

# 4 The Organisation of Iron Production

The picture presented at the beginning of the previous chapter was one of a long term stability in the technology for making iron. This chapter will focus how iron production was organised, not at the level of individual ironworks, but how they related to each other. Previous authors have sometimes emphasised the existence of vertically-integrated businesses,<sup>1</sup> and a survey of these will form the first part of this chapter. However that pattern did not persist everywhere. In the west Midlands vertical integration largely disappeared by the 18th century, and the latter part of this chapter will consider this and related organisational changes. These include changes in the ratio between forges and furnaces, the growth of trade between ironmasters in semi-finished products, and the development of the industry's mechanisms for self-regulation. These have to be addressed at a national level, because the differences in organisation between regions do not emerge in regional studies. The differences may not have been great, but they were not insignificant, as will be seen.

## Ownership

### *Early Developments*

The new indirect process was established in the Weald by immigrant French workmen from the *pays* of Bray on the eastern border of Normandy.<sup>2</sup> The ironworks of Bray apparently closed (or declined), perhaps due to woodland clearance and their workforce moved (or spread) across the Channel to the Weald, which is the continuation of the geological formation that had provided ore to them in Bray. The immigration took place mainly between 1506 and 1540.<sup>3</sup> The numbers involved were not large, but their descendants could be found as ironworkers (founders, finers and hammermen) generations later, not only in the Weald, but spread though Britain.<sup>4</sup>

J.J. Goring, who made a study of Elizabethan Wealden ironmasters, found that the majority of works were in the hands of yeomen and minor gentry, sometimes yeomen aspiring to be gentlemen, making these ironmasters essentially a typical class of businessmen. Goring found the aristocracy and upper gentry who had earlier dominated the industry had largely withdrawn from it, and in this his conclusions differed somewhat

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<sup>1</sup>. Hyde 1977, 15-17.

<sup>2</sup>. Awty 1981; 1987; 1990.

<sup>3</sup>. Awty 1990b; Cleere & Crossley 1995, 119.

<sup>4</sup>. Awty 1981b.

from those of L. Stone, who emphasised the participation of magnates in industry, However perhaps this is a reflection of the relative maturity of the Wealden industry even in the 1570s and of a trend found elsewhere at a slightly later period,<sup>5</sup> as will appear. Despite the labours of E. Straker and of the Wealden Iron Research Group,<sup>6</sup> the history and descent of many ironworks there still remain somewhat obscure, and probably always will do, but it seems there were relatively few ironworks in the Weald in the early 16th century, prior to a blossoming of the industry, which started in the 1540s and reached its zenith perhaps in the 1590s, as will appear in chapter 6 below. This is markedly different from the situation in the rest of the country, where the new process remained largely unknown until the 1560s and was still spreading in the early 17th century and to some extent even later.

The spread of the process into the Midlands, the North and Wales, was initially the work of great magnates. Sir Henry Sidney, while President of the Council of the Marches, established ironworks in east Glamorgan in the 1560s. The Earl of Leicester, Elizabeth's favourite, built works on his estate at Cleobury Mortimer. Lord Paget, the son of Henry VIII's Secretary of State had an extensive business on and around Cannock Chase, starting in the 1560s. However the greatest ironmaster of all was George Earl of Shrewsbury, also probably the richest man in England. Starting in the 1560s, he (or rather his officers) developed ironworks on many of his estates, at Whitchurch on his Goodrich estate in Herefordshire, at Lizard on his Shifnal estate in Shropshire, at Sheffield and Rotherham, and also on several of his Derbyshire estates. He also had interests in lead smelting and other industries.<sup>7</sup> When Edward Lord Dudley succeeded to the family estates around Dudley it included 'smithies', that is bloomery forges; though records of his activities are scarce, it is probable that, in partnership with his brother, he built furnaces in or adjoining woods, chases, or parks at Conigree (Dudley), Himley, Cradley, Askew Bridge in Gornal Wood, and probably also at Ettingshall.<sup>8</sup> While the first initiative came from great magnates, particularly those just mentioned, the expansion that followed was often on the estates of those gentry who were lords of manors. In an industry so heavily dependent on wood, such growth had to come from the exploitation of woodland. Such woodland was commonly growing on ancient manorial waste (or something similar) and as such belonged to the lord of the manor, though often subject to common rights. In seeking to exploit their woods, the wood owners quite naturally built (or allowed others to build) ironworks on their demesne land. For this reason ironworks standing on copyhold land were relatively rare, and generally of later origin. The development of the iron industry was thus facilitated by Henry VIII's Act for the Preservation of Woods, which enabled the owners of commonable woods to cut a quarter of them at a time and then to inclose them long enough to enable them to regrow.<sup>9</sup>

The development of the iron industry on the enormous Welsh estates of the Earls of Pembroke took a slightly different form. They were initially associated with supplying the wireworks at Tintern developed by

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<sup>5</sup>. Goring 1978, esp. 212; Stone 1965, 349; King 2001.

<sup>6</sup>. Straker 1934; Cleere & Crossley 1995.

<sup>7</sup>. Stone 1965, 349 etc.

<sup>8</sup>. King 1999a, 61; 2002b; Dudley Archives, DE 4/3, Himley 1585.

<sup>9</sup>. Statute, 35 Henry VIII c.17, ss.6-8.

the Company of Mineral and Battery Works in 1566, but were soon leased to farmers, of whom Richard Hanbury, a London goldsmith, was the most prominent. He, sometimes with partners, established ironworks in a number of places where wood was available. This usually took the form of their leasing a large tract of land from the Earl on terms that made them absolute owners of the tract for a term such as three lives, subject only to payment of a small rent. Some of these leases were renewed by members of the Hanbury family until they bought the freehold in the 18th century. In 1591 Richard Hanbury surrendered his lease of the wireworks at Tintern to the Company, who then let them to John Challoner and others, who developed a similar network of Welsh ironworks. The principal entrepreneurs in these enterprises were London merchants and goldsmiths.<sup>10</sup> This process may be compared with the establishment of ironworks at Bishopswood (in Walford, Herefs.) where a tract of woodland was sold in 1588 by the Crown and passed soon after to Robert Earl of Essex, who had ironworks there by 1591, which (with a forge at Lydbrook) were occupied by one of the Challoner family.<sup>11</sup> However ironworks on Crown land began with the sale of a large quantity of wood at so much per cord (a measure of volume), with a lease of a mill or of land where a furnace and forge could be built. This applies to the ironworks at Bringewood from about 1610 and also to four furnaces and four forges built in the Forest of Dean about 1612.<sup>12</sup> In transactions of this kind may be seen the beginnings (outside the Weald) of a class of professional ironmaster. Some work has sought to emphasise the role of Wealden ironmasters in establishing the industry elsewhere, following the early work of W. Llewelin, but the examples cited of this do not represent a coherent trend, as there are few other cases of Wealden ironmasters setting up elsewhere.<sup>13</sup> This contrasts with the iron workers (founders, finers, and hammermen) in all parts of England, who, as B.G. Awty showed, often descended from Wealden ancestors, whose parents had come from Bray in France.<sup>14</sup>

At this period a major motive for establishing an ironworks was that it enabled a large quantity of otherwise valueless wood to be converted into a highly saleable product iron. Thus a witness described the manor of Wentsland and Bryngwyn near Pontypool (Mons.) as 'overgrown with great woods ... worth nothing for want of use of the same', until in 1576 Richard Hanbury and others established ironworks there, which have given rise to the town of Pontypool.<sup>15</sup> Similarly Ralph Tomlins was induced to build a furnace in Burford in south Shropshire (probably Tilsop Furnace) in the 1590s because he had 'there great store of woods and underwoods which at that time and in that country would not yield any great profit by reason of the great store of wood thereabouts'.<sup>16</sup> The arrangement of leasing land to build an ironworks and contracting to purchase a fixed

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<sup>10</sup>. Donald 1961, 97-100 122-27; Locke 1916, 127-37; P.R.O., E 112/29/24.

<sup>11</sup>. Hart 1971, 8; P.R.O., PROB 11/109 q.22 f.165; Hughes & Hurley 1999, 27.

<sup>12</sup>. Bringewood: P.R.O., E 178/3874; C 2/Jas.I/A3/31; E 134/10 Chas.I/Mich.18; Bull 1869; Dean: Schubert 1953; Hart 1966, 86-175 passim.

<sup>13</sup>. Llewelin 1863a. The examples cited in Bevan 1956 are themselves disparate. There are in fact very few cases of Sussex ironmasters operating elsewhere. Examples include Arthur Middleton (died 1611) at Melbourne and Donnington (Leics.) and Middleton Goreing & Co. in Staffordshire around 1620. To these may be added George Mynne of Woodcote at Epsom in Surrey (and not in the Weald), who was a partner of Sir Basil Brooke in the Tintern wireworks around 1630 and later built his own ironworks in southwest Wales. King 2001. Melbourne: King, *North*; Middleton Goreing & Co.: King 1999a, 64-8; Mynne : Hart 1971, 12-14; Evans 1967, 22-25; N.L.W., Slebech 441.

<sup>14</sup>. Awty 1981.

<sup>15</sup>. Donald 1961, 99-100; P.R.O., E 134/13 Jas.I/Hil.15, interrog.41; E 134/13 Jas.I/Mich.16, interrog. and dep.64-66.

<sup>16</sup>. P.R.O., REQ 2/393/12.

quantity of wood per year was a common one, the term of the lease often being qualified by a phrase such as 'if the wood so long last.' At Longnor (Shropshire) such a lease was granted to Richard Howback otherwise Knowles of Kenley in 1605. This (unusually) required him only to use his landlords' wood and such other wood as they bought, giving the landlords considerable control over the operation of the ironworks.<sup>17</sup> As late as 1636 such a qualification as to the wood lasting appeared in the lease under which George Mynne built the ironworks at Blackpool (Pembrokeshire), but this provided for a fixed supply of wood, 4000 to 5000 Welsh cords per year.<sup>18</sup> In the case of Compton Furnace (in Kinver, Staffordshire) the lease, granted in 1606 to probable employees of Lord Dudley, was for a mere three years, which was presumably the time that wood from Compton Park and the rest of Gerrard Whorwood's demesne locally was expected to last.<sup>19</sup>

While the lessees under the Earls of Pembroke and at Bringewood were gentry or financiers, the development of the practice of leasing ironworks gave rise to the professional ironmaster. After a few years it must have been known what profit an ironworks would produce. Thus it became easier for a landowner to agree with his clerk that he should receive payment for the ironworks on a fixed basis, rather than to have the trouble and worry of overseeing a business, which he probably did not really understand. Thus after some years of operation by crown servants following the attainder of Lord Paget, his ironworks on Cannock Chase were let to Fulke Greville in 1588 for 21 years.<sup>20</sup> Similarly at Bringewood Sir Henry Wallop, himself a lessee, let the ironworks and 3000 cords of wood per year for four years to Richard Marchant, Robert Steward, and others in 1610. Marchant was described as 'of Toadhole Derbyshire founder', which suggests he was running the Earl of Shrewsbury's furnace there. Several of them were also partners in a three year lease of ironworks at Staunton Harold in Leicestershire.<sup>21</sup> Similarly Sir John Zouche's ironworks in Derbyshire (at Codnor, New Mills and elsewhere) were the subject of a series of short term arrangements in the 1600s.<sup>22</sup> Such short leases of ironworks seem to have been typical of the time, at least where the tenant was not building the ironworks himself. Richard Howback had prior to building the ironworks at Longnor operated the ironworks at Kenley and Harley. He was succeeded there in 1638 by William Fownes and William Boycott, who also took over Richard Newport's Leighton Furnace and Sheinton Forge and already had ironworks at Ruabon in Denbighshire, and Glyn Keiriog (probably in Weston Rhyn), Fernhill and Maesbury in northwest Shropshire. They later parted, Fownes moving to Yorkshire.<sup>23</sup> In 1616 Martin Ash, who had earlier been connected with the Earl of Shrewsbury's ironworks at Attercliffe, built Whaley Furnace and Cuckney Forge as tenant of

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<sup>17</sup>. Shropshire R.O., 567/box 28.

<sup>18</sup>. N.L.W., Slebech 441.

<sup>19</sup>. Herefs. R.O., E12/VI/KY/1.

<sup>20</sup>. *V.C.H. Staffs* v, 161.

<sup>21</sup>. P.R.O., C 2/Jas.I/A3/31; E178/3874; Robinson 1925, 210-2. This may also be related to a forge on Wallop's wife's estate at Moreton Corbett in north Shropshire: a 'forge house' is mentioned in a rental in 1627. While the manor of Moreton Corbett was entailed and remained in the Corbett family, various unentailed lands in the area on two occasions in the 17th and 18th centuries passed to daughters and had subsequently to be bought back passed by the owner of the manor. This complicates the history of the estate. On the first occasion there was a dispute between Sir Henry Wallop and his wife (née Corbett) about 1608: Shrops. R.O., 322/2/254; 322/2/294; 322/6/3.

<sup>22</sup>. Smith 1967, 115-29; King, *North*.

<sup>23</sup>. Longnor: *V.C.H. Salop*. viii, 49; Kenley & Harley: *ibid.*, 89-93; Leighton & Sheinton: notes taken by staff of *V.C.H. Salop*. from Raby Castle (Durham), wooden box 12, bundle 8; Ruabon: P.R.O., C 2/Chas.I/B90/63 C 2/Chas.I/K20/45; cf. Edwards 1958, 187-89.

the Earl of Kingston, who arranged for two members of his household to become partners as his nominees, but Ash was unable to perform the bargain and 'became nonsolvent and went into Ireland', as did Stephen Bentley one of the nominees.<sup>24</sup> All of these were essentially small scale enterprises, though Boycott's business at Leighton subsequently developed into something bigger.

### *Integrated businesses in South Staffordshire*

A rather different scale of operation is found in Staffordshire from towards the end of the 16th century. There were two major businesses, which I have described in detail elsewhere. One was established by Thomas Parkes, with William Whorwood of Sandwell Hall as partner until they fell out in 1597. That provoked a series of incidents, for which they and others were prosecuted for riot, following which Whorwood sold his share to Parkes. Parkes was succeeded by his son Richard, who died in 1618, leaving a son who sold the business to Middleton, Goreing & Co., a syndicate of Sussex gentry, who already had ironworks at Chartley. They handed over most of Parkes' works to Thomas Nye (one of the partners) in 1623, and virtually all of them subsequently turn up in the hands of Richard Foley of Dudley, who certainly had some from 1624 or 1625, and was a partner of Nye in at least some of them. He also leased several of Lord Dudley's ironworks about the same time, and ran them successfully for many years.

Parkes' and Foleys' rivals were the Chetwynds. This business began when Walter Coleman erected a furnace on his own copyhold land at Cannock about 1595. He later operated in partnership with Richard Almond and Thomas Chetwynd this and other ironworks including some of those on Cannock Chase, generally occupying a district north of the Parkes, but with some overlap. During the 1600s the works rented from Lord Paget were the subject of short term lettings, Almond at one stage renting them alone, but after Thomas Chetwynd joined the firm there was more continuity of ownership. The Coleman family at one stage abandoned their share, leaving Chetwynd to pay out Almond and bear financial responsibility for the business alone, with the result that there was acrimonious litigation in the 1620s. Thomas Chetwynd came out of this as owner of a business which was carried on by his family for much of the rest of the century. The main source both on Middleton, Goreing & Co. and on Coleman and Chetwynd is Chancery litigation in the late 1620s, which seems to result from difficulties in the years around 1620. That appears to have been a period of recession in the iron industry,<sup>25</sup> coinciding with the period when the difficulty in exporting English cloth to the Baltic resulted in a depression in the woollen industry.<sup>26</sup>

The cause of the difficulties in the iron industry is not wholly clear, as, in the absence of any continuous series of accounts, the prosperity of the iron industry can only be glimpsed from scattered evidence. In about six months in 1608 123 tons of bar iron made on Cannock Chase were sold for £1528.18s.6d., about £12.8s.6d. per

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<sup>24</sup>. P.R.O., C 2/Chas.I/C6/37; cf. E. of Shrews a/c.

<sup>25</sup>. King, 1999a.

<sup>26</sup>. As to woollen exports see Supple 1959; see also chapter 8.

ton.<sup>27</sup> In 1623 Middleton Goreing & Co. had a substantial quantity of unsold iron on hand and a dividend of 200 tons of iron (worth £2600) was distributed among the partners. In 1620 a younger generation of the Chetwynds and Colemans had taken a lease in their own and their fathers' names of Hales [Halesowen] Furnace and Forge. Thomas Chetwynd, despite saying that his signature was forged, performed the bargain because his son was bound, but probably excluded the Colemans from it. At the end of the decade he said that 'if the price of iron had not been increased since that time he had been a great loser'.<sup>28</sup> From other litigation in 1629 it appears that John Jennens of Birmingham was buying iron from Cleobury, Bringewood, and other forges delivered at Bewdley at £15 per ton.<sup>29</sup> John Middleton and his partner Nicholas Jordan, who left the iron industry in the 1620s appear to have suffered losses and died in debt. Walter Coleman also suffered losses, though perhaps elsewhere and earlier. However the Parkes family (who left the industry in 1618), Henry Goreing and the Chetwynds (who stayed in it), and the Jennens and Foley families (who became ironmasters during the 1620s) grew rich from it, Richard Foley leaving descendants who were raised to the peerage.<sup>30</sup>

With the possible exception of the activities of Richard Hanbury and of the Challoners in south Wales, who between them had five ironworks in Monmouthshire and two or three more in Glamorgan, and also the very scattered activities of the Earls of Shrewsbury, the businesses just discussed were on a hitherto wholly unprecedented scale. The great advantage in concentrating all the ironworks of a district in the hands of a single entrepreneur or firm was to enable the ironmaster to monopolise the supply of wood locally, and thus control the price he had to pay, long distance transport of charcoal by land being ruled out by its cost. In 1636 Richard Foley was prosecuted in Star Chamber probably at the instance of John Coleman, whose failure as an ironmaster was partly due to his failure to provide working capital for his business. The charge was that Foley was engrossing wood: engrossing was an ancient market place offence consisting of buying up goods with a view to reselling them (normally later in the day) at a higher price. This definition was not strictly applicable to Foley's activities, but undoubtedly he was monopolising the local wood. The underlying complaint was that the price of wood had risen, and this was alleged to be Foley's fault since he was buying so much of it, but it is most improbable he was buying wood with a view to reselling it at a profit. Indeed as an ironmaster, it is hard to see how he could have encouraged (or have gained by) a price rise, but he was nevertheless fined £1000 or more.<sup>31</sup> A major motive for creating such large networks of ironworks was almost certainly the ability to monopolise the local supply of wood, and so control its price. This constituted a monopolistic practice, which was the wrong that the offence of engrossing sought to prevent, but its use in these circumstances represented a considerable broadening of the definition of that crime.

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<sup>27</sup>. B.L., Add. MSS. 69895, f.10 14.

<sup>28</sup>. King 1999a, 66 70. The quotation is from P.R.O., C 2/Chas.I/C88/59.

<sup>29</sup>. P.R.O., C 2/Chas.I/J5/12.

<sup>30</sup>. King 1999a; 2001.

<sup>31</sup>. King 1999a, 74; P.R.O., SP 18/321/42.

*Integration of businesses elsewhere*

With the exceptions mentioned, there is nowhere else where such large scale integration began anything like so early. Generally the big businesses found elsewhere can only be traced back to the mid 17th century, and even then there was often little to distinguish them from their smaller contemporaries. The Shropshire business of Boycott & Co., as already mentioned, began in the 1630s with the acquisition of two furnaces and two forges. Following the entry of Francis Walker of Bringewood into the partnership, an extra forge was built at Upton, and that at Longnor was acquired. Finally in 1674 Willey Furnace was taken over. It is possible that pig iron for Longnor came at one stage from Walker's Bouldon Furnace, while another partner, Joshua Newborough the leading Stourbridge ironmonger, was around 1670 drawing pig iron from Leighton Furnace to supply Wolverley Old Forge in north Worcestershire, where he was a partner. With the passage of time the number of partners fell. Hon. Thomas Newport (created Lord Torrington in 1716) had been a sleeping partner for many years. By the time of his death in 1719, there were just three works, Leighton Furnace, Longnor Forge, and Sheinton Forge, his share in the first two being a quarter and in Sheinton a third. His widow was then bought out by Richard Boycott and Thomas Jenkins, two other partners. However all references to trading at these works for a long period before this were in the names of the clerks in charge of them, such as Richard Atkis of Longnor Forge, and (apart from the deed when Lady Torrington was bought out) one would not know that the works were still connected.<sup>32</sup> A 'Layton Company' is mentioned in records for Coalbrookdale in the 1720s and 1730s, and Thomas Dorset was apparently its manager, as well as being tenant of Wytheford Forge. However that forge had not previously belonged with Leighton, and the company managed by Dorset may therefore have been a new one.<sup>33</sup>

A firm, which may conveniently be referred to as the Cheshire Ironmasters, originated in north Staffordshire, where a new business began when Richard Foley III leased Mearheath Furnace, thus moving from being an ironmonger in Birmingham to an ironmaster at Longton. The scale of his early operations is not wholly clear, but he may have taken over some other works in north Staffordshire from his father. In the 1670s he seems to have bought up Lawton Furnace and Cranage and Warmingham Forges. In the early 1680s, a successor, his youngest half-brother John Foley, acquired Consall and Oakamoor Forges, to create a vertically integrated business known as the Moorland Works, but he (or perhaps his brother-in-law and successor, Henry Glover) sold off the Cheshire business. This was acquired by Dennis Hayford, a Yorkshire ironmaster with an estate in Cheshire, and William Cotton, the managing partner at Colnbridge (also in Yorkshire) with other partners, and was placed under the management of Thomas Hall. About the same time (1685) they took over the Cannock Chase works from the Chetwynds. The Chetwynd iron business had belonged successively to Thomas, Walter, and William Chetwynd and finally to Richard Chetwynd and Humphrey Moore, whose continued purchases of pig iron after 1685 suggest they retained Chartley Forge until 1692. On Henry Glover's

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<sup>32</sup>. There is no adequate account of this firm in print. This paragraph has been assembled from Shropshire R.O., 6000/3100 3230 14487 & 18289; Chaplin 1969; Schafer 1978, 104-6; notes taken by the staff of *V.C.H. Shropshire* on Raby Castle (Durham), wooden box 12 bundle 8; N.L.W. Cilybebyll 202 1291-5; P.R.O., E 112/880/Salop/9. A full account will appear in King, *Iron in Midlands*.

<sup>33</sup>. CBD a/c; Ford l/b, 30 Mar. 1733; Trinder 1973, 49-52.

death in 1689 the Moorland Works were taken over by John Wheeler, who was at the time a tenant of the Foley ironworks in the Forest of Dean, but subsequently their managing partner (of which more below). In 1692 he added the Cannock Chase Works to these, but evidently with a contract for a supply of pig iron from Lawton. Subsequently, in 1695, his manager, Obadiah Lane, took a share in the Cheshire Ironworks, but the Staveley Works in north Derbyshire (including Carburton Forge, Notts.), also acquired in 1695, were handed over to Dennis Hayford and various other Yorkshire ironmasters in 1698. Again in 1698, Philip Foley, who had been a sort of shadow partner and guarantor of Wheeler, was declared to have been Wheeler's partner in this whole business since 1689. Finally in 1705 the Cheshire and Staffordshire Works were amalgamated into a single integrated partnership with seven partners, which it is convenient to describe as the 'Cheshire Ironmasters'. Until then, the Cheshire ironworks had consisted of a number of distinct but interlocking partnerships. For example, Cranage was a partnership between William Cotton and Hall & partners; and Obadiah Lane (on behalf of the Foley Staffordshire Partnership) was one of Hall's partners.

The firm underwent a reconstruction in the 1730s, when some of the partners were being sued by a spinster daughter of Obadiah Lane, who (for reasons which are not relevant here) considered that they should pay a legacy due under her father's will. At that time an associated Lancashire partnership, the Cunsey Company, with furnaces at Carr near St. Helens and Cunsey on Lake Windermere was amalgamated with the Cheshire partnership. At some stage (probably earlier) Madeley Furnace (Staffs.) and Norton and Winnington Forges must have been added. These had been leased by Hall in the 1683, but evidently belonged to a separate firm, in which Philip Foley and John Wheeler were not concerned. Other alterations in the list of the firm's works had also taken place, including the building in the 1690s of Vale Royal Furnace (Cheshire) and Bodfari Forge (Flintshire) and their subsequent disposal. The partnership was probably again reconstructed in about 1751 with two of the Kendall family as the leading partners. Cunsey Furnace was disposed of at that time, in circumstances which will be described later (see page 109). It was still a substantial concern in the 1770s, when Thomas and John Hopkins withdrew taking over the Cannock Chase works as their own. In the 1780s a new generation of Kendalls moved to Monmouthshire to establish the Beaufort Ironworks, and the remainder of the works elsewhere were gradually disposed of, but Dovey Furnace in west Wales was still in their hands until at least 1796.<sup>34</sup>

In the Pennine Dales of Yorkshire, north of Sheffield, an ironworks business was established by John Spencer, William Cotton, and members of the Fownes family, probably in the 1640s, though the first unambiguous reference to it comes from litigation in the late 1650s. The works consisted of Kirkstall, Wortley and Colnbridge Forges and Nether Bank and Barnby Furnaces, but generally there was not a single partnership.

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<sup>34</sup>. Johnson 1954; Awty 1957; Lead 1977; King 1993; Fell 1908, 192 265-66; Herefs. R.O., E12/VI/MDc/2, MDf/22, MCc/1, MAc/68 and E12/VI/M series generally; Staffs. R.O., D.593/I/3/20; D.661/3/2/1-3; P.R.O., C 11/1760/29; Barrow in Furness R.O., Z 22-26; N.L.W., Maybury 255; Castell Gorfod 61; *V.C.H. Staffs.* viii, 231. I have not found the term 'Cheshire Ironmasters' in a contemporary source, but the 'Cheshire ironworks' appears in 1691 in Herefs. R.O., E12/VI/MDc/1. Their products later included pig iron known as 'Cheshire Coldshort'. The partners included members of the Hall, Cotton, and Kendall families, and it would therefore be misleading to use a single surname. Pig from Dovey Furnace of Henry Kendall & Co. was used at Mitton Forges in 1796/7: SW a/c; Ince 1991b, 117.

Instead it was the presence of members of the Spencer and (until 1718) Cotton families in most of the partnerships that gave the group its cohesion. These works are particularly well documented at some periods, as a result of the preservation of records by the Spencer-Stanhope family. After the death of William Spencer about 1756 the family seem to have ceased to take more than a passive interest in their ironworks, though shares in various works were retained for another generation. W.W. Cotton had left the firm in 1718 to establish Bretton Furnace and Kilnhurst Forge in partnership with Samuel Shore, a Sheffield merchant and steelmaker, and two of the Cheshire Ironmasters.<sup>35</sup>

At Sheffield there was a single ironmaking business until the Industrial Revolution. The early business of the Earls of Shrewsbury had shrunk to a modest one based on a forge at Kimberworth (now a suburb of Rotherham). A new start was made in Sheffield parish by Lionel Copley and several partners in 1639, who built a furnace and forge at Wadsley and another large forge at Attercliffe. After a disagreement in the 1650s, the other partners probably withdrew leaving Copley as sole proprietor. Outside that partnership Lionel Copley had Conisbrough Forge and in the 1650s acquired Kimberworth Forge and its furnace, Chappel Furnace, which subsequently served the whole group. On his death in 1675 his ironworks (including at this time Wortley Forge) were taken over by Dennis Hayford, William Simpson and others. This business remained in existence until the bankruptcy in 1808 of Richard Swallow II, but the partnership was reconstructed in 1727, and again in 1765, with Richard Swallow I becoming the sole proprietor in 1775. Despite becoming bankrupt in 1808, his son retained Attercliffe Forge until 1822. These works are particularly well documented, as almost the complete series of journals and ledgers is preserved from 1690 to 1764. Besides the ironworks, these records deal with a separate steel trade partnership with fewer partners. This was one of the three Sheffield steel firms of the second quarter of the 18th century, which operated a cartel in the best steel.

The composition of the partnership varied from time to time, and is too complicated to be usefully set out here. From 1690 (or earlier) John Fell I and then John Fell II were managing partners, until the death of the latter about 1762, after which his adopted son, Richard Swallow I succeeded him. The business finally disintegrated following the death of the latter in 1802 and the bankruptcy of his son in 1808.<sup>36</sup>

In 1696 all the Yorkshire ironmasters agreed to run all the furnaces on a break-even basis, sharing the costs and output in the proportions three to two between the Sheffield group and Spencer & Co. This enabled Rockley Furnace and Upper Bank Furnace to be retired, though a Rockley Furnace (probably another one) was revived by W.W. Cotton and his partners in the 1720s. This arrangement, with various adjustments continued at least

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<sup>35</sup>. Raistrick & Allen 1939; Raistrick 1938; King, *North*, from Sheffield and Bradford Archives, SpSt. and other sources. It is conventional and convenient to refer to this business as that of the Spencer family, despite other partners often having been the managers. References to the 'Spencer group' (and such like) elsewhere in this thesis are limited to these works, and do not include the Staveley works or the Sheffield Works, where members of the family were probably only sleeping partners.

<sup>36</sup>. Hopkinson 1954 1961; Hey 1977; King *North* from SIR Y a/c and other sources; Crossley 1989; King 2003. As with the Cheshire Ironmasters it is difficult to find a satisfactory contemporary name for this business. For many years it was formally 'Simpson & Co.' or 'Hayford & Co.' because they were the leading partners, but 'Fell & Co.' (from long time its managing partners) is more satisfactory until the 1760s, when Richard Swallow I succeeded his uncle John Fell II. Since it was the only business making iron there until 1782 (with minor exceptions), reference to it as the 'Sheffield iron firm' or such like provides a reasonably accurate omnibus description of all its owners from 1639 until its disintegration.

until the 1727 reconstruction of the Sheffield ironworks partnership, and arguments over the losses incurred by this super-partnership persisted into the 1740s. When John Wheeler gave up Staveley and Carburton in 1698 they were taken over by the Yorkshire ironmasters in the same proportions, but there were additional partners in respect of the Sheffield firm's portion of the business. In 1727 when William Spencer became a partner in the reconstructed Sheffield firm, it is likely (but unproved) that Millington Hayford became the sole proprietor of the Staveley Works. After his death, his interest was probably acquired by members of the Sheffield partnership. The number of partners (as at Sheffield) was reduced in 1763, but the firm continued in being until the late 1770s, when the Derbyshire iron industry underwent a rapid and sudden transition to coke smelting.<sup>37</sup>

Major integration in Derbyshire began after the Restoration under the Jennens family, who were originally (like the Foleys) ironmongers in the Birmingham area. Earlier there were a number of relatively small firms, many of them not well documented. The names of Silvester Smith and Thomas Johnson have turned up in a number of contexts, suggesting they were significant ironmasters in the 1620s and 1630s. In 1672 Thomas Pemberton, another Birmingham ironmonger, acquired New Mills Forge, adding Wingerworth Furnace in 1681, but all of this was on a relatively modest scale.<sup>38</sup> The first ironworks of the Jennens family were Aston Furnace and Bromford Forge (both in modern Birmingham), where they perhaps succeeded Thomas Nye.<sup>39</sup> They then extended their ironmaking business to the north and east, with the erection of Poolbank Furnace (Warws.) in the mid 1650s and Hartshorne Furnace in south Derbyshire in 1670. The next year Jennens built Kirkby Furnace. He probably also took over Bulwell Forge, both of them in or adjoining Sherwood Forest, and in 1676 three additional forges in the Tame valley in south Staffordshire, these latter from Philip Foley. He probably built Weeford slitting mill, near Hints Forge (south of Lichfield), which he had inherited from his father. His son and successor John Jennens probably bought Thomas Pemberton's Derbyshire works during the 1690s, but sometime in the early 1700s he seems to have retired, handing over the bulk of the business to his manager Humphrey Vaughton, or perhaps directly to the latter's sons Christopher and Riland Vaughton. They were succeeded by their sisters, who traded as John Mander & Co. In 1747 the Birmingham end of the business was sold to Edward Knight & Co. (the Stour ironworks partnership), but the Derbyshire end of it underwent another management buy-out, being acquired by Humphrey Mather (its manager) and his son Walter. Walter Mather was unsuccessful in this bid in 1781 to be allowed to convert to coke Wingerworth Furnace, which had generally been part of the business just described, but was in 1783 successful in a similar bid in respect of Staveley Furnace, which then became the centre of operations for his successors until very recent times. Some of the disconnected parts of this story can be found in various places, but its entirety only

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<sup>37</sup>. Raistrick 1938; King, *North* from Bradford Archives SpSt.5/5/4/6; Sheffield Archives, SpSt.60495/15; SpSt.60483/77; SIR Y a/c, various; P.R.O., C 9/372/11; SIR St. a/c.

<sup>38</sup>. For Johnson and Smith see King, *North*; otherwise see note 40.

<sup>39</sup>. It appears that Nye and Richard Foley were partners in Bromford, Hints, Perry, and Little Aston Forges and four furnaces in c.1628. The two latter were subsequently Richard Foley's, and both the former later belonged to John Jennens. It is therefore suggested that Jennens acquired to Nye's share, probably after his death in 1631 and that subsequently he and Foley partitioned the works: P.R.O., C 2/Chas.I/G49/51; King 1999a, 67. This is however mere inference.

in my unpublished synthesis. This is a good example of the disadvantage of regional studies, which here have reproduced details rather than the whole picture.<sup>40</sup>

South Wales lacked any significant large scale integration after the decline of the early works of the Hanburys and Challenors until the mid to late 18th century, when Reynolds, Getley & Co. (later Harford Partridge & Co.) and David Tanner dominated iron production in east Glamorgan, Monmouthshire and Gloucestershire. Before that there were a few small integrated groups. In a sense this was inevitable because the distances and nature of the terrain limited the possibilities of competition between them for resources. Machen and Tredegar Forges worked with Taff Furnace until that was replaced about 1680 by Caerphilly Furnace, forming a group that remained intact over a very long period for the simple reason that they all belonged to the Morgan family of Tredegar House near Newport, who at some periods ran the ironworks themselves and at others let them. The extent of the business of the Hanbury family of Pontypool after the death of Richard Hanbury in 1608 is not entirely clear, but it is certain that his nephews and succeeding generations of the family continued the ironworks. By the early 18th century when Major John Hanbury was actively managing his own ironworks, there were furnaces at Pontypool and Llanelly (Gwent but formerly Brecknock) with forges at each, and probably a wire mill, and one of the earliest mills for rolling blackplate. The latter probably became the first long-lived tinplate works in Britain, and was thus the forerunner of one of the leading industries of south Wales.<sup>41</sup> The Hanburys' business was throughout at least as significant as those of Boycott & Co. in Shropshire and John Fell & Co. in south Yorkshire, but neither rivalled the greatest business of them all, that of the Foleys.

### *The Foley family*

The origins of Richard Foley's business are to be found in that (already described) of the Parkes family and their immediate successors, Middleton Goreing & Co. and then Thomas Nye. Richard Foley II, its founder, was the son of another Richard Foley, a nailer at Dudley, who died in 1601 leaving a house and a net estate of just under five pounds, after debts of over £33.<sup>42</sup> It is conceivable that some of these debts were in fact incurred as guarantor financing a stock of nails belonging to his son, but there is no direct evidence. The next twenty or so years of his life remain obscure, but Richard Foley was probably an ironmonger dealing in nails and perhaps other ironware. In the mid 1620s he began acquiring ironworks, not only those previously of Thomas Nye, but also some of Lord Dudley's, including Himley Furnace and Greens Forge and the works at Cradley, some of which were for a time managed by Dud Dudley.<sup>43</sup> Indeed Foley appears that to have been Nye's partner at Aston Furnace and Bromford Forge.<sup>44</sup> Even before that, perhaps in 1623, he had bought

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<sup>40</sup>. King, *North* will contain a chapter on the Trent Valley where a full account of this business will appear, assembled from a large number of different sources, including P.R.O., C78/1030/2; C 112/106, no.180; Leics. R.O., DE.3541; Notts. R.O., DDP 84/15-16; DD4P 28/467-73; DD4P 58/77; DD4P 80/17; Land tax, Papplewick; Birmingham Archives, Holte 19-22 90-3; Derbs. R.O., D 3372/T8; D 1404.24; Hull U.L., DDFa 27/28; Harrison & Willis 1879 (where Hintes is printed as Hivles); Johnson (R.) 1960; Pelham 1963, 73-4; Riden 1985; 1990; King 1999a, 67 & 74.

<sup>41</sup>. Gwent R.O., D8A (J.C. Hanbury mss.), *passim*; Locke 1916; Gibbs 1951b. For tinplate see chapter 3.

<sup>42</sup>. Worcs. R.O., Consistory wills, Richard Foley 1600.

<sup>43</sup>. King 1999a, 61-2; 2002b, 45-6.

<sup>44</sup>. P.R.O., C 2/Chas. I/G45/19, answer of Allen Nye; see note 39 (above).

Cheslyn Hay Furnace from Middleton Goreing & Co., with ironstone mines there drained by a 'sough or gynne', which had been made by Thomas Nye while he was using the furnace.<sup>45</sup> For almost half a century he, and then his son Thomas and grandson Philip, were by far the largest producers of iron in the Black Country, but this did not constitute a true monopoly, since iron made in adjoining regions was almost certainly being consumed in the manufactures of the district. For example iron from Fernhill and Maesbury Forges in northwest Shropshire was sent to Richard Brindley of Hyde Mill in Kinver and later to Cookley Mill for slitting in the 1640s and 1650s.<sup>46</sup>

As I have shown elsewhere,<sup>47</sup> the great wealth of the Foley family (contrary to legend) did not derive directly from the introduction of the slitting mill, though Richard Foley certainly did set up the slitting mill at Hyde Mill in 1627. There seems good reason to believe that the existence of slitting mills close to an area of abundant coal gave an advantage to nail manufacture in the Black Country that enabled it to become the greatest iron manufacturing region in Britain, drawing in iron from far afield. Something is known of Richard Foley's activities from notes taken in 1636, when he was prosecuted in Star Chamber for engrossing. These name nine ironworks and mention 'divers others'.<sup>48</sup> Shortly after this, he began handing over ironworks to Thomas, the eldest son of his second marriage, who had just come of age. This certainly applies to Whittington Forge (in Kinver) and a share in Wilden Mill (downstream from Kidderminster), then apparently only a slitting mill. Though the exact date of transfer is elsewhere uncertain, the transfer of Whittington in 1637 took place when Thomas was aged 21, and he stressed in later proceedings that Wilden was part of his portion.<sup>49</sup> What is certain is that between 1648 and 1671 he had enormous sums of money available to invest in buying land, which can only derive from the profits of ironworks. A surviving list of the prices paid for his land purchases totals over £140,000.<sup>50</sup> Thus, for example, we know that the profits of the 'Brewood and Grange Works', comprising two furnaces and six small forges from 1650 to 1673 totalled slightly over £55,500.<sup>51</sup> This was a period when land was cheap and plenty of property was for sale due to a number of royalists who had to sell off land to compound for their delinquency, but the achievement is an impressive one and probably only matched in his time by a few of the wealthiest of the London merchants.<sup>52</sup>

In and around the Black Country, the ironworks, which Thomas Foley owned and then handed over his youngest son Philip in 1668 and 1669, differed little in identity from those his own father had owned in the 1630s. The change in the business was in the source of the pig iron that the forges in the lower Stour valley

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<sup>45</sup> . P.R.O., C 3/403/93, answer.

<sup>46</sup> . Edwards 1958, 197.

<sup>47</sup> . King 1999a, 67 74-5.

<sup>48</sup> . P.R.O., SP 18/321, no.42. Engrossing was essentially a market place offence, making it illegal for speculators to buy up produce with a view to reselling it later in the day. It is noteworthy that the principal prosecution witness was John Coleman, the impecunious son of Walter Coleman and earlier an unsuccessful rival ironmaster: see above; King 1999a, 74-5.

<sup>49</sup> . P.R.O., C 2/Chas.I/F49/46; E 112/258/144; *cf.* Schafer 1990, 23. Shares of Wilden were bought by Richard Foley in 1636 and 1642, but the construction of the forge there seems to have occurred in 1647.

<sup>50</sup> . Herefs. R.O., E12/VI/C/1 & 8.

<sup>51</sup> . Schafer 1990, 31 from Herefs. R.O., E12/VI/KBf/47.

<sup>52</sup> . *Cf.* Grassby 1995, 250-68 *passim*; Thirsk 1984, 85-108.

consumed, which now came from the Forest of Dean. His first investment in that region was the wireworks at Tintern, but the Earl of Worcester's ironworks there were held by William Herbert, later Foley's partner there.<sup>53</sup> This was followed by the purchase of Elmbridge Furnace in 1658, and leasing of Hope (or Longhope) Furnace in 1662, and of Bishopswood Furnace probably sometime in the 1660s.<sup>54</sup> Additionally he had a furnace beside the river Severn at Hampton Loade in Shropshire from about 1640 to 1660, which may have fulfilled a similar function, and from the late 1650s he was also for a time buying pig iron from John Brayne, another Forest ironmaster.<sup>55</sup> By 1669 he was not only supplying his own forges (or rather what were now his son's) at Shelsley and in the lower Stour valley from the Forest but also selling pig iron to John Morgan (evidently for Tredegar Forge near Newport) and to the owners of forges even as far afield as Cheshire.<sup>56</sup> As Andrew Yarranton commented in 1677,<sup>57</sup>

'The greatest part of the sow iron [made in the Forest of Dean] is sent up the Severn to forges into Worcestershire, Shropshire, Warwickshire, and Cheshire and there made into iron.'

In the late 1660s and early 1670s Thomas Foley handed over his business to his sons; Thomas (the eldest) had Tintern, Paul took the rest of the Forest furnaces, and (as already mentioned) Philip acquired all his works in Staffordshire and Worcestershire. This division between the furnaces and forges did not work well, because Philip was dependent on buying pig iron from Paul without Paul having a converse dependence for his sales. Additionally Philip had to pay his father's estate (or rather his eldest brother) the balance of the £60,000 for which he had purchased the works from his father. Due to these matters and perhaps a reduced profitability of the works, he began disposing of them. Paul on the other hand had leased Flaxley and Redbrook Furnaces, with the result that he was the sole producer of Forest pig iron, apart from the owners of Lydney Furnace (who probably only produced enough for their own forges) and his brother at Tintern. The story of this period has been told by R.G. Schafer, who showed how the brothers attempted to cooperate; how Philip disposed of many of his south Staffordshire works; how the works in the lower Stour valley were recombined with the Forest furnaces in 1685 by John Wheeler and Richard Avenant; and finally how in 1692 the Foley brothers re-entered iron production by becoming partners with them in the 'Ironworks in Partnership', as they called it.<sup>58</sup>

In 1698 several of the works in the Stour catchment were transferred to Richard Wheeler, who simultaneously withdrew from the firm.<sup>59</sup> The firm's last two forges in the Stour valley, with Hales[owen] Furnace

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<sup>53</sup>. B.L., Loan mss.16/2, f.94-94v; Rees 1968, 631; Paar & Tucker 1974, 10; N.L.W., Badminton manorial 1631; *cf.* Herefs. R.O., E12/VI/Ac/1-3; E12/VI/Af/1-4 10-15.

<sup>54</sup>. Elmbridge: Herefs. R.O., E12/VI/Daf/1-2; E12/G/13; Bick 1980; Hope: Hart 1971, 20-21, quoting Herefs. R.O., E12/VI/DAc/1; *cf.* Herefs. R.O., E12/VI/DAc/5 9-11 15; E12/VI/Daf/1-2.

<sup>55</sup>. Hampton Loade: Herefs. R.O., E12/VI/KAC/64 84 92; Brayne: E12/VI/KAc/86 88 *cf.* 47.

<sup>56</sup>. Schafer 1978, 59 98-99 & *passim*; Foley *a/c*; Cheshire: Bishop and Baddily built Warmingham Forge in 1668: Cheshire R.O., DCR 27/2, draft lease of 1668.

<sup>57</sup>. Yarranton 1677, 56-7.

<sup>58</sup>. Schafer 1972; certain aspects of this will be discussed later in this chapter; also Tintern: will of Thomas Foley: Herefs. R.O., E12/II/1/11; Paul: E12/VI/DAc/15 etc.; Philip: E12/VI/KBf/72-87; Schafer 1978 1990; Philip's sales: Herefs. R.O., E12/VI/KD KG-KH; recombination: E12/VI/DDc-DEc; Lydney: Glos. R.O., D 421/E9. Philip's arrangement with his father has been described as a partnership, but it is clear from the accounts that it was not, as they did not share the profit: see Schafer 1978, 58-61 and compare *ibid.*, 100-7 where the profit on certain other partnerships is shared.

<sup>59</sup>. Herefs. R.O., E12/VI/DEc/2-9.

were transferred to John Wheeler in 1705, so that (apart from a warehouse in Bewdley, retained until 1736) the business, henceforth known as the Forest Partnership, consisted of almost exclusively of furnaces and forges in and around the Forest of Dean.<sup>60</sup> On John Wheeler's death, he was succeeded in management by William Rea, and in 1717 following Philip Foley's death the number of partners was substantially reduced. Rea seems to have made some bad decisions during the ensuing period when prices were high due to the Swedish embargo, and this resulted in losses in the ensuing period, but unfortunately the accounts for 1717-25 do not survive. Since Rea had failed to provide accounts, the other partners met at Wolverhampton in 1724 and sacked him. They then appointed Warine Falkner, a son-in-law and servant of Obadiah Lane as manager. He was succeeded in 1730 by Thomas Pendrill.<sup>61</sup> From this time the business contracted, outlying works being abandoned usually when their leases expired. When Redbrook Furnace and two of the Lydbrook Forges were let in 1742 to Rowland Pytt, a Gloucester ironmonger, the Foleys were left just with Bishopswood and Elmbridge Furnaces and another forge at Lydbrook. The business was continued for a time, but was merely an ill-managed shadow of its former self.<sup>62</sup>

Contrary to what one might suspect from the title ('Did it fall or was it pushed?') of G. Hammersley's account of the final period of the Foley business,<sup>63</sup> its decline by no means marks the end of the charcoal era. According to his petition to the House of Lords in 1750, Rowland Pytt had a furnace and two forges in Lidney [now Lydney, Glos.], a furnace and two forges in Newland [Glos., *i.e.* Redbrook Furnace and two Lydbrook Forges], a furnace and forge at Aberavon and Melin y Court (west Glamorgan), two forges in Tortworth, a forge and other works at 'Abby Tintern' and a forge at Upleadon.<sup>64</sup> In 1750 he and others contracted to build a tinplate works at Ynysygerwyn in the Neath valley, but its erection was delayed by litigation until after his death. It was completed by his son-in-law, William Coles, with finance from John Miers of Crooked Lane, London, whose family eventually became the sole proprietors of a substantial business in west Glamorgan. The Gloucestershire works passed to his son Rowland Pytt II, who died about 1763. After that these works passed to Harford Partridge & Co. (or their predecessors) or to David Tanner.<sup>65</sup>

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<sup>60</sup>. Herefs. R.O., E12/VI/DEc/13.

<sup>61</sup>. King 1995c; P.R.O., E 112/957/94 107; E 112/1127/4-5; Herefs. R.O., E12/VI/DGd; Hammersley 1979.

<sup>62</sup>. Hammersley 1979; Herefs. R.O., E12/VI/DGf *passim*; Hart 1971, 67 76-7 and ch.2 *passim*. Hart's doubts over the date of the Foley accounts for a forge at Lydbrook dated 1746-51 are misconceived. Unlike earlier accounts these only relate to the lowest forge there, which remained the Foleys' after the others had passed to Pytt. The Foley accounts end in 1751, and the last account shows the stock at Elmbridge largely exhausted, but not that at Bishopswood and the forges. The last purchase of cordwood in the Forest by Thomas Foley III of Stoke Edith was under a warrant dated 1764 and he may have continued to own Bishopswood until his death in 1777. Indeed there may have been a certain logic in his retaining the furnace in the last decade of his life, as he (or rather a manager) was also operating Wilden Forge near Kidderminster, which he had inherited with the Great Witley estate from his cousin Thomas Foley IV of Witley (Lord Foley): P.R.O., LR 4/9/27 (purchasers in the following decade are not usually named); Herefs. R.O., Land Tax, Walford; HH a/c. The end of the surviving accounts may be a result of the way the muniments at Stoke Edith were sorted after the death of Thomas Foley III, when the Newent estate passed to his youngest son: *cf.* Herefs. R.O., E12/II/23/1.

<sup>63</sup>. Hammersley 1979.

<sup>64</sup>. House of Lords R.O., LP 245/15.

<sup>65</sup>. Hart 1971, 71-2 85-100 *passim*; Monmouth: Kissack 1975, 289; Coates & Tucker 1978, 40-45 & 47-8; Neath valley: Glamorgan R.O., CL236/221 269 271-73.

Towards the end of the 18th century ironmaking in Gloucestershire and southeast Wales was dominated by two businesses, David Tanner and Reynolds Getley & Co. (later known as Harford, Partridge & Co.). Both were at that time charcoal ironmasters, though both built coke furnaces in the 1790s, Tanner at Blaendare near Pontypool in 1790 and Harford, Partridge & Co. at Ebbw Vale towards the end of the decade. Harford, Partridge & Co. went under a number of names at different periods, and it is not clear whether there was a single partnership or a network of associated businesses. This (or these) originated out of an ironfounding business, which was taken over by a company ('The Welch Iron Foundry Company') in 1732 and run in conjunction with their Bryn Coch Furnace near Neath (built 1728), and out of an iron merchants' business in Bristol. They also had a tinplate works at Woollard in Somerset and from 1770 the Melin Griffith works near Cardiff. Later still they also had Monmouth Forge, Caerphilly Furnace and Tredegar and Machen Forges, as well as various ironworks around the Forest of Dean. David Tanner by 1790 owned the Hanbury family's works at Pontypool and Llanelly, the Tintern Works, and Caerleon Forge. He earlier had the Lydney works and later Redbrook and Lydbrook Forges, but became bankrupt in 1799. The business of Harford, Partridge & Co. was divided among the partners in 1808, but the Ebbw Vale works remained in the hands of some of them until the 1840s.<sup>66</sup>

## Organisation

### *The changing ratio of forges to furnaces*

It is a notable feature of many of the businesses (described above) that in the 16th and early 17th centuries there was almost invariably exactly one forge for every furnace. The names of individual ironworks have generally not been listed in the preceding sections, to avoid cluttering with an excess of detail what is intended as an overview of the industry, but some must now be mentioned. The 1619 partnership between John Middleton, Henry Goreing, Thomas Nye, Richard Middleton, and Nicholas Jordan related to 'Ellaston Forge and Furnace, Ockamore [Oakamoor] Furnace, Chartley Forge and Furnace, Norton Forge and Stones Furnace, Cheslenhay Furnace, Hintes Forge and Rushall Furnace, Bromwich Furnace and Forge, Little Aston Forge, Perrery [Perry] Forge and Furnace, Birmingham's Aston Furnace and Branford [Bromford] Forge with divers other lands grounds mynes and woodes.'<sup>67</sup> Of these, Chartley had belonged to some of the partners in 1616 and the Ellastone and Oakamoor works were taken on to use wood they had bought from the Earl of Shrewsbury,<sup>68</sup> but the rest were bought from Thomas Parkes of Willingsworth in Sedgley (Staffs.) as the executor of Richard Parkes and thus represent the final extent of his business. Lord Dudley's works which Richard Foley added

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<sup>66</sup>. This brief account of the two businesses has built up from a considerable number of original documents and published works, none of which provide a comprehensive picture of either. I understand that a biography of David Tanner has been the subject of a University of Wales Ph.D. thesis, which I have not seen, but there is no adequate single account of Harford, Partridge & Co. and their predecessors. Partial accounts of the businesses will be found in Chappel 1941; Ince 1993; Hart 1971; Riden 1991; note also EV a/c; N.L.W., Badminton II, 8440; Bristol R.O., 09458/26; 4658/6a-b; Swansea R.O., D/DXhr/34-38; Woolrich 1986, 34-5; 1790/4 list.

<sup>67</sup>. King 1999a, 66; P.R.O., C 2/Chas. I/M76/52; C 2/Chas. I/M57/66; C 2/Chas. I/I3/27.

<sup>68</sup>. *Ibid.*; P.R.O., C 2/Chas. I/G13/19; Notts. R.O., DD4P 46/23.

were Cradley Furnace and Forge and Himley Furnace and Greens Forge. He later also acquired (or built) Grange Furnace and Heath Forge, and his son added Coven Furnace and Brewood Forges in the early 1640s.<sup>69</sup>

Lord Paget's works on Cannock Chase consisted of two furnaces and two forges in Cannock Wood, a furnace in Beaudesert Park, a forge at Abbots Bromley (all on his own land) and another furnace at Teddesley Hay rented from the Lyttletons of Pillaton, the latter only used when one of the others was out of use.<sup>70</sup> The ratio is less clear in the operations of Coleman and Chetwynd, but Coleman's Cannock Furnace evidently supplied Brewood Forge; and Beaudesert Furnace and Bromley Forge clearly worked together. There was mention of Abbey Hulton Furnace and Forge, of ironworks at Hartshorne and Dunnington [Castle Donnington], of Halesowen Furnace and Forge, also of a forge at Wolsley [Park, near Rugeley], which 'was of small profit and ... only used for refining some few blooms', but near which the remains of a furnace have been found.<sup>71</sup> The Earl of Leicester had two furnaces and two forges at Cleobury Mortimer. Elsewhere in Shropshire, Longnor Furnace and Forge, Kenley Furnace and Harley Forge, and Leighton Furnace and Sheinton Forge have already been mentioned.<sup>72</sup> In Monmouthshire Richard Hanbury had three ironworks in 1597, Monkswood, Pontypool, and Abercarn, each of which seems to have consisted of a furnace and forge. Most of the witnesses said that his rivals had two ironworks, one naming them as at 'Pontemole and Bedwelltie', but Richard Pettingale said that there were four ironworks, that is two forges and two furnaces.<sup>73</sup> Examples of this 1:1 ratio could be multiplied *ad nauseam*.

That this ratio was almost axiomatic is also confirmed by the practice of using a single name for a furnace and forge, which was actually that of the forge. This applied to the Kimberworth Works, belonging successively to the Earls of Shrewsbury and of Pembroke, where the furnace was Chappel Furnace, beyond the pale of Kimberworth Park, and to Machen (or Rhydygwern), a forge which was probably supplied from Taff Furnace. Similarly, the names of the Pontypool and Pontymoyle [Pontmoel] works are those of bridges adjoining the forges, but the furnaces were respectively some distance away at Glyntrosnant and probably Wansuchan [Waun Sychan].<sup>74</sup> Such accounts as survive from this period generally give little indication that pig iron was a product that was considered saleable and sometimes no account seems to have been kept of the amount produced by the furnaces and consumed by the forges.<sup>75</sup> Henry Goreing acknowledged he had been ordered by his partners in 1622 to 'work out all stock at Norton Forge and Ellastone Forge which accordingly he did and thereby as well the works of Stone Furnace and Oakamoor Furnace did determine for that Norton Forge was furnished with sow iron from Stone Furnace and Ellastone ... from Oakamoor.' In later proceedings he

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<sup>69</sup>. King 1999a, 61-2 67-8.

<sup>70</sup>. Welch 2001.

<sup>71</sup>. P.R.O., C 2/Chas. 1/C5/67; C 2/Chas. 1/C88/59; C 21/C45/18; Welch 1995.

<sup>72</sup>. See above.

<sup>73</sup>. P.R.O., E 134/39 Eliz./Hil./23, plaintiff's depositions, 6-7; defendants depositions, 14.

<sup>74</sup>. Savile & Nevile a/c; Donald 1961, 97-100; P.R.O., E 112/29/24; Taff (or Tongwynlais): Riden 1992b, 81-8. The Earl of Pembroke's northern revenue (of which Kimberworth was part) resulted from his childless marriage to one of the Shrewsbury coheireses. These estates later passed to the heirs of Alatheia Countess of Arundel, the only daughter of Earl Gilbert of Shrewsbury to leave issue, and thus passed to the Dukes of Norfolk.

<sup>75</sup>. Lord Paget's accounts (Cannock a/c) record only the number of loads of sows carried.

described how 'sowes ... had been as formerly ... had been accustomed were carried [from Stone Furnace] to Norton Forge' in 1621: he seems to have had to buy some from Thomas Crompton, apparently the new tenant of Stone Furnace, probably so as to use up the stock of charcoal at Norton.<sup>76</sup>

This suggests a means of determining the output of furnaces, which disappeared long before the well-known 18th century lists of iron production, but where the output of forges is known either from those lists or earlier accounts. Thus Bromwich and Little Aston Forges are known to have had two fineries and one finery respectively and to have made 168 tons and 117 tons on average in seven years between 1667 and 1674, suggesting that Bromwich and Rushall Furnaces respectively made about 225-250 tons and 160-175 tons per year.<sup>77</sup>

During the 17th century there was a tendency for the ratio to be altered to two forges for every furnace. An early example of this relates to ironworks near Aberdare. These were the subject of much litigation at the end of the 16th century which was ended by an arbitration, awarding one forge to each claimant and requiring Robert Martin (who had the furnace) to supply John Morley's New Forge with 120 tons of pig iron per year for which Morley was to pay one ton of bar iron for every three tons of sow iron,<sup>78</sup> but in this case the amount suggests it was only a single finery forge. Similarly when Lord Paget was restored to his father's lands, he confirmed the lease made by the Crown to Fulke Greville of the ironworks on Cannock Chase, but on condition that only one furnace and two forges were used.<sup>79</sup> The transition may be observed in the operations of Coleman and Chetwynd: no furnace was associated with Wednesbury Forge when Coleman rented it from his father-in-law in 1606, nor was a furnace built when they erected Brewood Lower Forge about 1620. Thomas Bamford later built Coven Furnace to supply Brewood, but probably only because John Coleman was making life so difficult for him.<sup>80</sup> Richard Foley had difficulties over the supply of water from a brook flowing out of Sandwell Park to Bromwich Furnace in the late 1620s, but (though he won the consequent litigation) he does not seem to have renewed the furnace lease when it expired. Nor does he appear to have renewed that of Himley Furnace in the early 1630s after his initial term there, no doubt because Grange Furnace could supply Greens Forge as well as Heath Forge.<sup>81</sup> Renewals of other leases on the Dudley estates continued. In 1662 Thomas Foley again leased the Cradley Works, but he was allowed to remove the furnace bellows (implying its closure).<sup>82</sup>

The transition to the new ratio was complete in the case of the ironworks which belonged to Walter Chetwynd at the time of his sequestration in 1646. He had a furnace, a forge, and slitting mill on Cannock Chase

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<sup>76</sup>. P.R.O., C 2/Chas. I/M57/66; C 2/Chas. I/J3/27. The forge referred to was at Norton Bridge in Chebsey: cf. King 1999b, 66.

<sup>77</sup>. Forge output: average of figures from Schafer 1990, 16-23, excluding 1673 (not surviving); the range of furnace output is calculated on yields of 26 and 30 *cwt.* pig iron per ton bar iron and rounded off.

<sup>78</sup>. N.L.W., Bute 2343-5; Rees 1968, 252-58.

<sup>79</sup>. *V.C.H. Staffs.* ii, 111.

<sup>80</sup>. Wednesbury: Dilworth 1976, 112; Brewood: *V.C.H. Staffs.* v, 120; Coven: Herefs. R.O., E12/VI/KBc/44; difficulties: P.R.O., C 2/Chas. I/B96/36; C 78/480/19.

<sup>81</sup>. Bromwich: P.R.O., C 78/400/21; Himley: Dudley Archives, DE4/3, Himley leases 1628 (sic for 1625).

<sup>82</sup>. *Ibid.*, Rowley leases, 1662. This lease also conferred the right to take 'stones called hearth stones' from a quarry at Himley for making one furnace hearth yearly and limestone for any two of his furnaces from Conigree and Old Park. These rights had evidently been appurtenant to the Cradley ironworks, but were now enjoyed as 'profits in gross' (to use legal terminology).

together with Bromley Forge (nearby) and also in northwest Staffordshire Heighley Furnace and Winnington and Norton Forges.<sup>83</sup> In 1651 John Offley of Madeley complained that Madeley Furnace was out of repair, presumably due to a lack of use, and Heighley Furnace seems to have been abandoned in favour of Madeley, beginning an association with Norton and Winnington Forges that lasted over a century.<sup>84</sup> More strictly perhaps the new ratio should not be expressed as one furnace to two forges, but as one furnace to four fineries. Thus in the 1670s, particularly after Philip Foley disposed of them, Grange Furnace was supplying pig iron to four small forges, Heath, Swin, Greens, and Cradley Forges. Though Heath Forge (at least) had two fineries, their low output suggests only one finery was in use.<sup>85</sup> This new ratio between furnaces and forges must have depended on the furnaces becoming more productive, but it is not clear whether this was the result of the furnaces becoming bigger or of working them for more of the year. That may in turn have been made possible by improvements in hearth construction, perhaps merely by the identification of better refractory materials, enabling furnace campaigns to be longer.<sup>86</sup>

The transition from the old ratio to this new one could obviously be achieved either by closing surplus furnaces or by erecting extra forges, and both methods are found. The abandonments of Himley, Bromwich, and Cradley Furnaces by the Foleys are cases of the former, so are the disappearances of Longnor and Heighley Furnaces.<sup>87</sup> On the other hand, Upton Forge was built in 1654 by Francis Walker of Bringewood, whose son William was a partner in Boycott & Co. by 1661, and he also brought Longnor Forge (rented by him since 1635) into it.<sup>88</sup> The erection of Carburton Forge by William Sitwell and William Clayton again during the 1650s was similar. A more efficient use of the wood resources of a district was sometimes achieved by separating the production of pig iron from that of bar iron, that is by having the furnace and forge some distance apart. Where the two works were on adjacent sites as at Longnor, Halesowen, and Wingerworth (Derbs.), one of them was closed, the furnace at Longnor, but the forges at Wingerworth and Halesowen. This also applies much earlier to Ellastone, where the forge was supplied from Oakamoor Furnace, rather than from Ellastone Furnace, which evidently existed but went unused by Middleton Goreing & Co.<sup>89</sup>

This practice of separation was taken to its limits by Thomas Foley's move into the Forest of Dean and the Jennens' to having furnaces in Nottinghamshire and Derbyshire.<sup>90</sup> Here the distance between the furnace that made the pig iron and the forge that fined it was not merely a few miles but twenty to fifty miles. The next stage was for forges to begin to use pig iron that had been made by some one other than their owner. In other

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<sup>83</sup>. Lead 1977, 5, from William Salt Lib. (Stafford), Salt ms.330, i, 633-4 (transcript of Royalist composition papers). This Norton Forge was in Mucclstone on the Shropshire boundary and is not to be confused with the Norton Forge referred to above as associated with Stone Furnace, which lay at a house called 'the Hammers' near Norton Bridge in Chebsey.

<sup>84</sup>. P.R.O., C 6/116/45; Lead 1977, 7.

<sup>85</sup>. Finery numbers are deduced from numbers of pairs of bellows: Schafer 1978, 8; 1990, 8-9. Outputs: Schafer 1990, 17-22; Herefs. R.O., E12/VI/KD series. R.G. Schafer's account (1971, 29) is not quite accurate: King 2002b, 49-50.

<sup>86</sup>. As to furnace lining see chapter 3.

<sup>87</sup>. King 1999a, 75; Longnor: *V.C.H. Shrops.* viii, 96.

<sup>88</sup>. Shrops. R.O., 6000/3093; 6000/3130; 6000/3230; 6000/18289; *V.C.H. Shrops.* viii, 96.

<sup>89</sup>. Carburton and Wingerworth: Riden 1990, 68 70; Ellastone and Oakamoor: King 1999a, 66; for the others see above.

<sup>90</sup>. See above.

words, the owners of forges began to buy in pig iron. These were important developments, and will be addressed fully in a later section.

### *The break-up of vertically integrated businesses*

None of the big integrated businesses in the central and south Midlands, described in earlier sections, persisted far into the 18th century but the Cheshire Ironmasters and John Fell & Co. (and successors) at Sheffield continued almost to the end of the charcoal era.<sup>91</sup> C.K. Hyde used these examples to suggest that integration remained common, and also he fell into other errors by his uncritical use of A. Raistrick's *Quakers in Science and Industry*.<sup>92</sup> In Derbyshire, Walter Mather may be regarded as a successor of the Jennens family in Derbyshire, though his business, latterly consisting of Wingerworth Furnace and New Mills and Bulwell Forges and Borrowash Slitting Mill, does not really fall into the big business category, but in the last half century before the Industrial Revolution the iron industry in the east Midlands had regressed to consisting of two or three small vertically integrated businesses each consisting of a furnace and a couple of forges.<sup>93</sup> These areas where vertical integration persisted are characterised either by a lack of water transport or at least by none leading in useful directions, so that goods had to be carried expensively by land over considerable distances.

In contrast in Shropshire, south Staffordshire and southwards vertical integration was far less apparent after about 1700. This is not to say that there were not some large businesses, the largest being that of the Knight family. This began in 1695 when (following the bankruptcy of Job Walker, who was separately a partner in Boycott & Co.) Richard Knight bought the Bringewood Works, consisting of a

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<sup>91</sup>. Awty 1957; Raistrick & Allen 1939; Raistrick 1938; Hopkinson 1954; King, *North*.

<sup>92</sup>. Hyde 1977, 15-16. Hyde seems to have been misled into building an edifice of a Quaker network controlling the iron industry by A. Raistrick (1950, ch.4). Raistrick exaggerated the scale of the Backbarrow Company, which Hyde incorrectly called the Fell-Rawlinson combination though no member of the Fell family was a partner. Raistrick's account (1950, 102-3) tends to conflate the separate Backbarrow, Cunsey, and Newland Companies. The Cunsey and Backbarrow Companies did cooperate closely at least at times in buying charcoal and paying dead rents for bloomery forges, to keep them idle. Raistrick also implies that the Cunsey Company were also Quakers, which is not correct. If they had a single religious affiliation at all, it was probably Presbyterian (rather than Quaker): Philip Foley, who was an early member of the associated Cheshire Ironmasters had Presbyterian tendency (Lacey 1969, 395-6); Edward Hall was certainly not a Quaker (Lancs. R.O., DDMc30/17, 25 Feb. 1724); and Edward Kendall (formerly a clerk to Philip Foley's partner John Wheeler) gave property for a Presbyterian manse in Stourbridge in 1743 (Worcs. R.O., 898.4 BA 8441/6(iii), 20 Jul. 1743). Hyde's incorrect reference to the Fell family in relation to Backbarrow also falsely suggests the inference that there was a close association between the Backbarrow Company and John Fell & Co. of Sheffield. Furthermore, Raistrick's work is liable to a misleading interpretation in another respect. Having shown that various groups of ironmasters in Yorkshire worked closely together, and that some were Quakers, Raistrick seems to imply that all were. This was not so. In particular, it is very doubtful (contrary to Raistrick 1950, 153) whether Matthew Wilson of Wortley was a Quaker, since close relatives were Anglican clergy. Both William Spencer and Matthew Wilson used the normal 'you', rather than the Quaker 'thee' (Spencer l/b, *passim*; Sheffield Archives, SpSt. 60512/*passim*). As will appear below, cooperation between different firms was common in certain aspects of their business, and to this extent the use of the word 'syndicate' might be correct. However cooperation in some areas did not prevent competition in others. Linkages can certainly be made in terms of family relationships and being co-religionists, and these were significant in the case of Quakers, their term for themselves as 'Friends' not being a misnomer. However, Hyde's estimate that Quakers owned or managed 50-75% of the ironworks in operation in the early 18th century is certainly excessive, and unfortunately this erroneous statement has been quoted by J.M. Price (1986, 376).

<sup>93</sup>. Riden 1990. The above is a slight over-simplification, since Whaley Furnace was very occasionally used instead of Staveley and Kirkby Furnace and Clipstone Forge were retained on a care and maintenance basis: see King, *North*.

furnace and a large forge. He bought Cookley and Wolverley Forges on the bankruptcy of Richard Wheeler in 1703 and also owned a share in the (Foley) Forest Partnership from 1708 to 1717. At various times he had interests in other works including Willey Furnace and Morton Forge (Shrops.), Kirkby Furnace and Carburton Forge (Notts.), though in a relatively uncoordinated manner. This was rationalised into two businesses in the 1720s. One consisted of the Bringewood Works and Charlcot Furnace, which had been built shortly before 1700. The other was the Stour Works Partnership. Accounts survive for both for long periods in the 18th century. The Stour partnership was probably formed in 1725 and was initially made up of a number of unrelated partners, but the outsiders were bought out in 1736, so that two businesses were owned by two of Richard Knight's sons, Edward and Ralph, respectively the managers in the Stour valley and of the Bringewood Works, with the addition only in the Stour Works of their brother-in-law Abraham Spooner, a leading Birmingham ironmonger.

Initially the Stour Works consisted of Hales Furnace and Cookley and Whittington Forges. This was thus a small vertically integrated business. However within a few years Wolverley Old Forge and both Mitton Forges (at Stourport) were added, so that even with a substantial quantity of pig iron from Charlcot, considerable amounts of pig iron had to be bought from third parties.<sup>94</sup> The furnaces that provided this pig iron were scattered all over western Britain and even further afield, for pig iron from Virginia and Maryland was useful for ballasting tobacco, and accordingly a low freight was charged for its transatlantic shipment. Some furnaces were very significant sources for the Stour Works, providing two or three hundred tons or even more for a few years before their sales dwindled to little or nothing. Important sources in the 1730s and 1740s included Pontypool and Cardiff (*i.e.* Pentyrch) Furnaces, as well as 'Cheshire Coldshort'. From the 1750s furnaces using redmine from Furness became prominent suppliers, including Backbarrow, Leighton, Halton, and Lowwood (all Lancs.) and Lorn, Argyll, and Dovey. The Stour Works Partnership's demand for pig iron was very considerable for, following the purchase of Aston Furnace and Bromford Forge in 1746, they had six large forges (with a total of fourteen fineries) and two furnaces, while the Bringewood Partnership had a further two furnaces and a forge, and provided some pig iron for the Stour forges. These forges were among the largest in England according to a contemporary list dated 1749, which if anything underestimates their output. This was a large integrated business, but the integration was more horizontal than vertical. The tendency to seek to monopolise the supply of wood locally does not seem to have existed or at least not to the same extent as earlier.<sup>95</sup>

Most other forge businesses relying on buying pig iron on the open market were much smaller. In 1708 Thomas Foley of Witley (created Lord Foley in 1712), a grandson and namesake of the rich ironmaster of the 1650s and 1660s resumed possession of Wilden and Shelsley Forges, which were run as part of the Witley estates until the death of another Lord Foley in 1778,<sup>96</sup> but he and his successors never had a furnace. Similarly (amongst others) Pitchford, Longnor, Upton, and Wytheford Forges in Shropshire, Brewood and Congreve Forges in Staffordshire, Redditch, Ipsley and Clifford Forges in Warwickshire, Strangworth Forge

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<sup>94</sup>. Ince 1991b; Page 1979; Walker: N.L.W., Cilybebyll, various incl. 416; Charlcot pigs are mentioned in 1701 as used at Longnor Forge: P.R.O., E112/880/Salop.9; Forest: Foley a/c; P.R.O., E 112/1127/5; Kirkby & Carburton: King *North*.

<sup>95</sup>. SW a/c; Ince 1991b, 117-8; ballast: Middleton 1953, 170; Johnson (K.) 1959, 44; output: King 1996b, 38.

<sup>96</sup>. Foley a/c; BW a/c (for 1744-5); HH a/c.

in northwest Herefordshire, and Mathrafal and Dolobran Forges in Montgomeryshire were all run for long periods without their owners either having a furnace or any interest in one.<sup>97</sup> Some of the pig iron for Staffordshire and Shropshire forges came from Vale Royal Furnace in Cheshire in the early 1720s when it was operated as independently by the Vale Royal Co. and no doubt a similar function was served by furnaces in Denbighshire, such as Plas Maddock with which no forge was associated.<sup>98</sup> The majority of these usually operated entirely as independent businesses, the ironmaster probably performing the functions of the clerk and sometimes having some other source of income, for example as a farmer or land agent, like Thomas Dorset of Wytheford Forge.<sup>99</sup> Something similar is found elsewhere in the west Midlands, for [West] Bromwich Forge, Little Aston Forge, and Powick Forge at various times operated independently.<sup>100</sup>

Nevertheless not every 18th century ironmaster in west Midlands was quite so independent. Joshua Gee of Tern Forge also had Sutton Forge, Pitchford Forge, and an interest in Bersham Furnace and even iron ore mines in Cumberland.<sup>101</sup> Slightly earlier Charles Lloyd of Dolobran had a share in Bersham.<sup>102</sup> Later John Rowlands of Ruabon not only had Pontyblew Forge, but also Sutton (at Shrewsbury) and Llwyn Onn Forges.<sup>103</sup> Edward Kendall of Stourbridge not only had Cradley Furnace and Forge and Lye Forge, but was also a partner in the Cheshire Ironmasters and the Cunsey Co. and also owned Clifford Forge.<sup>104</sup> George Draper had Upper Mitton and Wolverley Forges before the Knights and also Upleadon Forge, but according to a single passing reference had a furnace at Overbury.<sup>105</sup> Edward Jordan owned Grange Furnace and Heath Forge in the mid 18th century and

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<sup>97</sup>. That these forges were not part of any integrated group is a conclusion, which is based on the history of all the ironworks in the area. I have built up their respective histories from many sources (see appendix 1). I hope to publish my conclusions on this, as *Iron in the Midlands*. It is only possible to cite here selected material on the works mentioned. This also applies to several succeeding notes. The histories of the forges mentioned have been determined from Foley a/c; Cheshire a/c; VR a/c; HH a/c; OP a/c; Trinder 1973; 2000; 1790 list; Chaplin 1969; 1970; Hyde 1973; King 1996b. As to particular forges named: Pitchford: *V.C.H. Shrops.* viii, 118 (slightly inaccurate see note 101); N.L.W., Pitchford Hall 893 952 995 1925-6 2101 2103; Birmingham Archives, 278103 278121; Longnor: *V.C.H. Shrops.* viii, 112; Upton: Trinder 1973, 207; Shrops. R.O., 1396/2; Wytheford: Trinder 1973, 49-52; Shrops. R.O., 625/15; Brewood: *V.C.H. Staffs.* iv, 20-1; Staffs. R.O., Brewood manor rolls; Congreve: Staffs. R.O., D 1057/E/1/8; D 1921/4; Clifford: *V.C.H. Warws.* iii, 269; Shakespeare Birthplace Trust (Stratford), DR37/2643-52 *passim*; DR37/vols 3 12-13. Mathrafal: N.L.W., Powis Castle Rentals, *passim*; the account by A.S. Davies (1939) contains significant errors; Dolobran: Lloyd 1968; 1975, 46-63; N.L.W., Dolobran, various incl. 14 41-3 & 51; Redditch, Ipsley and Strangworth are not well-documented.

<sup>98</sup>. VR a/c; cf. Cheshire a/c; Riden 1993, 72-3; Edwards 1961.

<sup>99</sup>. Trinder 1973, 49-52.

<sup>100</sup>. Dilworth 1976, 40-51; Gould & Morton 1967; Powick: Foley a/c; HH a/c; N.L.W., Maybery 1215; *Aris' B'ham Gaz.* 7 Apr. 1766; land tax, Wick Episcopi; Lloyd 1975; Clinch ts. (neither of which are quite accurate).

<sup>101</sup>. Chaplin 1969, 3; Shrops R.O., 6000/18209; 112/25/76; Butler thesis; Butler notes; Fletcher 1881, 20; Edwards 1961, 67; N.L.W., Pitchford Hall, 893 1925; Birmingham Archives, 278103 278121. *V.C.H. Shrops.* viii, 118 states the Pitchford Forge belonged to R & J Jordan. This is based on a provisional agreement for a lease. It was actually let to Joshua Gee of Tern Forge. His name appears subsequently in the rentals until 1755 when he sold it to Caswell and Gibbons and let Sutton forge to them.

<sup>102</sup>. Lloyd 1975, 47-63.

<sup>103</sup>. Edwards 1961, 85-90; Ruthin R.O., DD/LO/2; 1794 list; *Aris' B'ham Gaz.* 8 Oct. 1770.

<sup>104</sup>. Awty 1957; Dudley Archives, DE4/3, Rowley leases 1725 (assignment); N.L.W., Hawarden 919; Shakespeare Birthplace Trust (Stratford), DR37/vol.13; Prankard a/c (buying Russian iron, probably for his slitting mill at Cradley).

<sup>105</sup>. Page 1979, 15; Johnson 1953, 136; SW a/c (for 1729 and 1741 as vendor of stock at forges taken over by Edward Knight & Co.); Sheffield Archives, SpSt. 60516, 17 & 28 Jun. 1740.

probably also supplied Francis Homfray's Swindon Forge with pig iron. Together they also had Melin Griffith Forge and tinplate works near Cardiff.<sup>106</sup> These all seem to be cases of modest firms exhibiting some degree of integration, but it is clear that the supply for pig iron from their furnaces and the demand for it by their forges were not precisely matched. In some cases marginal amounts of pig iron were probably being bought, in order to keep a forge in work until the start of the new blast at an associated furnace. In other cases the quantities were substantial.<sup>107</sup>

A clear indication of the importance of this pig iron trade is the frequent appearance of the ironmasters at many of the forges named in surviving accounts of the Forest and other ironworks, and this has indeed been one of my main sources for elucidating the histories of those forges. Apart from accounts the trade is not well documented, but it is clear that the river Severn was the great highway on which much of this trade moved. Unfortunately the Gloucester Port Books which have provided so much information on commercial traffic on the river Severn are not exceptionally helpful in relation to pig iron: in the 17th century the main source seems to have been the Forest of Dean, but most of the pig iron was taken to minor ports on the Severn estuary, such as Newnham, Broadoak, and Cone Pill, which lay within the legal bounds of the port of Gloucester, so that no cocket was required and therefore no entry made in the port book. Also after 1725 when most export duties were abolished, though pig iron would appear (on the evidence of the Knight accounts) to have been coming from further afield, the need to obtain cockets for most coastal shipments had also been lessened. This again had the result that little indication of the trade can be found in the few surviving coastal port books.<sup>108</sup>

### *The Severn pig iron trade*

The origin of this pig iron trade on the Severn, of which the forges in the Stour valley were among the initial beneficiaries, seems in fact to lie far back in the 17th century. John Weld of Willey, in a memorandum for his heirs dated 1618 wrote of the possibility of obtaining pig iron 'from the Forest', which is more likely to refer to the Forest of Dean than to the nearby small, and recently inclosed, Shirlet Forest.<sup>109</sup> Certainly that is what later ironmasters meant by 'the Forest'.<sup>110</sup> Similarly when Walter Coleman sold Whittington Forge to his brother John in 1623, the consideration included paying £100 to Sir Basil Brooke on behalf of George Taylor, his predecessor there. Now Sir Basil Brooke of Madeley, a neighbour of John Weld, was one of the farmers of the King's ironworks in the Forest of Dean from 1615 to 1621 and again from 1627 to 1633. Whittington Forge was built by George Taylor about 1617, and is one of the earliest for which no very obvious connection with any furnace can be traced.<sup>111</sup> However the trade was not quite all one way for Richard Foley sold five tons of iron in 1631 for £27 10s. to Thomas Tildesley, an agent of Sir Basil,<sup>112</sup> the price indicating it to be pig iron. Shelsley Forge was almost certainly consuming Forest pig iron, since the farmers of the King's ironworks in the Forest, including Sir Basil were partners in it with Sir Walter Blount of Sodington in the early 1630s.<sup>113</sup> Sir Basil's estate included Coalbrookdale, where it is likely that iron had been

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<sup>106</sup> Hyde 1973, 39; Chappell 1940, 30-1; *V.C.H. Staffs.* xx, 213-4; Glamorgan R.O., D/D Mat 256. There was another Jordan family associated with Tintern and other works in the Wye valley, which may be unrelated.

<sup>107</sup> *E.g.* Foley a/c.

<sup>108</sup> Foley a/c; SW a/c; as to trade on the river Severn generally see Hussey *et al.* 1995.

<sup>109</sup> Cited in Wanklyn 1969, 98: the interpretation is mine. If Weld had meant a particular nearby furnace (as Wanklyn) then thought, he would no doubt have named it.

<sup>110</sup> *E.g.* 'the Forest Partnership': P.R.O., E 112/1127/4, first answer of Richard Knight, schedule; Herefs. R.O., E12/VI/DFf DGf, titles.

<sup>111</sup> P.R.O., C 2/Chas. I/T9/46; C 2/Chas. I/T1/30; C 2/Chas. I/T5/14; Hart 1971, 12.

<sup>112</sup> P.R.O., C 2/Chas. I/T3/15.

<sup>113</sup> P.R.O., E 214/459 and 523.

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made continuously since before the Dissolution of Wenlock Abbey, but the furnace there only apparently only dates from 1638 or

1658.<sup>114</sup> He also owned Bromleys Forge near the mouth of the river Perry in west Shropshire in 1623.<sup>115</sup> That forge and whatever forges there were at Coalbrookdale in the 1620s must also have depended on the Forest furnaces for pig iron. Sir Basil held a patent for making steel, which he was forced to surrender in 1618. His product was known as 'Gloucestershire steel', but (as I have suggested elsewhere) because it was made of iron from Gloucestershire, rather than that it was made there. There is little sign of his having steelworks in Gloucestershire, but he was said to have iron and steelworks in Shropshire in 1623 and he certainly had steelworks at Coalbrookdale before the Civil War.<sup>116</sup> All this implies that the beginnings of a pig iron trade up the river Severn are to be linked with the King's Works.

The King's Ironworks in the Forest of Dean were rather a troubled enterprise. They were one of the many 'projects' of James I's reign intended to increase the royal revenue, and were run by a succession of farmers, that is tenants. Initially there were two separate groups each of whom agreed to erect two furnaces and two forges, but they were accused of various abuses as to the use of wood, inhibited from proceeding, and then after an official inquiry required to surrender their lease, so that new farmers could be appointed. The next farmers, who included Sir Basil Brooke, suffered much the same fate in 1623, and the cycle repeated itself every five or six years until in the aftermath of the Civil War the works were abolished for a time. With equal numbers of furnaces and forges the original works clearly belong to the old vertically integrated system, but evidently they were by 1620 producing some surplus pig iron for sale. During the late 1620s two additional forges were built, no doubt so as to fine additional iron there. Even before that not all of the furnaces were being used, of course provoking accusations of 'waste'.<sup>117</sup> When some of the works were re-established during the Commonwealth, they were initially expected to produce shot, but when enough of that had been made the manager went over to producing pig iron for sale to ironmasters. To complete the story, after the Restoration the works were let to the nominees of the local gentleman to whom the whole Forest had been sold prior to the Civil War, but the prime object of the Forest in the eyes of the government was to grow timber for shipbuilding. The results of excessive exploitation by successive ironworks tenants was considered inimical to this, and the government in 1671 decided that the works should be abolished once and for all.<sup>118</sup>

It was not only the King's Works from which pig iron reached the Midlands. Thomas Foley was also buying pig iron in the 1650s, including 30 tons in 1651 at 'Sevenside' from John Bexx, a London merchant who was presumably running a furnace (perhaps Lydney), and a much larger quantity between 1657 and 1663 from

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<sup>114</sup>. The date of the furnace depends solely on that appearing on its lintels, which is currently shown as 1638, but older authors and photographs give the date as 1658: Raistrick 1953, 30 102-3; (1989 edn, *corrigenda*); Trinder 2000, 20-1; Paul Belfort, pers. comm. However the later date presents difficulties in terms of its history in that Madeley (and Coalbrookdale) were sequestered during the Civil War because the Brooke family were Catholic delinquents.

<sup>115</sup>. Trinder 1973, 15; Mott 1957a, 71; *Shropshire Newsletter* 44 (1973), 7 citing Shrops. R.O., 6000/18253; 6000/8494. It should be stressed that evidence of continuity between the 16th and 17th century ironworks at Coalbrookdale is lacking.

<sup>116</sup>. See King 2003, where this issue is discussed more fully; Wanklyn 1973.

<sup>117</sup>. 'Waste' is used here in its legal sense, meaning causing or permitting damage to the value of the freehold, which includes a failure to repair. For sales see notes 109-113 above.

<sup>118</sup>. Schubert 1953; Hart 1966, 88-175 *passim*; Hart 1971, 8-55.

John Brayne of Little Dean, the owner of Rodmore Furnace.<sup>119</sup> The erection in the 1630s of Elmbridge Furnace in the minute Newent Coalfield may have been to exploit the same market. Certainly the furnace was used from this purpose later.<sup>120</sup>

Pig iron from the Forest was also at some periods sent westwards. In 1630 and 1634 'raw iron in pigs' was shipped in vessels 'belonging' to Gatcombe and Tewksbury respectively to Aberdovey. This was no doubt intended for consumption by the forge at Mathafarn, and is the only evidence so far discovered of when it was in operation.<sup>121</sup> Apart from substantial shipments of pig iron from Chepstow to Newport for Tredegar Forge in the early 1680s, in that and the following decade pig iron was sent to Bristol for onward transmission to (and also direct to) Milford and Carmarthen. Some of the latter was entered with the Customs in the name of Alexander Phillips, who had Cwmbran Forge.<sup>122</sup> This trade almost certainly ceased not long after, when pig iron from northwest Britain became available.<sup>123</sup> Indeed to judge by the accounts of Edward Knight & Co., it would appear that the Forest had lost some of its importance as a source of pig iron for the Midlands,<sup>124</sup> possibly due to more of its output being fined locally or to a change in practice as to the management of the woods of the Forest after the completion of deliveries under sales agreed in 1705. Until then, wood was sold to provide revenue for the crown, but subsequently mainly only to pay administration expenses for the Forest.<sup>125</sup>

### *Bar iron trade on the river Severn*

It was not only pig iron that was moved on the river Severn, but also bar iron, in this case generally towards the Stour valley and the Black Country, the consumers being the slitting mills and ironmongers of that area. In 1590 merchant iron from Richard Hanbury's works at Pontypool and Abercarn was being sold to two Bristol merchants and a further six tons per month to John Kinge of Birmingham and his partners.<sup>126</sup> In 1629 there were three warehouses at Bewdley through which John Jennens was buying iron. He was allowing to William Glasbrooke, and probably also his neighbours William Tyler and William Smyth, (with a payment for carriage) a profit of five shillings per ton on Cleobury and Bringewood iron, but only two shilling for iron from Shelsley Forge. Glasbrooke was selling Jennens half the Bringewood iron he bought and a third of his Shelsley iron and was also able to obtain iron for him from Longnor in Shropshire, Pontypool in Monmouthshire, and 'colshire iron'.<sup>127</sup>

In 1635 there was a dispute concerning his business, when John Hanbury entered his house with the assistance of the undersheriff and seized his books and also goods stored

<sup>119</sup>. Herefs. R.O., E12/VI/KAc/7 86 88; for Becx see Hartley 1957, 65.

<sup>120</sup>. Bick 1987, 6 58ff; Herefs. R.O., E12/G, Oxenhall.

<sup>121</sup>. *Gloucester Port Books Database*.

<sup>122</sup>. Various Chepstow port books. These do not provide a reliable quantitative source as only the first few items listed on the cocket were entered in the coastal port book: Hussey thesis, 124; M. Wanklyn, *pers. comm.* As mentioned in a note to appendix 1, the only evidence linking Alexander Phillips with Cwmbran consists of a reference in the account of Blackpool Forge for 1709/10 to 40 tons of pig iron being 'in Alex. Phillips' custody at Comb.': Herefs. R.O., E12/VI/DFf/5, f.1.

<sup>123</sup>. BB a/c; Invergarry a/c.

<sup>124</sup>. SW a/c.

<sup>125</sup>. Revenue sales: *Cal. Treas. Books 1672-5*, 228 231 496-7; Hart 1971, 62; 1995, 165-6 177-8 202; Herefs. R.O., E12/VI/DCc/7-8; E12/VI/DDc/5-6; P.R.O., LR 4/1-2; other sales 1717-99: P.R.O., LR 4/3-18 *passim*.

<sup>126</sup>. P.R.O., E 112/29/24. John Witson of Bristol had five tons and William Colson of Bristol four tons per month. Each of the ironworks was making about 185 tons per year, but it is not stated what happened to the rest of the products.

<sup>127</sup>. P.R.O., C 2/Chas.I/J5/12.

there. Apparently Hanbury was his assignee in bankruptcy, an office to which a principal creditor was normally elected, suggesting Glasbrooke had failed to pay John Hanbury as owner of the Pontypool ironworks for iron sold at Bewdley.<sup>128</sup>

Little is known of this trade for several decades. Indeed when Thomas Foley was in 1673 trying to mediate between his sons, Philip in the Stour valley and Paul in the Forest of Dean, he did not approve of Paul selling iron at in Philip's market, saying this 'had not been done all [Philip's] grandfather's time and his but perhaps upon a glut in the Forest'.<sup>129</sup> Certainly there is little sign in Philip Foley's accounts that in 1669 his father was selling bar iron made in the Forest of Dean through the family's Bewdley warehouse.<sup>130</sup> A little later when an agreement was reached between the brothers, Paul agreed not to sell bar iron from the Forest ironworks above Gloucester.<sup>131</sup> Thus for most of the 17th century Bristol and the Severn estuary formed a separate region for the sale of bar iron from the Midlands. In the 1690s and 1700s and probably from 1685 when Richard Avenant and John Wheeler took over Paul Foley's Forest ironworks, merchant iron from there was being sold at Bewdley, including some iron from Gloucestershire neighbours, such as George White of New Weir, but this generally amounted to less than 100 tons per year.<sup>132</sup> However between 1684 and 1701 Henry and then Benedict Hall of High Meadow, who owned Redbrook Furnace and Lydbrook Forges, were sending iron up the Severn, employing the *Thomas*, the *James*, and the *Welcome* of Redbrook to carry it. Nevertheless the total inward shipments of bar iron through Gloucester were only 250-300 tons in the 1680s and 1690s and 300-400 tons in the early 18th century.<sup>133</sup>

Upriver traffic in foreign (that is imported) iron did not exceed 60 tons per year until 1720, when 235 tons were sent up the river. Over 200 tons of foreign iron is only recorded in 1724 (263 tons), 1728 (382 tons) and 1765 (429 tons). However in the 1720s, a considerable part of the iron dispatched from Bristol was merely described as bar iron, and this peaked at a further 343 tons in 1728. Such cargoes had appeared for many years and some of them were probably of British iron, but it is impossible to be certain as to their nature. The import of substantial quantities of foreign iron to Bristol and freighting it to Gloucester thus seems to have been fairly new in the 1720s. This seems to be confirmed by the Bristol overseas port books, which show Swedish iron coming mainly from Holland in 1723, but direct from Sweden by 1731.<sup>134</sup> It is possible this trade has its origins in the disruption of established trade patterns caused by the embargo on trade with Sweden and the consequent dearth of imported iron around 1718.

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<sup>128</sup>. Locke 1916, 122-3 from P.R.O., C 8/66/87.

<sup>129</sup>. Herefs. R.O., E12/IV/BE/15.

<sup>130</sup>. Schafer 1978, 59 94-96 98-99. Comparison between these three accounts shows that Philip Foley bought 383 tons of pig iron from his father and several others also bought metal, some of which passed through the accounts at the Bewdley warehouse and some did not. However the purchasers were the owners of forges (rather than ironmongers), which (with the price) confirms that it was pig iron.

<sup>131</sup>. Schafer 1971, 27.

<sup>132</sup>. Foley a/c.

<sup>133</sup>. *Gloucester Port Books Database*. The figures relate to iron coming from outside the port of Gloucester and so do not include iron from forges such as Lydney, Flaxley and Tortworth, which used ports such as Lydney and Berkeley that were within the port boundary of Gloucester.

<sup>134</sup>. *Gloucester Port Books Database*; P.R.O., E 190/1192/3; E 190/1207/2.

Little shipment of any iron is recorded in the Gloucester port books from the 1730s, but this is probably a consequence of what was recorded rather than of what was carried, since coastal bonds apparently ceased to be necessary for most cargoes within the Severn estuary.<sup>135</sup> However for the 1730s the accounts and letterbooks of Graffin Prankard of Bristol survive. He imported Swedish and Russian iron and sold considerable quantities, mainly of ordinary Stockholm iron to ironmongers and smiths in large parts of south Wales, the West Country and the Midlands. However, his largest customers were in (or close to) the industrial Black Country. They comprised two groups, steel converters and slitting mill owners. The steel converters included Thomas Tristram, Benjamin Harvey, and Francis Homfray all of Stourbridge and William Kettle of Birmingham. They mainly bought ore-grounds iron, which was the best grade for steel. The owners of slitting mills mainly bought the cheaper kinds of Russian iron (and sometimes large quantities of this). They included John Machin and Sampson Lloyd both of Birmingham, Edward Kendall (as owner of Cradley Mill), John Brindley (of Hyde Mill in Kinver), and the same Francis Homfray (as owner of Gothersley Mill in Kinver), as well as William Donne junior of Bristol who owned Combsbury [Congresbury] Mill in Somerset. In 1728 before Prankard first bought Russian iron, this group of customers were buying Gothenburg iron from him.<sup>136</sup> In 1732 he succeeded in buying a large part of the 12000 poods [180 tons] of Moscow iron that were exported from Russia that year and later negotiating for Millers [or Mullers] iron, probably from Olonitz.<sup>137</sup> All of this was no doubt destined for the slitting mills.

Rather less is known of the trade subsequently. In the 1740s Mullers iron appears in the accounts of Edward Knight & Co. They sent it, along with their own iron, to slitting mills and sold it as rod iron. These imports did not continue into the 1750s, but their partner Abraham Spooner may have taken them over on his own account. Certainly his son Isaac Spooner was importing through Bristol Swedish and Russian iron in 1789.<sup>138</sup> In 1754 R.R. Angerstein railed in his diary against Knight and Spooner for not buying ordinary Swedish iron for nailmaking.<sup>139</sup> Between 1763 and 1765 the Gloucester port books record 17 voyages from London with iron, mostly Russian and mostly accompanied by old iron, cast iron and iron shot. Certain of the shipments were in the name of Theodosia Crowley & Co. and all may have belonged to them.<sup>140</sup> Similarly nearly 700 tons of iron from Stockholm and 190 tons from St. Petersburg, imported by W. James for Isaac Spooner of Birmingham though Bristol in 1789, must have gone up the river.<sup>141</sup>

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<sup>135</sup>. Cf. Hussey *et al.* 1995, 9-10

<sup>136</sup>. Prankard a/c and l/b; Tristram was a 'steelmaker': Chambers 1988, 88; Harvey had a forge at Stourbridge: Worcs. R.O., b705:68 BA 309/4; cf. *V.C.H. Staffs.* xx, 55 60; Harvey & Homfray (as steelmakers): Dudley Archives, D/Pit/7/4; Perry 2001, 129; Kettle: Rowlands 1975, 31 74; Barraclough 1984(1), 95; Machin: Warws. R.O., CR 169/95-107; *V.C.H. Warws.* vii, 256; Pelham 1963, 71-2; Lloyd: Lloyd 1975, 101-24; Kendall: Dudley Archives, DE4/3, Rowley leases 1724; N.L.W., Hawarden 919; Brindley: Cooksley 1981; Homfray (for slitting mill): *V.C.H. Staffs.* xx, 146; cf. Herefs. R.O., E12/VI/KY/6-9; E12/S/30 [Kinver VIII]; Combsbury: Prankard a/c, 27 Jul. 1734; June 1736; *J.H.C.* xxii, 854; information from Mrs G. Bedingfield, citing Weston super Mare L.S.L., notes of Preb. Alex Cran, private deeds and P.R.O., PROB 11/917, will of William Donne.

<sup>137</sup>. Prankard l/b, 23 Feb. 1731/2 13 May and 7 Aug. 1732.

<sup>138</sup>. Ince 1991b, 19; SW a/c, pages entitled 'Making iron at all forges' and 'Mullers iron'; for Isaac Spooner see note 141.

<sup>139</sup>. Floren & Ryden 1996, 286-7.

<sup>140</sup>. *Gloucester portbooks database.*

<sup>141</sup>. P.R.O., E 190/1239/1. The imports were by 'W. James for Isaac Spooner'. Some of this may have been ore-grounds iron for making steel: cf. King 2003.

In the 18th century foreign iron for Midlands manufacturers was also imported through Hull and came up the river Trent, particularly after that river was made navigable up to Burton. Some of this was processed in slitting mills in the Trent valley. The importers in the late 18th century included brewers at Burton, for whom it was a return cargo for beer exported to Russia.<sup>142</sup> However most of the imports were handled by Hull merchants, such as successive heads of the Maister, Sykes, Mowld, and Williamson families. Their customers also included manufacturers and steel producers at Sheffield, but unfortunately, there is no means of determining the respective shares of Birmingham, Sheffield, and other places in these imports.<sup>143</sup>

### *Charcoal purchasing agreements*

The raw materials consumed by Midland forges were not only pig iron, but also charcoal. The mid 17th century system of local monopolies (described above) enabled ironmasters to control the price of wood. However the break-up of these large vertically integrated enterprises in the latter part of the 17th century presented a new challenge to the ironmasters, in that they no longer enjoyed a local monopoly in buying wood, as they had when they only had relatively distant rivals. As G. Hammersley pointed out it was generally not economical to carry charcoal more than a few miles by land.<sup>144</sup> The new situation demanded new solutions. The first solution to this challenge was for ironmasters bilaterally to agree boundaries beyond which they would not buy wood. The first of these arose out of the rivalry between Philip Foley and John Finch of Dudley, a member of an important family of ironmongers, who had also become an ironmaster.

John Finch's business probably owed its origin, at least in part, to the furnace which Dud Dudley built at Dudley in the late 1660s in his final attempt to fulfil his long held ambition to make iron with pitcoal.<sup>145</sup> Finch (one of the partners in it) converted Stourton Mill to a forge in 1670 and built another next to Cookley Mill about the same time. Additionally, he had forges (probably plating forges) at Kings Meadow and Clatterbatch in Stourbridge. There was also a furnace at 'Sudley', probably at Sudeley Castle near Winchcombe, in which Andrew Yarranton had an interest. The latter seems a strange place to build a furnace as it is neither close to navigable water nor to a source of ore, though there may well have been wood available cheaply. If 'Colonel Archer' was a partner there (as implied), it is likely that the forge built by Thomas Archer of Umberslade (Warws.) at Ruin Clifford near the mouth of the Warwickshire Stour in 1673 also belonged to this partnership.<sup>146</sup>

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<sup>142</sup>. Owen 1978, 113-4; *cf.* Hull port books; and see chapter 3.

<sup>143</sup>. Jackson 1972, *passim*; Hull port books; King 2003.

<sup>144</sup>. Hammersley 1973, 608.

<sup>145</sup>. King 2002a, 34-5; 2002b, esp. 47-50; P.R.O., E 112/538/94, dated Hilary Term 1674/5.

<sup>146</sup>. King 2002a, 34-5; King 2002b, 48-50. The identity of 'Sudley' is wholly clear. Yarranton was trying to sell his share in Sudley (or Shudley) Furnace to Philip Foley in 1673, but was also negotiating with Colonel Archer and John Finch. He met Finch at Winchcombe in October 1673. A furnace near Winchcombe is mentioned in September 1674 and another document names woods in that area. Accordingly a location near Sudeley Castle seems to be implied: Skippe's diary, 6 Sept. 1674. Stourton: Herefs. R.O., E12/VI/KE/28; Clifford: *V.C.H. Warws.* iii, 269; Shakespeare Birthplace R.O. (Stratford), DR37/264. See also next note. Yarranton was trying to raise money to invest in the Stour Navigation, for which see below and: Staffs. R.O., D(W) 1788, Stour navigation documents; Parker Oxspring.

The rivalry between Finch and Foley was evidently intense and damaging. At a meeting with Finch at Winchcombe, Yarranton 'prevailed with him to give me a paper to Ambrose [Crowley] to authorise him to agree with Mr Foley'. Yarranton and Crowley went to Prestwood (Foley's house) to meet him and most of Foley's clerks, and two agreements were reached. One of these related to exchanging Stourton and Wolverley Forges. In the other, Finch undertook to sell to Richard Avenant and John Wheeler (then Foleys' clerks) all charcoal or iron he bought or made (other than in specified places) at unrealistically low prices. The intention was probably to discourage Finch from buying or making anything that would be liable to be sold under it. This applied to any pig iron 'made with charcoal' at Dudley Furnace, any bar iron that he made except at Cookley, Stourton, and Wolverley Old Forges and (with exceptions) any wood he bought within seven miles of Foley's forges. However Finch was free to buy wood in certain more distant parishes. These events had been preceded by Finch entering into a provisional agreement with Sir William Child of Kinlet to lease his woods for £300 per year, with a premium of £1500 in advance. Child foolishly offered Foley the opportunity to match the terms, thereby setting in train the events just described. The result was that Yarranton could write, 'Sir W. is an old child for things are so ordered that he must lose the £1500 fine and three shillings per cord at least, at least 32 years as the bargain was, will lose £3000'. The agreement 'was a great satisfaction to both parties'. 'After 12 bottles and all cheerfully merry, we parted'. Sir William Child's wood was bought by Foley the following March at nine shillings a cord.<sup>147</sup> Six months later Finch sold his ironworks to Sir Clement Clerke and Alderman John Forth. Just over a year later Foley agreed the sale to them of Grange Furnace and the four associated small forges (previously mentioned), and they agreed (exceptionally) to pay £2000 over and above the value of the net assets.<sup>148</sup> Cornish, Langworth and Sergeant took all the works over from Clerke and Forth in 1676, but in 1681 quit the business, which then passed to John Wheeler and Richard Avenant, who were by then independent ironmasters.<sup>149</sup>

Philip Foley's 1674 sale to Clerke and Forth was the first of a series, by which he disposed (at least temporarily) of substantially all of his ironworks. In each case boundaries were defined beyond which the respective parties agreed not to buy wood. Such limits were agreed in connection with the sale to Clerke and Forth of the Grange Works and on the sale of Hales Furnace and his Tame valley forges to Humfrey Jennens in

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<sup>147</sup>. King 2002b, 49 from Staffs. R.O., D(W) 1788/P61/B7, 17 Apr. 1670; P61/B5, 21 Oct. 1673, 12 Nov. 1673. The agreements made are Herefs. R.O., E12/VI/KE/31-33 50; Child's wood: *ibid.*, E12/VI/KD/19. R.G. Schafer (1971, 30) interpreted the agreements with Finch as concerned with genuine sales. In view of the low prices, such as £12 per ton for bar iron (then worth about £16), I am convinced it was intended that neither party should act so as to be obliged to make any sale under the agreement.

<sup>148</sup>. I cannot recall coming across any other case of a payment for 'goodwill' (as it is termed today) on any sale of ironworks in the 17th or 18th century. The nearest approach to one is where a payment was made on the sale of a lease where the vendor had erected buildings whose value he had been writing off by annual instalments in his accounts, a process still incomplete at the time of the sale, as when Bodfari Forge was sold to Thomas Hart and William Burslem in 1709 (Herefs. R.O., E12/VI/MDf/9; *cf.* King 1993, 7) or where a substantial fine (also called a premium) had been paid to a landlord on the grant of a lease, this being in effect an advance payment of rent in a lump sum.

<sup>149</sup>. Schafer 1971, 29-31 35 from Herefs. R.O., E12/VI/KD series; P.R.O., E112/502/77. The 1674 sale took the form of an assignment of some works, and a 21 lease of others (where Foley was freeholder); however the whole transaction was subject to a break clause at seven years (as we would call it today), whose exercise vested the whole business in Foley again. A further complication to Clerke and Forth's business was that they separately agreed to (but did not) complete making the river Stour navigable. That troubled business is mentioned briefly below, but cannot be discussed in detail here: see Staffs. R.O., D(W) 1788, Stour navigation documents; Parker Oxspring; I hope to deal with that subject elsewhere.

1676, though in this case they were to be set out afterwards by the parties' clerks.<sup>150</sup> No boundaries were set out when he sold Brewood Forges to William Mansell in 1678,<sup>151</sup> no doubt because boundaries already existed with Jennens to the east and Cornish, Langworth and Sergeant to the south. In 1682, after Hales Furnace had come into the hands of John Wheeler and Richard Avenant jointly with John Downing (who had long been the clerk there), an agreement was made between them and Jennens for the latter to buy 150 tons of pig iron per year, and again a detailed boundary was defined. Jennens made a similar agreement with Downing and his son Zachary in 1692 for 100 tons of pig per year, but in autumn 1704 Zachary Downing complained, 'a short time after the sealing and delivery of the articles [of agreement] and on occasion of the wars then arising and the difficulty of the coming of forren iron and other accidents not only the price of iron but also the price of wood in the countries about Hales Furnace ... did considerably rise' from five to six shillings per cord to nine shillings or more. The Downings were tied to a fixed sale price for pig iron when the cost of wood was rising, and were trying to find a way out of the agreement. Jennens in reply set out the agreed bounds, and stated that the prices paid for wood on his side of it were much the same and that he had had to fetch his charcoals from up to 10-12 miles away.<sup>152</sup> The increased duty imposed on iron imports around this time must also have contributed to the rise in home prices.<sup>153</sup> However, this system of districts where one ironmaster was accorded exclusive wood purchasing rights by his neighbours was inevitably an inherently unstable one: the agreements were for fixed periods that expired, after which the agreements had to be renewed. Those for Hales Furnace were linked to the sale of its pig iron and to the term of successive furnace leases. The acrimonious end to the agreement between Jennens and Downing points to its not being renewed, and it is not clear how quickly this system was replaced by a new one of the regulation of the industry by quarterly meetings (of which more below).

This period in the late 17th century was also one when additional forges were being built in the Stour valley. As already indicated, this was a counterpart to the expansion of pig iron production in the Forest of Dean and of trade in pig iron on the river Severn. It also coincides with the time in the 1660s and 1670s when Andrew Yarranton was attempting to make the river Stour navigable on behalf of Thomas Lord Windsor, Sir Samuel Baldwin, and others. The question arises whether these events were connected or merely coincidental. The navigation scheme was under-capitalised and was ultimately unsuccessful. Despite hopes that it could be used for the carriage of iron and charcoal, there is no evidence of its being used for anything but coal. The construction of Wolverley Lower Mill (built in 1669 as a combined forge, slitting mill and tinplate works) was certainly a result of the scheme, the mill being sited specifically so as to enable boats to get past a shallow ford. Philip Foley and Joshua Newborough as its owners were permitted by the navigation proprietors to erect it in consideration of constructing a lock.<sup>154</sup> There was apparently a similar agreement with John Finch in respect of Cookley Forge, which was probably built around the same time alongside William Winchurst's slitting mill

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<sup>150</sup> . Herefs. R.O., E12/VI/KD/11; E12/VI/KD/5.

<sup>151</sup> . Herefs. R.O., E12/VI/KBc/39-44.

<sup>152</sup> . P.R.O., E 112/880/41.

<sup>153</sup> . Statute 2 W. & M., sess. 2, c.4; Ashton 1924, 105.

<sup>154</sup> . King 1988, 104.

there.<sup>155</sup> However Finch's earlier substitution of a forge for Stourton (corn) Mill appears to have been his own idea rather than Yarranton's.<sup>156</sup> Yarranton sometime prior to autumn 1673 considered replacing a walk mill at Mitton, 'driven quite down' by the flood when a pool broke in April 1670, with a forge to be built in partnership with his son-in-law Tom Cole, but nothing came of that and the two forges there were built by members of the Willmot family some years later.<sup>157</sup> While it is clear that Yarranton was at pains to exploit any opportunity he could for the benefit of the navigation, it is probable that the construction of the forges in the same period was largely a coincidence. Certainly the construction of Wilden, Wolverley Old, and Whittington Forges took place long before the navigation scheme was devised.<sup>158</sup>

In granting a lease of ironworks it was common for the landlord also to agree to sell all the cordwood from his coppices, or so many cords per year from them. Sales were generally at a fixed price per cord, for example, at Bringewood in 1614, Blackpool in 1635, and Hales in 1742.<sup>159</sup> In the Midlands and south Wales in the late 17th century, similar bargains between ironmasters and other landowners of substantial quantities of wood were also common. Thus Sir William Morgan of Tredegar sold 3000 cords of wood at Kilfiggin in Llanbadog (Mons.) to John Hanbury in 1640, and Thomas Morgan sold half a wood in Llanon to Thomas Erbury of Merthyr Tydfil in 1635.<sup>160</sup> The Foley archive contains agreements and consequent accounts relating to many such bargains in the Midlands. For example Thomas Foley bought wood (for example) from Sir Richard Leveson and then sold some of it on in April 1654 to his fellow ironmasters, Thomas Fox of Muxton and Robert Slaney of Shifnal, as well as (presumably) using some at his own Wombridge Furnace.<sup>161</sup> He or his wood clerks made similar purchases from many of the local gentry including Edward Littleton of Pillaton (Staffs.), Sir Walter Wrottesley, Sir William Whitmore, and others. The 1662 sale of wood from Lord Ward's estates around Dudley was made at the same time as the lease of Cradley Forge, but by a separate deed. These transactions often lasted several years, and sometimes involved an advance payment from the ironmaster to the landowner.<sup>162</sup> His son Philip Foley made similar purchases, but was sometimes buying wood at quite great distances, as from Thomas Thinne from near Caus Castle on Long Mountain and from Major Salwey of Richards Castle. Some of this was to supply Willey Furnace in the period when he was trying reduce his dependence on his brother for pig iron, and the two contracts just mentioned were sold on to other ironmasters after he disposed of Willey Furnace. A much less common arrangement was for the ironmaster to take a

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<sup>155</sup>. That there was an agreement for Finch to build a lock appears only from a letter of 1678 from Robert Chelsham, the ironworks manager for Cornish, Langworth and Sergeant: Staffs. R.O., D(W) 1788/P61/B7, 26 Apr. 1678. This probably implies the forge was built in about 1670 or 1671, Yarranton having persuaded instead of him to build there rather than converting Wollaston Mill to a forge, as had apparently been Finch's intention in April 1670: *ibid.*, 17 Apr. 1670. This was probably an exercise of the power granted to Yarranton to authorise the erection of ironworks and other mills, under the agreement that he made with the navigation proprietors in August 1670 for him complete the navigation: Staffs. R.O., D(W) 1788/P37/B5, 1 Aug. 1670.

<sup>156</sup>. Staffs. R.O., D(W) 1788/P61/B7, 17 Apr. 1670; *cf.* Herefs. R.O., E12/VI/KE/28-33.

<sup>157</sup>. Staffs. R.O., D(W) 1788/P61/B7, 17 Apr. 1670; D(W) 1788/P61/B5, 21 Oct. 1673.

<sup>158</sup>. King 1999a, 70 72-3. At Wilden the forge seems to have been built in 1647, there only being a slitting mill there previously: *cf.* Schafer 1990, 23. Wolverley Old Forge may date from 1651, if the original lease was for 21 years: *cf.* Herefs. R.O., E12/VI/KE/1. The forge was still a corn mill in the Parliamentary Survey of 1649: Cave & Wilson 1924, 162.

<sup>159</sup>. P.R.O., C 2/Jas.I/A3/31; N.L.W., Slebech 441; Knight 7158.

<sup>160</sup>. N.L.W., Tredegar Park, 75/1; 70/352. This sale to Erbury is the last evidence of iron being made in northern Glamorgan in the 17th century.

<sup>161</sup>. Herefs. R.O., E12/VI/KAc/18-20 35B 45 94-98

<sup>162</sup>. Herefs. R.O., E12/VI/KAc/*passim*.

lease of the woods, such as was agreed provisionally between Sir William Child and John Finch in 1673. Philip Foley leased Sir Henry Lyttelton's woods in Upper Arley (Worcs. formerly Staffs.) in 1671 and then Andrew Yarranton's Alton Woods in Rock (Worcs.) in 1672.<sup>163</sup> Such leases hardly existed at other dates and may have been a consequence of the extreme competitive situation already alluded to.

There is much less evidence of such sales by written contract in the 18th century, other than where they were part of the arrangements for leasing ironworks, in circumstances where they were probably merely a continuation of earlier ones. It is conceivable that the dearth of such contracts is more a result of what has survived, rather than of what was agreed. That there are none in the Foley archive after the 1670s is a result of the subsequent history of those ironworks, for in the 1690s the management of their 'Ironworks in Partnership' was entrusted to John Wheeler and contracts would have been made in his name and kept by him as manager.<sup>164</sup> However it is probable that they had become less necessary due to new organisational arrangements within the industry, which will be described in the next section.

Arrangements were slightly different in other parts of the country. In north Lancashire an agreement was reached in December 1714 between the Cunsey and Backbarrow Companies that their wood clerks would cooperate in buying wood, providing their furnaces with 1500 loads of charcoal alternately. The two companies also leased rival (bloomery) forges, sharing the cost of the dead rents equally. This agreement was still in operation in the mid 1720s.<sup>165</sup> In March 1735/6 there were articles as to working Coniston Forge jointly, and a year later they jointly agreed to build Duddon Furnace, but the Backbarrow Company sold their share to the Cunsey partners in 1741.<sup>166</sup> A third furnace, Nibthwaite had by then been built in the district in 1735 and its owner persuaded neighbouring landowners to supply him with charcoal at a guinea a load for seven years. In 1748 it appears that the local wood owners led by William Penny of Penny Bridge rebelled against the low prices they were getting and promoted a rival furnace at Pennybridge. The gentlemen who built this furnace then offered to contract to buy charcoal for 30 years at 34 shillings per load with adjustments according to the place of delivery and for changes in the Bristol price of pig iron. 184 landowners subscribed to sell charcoal thus. The owner of Backbarrow then offered to amalgamate his business with Pennybridge. This probably left Cunsey Furnace with little fuel and its owners (henceforth known as 'the Duddon Company') sold it to the Backbarrow and Pennybridge Company. By 1781 there were three other companies each operating one furnace, and they agreed that the available charcoal should be split equally between them for 17 years and set boundaries for buying it. Later correspondence indicates the charcoal price was varying with the

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<sup>163</sup>. Herefs. R.O., E12/VI/KC/*passim*; E12/VI/KBc/27-38; cf. *V.C.H. Shrops.* viii, 297-318.

<sup>164</sup>. Management (as opposed to proprietorial) records for the Foley ironworks generally do not survive for this period, the archive comprising little except annual accounts and partnership agreements: Herefs. R.O., E12/VI/DEc DEf DFf DGc DGf.

<sup>165</sup>. Lancs. R.O., DDMc 30/17.

<sup>166</sup>. Lancs. R.O., DDMc 30/40; DDSa 38/3. However Miles Troughton of Sowley in Hampshire probably had a share in Carr and Duddon Furnaces in 1740, which he probably obtained as part of arrangements for procuring cast iron ballast to supply to the Navy: ADM 106/927, from Miles Troughton 25 Feb. 1739/40 8 and 21 Apr. 1740. I owe these references to Jeremy Greenwood.

#### 4. THE ORGANISATION OF IRON PRODUCTION

Figure 4.1 Iron and charcoal prices compared

Charcoal Prices/PriceCh

iron price as at fixed ironmasters' Quarter Day meetings.<sup>167</sup> What these Quarter Days were will appear in the next section.

The fluctuation of wood prices with those for iron was fairly general. This is quite obvious when the sale price of iron is plotted against the charcoal cost for forges in the Stour valley in north Worcestershire (see figure 4.1). Provision for the variation in price to be paid for cordwood is expressly contained in a contract for the sale of wood at Welch Bicknor (Mons.) in 1615 and in the lease to Rowland Pytt of Aberavon Forge (at Port Talbot) in 1747.<sup>168</sup> Similarly, the obligation to fulfil contracts for wood entered into at high prices, when iron prices (in this case for ordnance) were high, led to a series of bankruptcies of the important Wealden ironmasters and gunfounders, Richard Tapsell and John Churchill, when the Board of Ordnance greatly reduced both the quantity required and price of ordnance at the end of the Seven Years War.<sup>169</sup>

### *Regulation by ironmasters' meetings*

The picture, painted in a preceding section, of the iron industry as it emerged into the 18th century might appear to be one of industrial chaos. Unlike the Swedish iron industry (and to the surprise of Swedish visitors), the English iron industry was almost entirely free of state control.<sup>170</sup> The only attempt to regulate it took place in 1636 while Charles I was ruling without Parliament. He set up an office for marking iron, allegedly as a quality control measure, but actually to provide the crown with a small sum in revenue. However, the attempt failed and 'according to His Majesty's especial direction' the patent creating the office was revoked in 1638 along with several others, including one for compounding for the destruction of woods in ironworks, as 'very grievous and burdensome to the subjects'.<sup>171</sup> Otherwise the only control was in the form of the criminal sanctions over what wood could be used to make iron, discussed at the beginning of chapter 3.

Instead there was a form of self-regulation. The existence of a series of ironmasters' meetings or associations in the late 18th century and the 19th was recorded by T.S. Ashton and more recently by A. Birch,<sup>172</sup> but this system went considerably further back than that. Unfortunately no minute books or other internal records of such associations before the late 18th century survive, and details of their earlier operation are only available from passing references in other material. However, such meetings were certainly taking place regularly by the 1720s, when there were quarterly meetings at Stourbridge.<sup>173</sup> Half-yearly meetings were evidently held at Bristol before the two fairs there. In February 1717/8 (during the embargo on Sweden), Lord Mansell's steward reported that he had attempted 'to learn the rates of iron at the fair but the rate was not fixed (as usual) at the meeting'.<sup>174</sup> These fairs were like a market, but on a much larger scale. Much of the business was

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<sup>167</sup>. Fell 1908, 142-57.

<sup>168</sup>. P.R.O., C 115/D24, no. 2077; N.L.W., Penrice and Margam 5082.

<sup>169</sup>. Hodgkinson 1996b, 160-4; P.R.O., WO 47/81, 236.

<sup>170</sup>. Hammersley 1976; for Sweden: Hildebrand 1957; 1992; 1995; Nisser 1975; Attman *et al.* 1987.

<sup>171</sup>. *Cal. S.P.D. 1636-7*, 304 357 1022; P.R.O., PC 2/49, 209.

<sup>172</sup>. Ashton 1924, ch.7; Birch 1967, ch.6.

<sup>173</sup>. See next paragraph.

<sup>174</sup>. John 1950, 12; John 1943, 99.

wholesale and traders came from considerable distances. The Bristol fairs performed this function for the West Country and south Wales, just as Stourbridge Fair (outside Cambridge) did for eastern England.<sup>175</sup>

No earlier reference to price fixing than 1718 has been discovered, but it is clear there were regular times for settling accounts and generally doing business. Henry Glover was certainly attending the Bristol fairs in 1677, as he had to break off protracted negotiations with the Company of Mineral and Battery Works concerning their lease of Tintern and Whitebrook wireworks to Thomas Foley II of Witley, because he had to prepare for Bristol Fair.<sup>176</sup> The previous winter Glover wrote a long letter to Paul Foley reporting his inspection of the latter's Forest ironworks on his way home from Bristol Fair.<sup>177</sup> The Foley manuscripts include a series of papers relating to the collection of debts from Bristol ironmongers in the 1660s and 1670s, but this seems to refer to debts for nails sold them by Henry Glover, Robert Foley and George Gibbons, and assigned to Paul Foley towards their own debt to him, rather than to sales of bar iron.<sup>178</sup> However there is a similar series of papers in the 1670s, showing the amounts owed by Birmingham ironmongers, but this time presumably referring to bar or rod iron. These latter give quarterly balances due and bear dates some days after the usual quarter days.<sup>179</sup> This suggests that a balance was struck in the account books each quarter day, payment being sought a few days later. Ironmasters' quarter days were still different from the normal ones in the 19th century.<sup>180</sup>

It is likely that the price-fixing role began in connection with the fixing of maximum prices for wood following the breakdown of the system of boundaries described in the previous section. In the 1720s Henrik Kahlmeter, a Swedish visitor, recorded that the ironmasters met at Stourbridge on the first Friday after Twelfth Night and monthly thereafter.<sup>181</sup> The choice of Stourbridge may in itself be significant, for that was the place where Richard Foley II lived and from where Henry Glover and then John Wheeler managed the Foley iron business. Furthermore the meetings took place in the Talbot Inn, which was next door to Richard Foley's house and owned by him.<sup>182</sup> John Kelsall, as clerk of Dolobran Forge in the 1720s, regularly attended these Stourbridge meetings 'dining with the ironmasters'.<sup>183</sup> In 1729 Graffin Prankard was severely alarmed by the ironmasters having reduced the price of iron. He therefore reduced the size of his order for iron to Francis

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<sup>175</sup>. As to fairs generally see Cameron 1998, esp. 28-53 131-52; for Bristol Fair see Minchinton 1954, esp. 80; Morgan 1993; 100-1; Prankard l/b and a/c, *passim*; the latter very clearly indicate that Bristol's sphere of influence stretched as far as Pembrokeshire and north Devon.

<sup>176</sup>. Minutes of Company of Mineral and Battery Works: B.L., Loan 16/2, f.174.

<sup>177</sup>. Herefs. R.O., E12/VI/DDc/11.

<sup>178</sup>. Herefs. R.O., E12/VI/Daf/3-15.

<sup>179</sup>. Herefs. R.O., E12/VI/KBf/62-71.

<sup>180</sup>. Note the mention in the early 19th century of the dates 24 October, 15 July, and 19 April in Smith 1978, 7 10 n.83. These are all about three weeks after the usual quarter days, which approximates with what was reported much earlier (see next paragraph).

<sup>181</sup>. Hildebrand 1958, 28.

<sup>182</sup>. For the location of their meetings see Davies 1939, 51-2. Henry Glover was always described as 'of Stourbridge': e.g. Herefs. R.O., E12/VI/KE/1; John Wheeler was living at Wollaston, about a mile outside the town by 1685: Herefs. R.O., E12/VI/DDc/3. There seems to be some confusion as to the exact identity of Richard Foley's house (e.g. Perry 2001, 40). It seems he owned two adjacent houses, the Talbot Inn (now Hotel), which he left to his son John and then passed to Samuel, and The Brick House, which he probably settled on his son Robert: deeds in private hands; Palfrey 1927, 9-11; Herefs. R.O., E12/II/1/5; E12/S, Stourbridge. The latter, of the south side of the inn is a fine building, whose ground floor has been converted into shops and whose upper floors are now used as additional bedrooms for the hotel.

<sup>183</sup>. Lloyd 1975, 49; Davies 1939, 51-2.

Jennings (his factor in Stockholm) and told him to fill up his ships with tar and deals. The ironmasters' decision seems to have been made because the market was over-stocked with iron, as a result of the amount imported. Subsequently Swedish prices also fell and Prankard was able to continue importing iron.<sup>184</sup> Similarly Edward Knight warned Sampson Lloyd, the Birmingham ironmonger, of a price increase by 'the ironmasters' in autumn 1731. Other mentions make it clear that there was by this time a regular system of fixing iron prices.<sup>185</sup>

Many of the early signatures of ironmasters, including those of John Mander, George Draper, Edward Kendall, George Draper, Edward Knight, and Thomas Pendrill, to the 1737 petition to Parliament for protection from competition (as recorded by the Yorkshire ironmaster by William Spencer) are likely to have been collected at a Stourbridge ironmasters' meeting. This suggests that they were responsible for starting this agitation. Though even less is known of the petition that led to a Commons debate in 1718 (as to whether the embargo on Swedish imports should be lifted), some trade organisation may lie behind it. The petition to the Privy Council in 1668, seeking protection for the industry from imported Swedish iron was expressed to come from many counties, but these did not include Worcestershire, Gloucestershire, and Herefordshire, where Thomas Foley was the principal ironmaster, suggesting that Foley was not a petitioner. However it is possible that the signatures contributed from Shropshire, Staffordshire and Warwickshire ironmasters, as well as those of Nottinghamshire and Derbyshire (if Humfrey Jennens signed) may have been collected at such a meeting, but this cannot be proved.<sup>186</sup> Similarly the agreement for several ironmasters and others in 1665 to sponsor Andrew Yarranton's tinplate experiment may have arisen out of such a meeting.<sup>187</sup>

A price for coldshort pig iron was certainly being fixed in the 1730s and 1740s, as the fluctuation of its price was used to determine that for wood supplied under successive leases of Aberavon Forge in the 1730s and 1740s.<sup>188</sup> In the 1760s Robert Morgan of Carmarthen apparently sometimes attended the Bristol meetings, but in 1761 appointed a 'plenip[otentiary]', whom he instructed to oppose any decrease in price, telling him that as he (Morgan) had more forges than anyone else except Mr Pytt, he ought to have the first or second vote. Morgan was alarmed because 'the Great Mr Knight [Edward Knight of Wolverley] has fallen iron by more than 30 shillings and they say it will fall more,' but he seems to have found that the better quality iron he made did not fall correspondingly. This was a few years after the opening of Horsehay and other coke furnaces in Shropshire, which had provided a new cheaper source of the coldshort iron that was used to make nails, thus enabling the price differential between tough and coldshort to increase. However this points to the important role played by successive members of the Knight family, who were the greatest ironmasters of their time both in terms of the number of works and their output.<sup>189</sup> When Richard Crawshaw and Joseph Stanley, London

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<sup>184</sup>. Prankard l/b, 10 Mar. 1729; cf. 30 Sep. 1728 to A. Lindebergh and *passim*.

<sup>185</sup>. Rowlands 1975, 72-3.

<sup>186</sup>. 1668 and 1737 petitions: King 1996b, 24-31 (where this subject is discussed in detail); 1718: Cobbett's *Parliamentary History* vii, col. 548-50.

<sup>187</sup>. Staffs. R.O., D(W) 1788/P61/B5, 20 Mar. 1666/7.

<sup>188</sup>. N.L.W., Penrice & Margam 5695 5082.

<sup>189</sup>. Morgan l/b, 22 Jan. 1761 2 and 20 Jul. 1761 2 Nov. 1761 etc. As to the Knight family see Ince 1991b and above. As to Horsehay etc.: Trinder 2000, 29-39.

'merchants and manufacturers of iron' appeared before the Board of Trade in 1785 in connection with the Irish Proposals and were asked what the price of iron was he replied, 'Best English iron made by Mr Knight and many others is by the last quarterly meeting of ironmasters at Stourbridge fixed at £19 per ton [and] ordinary mill bar at £14.10s. per ton.'<sup>190</sup> It is likely that the ironmasters were also agreeing maximum prices to be paid for wood. Alternatively its price may have followed naturally from the price of iron. Such a fluctuation of the wood price with that of iron has already been mentioned in relation to Furness from 1748 and (as mentioned) was expressly provided for in the lease of Aberavon Forge in 1747.<sup>191</sup>

It is to be presumed that these ironmasters' associations were responsible for defining new grades of iron such as 'best best', which Edward Knight began to make at Cookley Forge in 1785,<sup>192</sup> and the various numbered varieties of foundry pig iron, which are mentioned in the accounts of Old Park Ironworks in the early 19th century,<sup>193</sup> for prices can only have been fixed for different grades if those grades were adequately defined. It seems clear this regulation of the market was not capricious, or an attempt of the stronger ironmasters to drive out the weaker ones in order to monopolise it, but a genuine effort to create an orderly regional market without cut-throat competition.

Price fixing mechanisms continued into the 19th century. With the growth of the south Wales industry a Welsh Quarterly Meeting was instituted at Abergavenny in 1802. A Yorkshire association was established in 1799. The Shropshire ironmasters met at Shifnal, but apparently to agree a common position to be adopted by them at the Stourbridge quarterly meeting a few days later. Furthermore at times joint meetings of representatives of the various associations were held at Gloucester to coordinate action between them. The agreement was sometimes to restrict production and enhance prices, something which the Swede Angerstein reported being done in the early 1750s.<sup>194</sup> About 1871, a separate Marked Bar Association was formed, whose members were the producers of the best quality iron, such as John Bradley & Co. of Stourbridge.<sup>195</sup> There was also an association of nail ironmongers, whose minutes survive from the 1850s, but which may go back at least to the 1780s, for a meeting of nail ironmongers was called at Stourbridge in March 1782 to petition against a proposed tax on land and water carriage.<sup>196</sup> However most of these events lie at the end of or beyond the period of this study.

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<sup>190</sup> . P.R.O., BT 6/112, f.227; *cf.* BT 6/106, 2 Mar. 1785.

<sup>191</sup> . N.L.W., Penrice and Margam 5082.

<sup>192</sup> . Knight 6758.

<sup>193</sup> . OP a/c.

<sup>194</sup> . Ashton 1924, ch. vii; Birch 1967, 104-18; Smith 1978; Angerstein: Hildebrand 1958, 28.

<sup>195</sup> . Mutton 1973b, 127; 1976.

<sup>196</sup> . Willetts 1996, 7. The author exhibited the minute book a few years ago in Stourbridge Library. *Aris' B'ham Gaz.* 18 Mar. and 25 Mar. 1782; *cf.* Downing 2001, 41-50.

***Conclusion: The return to integration***

The adoption of the new processes of puddling and rolling inevitably brought about changes in the industry. Some of the largest slitting mills such as Whittington, Hyde and Stourton, all on the river Stour, were adapted for rolling out puddled blooms into bar iron. Two of these belonged to the Homfray family and are likely to have rolled blooms made at their works at Penydarren at Merthyr Tydfil or Lightmoor in Shropshire. Whittington belonged to the Knight family, who also converted Wolverley Old Forge to a rolling mill in 1803.<sup>197</sup> That is a case of dis-integration within a business, but the main trend of the period was towards integration, with the whole ironmaking process being carried out in a single works containing both furnaces and forges. Thus melting fineries were built at Cyfarthfa in 1767 even before the furnace there, and others were built at Bradley by John Wilkinson, who also built a rolling mill near those furnaces in 1787.<sup>198</sup> In Shropshire puddling furnaces were progressively erected at Horsehay and Old Park. Eventually these two ironworks, which had hitherto supplied pig iron to forges throughout the Midlands, were merely supplying their own puddling furnaces. Thus, at Horsehay from 1806 and at Old Park from 1825 most pig iron was consumed within the works, rather than being sold to others.<sup>199</sup> As a result furnace accounts, which in the century and a half after the Civil War constitute an important source for the histories of forges, cease to be such.

The transition was made possible by the iron industry having replaced renewable energy sources with a non-renewable ones. Water-power from rivers was replaced by power from the improved steam engines developed by James Watt in the 1770s and 1780s.<sup>200</sup> These used steam generated from slack from collieries, and the fuel both for blast and puddling furnaces was coal from those same collieries, whence also came ironstone. Thus the resources for the whole process came out of the ground on which the ironworks stood, and it only added to costs if different parts of the process were dispersed across the countryside. This is in marked contrast to the earlier period when dispersion enabled the charcoal resources of a region to be used more efficiently.

The reliance on coal as a fuel meant that the coke-fired ironworks companies of the Industrial Revolution often conducted extensive mining operations themselves. In contrast, in the preceding period ironstone was a by-product, albeit a valuable one, of coal mines, and it was unusual for ironmasters to be operating coal mines as well as making iron. As far back as the 1620s Henry Goreing (of Middleton Goreing & Co.) could not give up the Chartley ironworks when his partners wanted him to do so because amongst other things there was a 'bargain for ironstone from Mearheath at £32 yearly rent for divers years yet enduring'.<sup>201</sup> However Richard Foley was apparently mining coal in Coneygree Park at Dudley in the 1630s.<sup>202</sup> Ironstone for Hales Furnace

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<sup>197</sup>. Ince 1991b, 44.

<sup>198</sup>. Gross 2001, *passim*; 1790 list.

<sup>199</sup>. HH a/c; OP a/c.

<sup>200</sup>. Dickinson & Jenkins 1927, esp. 245-9.

<sup>201</sup>. P.R.O., C 2/Chas.I/M57/66

<sup>202</sup>. Dudley Archives, DE4/3, Dudley leases, 20 Mar. 11 Charles [1636/7].

in the middle of the 18th century was obtained from a number of coalmasters from all over the Black Country.<sup>203</sup> Even the Coalbrookdale Company, who did use coke, initially obtained their raw materials from Richard Hartshorne and others, but may have been managing mines themselves from 1727 when they started paying for 'getting coal' from William Hayward's mines at Colmore in Little Wenlock. Certainly in 1755, when they were about to build Horsehay Furnaces, some of the partners leased the Lawley coalworks to supply their furnaces, as well as mines in Dawley leased in 1753 with the Horsehay site.<sup>204</sup>

This chapter has presented a rather more complicated organisational development of the iron industry in England and Wales than has previously been suggested.<sup>205</sup> In a sense the re-integration of the industry in the 19th century was a reversion to the practice of the 16th century when furnaces and forges were commonly on adjacent sites. The industry had thus taken two centuries or so to go full circle from integration of the process to dispersion and back to integration. More specifically it had gone from a mass of small vertically integrated businesses, through a period of dispersed ironworks in large regional monopolies, followed in some areas by fragmentation into single ironworks or small non-integrated groups, and finally back into vertically integrated businesses usually on single sites. The regional partnerships had persisted in the North, sometimes with an increased degree of integration, but not in the Severn basin where independent forges and (to a lesser extent) furnaces could operate successfully buying and selling pig iron on the open market, something which was facilitated by the development of a trade in pig iron on the Severn in the 17th century. This organisation also avoided the necessity of having a general manager, who had been needed to supervise the whole business in the period of regional integration, with a consequent saving in overheads. Moreover, once all the necessary resources could be obtained from the tract of mineral ground on which the ironworks stood, the need for the relatively complicated economic organisation of the industry, which marks the industry in the 18th century, disappeared. None of this however explains why it took so long for mineral coal to replace charcoal as the fuel of choice. That question can only be answered from an examination of the accounts of the Coalbrookdale Works, and that will be the subject of the next chapter.

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<sup>203</sup>. SW a/c.

<sup>204</sup>. Shrops. R.O., 6001/330, 458 and *passim*; Wilts. R.O., 473/156, 10 Aug. 1759; Raistrick 1963, 70.

<sup>205</sup>. *E.g.* Hyde 1977, 15-18.