one room on each floor and were built into the hillside opposite Ty Mawr, the house of the ironmasters,

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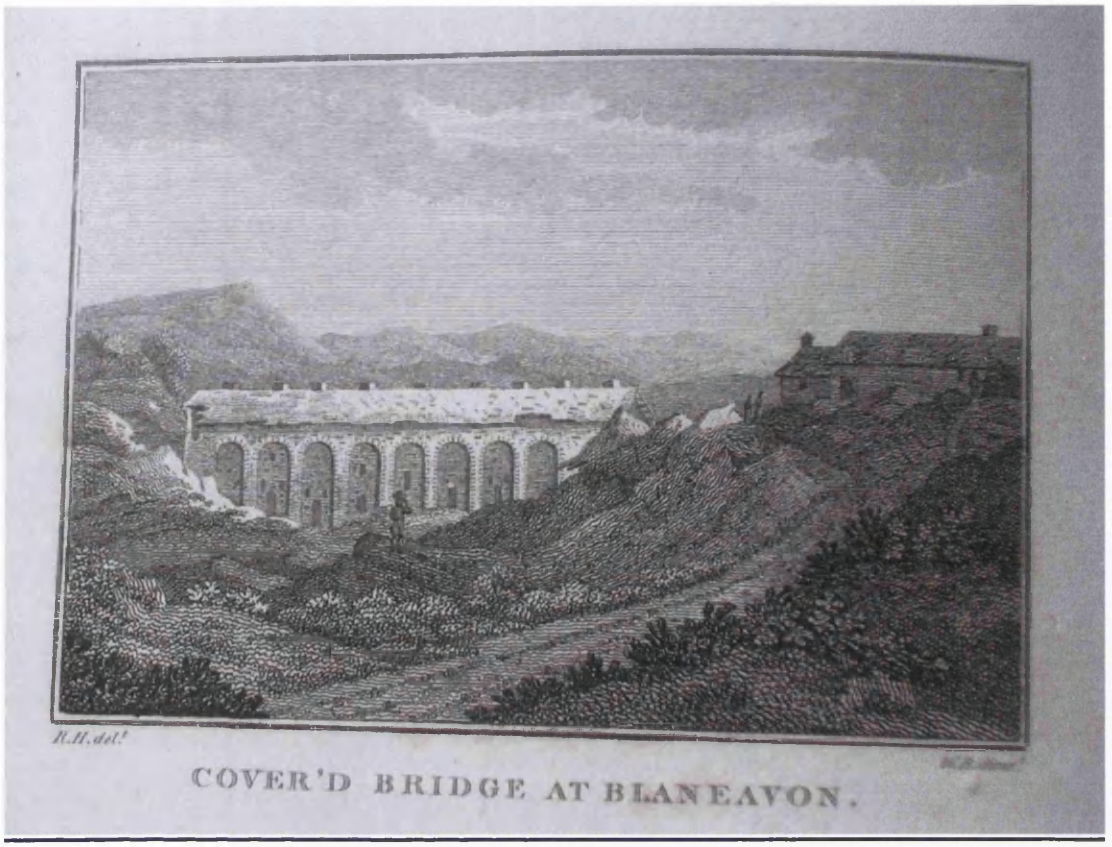
[57] J. B. Lowe, *Welsh Industrial Workers Housing 1775-1875*, Cardiff, 1977, pp 16-17.
[58] Coxe, *An Historical Tour of Monmouthshire*, p 251.
[59] F. J. Ball, 'Housing and the Industrial Revolution in Ebbw Vale' in *Presenting Monmouthshire, The Journal of the Monmouthshire Local History Council,* No. 10, (Autumn 1960), pp 10-11.
[60] Coxe, *An Historical Tour of Monmouthshire*, p 228.
[61] Jeremy Lowe, 'Industrial Houses and Settlement Patterns at Nantyglo 1811-1845', *The Monmouthshire Antiquary,* Volume 111 Parts 3 & 4, (1977), p 196.

Illustration 3 Bridge houses at Blaenavon.



Source. William Coxe, *An Historical Tour of Monmouthshire*, p 222.

the Baileys.[62] Another example of two-room housing was at Bunkers Row, Blaenavon built around 1792. These houses were of the rare back-to-back type with each pair of houses having one room plus a loft area above accessed by a ladder. Obviously small these houses were provided for lower paid workers.[63] Some houses had three rooms, examples being at Lions Row, Nantyglo and at Upper New Rank, Blaenavon. The Lions Row houses had two rooms downstairs and one room above with less floor space than the ground floor.[64] The Upper New Rank houses had a kitchen and back

[62] J. B. Lowe, *Welsh Industrial Workers Housing 1775-1875*, p 37.
[63] J. B. Lowe, *Welsh Industrial Workers Housing 1775-1875*, p 15.
[64] J. B. Lowe, 'Industrial Houses and Settlement Patterns at Nantyglo 1811-1845', p 197.

bedroom downstairs in addition to a living area. There was a large open sleeping area above and so these houses were larger than the Nantyglo houses.[65]

There are a number of examples of the standard four room house, one of the earliest being Stack Square at Blaenavon. These houses still exist being very close to the site of the old furnaces and are substantial being two rooms on each floor plus a larder. A later example of the four room type was at Chapel Row, Blaenavon. These houses were built in 1839 by the Blaenavon Iron and Coal Company who built a large chapel in the middle of the row.[66]

From the above brief account of the housing of the area it can be seen that although houses varied in size and in numbers of rooms, in general they were small and usually closely packed together in rows. Such rows of workers' houses were common in the period in the country and not just in South Wales, the Coalbrookdale Company for example built several terraces of interlocking houses.[67] The houses of the area usually had gardens as can be verified from early maps but they were built with little regard for drainage or sanitation in general.[68] This was partly because the rows of houses were built in narrow valleys which made drainage difficult.[69] However many, if not most, of these early houses were built to last, quite a number still being occupied until the 1960s. Colliers Row at Ebbw Vale for example was still occupied in that decade.

To obtain an idea of the average level of occupation of the houses of the area the enumerator's returns for the 1841 census was examined and three enumerator's districts in the parish of Aberystruth was selected. The area covered by these three

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[65] J. B. Lowe, *Welsh Industrial Workers Housing 1775-1875*, pp 30-1.
[66] J. B. Lowe, *Welsh Industrial Workers Housing 1775-1875*, p 42.
[67] Barrie Trinder, *The Industrial Revolution in Shropshire*, pp 144-5.
[68] K. Sullivan, '"The biggest room in Merthyr". Working class housing in Dowlais, 1850-1914', *Welsh History Review*, 17 (1994), p 155.
[69] David Williams, *John Frost: A Study in Chartism*, Cardiff, 1939, p 112.

districts is in the centre of the whole area under study being between the Ebbw Vale furnaces on the Aberystruth side of the Ebbw Fawr River, approaching the Beaufort ironworks and including the area to the west of the Nantyglo ironworks and this ironworks itself. The following table is the official table published in the census data giving overall figures for the three districts. To this the average house occupancy has been added.

Table 6.16 Overall house occupancy of three enumeration districts of the 1841 Census for the County of Monmouth, Hundred of Abergavenny, Parish of Aberystruth.

District	Occupied Houses	Males	Females	Totals	Average Occupants Per house
1	96	350	244	594	6.2
2	197	644	499	1,143	5.8
5	261	831	632	1,463	5.6
Totals	554	1,825	1,375	3,200	5.8

As expected the data in Table 6.16 again demonstrates the excess of males over females and the average house occupancy, 5.8, was only a little higher than the average for England and Wales which was around 5.5 in 1841.[70] For comparison the original Nantyglo target area using the 1851 census enumerators' returns as earlier was also analysed. In this case the complete occupancy breakdown is shown. Two exceptional properties have been excluded because they did not represent normal housing, the properties being the Bush Hotel that had 14 occupants and its neighbouring property which appears to have been a substantial shop probably the company shop. This shop had 15 occupants most of whom were called 'shopman' in the returns while two were termed 'grocer' and two 'servant'. For comparison the results of a similar exercise carried out on houses in the southeast section of the County of Monmouth are shown.

[70] Enid Gauldie, *Cruel Habitations: A History of Working-Class Housing 1780-1918*, New York, 1974, Appendix 2, p 320.

Table 6.17 Household occupancy analysis 1851 Census, 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo) and for comparison a selection of villages in South East Monmouthshire

Occupants in Household	Occurrences Nantyglo sample	Occurrences South East Monmouthshire
1	1	18
2	26	45
3	59	49
4	67	64
5	66	46
6	70	47
7	50	30
8	32	14
9	16	7
10	5	3
11	7	(11+) 11
12	2	
13	1	
Total	402	334

Source. The South East Monmouthshire villages were Caldicot, Caerwent, Pontskewett and Rogiet and the analysis was obtained from R. L. Gant, 'Socio-Economic Structure in South-East Monmouthshire' in *Presenting Monmouthshire, The Journal of Monmouthshire Local History Council*, No.33 (Spring 1972), p 15.

The average occupancy of this sample was 5.3, less that for the 1841 sample suggesting some improvement in the level of accommodation. However this average occupancy was considerably higher than that for the houses in the group of east Monmouthshire villages which was around 4.7. The 1851 analysis for the Nantyglo sample also shows that there was a considerable degree of almost under occupation with nearly 38 percent of the houses having four or less occupants (52 percent for the south east Monmouthshire sample). Unfortunately the 1851 census for the Nantyglo area like that 1841 rarely included street information and so even where there is some knowledge of the type and size of housing in the area it cannot be matched with household occupancy from census data with any accuracy.

A final point on house occupancy is that there was a tendency for certain types of workers to live close together. To look at this suggestion the target Nantyglo sample was further studied and within the enumeration district each group of 50

houses were analysed by occupation of males over fourteen for the main occupations of the district.

Table 6.18. Jobs analysis – males aged fourteen and over. Key jobs analysed per 50 households 1851 Census, 578 Abergavenny, 5 Aberystruth, Enumeration district 11(Nantyglo)

Household Number	Puddlers	Colliers	Labourers	Ballers	Rollers	Iron Miners
1-50	0	50	12	0	0	0
51-100	21	3	8	18	6	0
101-150	31	13	7	9	1	0
151-200	29	13	8	5	5	0
201-250	35	10	4	2	2	8
251-300	18	14	7	3	4	14
301-350	18	17	15	0	0	2
351-end	20	16	14	7	4	4
Totals	172	136	75	44	22	28

The analysis confirms the tendency for particular occupations to be clustered. There were no ironworkers (puddlers, ballers and rollers) at all in the first 50 households though some of the labourers may have been working at the ironworks. This first zone of the enumeration district had a concentration of colliers and, to some extent, the reverse was true in the next 50 households with only three colliers. The remaining groups of 50 households were more evenly distributed except for the absence of miners (iron ore miners). There were none of these in the first 200 households but 28 in the remaining half of the district. The distribution of lodgers also contributed to this clustering as there was a tendency for lodgers to be of the same occupation as the head of the household in which they were staying.

With regard to the general layout of the housing within the new iron towns of the area there is little evidence for any cohesive town planning except possibly in the case of Tredegar. In general the ironworks were positioned in the base of the valleys close to the rivers. This tended to dictate where houses were built, the earliest near the furnaces and the remainder usually around the sides of the valleys still quite close to the ironworks sites. With local knowledge of the location of the original ironworks

this feature can be appreciated today at Tredegar, Nantyglo and Clydach and also at Ebbw Vale with regard to the steelworks site, the most northern part of which was coincident with the old ironworks site. The layout of workers' housing with respect to the ironworks can be appreciated by examination of Ordnance Survey maps, for example those covering the Ebbw Vale area 1880, Beaufort Iron Works area 1880, the Sirhowy Iron Works area 1879, the Tredegar area 1878 and the Nantyglo area, 1880 and 1881.[71]

There is a suggestion that an attempt at planning the layout of housing development was made at Tredegar by Samuel Homfray, the elder. Streets appear to have been planned around what is now 'The Circle', south of the ironworks. The planning seems to have occurred between 1813 and 1818 as it does not appear on an Ordnance Survey map dated around 1813 but does on an Ordnance Survey map of 1826 and it is believed that houses built after 1818 were built elsewhere.[72] The streets deemed part of the town planning can be seen on the 1878 Ordnance Survey map of Tredegar. These are principally Morgan Street, Iron Street, Market Street, West Lane, South Lane, North Lane, East Lane and Iron Row.[73]

In summary the ironmasters were responsible for the provision of housing throughout the period of the study and by the mid nineteenth century each company had a sizeable housing stock in response to the greatly increasing numbers of the workforce. The houses provided by the ironmasters were basic and small, largely consisting of rows of two to four room houses with the latter size dominant. Initially

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[71] Although permission had been received from the Controller of Her Majesty's Stationery Office to include details of these Ordnance Survey maps in this thesis it was not possible to do so as a result of the photocopying permission paragraph that was required to be included in the 'Declarations and Statements'.

[72] John B. Hilling, 'Britain's First Planned Industrial Town? The Development of Tredegar, 1800-1820', *Gwent Local History, Journal of the Gwent Local History Council*, No. 94 (Spring 2003), pp 55-76.

[73] Hilling, 'Britain's First Planned Industrial Town? The Development of Tredegar, 1800-1820', p 69.

the houses were sited near the works or sometimes near pits. Later the rows were positioned wherever it was convenient for them but never very far from the ironworks. They were probably solidly built if the extant Stack Square in Blaenavon is typical and they usually had small gardens. However there was no water supply or drainage.

In the 1840s and early 1850s the average occupancy of the houses was likely to have been in the range five to six persons, quite close to the national average. Thus the degree of overcrowding in the area seems not to have been as severe as nearby Merthyr. The population there at this time suffered more from overcrowding such that Government inspectors in the 1840s thought that only the worst districts of Liverpool exceeded the overcrowding in Merthyr.[74]

Apart from Tredegar there is little evidence of town planning in the siting of housing developments while at Tredegar there is good evidence to support the suggestion that the structure of the streets to the south of the ironworks were planned at least for a period in the 1810s. As can be seen from the Ordnance Survey maps mentioned an array of substantial urban areas grew up around the ironworks leading to the towns that exist today.

6.6 Conclusion.

The industrialists who came to the North West Monmouthshire area setting up and developing an iron industry wanted to keep control to themselves or to relatives and as such the proprietorships were usually restricted to a small number of men. While the works were relatively small concerns the principal partners, the ironmasters, often acted as managers of the concerns themselves and even when the works expanded managers and other senior positions were often filled by relatives or others

[74] Chris Evans, *'The Labyrinth of Flames' Work and social conflict in early industrial Merthyr Tydfil*, Cardiff, 1993, p 156.

by personal contact. However it was shown that advertising for senior positions had become common by the 1830s.

A consequence of the successful iron industry that was developed in the area by the industrialists was the provision of employment for large numbers of workmen when there had been no appreciable work in the area previously except at the scattered farms around the hills. When they arrived in the area the ironmasters had no pools of labour to call upon and the attraction of labour to the area was always an issue for them. Although some skilled workers were recruited from other works at times especially in the early years or in times of major changes to processes, the majority of the skilled workers had been employed previously in the area as unskilled men.

Unskilled labour was attracted to the area by the lure of higher wages. It has been demonstrated that the largest numbers of men came from nearby farming areas in Monmouthshire and Breconshire or nearby industrial areas such as Merthyr. Others came from farther away. Many of those who travelled considerable distances for the time came from west Wales and from neighbouring counties in England. There was some change in the pattern of immigration to the area with increasing numbers coming from the neighbouring counties of England in the later years and fewer from Glamorgan excluding Merthyr. Immigration from west Wales was constant, especially from Carmarthenshire. With regard to unskilled labour it was shown that very few women were employed in the ironworks at the end of the period when the works had grown to be large enterprises. Because of inconsistencies in the 1851 census enumerators returns it was difficult to assess the degree of child employment but it was clear that many children, mostly boys, were employed, few at ages seven or eight, many from ages 11 onwards.

The consequence of the expansion of the ironworks through the first half of the nineteenth century was a dramatic increase in the population of the North West Monmouthshire area. This population growth was quite remarkable transforming a largely deserted landscape broken up only by scattered farms into an urban landscape in the valleys and on the hillsides. Evidence shows that in the period 1801 to 1851 the populations of the parishes of Aberystruth and Bedwellty grew by more than 1,600 percent, the population of the whole study area by over 900 percent compared with the national average growth rate for England and Wales of only 102 percent.

The dramatic growth in population of the area was due to immigration and there is little evidence to suggest that natural increases in population that is by increases in fertility rates and decreases in mortality rates were in any way exceptional by national standards. As the immigrants settled the population was further extended by descendents of these immigrants. There is evidence that there might have been considerable emigration from Monmouthshire to the United States and the colonies and so the growth in population is even more startling if this factor is taken into account. A final point on population is the constant pattern of an excess of males over females found in the area. This factor is consistent with a region experiencing vast immigration of workers as males tend to migrate first seeking work rather than females, an assertion confirmed by the fact that the vast majority of the lodgers identified in the census enumerations, likely to be among the most recent immigrants, were male.

The ironmasters had the responsibility of housing their workforce and their families. They managed to achieve this by erecting rows of two, three and four room houses usually relatively close to the ironworks or nearby mines. The houses were solidly built but lacked water supply and drainage. The masters encouraged their

worker tenants to take in lodgers but despite this the average house occupancy was little different from the national average. With the ironworks, the associated industrial buildings and the increasing numbers of rows of workers houses the iron districts were transformed from an essentially rural setting into an urban area. However there was little town planning apart from that at Tredegar and even then it was for a limited number of years.

On the issue of population growth and the industrial revolution H. J. Habakkuk posed this question in 1958 'Did the Industrial Revolution create its own labour force? Or did the vagaries of disease and the weather produce an additional population that either stimulated an Industrial Revolution or had the luck to coincide with one independently generated'?[75] P. Deane and W. A. Cole believed that 'most historians would agree that the population changes were both a cause and an effect of the concomitant economic changes. They differ however, in their analysis of the mechanism of interaction, of the timing of cause and effect, and hence the relative importance of the causal factors'.[76] They added that in the areas most affected by the industrial revolution most of the population upsurge preceded the period of rapid industrial growth.[77] As regards the area under study it would appear at first sight to be clear that the industrial revolution caused the population surge in the area but this surge was due very largely to inward migration with the natural growth of the population playing the lesser role. In fact the effect of fertility and mortality collectively was neutral or even slightly negative when compared with the national average growth in population. The situation in the North West Monmouthshire area also seems to contradict the assumptions made by Robert C. Allen that the industrial workforce of an area was the result of population growth rather than movements from

[75] M. W. Flinn, *British Population Growth 1700-1850*, London and Basingstoke, 1970, p 52.
[76] Deane & Cole, *British Economic Growth 1688-1959*, p 286.
[77] Deane & Cole, *British Economic Growth 1688-1959*, p 287.

agricultural areas.[78] Migration to the study area from agricultural areas, nearby, in West Wales and in other areas, was dramatic. Probably it has to be accepted that the study area was rather different from the norm as discussed by most historians. That is what makes the area such an interesting subject for research.

[78] Robert C. Allen, 'Agriculture during the industrial revolution', in Floud and Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, p 101.

Chapter 7 Conclusion.

An attempt has been made in this thesis to describe how the industrial revolution occurred in the North West Monmouthshire area in the last two decades of the eighteenth century and how it arrived later than in the nearby Merthyr area. Dramatic changes followed the onset of the industrial revolution in the study area and attempts have been made to account for these changes in the period to 1850. The changes came about as a direct result of the establishment and growth of a vibrant iron industry, an industry almost non-existent in 1780 but one that by 1830 made nearly fifteen percent of British pig iron output.[1] It has been shown how a small group of incoming industrialists were the catalysts for the changes and it was stressed how vital their role was especially in setting up the iron industry. The difficult conditions that faced these early industrialists such as poor communications have been described and a considerable degree of ingenuity, skill and perseverance was necessary as well as access to capital. These industrialists were not untypical of industrialists in the early industrial revolution in Britain but most already had an industrial background especially in the iron industry before they came to the area.

Control of the ironworks was often kept within the same family or within close social contacts for long periods of time. For example the Harfords of the Ebbw Vale Company who through various partnerships consisting of family members and social or business contacts retained control of the company right through to 1843 from the 1790s. Joseph and Crawshay Bailey were proprietors of the Nantyglo Company to 1850 and beyond and there were three generations of Thomas Hills and two generations of the Hopkins family at Blaenavon. The Homfray family was prominent at Tredegar ironworks from its inception through to the end of the period of the study

[1] H. Scrivenor, *History of The Iron Trade*, London, 1854, pp 96, 134; Philip Riden and John G. Owen, *British Blast Furnace Statistics 1790-1980*, Cardiff, 1995, p lx (Table 1.2).

and in addition the Kendall family ran the Beaufort works for decades until the works was taken over by the Baileys in 1832. This pattern of control was of course common in the industrial revolution period and was deemed desirable by partners in view of the uncertainties of the period. The point is illustrated by Pat Hudson: [social and familial networks were engaged to underpin economic exchange in the uncertain, high-risk, information-poor business environment of the industrial revolution].[2]

Thus the early industrialists of the area and their successors generally succeeded in running their businesses within a national economic climate of fluctuating demand for iron and a continual trend of falling iron prices. It has also been shown how the ironmasters had a pragmatic approach to changes in technology introducing improvements when circumstances suggested they would aid their businesses, sometimes continuing to use older approaches if these were deemed cost effective at the time. However the ironmasters of the area were also leaders with the introduction of new processes at other times. In the nineteenth century iron industry improvements were usually relatively minor in nature but were frequent and had the effect of improving performance over time. The masters' pragmatic approach to technological change did not prohibit the growth in output in any way. Iron output increased continually in the area over the period such that the core group of ironworks plus the newer ironworks that were set up lower down the Monmouthshire valleys formed one of the major iron manufacturing districts of Britain in the second quarter of the nineteenth century.

Throughout the period of the study access to capital was always a vital element in the success of the ironworks and there were a few cases where shortages of capital or overexposure to loans caused the companies to fail, the Harford partnership of

[2] Pat Hudson, 'Industrial organization and structure', Roderick Floud and Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1 Industrialisation, 1700-1860*, Cambridge, 2004, p 55.

Ebbw Vale in 1843 being the prominent example. However in general this company and the others of the group were able to acquire sufficient finance for their concerns to function successfully. The partnerships were always restricted to a handful of individuals and in good years much of the profits were reinvested rather than having to be distributed to large numbers of shareholders. In fact with regard to capital structure it has been suggested that the partnership was the most suitable structure for these iron companies in the first half of the nineteenth century.

Labour was the other vital element in the growth and success of the iron companies. There were no pools of labour available to the industrialists in the early years and they had to bring skilled men with them or attract skilled labour from neighbouring industrial areas such as Merthyr. It has been shown that apart from the early years the majority of skilled ironworkers were originally recruited unskilled, converting to skilled after serving time with skilled men. Unskilled workers were attracted to the area by the wages offered and they came from areas both close by in Monmouthshire and Breconshire and from farther afield in Glamorgan, West Wales and the neighbouring counties of England. Credit should be given to the ironmasters for their ability to attract farm workers and others to move to the area in times when the lack of transport meant that such moves were very cumbersome.

A consequence of the growth of the ironworks of the group and the recruitment of large numbers of workers to the area was a dramatic growth in the population of the iron districts. This growth was truly exceptional for the industrial revolution period in Britain. The masters were responsible for housing the incoming workers and they built up large stocks of housing, small units but not unreasonable for the time. The level of house occupancy was not very different from the national average.

The overall conclusion therefore is that the industrialists who came to the study area, and their successors, deserve considerable credit for setting up an iron industry in the circumstances described and for the expansion and general success of this industry through difficult economic circumstances throughout the first half of the nineteenth century. This group of men were tough businessmen who expected much from their employees but they did provide regular employment for many people over a long period of time.

As a result of the success of the iron industry and its associated mineral workings the study area was converted from a rural one to an urban district consisting of an array of new towns across the heads of the Monmouthshire valleys. These new towns were Tredegar with Sirhowy, Ebbw Vale with Beaufort, Brynmawr and Nantyglo and Blaenavon. Further towns such as Blaina, Victoria, Abersychan, Varteg and others developed lower down the valleys in the first half of the nineteenth century as the iron industry of the district expanded. The dramatic changes to the study area and its urban character is most clearly demonstrated by contrasting Thomas Kitchin's 1748 map of Monmouthshire, Illustration 1, with the Ordnance Survey maps of around 1880, discussed earlier.

It has been shown that by the mid nineteenth century the ironworks of the study area formed a successful group of companies principally manufacturing wrought iron rails and other bar iron products, making a substantial contribution to the British iron industry. However the next three decades were to see further dramatic changes and as a postscript to this study the main features of these changes are now outlined. Output of wrought iron in Britain continued to grow such that by 1865 output was not

far off double that of 1850.[3] However the British iron industry was adversely affected by the extra tariffs imposed by the Americans on imported iron during the American Civil War which had started in 1861. Competition from Continental iron producers was also beginning to have an effect[4] but the biggest threat to the mass wrought industry was to come from the development of processes enabling steel products to be manufactured on a commercial scale. Henry Bessemer's process for manufacturing steel was introduced in the 1850s in Britain rather erratically, steel being used in the production of rails and other products such as plate used for building ships.[5] However in the next two decades steel manufacture increased dramatically such that by 1880 it was in the ascendancy and the iron industry was collapsing.[6] In South Wales the production of wrought iron rails fell from 534,000 tons in 1869 to less than 100,000 in 1877.[7]

The Bessemer process was originally introduced as a method of producing wrought iron without the puddling process as well as a steel manufacturing process. However once steel could be made commercially its flexibility of use over that of wrought iron meant that a decline in the wrought iron industry was inevitable.[8] The study area had already been affected in that the improved blast furnace technologies such as hot blast greatly reduced the fuel needs such that by the 1850s the optimum location of iron and steel works was at or near the coast rather than within the coalfields.[9] Local ironworks had already been importing ores in increasing amounts and in addition local ores could not be used in the steel making process in its early

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[3] Alan Birch, The *Economic History of the British Iron and Steel Industry 1784-1879*, London, 1967, p 121.
[4] John P. Addis, *The Crawshay Dynasty*, Cardiff, 1957, pp 130-1.
[5] J. R. Harris, *The British Iron Industry 1700-1850*, Basingstoke and London, 1988, p 76.
[6] Michael Atkinson and Colin Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880: An Industrial History*, Cardiff, 1987, p 3.
[7] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 15.
[8] *Monmouthshire Merlin*, 4 October 1856, Bessemer's Invention, from *The Engineer*.
[9] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 77.

years.[10] The net effect was that by 1880 iron ore mined in South Wales represented only 1.9 percent of the United Kingdom total compared with around 17½ percent in 1855.[11] Added to these problems for the South Wales ironmasters was the heavy capital investment needed to enter the steel market commercially.[12]

It is not surprising therefore that many of the South Wales ironworks closed, not having the resources to convert to steel manufacture. Amongst others Penydarren, Hirwaun, Golynos, Varteg and Pentwyn ironworks closed in the 1860s while the Abersychan ironworks closed in 1881.[13] Within the core group of ironworks the Clydach Company shut down their blast furnaces in the 1860s. The concern continued for a time as the New Clydach Sheet and Bar Iron Works but closed finally in the 1870s.[14] Clydach was always one of the most vulnerable of the study group being one of the smallest works and often short of capital. The Sirhowy ironworks that had been a subsidiary of the Ebbw Vale works since its break with the Tredegar ironworks in 1818, closed for the last time in 1881.[15] However three of the core group of ironworks did convert to steel manufacture.

Under the dynamic leadership of Abraham Darby and Thomas Brown the Ebbw Vale Company expanded and acquired the Victoria works and collieries in 1848, the Abersychan works in 1852, and the Pontypool blast furnaces and collieries and the Pentwyn works in 1857.[16] For about ten years from 1854 the company experimented with steel making but eventually in 1864 the company adopted

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[10] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 13.
[11] B. R. Mitchell and Phyllis Deane, *Abstract of British Historical Statistics*, Cambridge, 1962, p 129.
[12] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 15.
[13] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 13; Laurence Ince, *The South Wales Iron Industry 1750-1885*, Merton, London, 1995, p 112.
[14] GRO. D.591.19.365. Sale Particulars of the New Clydach Sheet and Bar Iron Works; Riden and Owen, *British Blast Furnace Statistics 1790-1980*, p 9.
[15] Geoffrey Hill and Gordon Green (compiled by), *Industrial Locomotives of Gwent*, London, 1999, pp 85-6.
[16] John Lloyd, *The Early History of the Old South Wales Iron Works (1760-1840)*, London, 1906, p 156; Ince, *The South Wales Iron Industry 1750-1885*, p 106; B. Caswell, J. Gaydon, M. Warender, (edited and compiled), *Ebbw Vale 'The Works' 1790-2002*, Ebbw Vale, 2002, pp 433-44.

Bessemer's process and in the same year the company converted to joint stock status. By 1870 the Ebbw Vale Company was operating seven 6 ton Bessemer converters but it was still producing huge amounts of puddled iron having 161 puddling furnaces in 1872. In 1873 Abraham Darby retired and the company was reconstituted into the Ebbw Vale Iron and Coal Company (Ltd). The production of steel was growing at Ebbw Vale such that by 1878 the company was making 1,200 tons of steel rails each week.[17] The Ebbw Vale Company had been one of the leading British concerns in steel making developments, so much so that the recently formed Iron and Steel Institute of Great Britain paid a visit to Ebbw Vale in September 1870 to view the new processes; Mr Bessemer was present.[18]

The Blaenavon ironworks opened their new forge in 1859 and the new mill was completed in the following year. The company also built three new blast furnaces in the late 1860s. About six years after the company converted to limited company status it was forced into liquidation in 1878 following the failure of its bankers, the West of England Bank. By this time the company had already invested in two steel converters and fortunately a new company was formed such that by 1881 there were five furnaces in blast.[19]

Like the Ebbw Vale works the Blaenavon ironworks also made a valuable contribution to the development of steel manufacturing. In 1878 Percy Carlyle Gilchrist and his cousin, Sidney Gilchrist Thomas invented a process that made it possible to produce phosphorous free steel. Prior to this invention iron made from ores that had a phosphorus content could not be used in Bessemer converters to make steel.

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[17] Ince, *The South Wales Iron Industry 1750-1885*, pp 107-8.
[18] *Monmouthshire Merlin*, 17 September 1870, The Iron and Steel Institute of Great Britain, Excursion to the Ebbw Vale Works.
[19] Ince, *The South Wales Iron Industry 1750-1885*, p 123.

Following this invention a much greater range of iron ores could be used in steel manufacture.[20]

The last works of the group to enter the steel market was the Tredegar Company. Samuel Homfray II who had dominated the scene at Tredegar for more than forty years had relinquished his share in the partnership by 1862[21] and retired to his Glen Usk estate near Newport. By 1867 the Homfray family had sold their interests in the company[22] and eventually the new owners looked towards steel manufacture. A Bessemer plant was erected and the first steel ingots were rolled in August 1882 followed by the first steel rails in September of the same year.[23]

The dependency on key industrialists such as the Harfords and the Darbys at Ebbw Vale, the Homfrays at Tredegar and the Hills at Blaenavon is no better illustrated than in the case of the Nantyglo works. It has been demonstrated that under the leadership of the Baileys this works was the most successful of the core group of ironworks for many years. Iron production continued at Nantyglo and Beaufort in the 1850s and 1860s but in the late 1860s it became clear that the Bailey family wished to retire from the business.[24] Sir Joseph Bailey died in 1858 but the company continued as J. and C. Bailey and although day-to-day management of the works had been passed onto the next generation of Baileys,[25] Crawshay Bailey retained financial control. Finally, in March 1871, it was announced that the company was to be sold, the reason offered being Crawshay's advanced age.[26] In July of the same year it was announced that a company was being set up to acquire the works and mineral estates

[20] Harris, *The British Iron Industry 1700-1850*, p 76; Hill & Green, *Industrial Locomotives of Gwent*, p 53.
[21] David Morris, The History of Tredegar From the Beginning of the Iron Works up to the present day, (Winning entry in the Eisteddfod of the Cymrodorion of Tredegar in 1862), p 20.
[22] Ince, *The South Wales Iron Industry 1750-1885*, p 81.
[23] *Monmouthshire Merlin*, 25 August 1882, Tredegar, Commencement of steel making, 8 September 1882, Tredegar, The Works, First rolling of steel rails.
[24] Ince, *The South Wales Iron Industry 1750-1885*, p 130.
[25] *Monmouthshire Merlin*, 22 July 1853.
[26] *Monmouthshire Merlin*, 31 March 1871, Nantyglo.

of the Nantyglo and Beaufort concerns and those of the Blaina Iron and Coal Company Limited that included the ironworks at Blaina, Cwm Celyn and Coldbrook Vale. £650,000 was to be paid for the properties.[27] The new company, The Nantyglo and Blaina Iron Works Company (Limited) ran the Beaufort and Nantyglo ironworks for a few years but closed the Beaufort works in 1783 and the Nantyglo works the following year.[28]

In late October 1871 Crawshay Bailey, then aged 82, received a formal presentation of an elegantly bound Bible on his retirement from the proprietorship of the Nantyglo and Beaufort ironworks, the address commenced as follows:

> We address you on the present occasion with mingled feelings of pleasure and regret. For many years we have enjoyed the privilege of being employed by you, and the severing of such relationship is to us a cause of painful regret. We remember with delight the confidence and good fellowship that invariably existed between you and your workmen however critical the times, however dark the horizon, unity and peace prevailed. We do not take absolute credit to ourselves for this important fact, but attribute much of our success to your firm, judicious, and skilful management.[29]

Crawshay Bailey did not live to see the demise of his enterprise as he died a few months later.[30] Crawshay's great ironworks is shown in Illustration 4 on the next page.

In this study the partnership was deemed the most suitable capital structure for iron manufacturing companies in the first half of the nineteenth century but the

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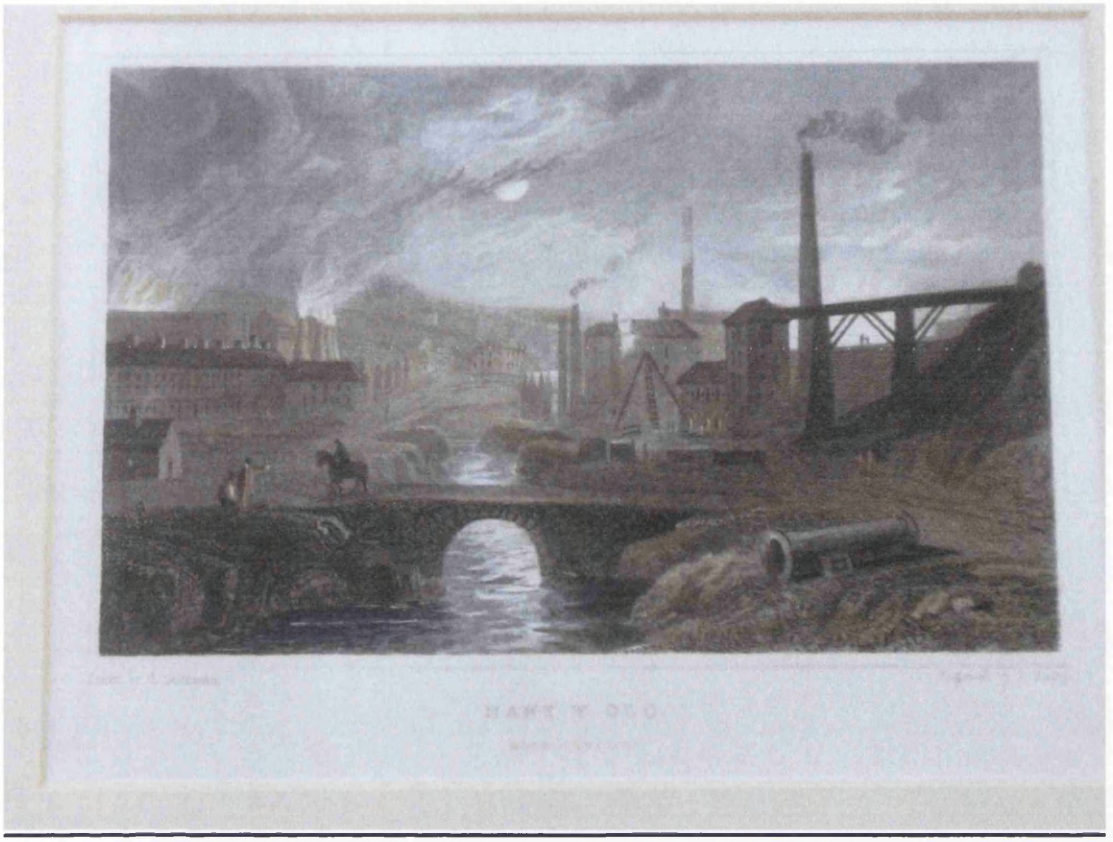
[27] *Monmouthshire Merlin*, 28 July 1871, The Nantyglo Iron Works.
[28] Ince, *The South Wales Iron Industry 1750-1885*, p 130.
[29] *Monmouthshire Merlin*, 3 November 1871, Presentation to Mr. C. Bailey, Senior.
[30] *Monmouthshire Merlin*, 12 January 1872, Death of Mr. Crawshay Bailey.

Illustration 4 A view of the Nantyglo ironworks c.1830.



Source. *South Wales Illustrated in a Series of Views,* London. (No date or author supplied). The engraving is adjacent to page 133 of the book and was engraved by S. Lacey from a drawing by H. Gastineau with colouring added later.

situation was changing in the second half of the century. The amount of capital needed for the new steel making processes was such that the joint stock company structure was becoming more appropriate and in South East Wales only the two major Merthyr iron companies, Cyfarthfa and Dowlais had the financial resources to resist the trend. These two companies did not become limited liability companies until 1890 and 1899 respectively[31] and in the case of the Cyfarthfa Company it was the immense cost of introducing steel manufacture in the 1880s that led the partners to convert to limited company status. The Dowlais Company however had rivalled the Ebbw Vale Company in its early experiments and adoption of steel manufacturing processes and

[31] Atkinson and Baber, *The Growth and Decline of the South Wales Iron Industry 1760-1880*, p 63.

had six Bessemer converters by 1870[32] and in the following year the company was making steel from Siemens-Martin open-hearth furnaces in addition.[33]

While the steel industry was the successor to the iron industry in the study area, in South East Wales and in other districts of Britain, and the tinplate industry was expanding, the sale coal industry was becoming the dominant industry in the coalfields. This industry was expanding rapidly in the second half of the nineteenth century such that in just four years from 1871 to 1875 the number of coalmines in Britain increased from 2,885 to 3,933 and in South Wales in the same period from 299 to 415.[34]

[32] Birch, The *Economic History of the British Iron and Steel Industry 1784-1879*, pp 170-1.
[33] John A. Owen, *A Short History of Dowlais Ironworks*, Merthyr Tydfil, 1972, p 44.
[34] *Monmouthshire Merlin*, 8 September 1882, Progress of the Coal Trade.

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