

ART. IX. — *Force Forge in the Seventeenth Century*. By BRIAN G. AWTY, B.A.

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AFTER 1564 tenants on the Duchy of Lancaster lands in Furness Fells were prohibited from manufacturing iron, except for domestic use, in order to preserve the woodlands there. This *bloomsmithy decree* remained in force until 1616. In 1613 James I authorized the sale of the Duchy lands in the Colton division of Hawkshead, reserving only the bloomsmithy rents to the Crown, and such trees as he should sell or dispose of within the following three years.

It was the great ironmaster William Wright¹ who first took advantage of this relaxation and among the forges that he was soon working in the area was one on Force Beck above Rusland Pool. A moiety of the forge was sold to him by John Sawrey of Sawrey on 16 March 1621 for £180, and the probability is that Wright had himself erected it and that the sale of half the interest in the forge to Wright was pursuant to the terms of an agreement already entered into between the two men for its building and operating. In 1629 Sawrey mortgaged the second moiety of the forge and other property to Rowland Dawson of Kendal for £203, repayment of the mortgage to be made in bar iron. Probably the mortgage was not redeemed because a deed to declare the uses of a fine and recovery in favour of Samuel Sandys of Esthwaite conveyed the interest in this moiety of the forge to the Sandys family in 1638.²

By the 1660s Wright's fortunes had declined and most of the Lakeland forges appear to have been in separate hands. This was certainly true in the case of Force forge. Accounts recently deposited at the Lancashire Record Office show that from 1658 onwards it was being worked on behalf of the Fells of Swarthmore by Thomas Rawlinson, son of William Rawlinson of Graythwaite.³

Much to his father's distress, Thomas had been a convert to Quakerism in 1653, a fact reflected in the accounts, which are dated in Quaker style throughout. He was one of the *First Publishers of Truth* in Durham, and his letters to Margaret Fell at Swarthmore Hall whilst he was companion to George Fox and James Naylor in the south of England are cited on several occasions by William Braithwaite in *The beginnings of Quakerism* (London, 1912). His accounts cover the period 1658 to 1663, and whilst we do not know what brought him to the forge, apart from his close connexion with the Fell family, we do know one of the reasons for his departure, because the date of the inventory drawn up when he handed over his charge to the new clerk, Reginald Walker, is 15 May 1663, which was also the date of his marriage. We owe the survival of the accounts to the fact that Rawlinson's stewardship of the forge resulted in a dispute between him and the Fell family. Some account of this is given by Isabel Ross in *Margaret Fell, mother of Quakerism* (London, 1949) and in February 1669 the Monthly Meeting at Swarthmore decided to "read a paper" at the three local meetings, evidently in condemnation of Rawlinson. The apparent lack of profit of the forge mentioned in the concluding section of this paper could well have been the occasion of the Fell family's discontent and another reason for Rawlinson's departure.

It seems from the accounts that the Fells took over the forge at the beginning of March 1658, and the first expenditure recorded was of one shilling “for one day waling at the dame per James Fell 4. 1. month 57 [58]”. The first entries continue to record payments by James Fell, and then Rawlinson says, “Imprimis at entery I received of James Fell the 16th of 1st month 1658 [*sic*] with disbursements and in oare and coals in money and for iron and on al accounts 80^{li} 00^s 00^d”. Further advances of another £70 altogether were received from Judge [Thomas] Fell in May, July, August and on 19 September. We know that Fell died on 8 October 1658, so it was from Margaret Fell and her daughters that further advances of £50 were received, and when indentures were finally made to convey the two moieties of the forge they were in favour of George Fell, the Judge’s son. The first moiety was conveyed on 22 January 1659 by Thomas Massocke of Cart Lane, near Grange, and the second by William Wright of Snab, near Gressingham, on 3 February 1659. Strictly speaking moieties seem not to have been involved, because the preliminary sheet of the accounts shows that of the £250 paid for the forge only £100 went to Massocke, £51 on 19 November 1658 and the remainder on 22 December, but the payment made to Wright on 11 February 1659 was of £150. We shall see later some indications of a continued interest of the Sandys family in the forge, so it may be that Massocke had conveyed only two thirds of the second moiety.

George Fell spent most of his time in London, had little sympathy for the religious enthusiasm of his mother and sisters and plays little part in the accounts, a situation recognised in June 1666 when he conveyed the forge to his sisters. As forge clerk Rawlinson was principally responsible to the widow, Margaret Fell, but several of her daughters are mentioned. The Fells continued to work the forge until 1681, when Thomas Lower and Mary (*née* Fell) his wife conveyed it to Rawlinson himself,⁴ after he had inherited his father’s Graythwaite estates.

The Forge

In the inventory of 1663 Rawlinson stated

when I came to itt, it was so much roten down and in a decay that no man could stand dry headed in no part of the forge when it raint, and belows and lether stopt, patcht and clouts, and al dames and going work and wheles much brocken down in many places and roten, and hutch and all wheels and cases and al implements and appurtenances in bad order.

For our purpose this is helpful, because the repairs, which averaged around forty pounds in each of the first three years, give us information about the forge which supplements valuably what is given in the inventory.

Force was a typical bloomery forge of the seventeenth-century Furness pattern. It produced iron not by the *indirect* process introduced into England from the continent around 1500, in which the ore was first reduced to pig iron in a blast furnace, but by a fully mechanised version of the earlier *direct* process. We may infer that this was the result of a perfectly conscious decision. The use of the indirect process in northern Ireland, and the use there of ores exported from Cumbria, argue against the supposition that the area was a technological backwater as far as iron manufacture was concerned. In any case much of the equipment at Force was so similar to that used in the indirect process that only workmen thoroughly conversant with that process could have designed it, and the terminology used was entirely that of the indirect process. Words of French origin such as *finery* (bloom hearth), *chafery* (string hearth), *loop* (bloom), *mackett*

(partly forged piece of iron),⁵ *hutch*, *drome* beam, *bray*, *hurst* and *cam* occur in these accounts or were used earlier in the area, and words such as “water post”, “prick post”, hammer “arms” (Fr. *bras*), “legs” (Fr. *jambes*), which remained a standard part of forge terminology into the nineteenth century at least, are also used.

The machinery of the forge was fully water-powered, the water from a dam with a system of water courses, great and little floodgates and a hammer gate being used to drive three water wheels. These were the finery and chafery wheels, which drove pairs of bellows at the finery and chafery hearths, and the hammer wheel, which drove the tilt hammer. New finery and chafery wheels were purchased from Adam Sandys in 1659, and in 1660 a new hammer wheel was constructed from wood trailed across Millom Sands on 5 May. Mention of the finery “trough” and its “penstock” indicates that at least the finery wheel, which was the one nearest the dam, was overshot. Although “waleing at the dame” was mentioned, both the inventory and statements in the accounts indicate that it was only the part of the dam in the vicinity of the floodgates that was walled. Other parts of the dam as well as large sections of the watercourses were constructed from sods and earthwork, faced where necessary with timber. When the new finery wheel and beam were installed in the summer of 1659 the opportunity was taken to do a major reconstruction of the watercourse and though stones were used in this work the major item listed was 478 horse draughts of sods, and much of the 27 days’ work by the carpenters may have been on the watercourse. The finery wheel case was of earthwork faced with planks and boards, but walled up the side near the dam. The part of the watercourse that carried the water off from the wheels was the *hutch*,⁶ and this was very often in need of repair, even the bottom of it being planked. This extensive use of timber agrees with illustrations of the period and also explains why traces of the bloomery forges have so largely disappeared.

The accounts throw no light on the construction of the two hearths and their chimneys. Loads of clay were acquired from time to time to build up the hearths, but there is no mention of metal plates such as formed the hearths of the true finery forges of the indirect process. Mention of a “lader to cary coales up on” may suggest that one of the coalhouses was in an elevated building or loft, rather than that any kind of tall hearth or furnace was in use. A later source of information on the forge is Sarah Fell’s household account book, dating from the 1670s, and in this we learn that in December 1675 the clerk of the forge paid £1. 1s. 6d. for the freight of six iron plates from Bristol to Grange,⁷ which suggests the installation of a plated hearth at this date.

Each hearth was served by a pair of water-driven bellows and it was this part of the apparatus that was most frequently in need of repair. The blast was obtained when the top bellows board was depressed by one of the cams on the rotating finery and chafery shafts. The bellows board was afterwards raised by a “harness”, which caused reinflation at the same time as the other bellows of the pair was blowing. At Force forge the harness consisted of *stirrups*, *shamels*, *swingletrees* (and possibly *forkers*), which were all of wood, and *shamel plates*, *hanckers* and *speaks* (spokes?), which were of iron manufactured at the forge. The use of the term *swingletrees* suggests that the top bellows board of each pair was linked to either end of a pivoting crosspiece, so that the depression of one board automatically raised its companion. Bellows of this type are depicted in Diderot’s *Encyclopédie*,⁸ but there seems to be no contemporary English illustration and the terminology remains obscure.

Ox hides, bull hides and sheep skins were all used in the construction of bellows, with sheets of white plate protecting the woodwork and hides from sparks at the end nearest the tuyères. The skins were *leckered* with a mixture of oil, tallow and meal at frequent intervals. During 1660 both pairs of bellows had to be completely rebuilt and again in 1662 one of the pairs needed new boards and two ox hides. Other items manufactured for the repair of the bellows were iron hoops, rings, staples, *charnells* (hinges) and thousands of “stone nails” or “stone prods”.

Frequent repairs were also needed to the tuyères, through which the blast from the bellows was directed into the hearths. Due to the high temperature generated here the iron swiftly disintegrated and in 1660, the year of highest output, ten new tuyères were needed. These too were made at the forge.

In genuine chafery forges the tilt hammers and their anvils were of cold-short iron. Their life was short, but they could fairly readily be replaced by new castings from the furnace which the particular forge served. At Force forge the same anvil seems to have done duty throughout the period of the accounts and the hammer did not need replacement until 1662. The new hammer cost about £5, a charge which included trailing it to the forge. Unfortunately we do not know its source, but the fact that a spare hammer was inventoried at £10 in 1663 suggests that the one acquired in the previous year may have been from a derelict forge.⁹ The mouths of hammer and anvil were recut with a chisel, usually about once a year. The anvil block was bedded on iron *neeses* (presumably nose-shaped pieces) manufactured at the forge. They were replaced once or twice a year, and when this was done in August 1660, eight such neeses weighed rather more than one hundredweight.

The hammer was raised by the great beam of the hammer wheel. This shaft was probably the largest in the forge and to withstand its heavy work intact it was strapped at strategic points on its length with 13 bands or hoops of iron.¹⁰ These were most numerous at the end adjacent to the hammer helve. Through this end the hammer arms were inserted (presumably two pairs at right angles to each other) and it was the impact of these working on the hammer helve that successively raised the hammer from the anvil and then allowed it to fall. The use of a protective iron collar called a *bray* (Fr. *braie*) on the helve at the point of impact of the arms indicates that the point of impact was the underside or belly of the helve, not on its tail (in a downwards direction) or on its head (beyond the hammer). The bray weighed about 30 pounds and was replaced three or four times a year.

Across the forge, above and parallel to the helve, ran the drome beam, another enormous trunk of wood trailed across the fells on 14 May 1658 at a cost of 9s 6d. and erected about the end of June.¹¹ At the end nearer the wheel the drome beam was supported by the “water post” and at the end beyond the anvil by the “prick post”. Into it were wedged the two legs which straddled the hammer helve. This end of the helve was wedged into another collar called a *hurst* (Fr. *hurasse*), which had pointed projections on either side. These points pivoted in metal bolts (Fr. *boîte*) bedded into the insides of the legs and formed the fulcrum on which the helve swung.

Eighteenth-century illustrations of forges¹² depict two other necessary components, neither of which is mentioned at Force forge. These are a spring board or *rabbet* above the tilt hammer, and a *poppet* (Fr. *poupée*). The rabbet shot the hammer down onto the anvil with added force after the arms had raised it. The far end of the rabbet was bedded

into the foot of a vertical post called a poppet, the top end of which was wedged into the underside of the drome beam between the legs and the water post. Possibly the *needle* strapped with an iron hoop or band, mentioned in both inventory and accounts, might be one of them.

The accounts mention several of the buildings but do not make the layout of the forge clear. It had an "upper end" mentioned in conjunction with the "crosshouse" over the harness. The other buildings were a firehouse, an ironhouse with a cowhouse at the end of it, a hayhouse and at least three coalhouses. These were named the "litle" and "midle" coalhouses and the "coalhouse next the water". A "great" coalhouse is also referred to, but this may have been an additional name for one of the others. In the firehouse was an oven, and possibly also the "servants' chamber", which had a locked door.

The roofing of some of these buildings, notably one of the coalhouses, was of thatch, but relating to the forge itself, where thatch might have been dangerous, the accounts mention only slating. Nevertheless, the walls of the forge seem to have been entirely of timber, the use of stones being mentioned only in connexion with the construction of the "mine place", which was paved and flagged, after "delveing into the earth a yard and a halfe deep".

The Personnel

Though there is no indication of their having any proprietorial interest in the ironworks in the seventeenth century, the Russell family was next in importance for the iron trade in the north west after that of William Wright. The Colton parish register mentions a Richard Russell in connexion with Force forge from 1630 to 1647. The forge accounts show that the hammerman there up to June 1658 was Peter Russell, formerly of Hornby forge. He was followed by his son James Russell, who stayed at Force until February 1660, whilst his father moved on to Cartmel forge, where Russell entries in the parish register commence in 1662. Peter Russell was buried at Cartmel in 1673, but James Russell is mentioned there in further entries of 1680 and 1683. In the 1670s the hammerman was Robert Russell, son of Charles Russell of Cunsey and formerly of Hornby forges. Robert Russell was buried at Hawkshead in June 1681, but his will in the Kendal Deanery probate records¹³ shows him by that time to have been hammerman at Hacket forge.

Between James and Robert Russell our accounts show two other hammermen. Thomas Bibby took over from James Russell in February 1660 and worked at the forge for almost three years. The Hawkshead register shows that Bibby's wife died in April 1662 and he himself left the forge in the following November. The Robert Bibby mentioned in the Coniston register as hammerman at Coniston forge around 1690 was presumably a relative.

Thomas Auericke was the next hammerman at Force and he may have stayed on until 1668, when administration of his goods and chattels was granted to his widow Margaret. He may have been related to Thomas Everick of Kendal, who is mentioned in Sarah Fell's account book. It was he who was paid for the freight of the iron plates shipped to Grange in 1675, probably being proprietor of the boat in which they came.

The other workman referred to by name was James Pennington, the bloomer, who was given a shilling "for his care" in May 1658, at the express wish of Judge Fell. In March

1659 he was given a further shilling “in earnest for a year to work at the chafery hearth”. A James Pennington had been hammerman at William Wright’s Burnbarrow forge around 1620 and was involved in Wright’s dispute with George Preston of Holker Hall over interference with that gentleman’s fishing rights. The interrogatories in the case were taken in 1628 and in them Pennington is described as “of Satterthwaite, hammerman” and his age at that time was thirty-five. His residence at Satterthwaite would imply that he was hammerman at Force forge in 1628, but probably this work had become too heavy for him – he would be aged over sixty – before Thomas Fell acquired the forge.

No other payments to workmen are recorded. It was expected that the hammerman would remunerate the other forgesmen out of the £1. 13s. 4d. paid to him per ton of iron produced.

Sarah Fell’s account book shows that Reginald Walker, who took over the forge from Rawlinson, remained its clerk until the summer of 1676. He was from Fell Foot in Little Langdale and was one of the more prominent Lakeland Quakers, being for a time the clerk of Swarthmore Monthly Meeting.¹⁴

He was followed at the forge by William Wilson, who may have been the tailor from Little Langdale, who visited Hamburg on behalf of Friends in 1657 and who was later imprisoned at Lancaster for alleged complicity in the Kaber Rigg plot. He was still at the forge in 1678 when the account book ends.¹⁵ Wilson died in 1682, as did Walker early in 1683.

Raw Materials

The iron ore for the forge seems all to have been mined in Plain Furness. It was purchased at a uniform price of 4s. 6d. per quarter, a price which still obtained in 1677,¹⁶ and it was mined on the lands of William Spenceley,¹⁷ John Wilkinson, Matthew Richardson and Thomas Ripon, or rather Thomas Ripon’s wife. Richardson was Margaret Fell’s brother-in-law and he had an estate at Elliscales, which would be within the mining area.¹⁸ A receipt for carriage direct to the forge at 3s. 4d. per quarter mentions Adgarley as the source of supply,¹⁹ and the use of Birkrigg Common, midway between Great Urswick and Bardsea, as a staging point, indicates the same general area. The Common was at an elevation of over one hundred meters and the ore was carried there at a cost of one shilling per quarter. Carriage onwards to the forge from there was slightly less than the 3s. 4d. paid direct from Adgarley. A marginal note of 1659 concerning rates of pay and bonuses states

6 score to the C. and 6^d to the carige per C. and 12^d at every C. quarters to head workmen, bearers and caryers in bread, cheese, drink and tobacko, and 2^d for every quarter to the head of the measurers-up, is the custom.

A little over 600 quarters of ore appears to have been led to the forge over the whole period, which reckoning 1.67 quarters to the ton, would work out at about 360 tons. For the 90 tons of iron produced this would give an extraction rate of 25%, but this figure should be viewed with caution. Firstly, we do not know the amount of ore in stock in 1658. Secondly, there is confusion over the use of long hundreds in the accounts. Thirdly, a quantity of 166 quarters was “diferd on by William Spenser and M[argare]t F[ell]”. Fourthly, an amount of 40 quarters which had been paid for was not led to the forge until after Reginald Walker had taken over.

With charcoal consumption we are on much firmer ground, because the rates are given for the first three years. Excluding from consideration abnormal circumstances, the figure fluctuated between 9 loads 2 sacks (*i.e.* 110 sacks) per ton from a parcel of charcoal obtained in 1660, to 11 loads (132 sacks) per ton on a quantity of 122 loads 6 sacks obtained from Adam Sandys in 1659. The usual figure seems to have been 10 loads of charcoal per ton of iron produced, but variations could be caused by the weather conditions in which it was coled, by the kind of wood used and by storage conditions.

The chief supplier was Adam Sandys and to him went £483 of a little over £1200 spent on charcoal. He supplied 34 loads from Cringlemire in 1660, but the provenance of the remainder is not stated. Under an agreement of 18 November 1658 Margaret Fell paid Sandys £1. 14s. 6d. per load of charcoal. This was about 10s. above the usual rate and the fact that Sandys was able to obtain this exceptional price is one of the factors that suggest he had an interest in the forge.

Apart from Sandys, George Braithwaite of Stott Park supplied the most expensive (12 loads at £1. 8s. in 1658), but also the cheapest charcoal (20 loads 6 sacks at £1. 2s. 6d. in 1660). In 1661 lower rates of around £1 per load were introduced, but it was not until 1663 that all the suppliers were reduced to "bargains" at the new rate.

Though locations of suppliers are frequently stated in the first three years' accounts, duplication of names and the possibility of supplies by the same person from rather different areas makes it impossible to be certain of all the sources of supply. It is clear, however, that the bulk of the small supplies came from an area within five kilometres of the forge. Satterthwaite, Dale Park, Grizedale, Rusland, Crosslands and Bowkerstead figure prominently, and locations only slightly more distant are Stott Park, Finsthwaite, Bouth, Tottlebank and Bridgefield, though from these supplies were sporadic. The only regular supply from beyond these areas was from Coniston, which supplied a total of over 400 sacks in the years 1659, 1660, 1661 and 1663. In 1662 86 sacks came from Skelwith and the following year over 200 came from Yewdale and 48 from Stennerley, which lay well to the west of the Crake. These supplies from more distant places may indicate a change in the general pattern of supply, but as the accounts end in May 1663 it is impossible to be quite sure of this.

Produce and Markets

The accounts show a make of just over 89.25 tons of iron over the entire period. Excise duty at the rate of 10s. per ton was levied on slightly less than 62.5 tons of this iron up to March 1662, when the excise ceased to be levied.

The usual output of a Lakeland bloomery forge would seem to have been around 20 tons per annum. In replies in the 1628 interrogatories concerning Burnbarrow forge, Thomas Jackson of Esthwaite stated that in 1621 Wright had made about 20 tons of iron. The 28 tons mentioned by James Pennington may have been a maximum figure, because he does not assign it to any particular year. At Force forge the maximum output was 23.75 tons in 1660.

The sales accounts make no distinction as to the kind of iron supplied to customers, but the statements of iron sent to Swarthmore for use on the Fell estates show that two kinds of iron – "square" and "plain" – were produced. We have seen that a variety of items was manufactured for use at the forge. Items for Swarthmore included windmill spindles, axes, chisels, hammers, square iron for grates, a grindstone axletree, a water

dish, window stanckers, curtain rods, gavlocks, socks and sock-ends, and a great variety of nails. The ordinary customers were supplied with only one kind of manufactured article – girdles, charged at £1. 16s. or £1. 18s. per hundredweight. The only frying pan went to Swarthmore.

The striking feature of the sales as a whole is the large amount of iron sold in Cumberland (Fig. 1), especially in the first two years. Of the sixteen customers in 1658, the eleven who lived in Furness took only just over a ton and a half between them, whilst four Cumberland customers each took over half a ton, the total amount sold in that county being over 2.75 tons. Over half a ton was supplied to John Washington, probably a Kendal customer. The following year the disparity was even more striking, 14.5 tons being sold to customers in Cumberland and Westmorland, whilst those in Furness and Cartmel took only just over 2 tons. About 1.5 tons were sold in other parts of Lancashire, mostly in Lancaster itself, but Richard Bisbrowne of Poulton-le-Fylde bought just over five hundredweights of it.

Prices varied apparently according to the distance from the forge, customers in Furness and Cartmel being charged the highest rate, £1. 1s. 6d. per hundredweight in 1659, two Lancaster customers and one in Grasmere being charged £1. 1s., whilst Richard Bisbrowne and the Cumberland customers all bought at even more favourable rates. The 1663 accounts of arrears show that these were the prices at the forge, carriage being extra. Three loads of iron for John Richardson of Wigton were carried to Keswick for 5s. 6d. and a further load cost 2s. The carriage of a ton of iron to Poulton-le-Fylde cost 5s., but the same sum was paid for the carriage of half that quantity to Lancaster.

From 1660 onwards there was a considerable change in this pattern of trade. The number of customers rose from about 40 in 1659 to around 80 in 1660 and to almost 90 in 1661. Most of the new customers bought smaller quantities of iron and the total amount sold was slightly reduced. In June 1660 Rawlinson went “into side of Yorkshire and soe downe into Lancashire to sel iron 3 daies”. In August he made a similar trip to Cumberland and to Ravenglass and in October he visited “Pou[l]ton” (le-Fylde) on the same errand. These are the only mentions in five years of such commercial travelling and it is probable that the venture was not very successful, because by 1661 a different method of selling was in operation. This was the establishment of a shop at Wellhead in Ulverston, for which a rent of 4s. per annum was paid to the Fell family. In 1663 this method of selling was expanded, the accounts showing the payment of a rent of 2s per quarter to a certain John Fell for a shop at Town Yet, possibly in Nibthwaite.²⁰ As a result sales in Furness and Cartmel rose from just over 6 tons in 1660 to 9.5 tons in 1661 and in 1662/3 were just under 8 tons. The proportion of iron sold in Cumberland and Westmorland fell from around 70% in 1659 to about 40% in 1660 and 35% in 1661, at which figure it levelled off, partly due to the continued custom of John Richardson of Wigton and William Swinburn of Birkby, both of them Quakers. Richardson took about 2 tons a year, or about 10% of the output.

In 1661 and 1662 there was a fall in prices paid by all customers, and this fall must be linked with the fall in the price of charcoal which occurred about the same time. Concurrently considerable variations in the prices charged in particular areas are apparent. For instance, two new customers who seem to have worked in partnership, John Hunter (of Newbarns) and Henry Chamley (of Dalton), were charged £1 per cwt. for over 2 tons of iron in 1661, whilst the ton they purchased in 1662/3 was charged at

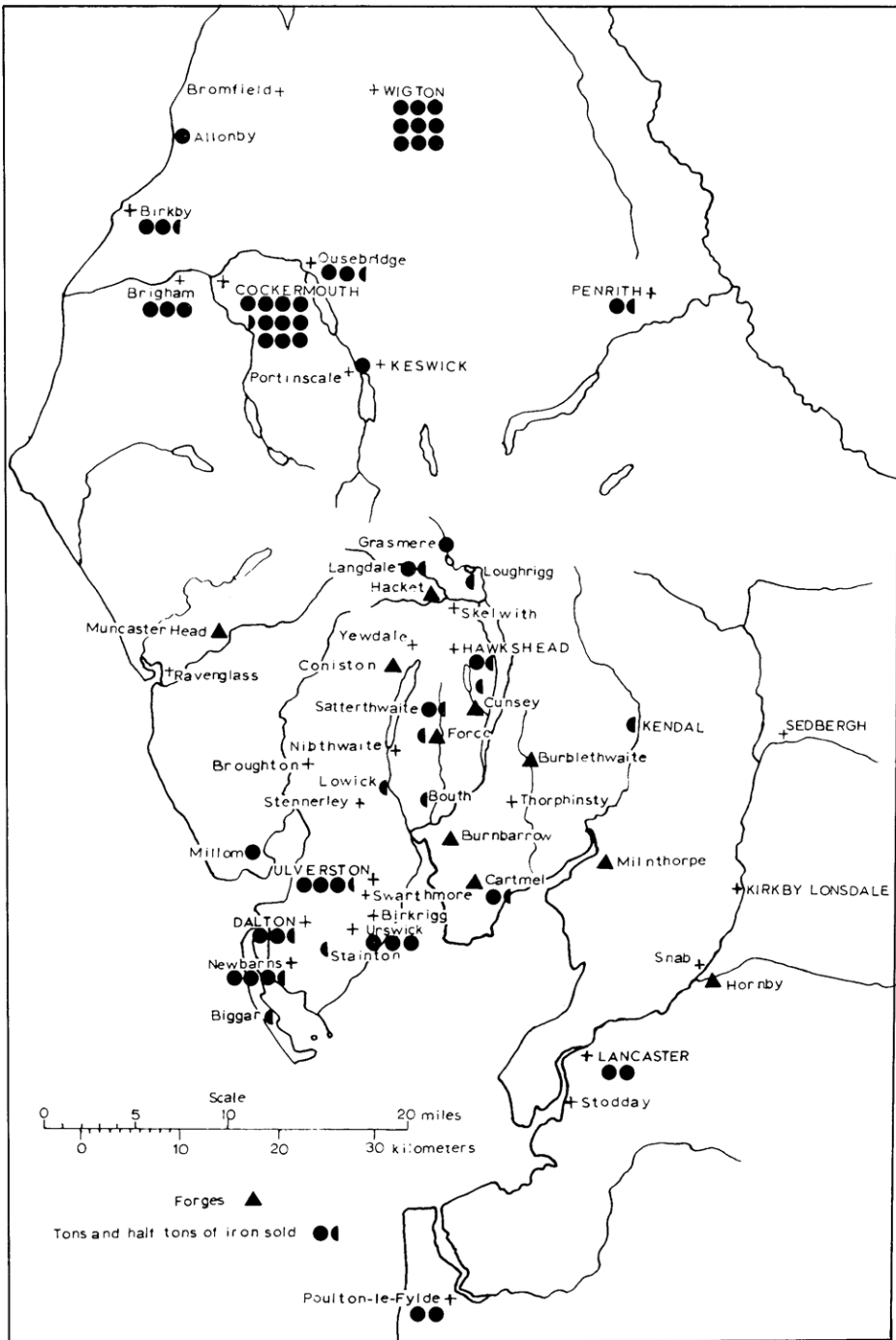


FIG. 1. — Force forge sales of iron to major customers and sites of competing forges, 1658-1663.

18s. per cwt., almost the lowest price paid by any customer. Only the very distant John Richardson paid less than this – 17s. 10d. in 1662. Richard Lister, possibly of Cockermouth, was another new customer who paid 18s. 9d. in 1661 and 1662, John Wennington, possibly of Millom, paid 19s. 6d. in 1662/3, Henry Crosfield of Lancaster paid 19s. 6d. from 1662 onwards, and Thomas Boarbanck and Richard Airey, both of Penrith, each bought over half a ton of iron in February 1663 at 18s. per cwt.

For the 1670s Sarah Fell's account book is not a good guide to the distribution of sales. This was because payments were channelled through her only in the case of southward-lying customers. John Hunter of Newbarns is the only customer mentioned in both sources. Probate records show that he died owing money to William Wilson on account of iron.²¹ Other customers mentioned in Sarah Fell's accounts are William Callow, a Quaker from Ballafayle in the Isle of Man (1671), William Bickerstaffe of the Fylde (1674), Francis Taylor of Stodday (1676), John Kirkby of Merebeck, near Dalton (1677), and John Preston and Thomas Gardner, both of Dalton (1676). The Lancaster ironmonger, Henry Coward, handled a proportion of the forge's trade and during 1677 he even took part in a voyage as far as Cornwall to sell corn and iron on behalf of the Fell family.

Conclusions

The accounts are not a balance sheet, but a cash account. But they do seem to show, unless there were factors not adequately reflected in them, that the forge was running at a loss.

	£	s.	d.
Cash received for iron sold 1658-1663	1407	19	7
Value of iron in stock and accounts outstanding in 1663	248	18	2
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	£1656	17	9
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Expenditure on charcoal	1237	12	1
Paid in excise	31	4	9
To hammerman	148	16	8
Repairs, assessments, etc.	160	11	11
Leading and measuring ore	203	3	7
Paid for ore in 1662 and February 1663	20	0	0
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	£1801	9	0
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The preliminary sheet of expenditure shows that the Fell family had already paid £182. 8s. 6d. on account of the iron ore used at the forge up to March 1661. In addition they had laid out £250 for the purchase of the forge and had made advances of £200 to Rawlinson in 1658. Rawlinson also charged considerable personal expenses, but much of this was disallowed.

There were mitigating factors: the excise had ceased; repairs had fallen from around £40 per annum to about £15 in each of the last two years; Rawlinson had repaid the money advanced, £93. 9s. 6d. in cash and the remainder in supplies of iron on the Swarthmore account. Lastly, the whole question is complicated by the possibility that Adam Sandys had an interest in the partnership and may have been overpaid for

charcoal on this account. Full partnership accounts would explain why of a sum of £678. 8s. 3d. owing on 11 October 1661, "Thomas Rawlinson and Adam Sandys hath received in money, stocke and oare towards this . . . £652. 5s. od." They would also explain why Thomas Massocke was paid for "halfe the droame beame" in 1659, and why 3s. 6d. was paid in 1658 to Christopher Walker "for our part of the water post".

Such accounts might also show how large was the share in the forge which George Fox is traditionally supposed to have had. The Quaker leader was imprisoned along with Margaret Fell in the persecution that followed the Kaber Rigg plot, so he was available when Luke Pearson of Gressingham brought Rawlinson to Lancaster castle to show his account book to Margaret and Sarah Fell on 26 September 1664. Rawlinson's father-in-law, Thomas Hutton, testified that after agreement appeared to have been reached, "George Fox came into the rome from out of an upper rome and spoake these wordes to them, or wordes to the like effecte, *vizt.* Friendes, seinge you are agreed let all jealousies and preiudices bee put out of your myndes and come into the Unitie".²² Sadly, the dispute broke out again with renewed vigour after Margaret Fell's long imprisonment was over in 1668.

The large extent of the Cumberland trade and the continuance of large customers in Birkby, Wigton and Penrith, even after home sales had been expanded, is of interest in the economic development of the area. Was it something started by William Wright and handed on by him? Was there some particular reason – lack of competition from rival forges perhaps – that would explain the very large sales there in 1659? Was the opening of shops to foster the local trade after 1660 a part of a general upsurge of economic activity in Furness?

A fall in the price of iron in a time of increasing economic activity would indicate that production of iron had been over-stimulated. Increased competition would have explained both the necessity to open shops and the reduction in the price of iron. A complementary need to seek cheaper charcoal would account for the need to draw on more distant supplies of charcoal noticed in 1662 and 1663. The slightly reduced outputs of those years would then be explained, not by an overall shortage of charcoal, but by an inability to secure it at a low enough price. Force forge was indeed very favourably located for charcoal supplies, and it is other forges which are more likely to have been at a disadvantage in this respect.

Appendix

1. Customers

The accounts survive in two versions, the first of which ends in 1660. It is not in Rawlinson's hand, but it gives greater detail of forge repairs, etc. It gives no locations of customers. The second version is by Rawlinson and is complete. Detail becomes progressively less, but some locations are given. It is a copy from a lost original and want of space has led to the omission of most of the locations, or to their contraction so that in some cases only the initial letter survives. Out of 180 customers I have tried to identify those who purchased more than 5 cwt. of iron. This proved impossible in the case of four customers, but the 44 remaining purchased over 57 of the 69 tons of iron sold.

The map is based on these 44, with the addition of the two Penrith customers whose accounts were in arrears, and of 6 cwt. 5st. on account of Henry Crosfield, also in arrears. In considering the map, it should be remembered that the numerous small customers, whose 8 tons of iron are omitted, were probably from the Furness area.

FORCE FORGE IN THE SEVENTEENTH CENTURY

Name	Location	In accounts	Additional information	Period	Amount of iron		
					Tons	cwt.	st. lb.
Isaac Rawlinson	Kirkthwaite(?)	—	Colton PR 1636	1660/62	0	8	7 3
Stephen Barker	Force	Fors		1659/63	0	7	0 3
William Pepper	Satterthwaite	Satterthwait		1658/63	1	4	2 12
Edward Taylor	Bouth	Bouth		1658/60	0	6	0 7
George Braythwaite	Hawkshead Hill	Lonthwait	CW2 lxxiii, 210	1660/63	0	15	3 9
Christopher Fisher	Hawkshead(?)	—	Hawkshead PR	1660/62	0	9	5 4
Thomas Jackson	Sawrey	Sawrey		1658/63	0	13	4 2
Christopher Sawrey	Lowick Green	Loakg	Ulverston PR	1659/61	0	9	6 10
John Ashburner	Dragley Beck	Ulverston	Penney, 549	1658/63	2	4	4 6
Richard Collison	Ulverston	—	WRW F 1680	1658/63	1	7	5 9
Thomas Ashburner	Adgarley	Urswick	DDHJ, Interrogatories	1658/63	1	9	1 0
Edward Fleming	Urswick	—	Urswick PR	1659/63	0	11	5 1
William Goad	Urswick	Urs		1659/63	0	19	2 4
Leonard Hartley	Adgarley	—	Urswick PR	1660/61	0	5	1 10
Robert Washington	Stainton	—	WRW F 1680	1658/63	0	6	5 11
John Edmondson	Dalton	Dalton		1659/61	0	5	0 3
William Dawson	Newton	Dalton	WRW F 1673	1659/63	1	1	0 12
Thomas Robinson	Dalton(?)	D	FR	1658/59	1	0	0 5
John Hunter	Newbarns	—	WRW F 1679	1661/63			
Henry Chamley	Dalton	—	WRW F 1672	1661/63	3	8	6 0
William Richardson	Biggar/Walney	—	WRW F 1696	1661	0	6	4 0
Nicholas Maybury	Cartmel	—	Cartmel PR 1654	1659/63	1	2	2 5

Sales in Cartmel and Furness 19 2 6 4

Henry Joanes	Lancaster	Lanc		1659	0	10	1 1
Francis Sands	Lancaster	Lan	WRW A 1681	1659	0	10	0 11
Henry Crosfield	Lancaster	Lancaster		1662	0	3	3 0
Richard Bisbrowne	Poulton-le-Fylde	—	WRW A 1661	1659/62	1	14	2 5
Richard Barton	Poulton-le-Fylde	—	WRW A 1678	1660	0	10	0 0

Sales south of the sands 3 7 7 3

James Collison	Penrith	Cu	FR Penrith PR	1659	0	10	1 0
John Richardson	Scotby(?)	Wigton	FR QM records	1658/63	9	7	2 6
Edward Martindale	Allonby(?)	—	FR QM records	1659	0	18	1 0
William Swinburn	Birkby	—	FR QM records 1681	1658/63	2	8	5 6
Henry Robinson	Brigham	Brigam		1658/63	2	16	4 13
Thomas Banckes	Cockermouth	Cockermo		1659/61	6	1	0 6
Richard Lister	Cockermouth(?)	—	Cockermouth PR	1661/62	1	10	0 0
Christopher Peele	Cockermouth	Whi	WRW C 1679	1659/63	1	15	4 7
John Fisher	Ousebridge End	Whit[efield]FR	QM records 1668	1659/63	2	8	2 1
Thomas Grave	Keswick	Kaswicke		1659	0	12	0 11
Hugh Tickell	Portinscale	—	FR Penney, 542	1660	0	6	0 5
John Wennington	Millom(?)	—	Millom PR	1662/63	0	15	0 0
Richard Fisher	—	Cu[mberland]		1658/61	1	16	4 4

Sales in Cumberland 31 5 3 3

Name	Location	In accounts	Additional information	Period	Amount of iron		
					Tons	cwt.	st. lb.
Edward Fisher	Loughrigg	L	WRW K 1662	1659/63	0	14	3 10
John Sewart	Langdale(?)	Lan	Hawkshead PR 1662	1659/63	1	8	0 9
John Washington	Kendal	Ke		1658	0	10	0 5
John Partridge	Grasmere	Gr	WRW K 1668	1659/63	1	2	0 4
Sales in Westmorland						3	14 5 0
William Penney		—		1660	2	2	0 11
John Borwick		—		1660/61	0	10	0 8
Edward Sewart		—		1660/62	0	7	4 3
John Lindall		—		1660/63	0	8	5 12
Sales to unidentified customers						3	8 3 6
Total sales to large customers						60	19 1 2
Sales to small customers						8	3 1 6
Total sales						69	2 2 8

PR = parish register. FR = "frind" in the accounts. QM records = registers of Quarterly Meetings of the Society of Friends. WRW references are to the probate records for the western deaneries of the Archdeaconry of Richmond.

It is probable that the places given in the accounts were the nearest market towns in the direction of the customers. The Washington family was well established at Kendal, but the 1659 John Washington may have resided at Sedbergh (WRW L 1674), where the parish register indicates a Washington family of blacksmiths and whitesmiths.

In the first set of accounts the name Barton is substituted for that of Bisbrowne in 1660, and the probate entries here are mutually confirmatory. Richard Bisbrowne of Staining, late of Poulton, had ten pounds worth of oak timber on "Richard Barton's hill". He owed £18. 6s. 4d. to James Fell and his smithy was probably at Skippool. A second Richard Bisbrowne praised the inventory of Richard Barton (1678). Similarly John Hunter had been a praiser of his partner Henry Chamley's inventory in 1672.

In identifying the Cumberland customers I am particularly indebted to the help of Mr B. C. Jones. His suggestion that Peele was from Cockermouth was confirmed from the probate records, which show that Peele was a "hardwareman" with a shop in Cockermouth. At Friends House Edward Milligan drew my attention to the Bristol and Somerset Quarterly Meeting registers of deaths (1703) which give Edward Martindale's father as "John Martindale, Cumberland". Mr Jones informed me that the Cumberland protestation returns show four John Martindales in Bromfield. Nicholas Martindale of Allonby is the only Martindale listed in the Quarterly Meeting registers for Cumberland in the 1660s, so that the Bromfield or Allonby area seems indicated as Edward's place of residence.

Dr C. B. Phillips also helped with identifications by providing me with a list of Coniston forge customers. He suggested that my Edward Fisher of "L" was identical with Edward Fisher of Rydal in the Coniston list and that he came from Loughrigg. This was confirmed by the probate records of Edward's father, Adam Fisher of Rydal.

2. Charcoal Suppliers

Fortunately charcoal suppliers were less widely spread and some of the more distant ones could be identified from the Coniston and Hawkshead registers.

Name	Location	In accounts	Additional information	Quantity loads sacks
Richard Atkinson	Monk Coniston	Coniston	Coniston PR 1651	2 0
William Robinson		Coniston		3 3
George Kirkbie	Coniston	Con	Coniston PR	4 11
William Sawrey	Waterhead	Co	CW2 lxxiii, 209	12 0
Francis Bancke	Coniston	C	Coniston PR 1658	4 11
William Dodgshon	Little Arrow	—	Coniston PR 1683	2 7
George Rowenson	Coniston	—	Coniston PR	4 8
James Rigge	Skelwith(?)	—	Hawkshead PR	7 2
George Tyson	Yewdale	—	Hawkshead PR	17 5
	Tilberthwaite		Coniston PR 1668	
John Elartson	Stennerley	Stenerley		4 0

3. Site

The suggestion that the location of the original Force forge was not at the site thus marked on Ordnance Survey maps, but was at the site marked *Force Mills* (specifically at the North Bobbin mill, NGR 3395 9095)²³ seems to be supported by material in the accounts. The fall of Force Beck at the southern site is so gradual that it is difficult to see how an overshot wheel could have been accommodated there. Possibly this was the location of Force smithy, mentioned in connexion with the Rusland estate in the 1622 will of Thomas Rawlinson's grandfather, and still operated by William Rawlinson in 1659 and 1665.²⁴

At Force mills the situation is rather complex. Fell tells us that the Backbarrow company rebuilt the bloomery forge and converted it into a refinery in 1713, and that it continued in operation until 1744. In 1719 the same company removed three hundred tons of slag from Force mills for use at Backbarrow and Leighton furnaces.²⁵ The North Bobbin mill was situated at the bottom of the force, a quite steep descent of the beck from Satterthwaite. Slightly further up, on the opposite side of the stream from the bobbin mill is Force Mill farm, formerly a corn mill. Surface cinder is apparent on the banks of the stream at both sites and both could have accommodated overshot wheels without difficulty. The extensive dam shown at the bobbin mill on the 1846-8 OS map has now been filled in to form the lawn of White Lodge. At a point near the eastern perimeter of the lawn material extruded by a mole at the time of my visit showed that this section of the dam had been filled in with pure charcoal. At the corn mill the dam would appear to have been smaller and on a site through which the Satterthwaite road has since been driven. The dam was fed from a long watercourse, the remains of whose embankment run parallel with the road a meter or two from its streamward edge. Not far from the farm there are traces of stonework in or near the foot of this embankment.

In favour of the bobbin mill site is the location of one of the coalhouses "next the water", which is easy enough to envisage there, but less easy at the corn mill, on the supposition that the water referred to was the beck and not one of the watercourses. In favour of the corn mill site is the very extensive use of wooden bottoms and sides in the watercourses and planked hutches. These would have been imperative to prevent rapid erosion of the site. The use of four hundred horse draughts of sods mainly on the

watercourse, and this merely for repair work, is also a strong argument against the bobbin mill site, where the watercourse was quite short.

Acknowledgements

It was Dr J. D. Marshall who was kind enough to inform me of the existence of the Force forge accounts in the first place. I have been greatly helped by discussion with Dr C. B. Phillips, who has been making a study of the career of William Wright, and it was he who drew my attention to the Sandys deeds in the Lancashire Record Office. I must also thank the staff of that office for making available to me a quantity of probate records several times larger than the successful ones cited above.

Notes and References

- ¹ For the first substantial account of this ironmaster see C. B. Phillips, "William Wright: Cumbrian ironmaster", in *Transactions of the Lancashire and Cheshire Antiquarian Society*, vol. LXXIX (1976).
- ² Lancashire Record Office, DDSa 16/1-3.
- ³ LRO, DDHJ.
- ⁴ A. Fell, *The early iron industry of Furness and district* (Ulverston, 1908), 193-194. Fell quotes from the deed of 1681. This recites parts of the deeds of 1659 and 1666.
- ⁵ Public Record Office, DL 4. 77/45. The words *loop* and *mackett* occur in interrogatories taken in 1628 at Ulverston, in the case concerning the interference of Burnbarrow forge with George Preston's fishing rights.
- ⁶ H. R. Schubert, *History of the British iron and steel industry* (London, 1957), 409. Here the hutch is defined as 'leadinge the back water from the wheele', whereas the French *huche* appears to have been the pen from which the water was discharged onto the wheel.
- ⁷ N. Penney (ed), *The household account book of Sarah Fell of Swarthmoor Hall* (Cambridge, 1920), 234, 562.
- ⁸ D. Diderot and others (eds), *Encyclopédie; ou, Dictionnaire encyclopédique: recueil de planches*, etc. (Paris, 1765), Forges, 4^e section, pl. 4.
- ⁹ In 1660 when a new hammer wheel was needed Rawlinson spoke to John Myres 'conserneing the great beam which is at Thafinstie [Thorphinsty]'.
¹⁰ H. R. Schubert, *op. cit.*, Appendix XII, shows that the hammer beams of Lydbrook and Park End forges in the Forest of Dean also carried 13 bands. The 4 and 5 bands on the finery and chafery beams at Force forge (Inventory) are also exactly paralleled at the genuine fineries and chaferies in the Forest.
- ¹¹ Trees strong enough for use as water wheel shafts were even more difficult to find. A tree for the chafery beam was bought in Coniston Park in 1659 for £2. 10s. It was trailed to the lake, boated to Nibthwaite and then trailed to the forge for a further £3. 14s. 11d. The trailing was done by teams of oxen, and walls and hedges were left demolished in its wake.
- ¹² Incomparably the finest illustrations are the many plates in Diderot, *op. cit.* E. Straker, *Wealden iron* (London, 1931) reproduces a painting dated 1772 of the interior of an iron forge by Joseph Wright, A.R.A., of Derby, facing page 84. Straker also reproduces a working drawing of a forge on page 87. A photograph of the restored tilt hammer at Wortley ironworks, near Sheffield, will be found in W. K. V. Gale, *Iron and steel* (London, 1969), plate 13. All three English examples differ from Diderot in depicting the arms which raised the hammer helve as being bedded in an "arm case". No arm case is mentioned in the Force accounts. Illustrations in Schubert, *op. cit.*, depict the timber construction of continental ironworks of an earlier period, *viz.* frontispiece (before 1550), plates XVI (1580) and XX (before 1550).
- ¹³ LRO, WRW K 1681. The entries linking the Russell family with Hornby forge will be found in the Melling parish register, baptisms 1635-1640. A. Fell, *op. cit.*, 192, 195 indicates that Charles Russell II moved to Coniston and his son Joel is mentioned there in a parish register entry of 1699. LRO, WRW Russell, Peter F 1674 suggests the possibility of the family's connexion with a sixth forge, Burplethwaite, mentioning a debt owed by Thomas Knipe of Burplethwaite of £23. 3s. 4d. That Peter Russell's son, Nicholas, was resident in the area is shown by baptismal entries in the parish register of Crosthwaite cum Lyth 1672-1675.

- ¹⁴ Penney, *op. cit.*, 517.
- ¹⁵ W. C. Braithwaite, *The beginnings of Quakerism* (2nd ed. Cambridge, 1955), 415, and *The second period of Quakerism* (2nd ed. Cambridge, 1961), 33 and 224. Penney, *op. cit.*, 517. The forge clerk is probably the same as the intermediary for the passage of money and the Hawkshead borrower of money, but distinct from the Ulverston stock-raiser.
- ¹⁶ Penney, *op. cit.*, 471. 40 quarters of ore from John Marshall and Robert Buskell cost £9.
- ¹⁷ "Spensor" and "Spencer" in the accounts.
- ¹⁸ Penney, *op. cit.*, 543.
- ¹⁹ LRO, DDHJ, Receipt dated 5 July 1660.
- ²⁰ The Colton parish register mentions "Nybtwt Towne Yet" in an entry dated 3 Nov. 1645. I am grateful to Mr B. Harrison, Archivist-in-Charge, Barrow-in-Furness, for pointing out this entry.
- ²¹ LRO, WRW F 1679.
- ²² LRO, DDHJ. Defendant's interrogatories, 1669.
- ²³ J. D. Marshall and M. Davies-Shiel, *The Industrial Archaeology of the Lake counties* (Newton Abbot, 1969), 242.
- ²⁴ Fell, *op. cit.*, 193 for the 1622 reference. LRO, DDHJ contains an agreement by William Rawlinson dated 1659 to supply merchantable iron to Gabriel Whitehead and Christopher Caiton of Garstang. LRO, DDCA 1/106 shows that William Rawlinson was still purchasing iron ore in 1665.
- ²⁵ Fell, *op. cit.*, 172, 195, 231.