

# THE AD LEAD MINES IN SWALEDALE, YORKSHIRE.

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**Abstract:** This paper draws the attention of mining historians to the Chancery Masters' Exhibits, which are used as the basis for a study of a group of important mid-18th century, Yorkshire lead mines. The evidence relating to many aspects of the mines' history is reviewed and presented in a wider context.

The Chancery Masters' Exhibits are documents relating to cases tried in Chancery and are kept at the Public Record Office, Chancery Lane. They are little used by Mining Historians, yet their contents can prove highly illuminating; in this case for the local history of the Swaledale lead miners. There are, however, documents relating to most kinds of mining and some iron and lead smelting.

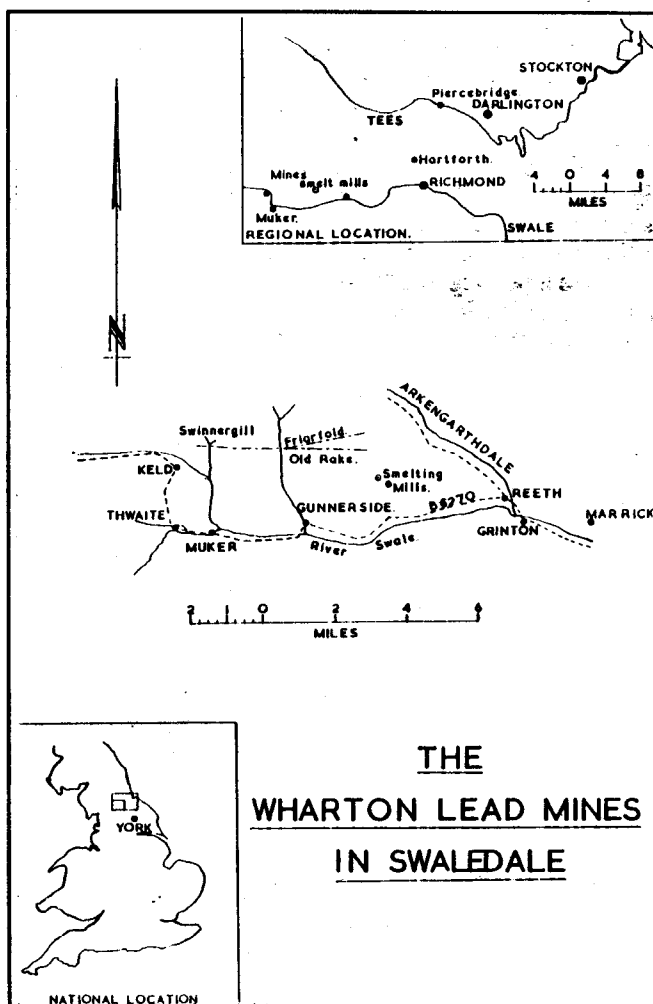
To give an example of the wealth of detail they may contain, it was decided to study the documents arising from the trusteeship of the Duke of Wharton's estates<sup>1</sup>. This consists of 148 sheets of accounts, relating to lead mining in Melbecks and Muker, and covers nine, six month periods from November 1735 to June 1756. The accounts were prepared by the Receiver and endorsed as correct by a Master Extraordinary of the High Court of Chancery. The accounts were attached to the Receiver's reports but the reason for their selective survival is unclear. They do mark the beginning and end of one Receiver, James Close, and the start of his successor, Thomas Hutchinson. They may, however, have been used in one of a series of litigation, which arose in 1751 and 1769, about the rights to mines at Beldi Hill (NCMRS, 1968). These accounts, together with a wider knowledge of Swaledale, make it possible to build up a detailed picture of what was happening in this period. Before looking at the details, it is first of all necessary to look at the background of the mine itself and its owners.

The Wharton family's involvement began in 1544 when, in an attempt to stiffen its northern defences, King Henry VIII granted the manor of Muker and a moiety of the adjoining manor of Healaugh to Sir Thomas Wharton (Fieldhouse, 1978, p.114). There is, however, no evidence of their direct involvement in mining until the late 17th century, when Philip Swale and Robert Barker leased the mines and Philip, Lord Wharton became their senior partner<sup>2</sup>. The latter's son, Philip, the first Duke of Wharton, was a spendthrift. He also lost money in the South Sea Bubble speculations of 1722 to such an extent that, in that year, the Court of Chancery vested his estates in Trustees for the payment of his debts.

Philip was the first and last Duke of Wharton and, when he died in 1731, his estates were shared equally between his sisters, Lady Jane Coke and Lady Lucy Morice. When the latter died without issue in 1739 her moiety returned to Lady Jane Coke. She, in turn, died c1760 and left her estate to her niece, Anna-Maria Draycott, formerly Delagard, of Sunbury, Middlesex (Doubleday). This settlement must, however, have made provision for the

support of the Duchess of Wharton during her lifetime because orders of the Court of Chancery, confirmed in December 1752, refer to payments of an annuity. Between midsummer 1752 and January 1758, this amounted to £15,245.94. Anna-Maria Draycott married George Fermor, the 2nd Earl of Pomfret, in May 1764 and he prosecuted the mines vigorously.

Much of the output referred to in the accounts came from the mines now regarded as the Old Gang. This name is never used in the accounts, however, which always describe them as 'the Lead Mines in Swaledale in the possession of the Trustees of the late Duke of Wharton'. The title Old Gang was not used until the end of the eighteenth century and probably came from Gang Hall, near the Old Rake. At the same time, or possibly slightly earlier, the title AD mines started to be used and was retained until the early twentieth century by the Mineral Lords, as the AD Lessors. It was also used by the AD Mining Company between 1873



By 1750, the pigs of lead from these mines carried the monogram **AD**. They are now commonly known as part of the Old Gang Mines.

and 1887. There are two possible origins of the title AD. The first relates to the initials of Anna-Maria Draycott but this is unlikely because the AD mark was being stamped on pieces of lead produced by the smelting mills by 1750, when she was only fourteen. It is much more likely, therefore, that they are the initials of Alexander Denton, the head trustee.

The AD mines were in three groups (at Swinnergill, Lownathwaite and Merryfield) and worked a section of the richest mineral veins in Swaledale, between Swinnergill in the west and the Arkengarthdale boundary in the east. These veins run to the north of the river, in a narrow east to west belt, about 12 miles long, which has been described by the British Geological Survey (Dunham 1985). They have been worked from shafts and, where cut by deep valleys, from adits. Unlike Cornwall, however, mineralisation was of limited vertical extent and was confined to certain beds of rock, usually limestone, often no more than 20 metres thick. It might, however, be of considerable lateral extent in bearing strata.

Lead mining in Swaledale was well established in the early 16th century when John Leland visited this remote part of North Yorkshire and wrote that "The men of Sualdale be much usid in digging leade owre [from the] great hills on each side of Sualdale." (Smith 1908 p.26; Gill 1988). The only alternative employment was in the area's pastorally based agriculture and, later, the hand knitting of stockings, which was estimated to be worth £40,000 annually in 1823 (Fieldhouse 1978 p.452). Nevertheless, lead mining remained the valley's principal employer until the late 19th century. In the debate about rural industry and proto-industrialisation, historians have held that the high capital requirement of mining precluded it from the model and concentrated on handicrafts instead<sup>3</sup>. Recently, however, this view was challenged by two papers which show that, until the late eighteenth century, most mining comprised of small units, with very little fixed capital, and that mining did, after all, fit the proto-industrialisation model (Burt 1991; Gill 1990). Moreover, the Trustees accounts confirm that it was a mistake to ignore the contribution of mining to marginal areas such as the high Pennines. The AD mines were a major, mid 18th century, rural industry with six-monthly turn-overs varying from £6,918 and £27,326 and profits between £451 to £17,928. The accounts do not, however, tell us how many were employed by the mines, although a conservative estimate would be a minimum of 150, plus ore-dressers, who do not appear in the accounts (see below). To that must be added the miners in the adjoining liberties of Arkengarthdale, Grinton and Marrick, who certainly exceeded another 100.

As remarked above, the Whartons derived an income from their lead and coal mines but there is no evidence of their direct involvement until the late 17th century, when Lord Wharton's partnership with Philip Swale and Robert Barker is well recorded (Raistrick 1982). Direct working continued under the Trustees and the Earl of Pomfret until it was abandoned between 1790 and 1811, when the mines were taken under lease by private companies. The longevity of direct working contrasts with the policy of many northern Mineral Lords, most of whom leased their mines to groups of adventurers from, at least, the 1740's. Nevertheless, the divisions of labour and the system of regulating it are broadly similar to those found in the industry elsewhere in the north (Smith 1776 pp.109-126).

The Trustees had overall control but their Receiver, assisted by an auditor, was responsible for the final accounts. Day to day management was the task of the Field and Mill Clerk, helped by two Grove Stewards. The latter directed mining and set bargains for the underground tasks. There was also an Assistant Clerk who negotiated the sale of lead with the merchants. All six were on salaries which, like the wages of all other employees, were paid half yearly. For convenience, the foregoing may be thought of collectively as a company and work done in its name was for the "masters". The units used in the accounts, especially those of weight, are familiar to mining historians but, because of variations within the lead trade, they have all been converted to imperial tons, which may have led to small rounding errors. The ore was measured by the bing, which weighed 8 cwts and, in Swaledale, it was comprised of 4 horse [loads]. The ore-carriers, who used jagger horses to take ore from the mines to the smelting mills, were paid so much per horse (Hooson, 1747). Like the nautical measure, the fathom was 6 feet, and was subdivided into yards and inches. The smelters were paid by the fodder, in this case 22 cwts or 2464 lbs, of lead metal which was used at Stockton-upon-Tees. The carriers of lead, from the mills to the market, were paid by the mark, which was 400 pieces of lead<sup>4</sup>. The nominal weight of each piece was 145 lbs, making a mark about 26 tons. The practice of varying the weight of a piece from mill to mill may be a valuable aid to provenancing finds of pig lead, especially by marine archaeologists, but, as yet, the implications of this have been insufficiently appreciated. The cargoes of ships which had sailed from Hull, for example, may contain lead from Derbyshire and the Craven area of Yorkshire. Where no manifest is available, the source might still be determined by careful weighing and comparison of the mill marks (Willies, 1985 & Raistrick, 1982, pp.48-50).

The grovers were paid on piece rate, either by Bingtale or Fathomtale, and the company supplied their candles and blasting powder, for which they were contra-charged at the six monthly reckoning. Unlike the Cornish systems of Tutwork and Tribute, however, the men were not charged for the provision of tools and the resharpening of picks. The masters also provided the ropes, kibbles etc. for winding the ore and spoil from the shafts but the miners paid for winding out of their rates. There is no reference to powder in the first account, for November 1735 to May 1736, and one barrel, worth only £4.10, was used in 1752. This small amount agrees with the growing belief that the introduction of blasting in the 17th century was not the change of paradigm it was once believed to be (Rieuwerts, 1983, pp.315-329)<sup>5</sup>. The hammer, pick and wedge were still favoured for breaking rock in this part of Swaledale.

Men on bingtale raised ore for which they were paid at a rate per bing which was fixed by the richness of the vein (viz. poorer the vein, higher the rate) and the market price of lead. Another group of workers, about half of whom were women, went over old waste heaps and gleaned ore from them. They too were paid on bingtale. Men on deadwork were paid a rate per fathom of advance, which was called fathomtale and this depended on the hardness of the rock and, to a lesser extent, the urgency of the task. Rather than using enhanced rates, however, it was usual to offer a premium for the completion of a fixed length of tunnelling. Because they were often on lower rates, these men and their Cornish equivalents, on tutwork, are often thought of as second class workers. In terms of skill, however, this cannot have been so. To make progress, they

had to detect and exploit the weaknesses in solid rock whilst men in stopes followed a clearly defined rib of ore.

Every half-year, between ten and twenty men were paid day-wages, usually 9d/day. This was for doing work which was outside the scope of their bargains and included repairs to shafts, reclaiming old equipment and fixing ventilation trunks. One man spent a day assisting the agents with "dialling", which is the term, still in common use, for underground surveying<sup>6</sup>. After a flood, on February 16th 1753, men were paid to repair dam strikes and jagger roads, which had been washed out, and to clear debris from the mouth of Swinnergill Level. Only two men were on full time daywork: the blacksmith, who, with his partners, was paid 23s per week, and the joiner, on 15d/day.

Most of the workforce was producing ore, from the mines or wastes, on Bingtale. The lack of fathomtale suggests that development work was either being ignored to push up profitability or it was done in the veins, which may have been rich enough to be self-financing. Sadly, the run of accounts is not long enough for us to see which was the case.

It was in the miners' interests to bring the ore to the surface as free from impurities as possible. Nevertheless, it would still require some dressing, to free it of rock and vein minerals, before it could be sent to the smelting mills. Until dressing floors were mechanised in the early 19th century, the dressers, who were usually women, boys and older men, were often employed by the miners and, except for the provision of water-tubs and buddle boards, this process is not detailed in the mine accounts<sup>7</sup>. As noted above, the proto-industrialisation debate has ignored metalliferous mining, yet miners' wives, at least, often dressed their husband's ore (France, 1951, p.19). This work was done on the surface near the top of the shaft.

When it was ready for smelting, the ore was carried, by jagger horses<sup>8</sup>, the three to five miles across the fells to the smelting mills. There were nine carriers, including one woman, who were paid between 14.6p and 33.3p per ton, depending on the distance. The number of animals is not given but, if each carrier used only one, for six days each week, the output could have been shifted easily. Each took an equal share of the total amount carried, no matter what the distance. In 1750, the trust's three carriers were in dispute with the rectors of East Grinton about the agistment (price paid for pasture) of jagger horses. In the depositions, however, no one answered the question about how many horses were involved<sup>9</sup>. In the autumn of 1755 and again in the spring of 1756, the carriers were paid a gratuity of five guineas because of the 'extraordinary dearness of hay and corn'.

Like all large lead mines in Yorkshire, smelting was an integral part of the concern, and the value-added component of selling lead rather than ore was a financial advantage. Dr Raistrick gave the early history of the Wharton's four smelting mills alongside Barney Beck and the accounts add to that history (Raistrick, 1975, II pp.23-29). The two Low Mills, Old and New, were near the site of the Surrender mill. The High Mill was about 900 metres upstream and the other, at the junction of Raygill, was in the possession of Thomas Smith. The first three were equipped with ore-hearths and at least one, probably the New Mill, had a slag hearth. By 1736, however, only the old Low Mill and the New Mill are named in the

accounts. The latter was called the High Mill by 1750. In order to deal with the increased output, another mill was opened between June 1753 and June 1755. This was near the Low Mill because, thereafter, the accounts use the plural, Low Mills. It is probable that the disused Low Mill was refurbished rather than a new mill built.

The smelting equipment, especially the furnaces, had a high rate of attrition and there are many entries for repairs and replacements. None of the mills had a horizontal flue. Instead, like Marrick High Mill, they all had short chimneys directly above the hearths. The first phase of the Old Gang mill was built at the close of the 18th century and, in 1805 and 1806, its flue was extended by 155 metres (Jennings, 1959, p.95). Its final length was about half a mile.

The ore-hearth burnt wood mixed with peat from the local moors. The former, called chopwood, came from woods at Whitaside, in Swaledale, where it was dried, over a slow fire, in kilns which were cut into bankings. A study of the distribution of these kilns, which are found in all lead dales, would be most rewarding. As part of a landscape survey, they would reveal much about the supply of fuel to the mills, either from ancient woods or coppices<sup>10</sup>. During the summer, large amounts of peat were carried from the neighbouring moors by the cartload. Before the Old Gang peat-house was built, peat was put in well drained stacks, near to the mills, which were thatched with ling. For example, it cost £130.96 to cut, carry, stack and thatch some 2812 cart loads of peat between June and December 1755 (Collingwood, 1987)<sup>11</sup>. In that time, 1649 sacks of chopwood, costing £78.21, were cut, dried and carried to the mills. To those sums must be added the cost of providing and maintaining roads and kilns.

Because the lead would volatilize and be lost up the chimney, if the hearth became too hot, it was run at a temperature just high enough to sweat the lead from the ore. The resulting slags were still rich in lead (about 20%) and were treated in the slag hearth, which was fuelled with coke and ran at a far higher temperature and liquified its charge. Owing to the great difference in the specific gravities of molten slag and lead, the former floated on the latter and could be skimmed off. The lead was cast into pieces, stamped, weighed and recorded at the smelting mills. The black, vitreous slags, from the slag hearth, still had small amounts of lead in them and they were collected, crushed and treated again. Because the slags and mill wastes were the property of the Mineral Lord the cost of their treatment appears in the accounts. A stamp mill was used for crushing the black slags after 1753<sup>12</sup>.

From 1750 to 1755, the smelter was paid 43p/ton (9s 6d/fodder), from which he provided the fuel and his own labourers. This ensured that he extracted the lead from its ore as efficiently as possible. The slags were paid for at a higher rate, because it took more fuel to smelt them and they were not so rich. From June 1755, however, the trust found its own fuel and the smelter's rate was decreased to 23p/ton (5s 0d/fodder). The peat and chopwood needed to smelt 1357.82 tons of lead, between June 1755 and June 1766, cost £220.07 or 16p/ton (3s 7d/fodder). This represents a small saving, but it was probably absorbed by other expenses, such as roads.

In the 17th century, the Whartons had a smelting mill at Hartforth, but, by 1735, it had been closed and was used as the mine store (Raistrick, 1975b, pp.29-32). The lead was

Table 1. Breakdown of Expenditure by Percentage 1750-1756

	June Dec 1750-1750	Dec Dec 1750-1751	Dec Dec 1751-1752	Dec June 1752-1753	June Dec 1755-1755	Dec June 1755-1756	Totals 1750-1756
Day Wages	1.46	1.72	1.56	1.84	4.01	2.48	2.14
Mining	56.31	53.34	52.96	52.50	50.77	56.38	53.55
Materials	20.08	21.99	19.02	19.77	20.18	17.41	18.60
Carr of ore	3.58	3.01	3.14	3.22	3.64	3.54	3.31
Smelting	5.43	6.73	10.48	10.36	4.78	5.82	8.65
Carr of lead	10.44	10.25	10.28	9.64	14.66	12.67	11.28
Salaries	2.71	2.97	2.60	2.66	1.97	1.70	2.46

carried from the mills, in Swaledale, to Hartforth on the first leg of its journey to Stockton-upon-Tees. It is still possible to trace the routes used by finding roads with names such as Orgate and Jagger Lane. From Hartforth, the lead went to Darlington and on to Stockton, which was a total distance of about 39 miles. By the 1750s, lead went via a yard in Richmond and then to Stockton by way of Piercebridge, which was about 45 miles but it was £2.00 per mark cheaper. From early in 1755, however, the trade returned to its earlier route because the owner of the Richmond yard, Mr Pierse, had given up carrying lead.

The place of women in the lead industry is seldom mentioned, but here it is seen that some were contributing to it at levels above that of the labourer. In 1736, for example, the mines traded with three lead merchants at Stockton, one of whom was a woman called Mary Ferrand. Her status is unknown but she was probably a widow. Nevertheless, her business was substantial enough for her to buy lead worth £836.71, which was the equal largest share. Between 1750 - 1756, all of the lead merchants dealt with at Stockton were men. The interest of women was, of course, not restricted to Swaledale and, in other areas, they were major shareholders in mines. The Customary Mining Laws protected women's rights, by making share holdings inheritable and dowerable. Thus, a husband may have had effective control of them in his lifetime, but a widow was an acceptable adventurer. Moreover, upon her death, she was, in theory at least, able to dispose of mining shares as she willed (PDMHS, 1988).

It seems likely that the general context of this local industry was buoyant, but there are no continuous figures of pig lead prices before 1780. The accounts show that, in the mid 1750's, the price of lead advanced from about £11.50 to between £14 and £15, with an increase in output. Hitherto, the paucity of production statistics has made it impossible to detect any relationship between the output of the Swaledale mines and the price of lead. The accounts were looked at in greater detail by splitting them into the following categories: Day wages, Mining (including dead work and dressing), Materials, Carriage of ore, Smelting, Carriage of lead and Salaries. Except for smelting, which fell, the percentage of expenditure devoted to each remained similar [See Table 1]. As noted above, from June 1755 the trust found its own fuel for smelting.

The detailed breakdowns for the years 1751 and 1752 [See Tables 2 and 3] show the amounts of cash expended per category. They also give the overall cost of mining each ton of ore and of producing each ton of pig lead. The former was about one-quarter, and the latter about two-thirds, of the selling price. When studying industrial processes, the

output per man year (OMY) is of great interest but, owing to lack of detail, it is seldom available for lead mining.

In order to estimate the OMY for the AD Mines, it was assumed that each underground partnership had two men and that individuals reclaimed ore from wastes. This is obviously prone to error and to facilitate recalculation with more or fewer employees, all the figures used are given. Unlike coal mining, however, where seam thicknesses are fairly constant, lead veins are very variable and this is reflected in the jump from 7.18 to 8.39 tons per man year. Moreover, the neighbouring Arkengarthdale Mines only achieved an OMY of 4.66 tons between 1782 and 1791<sup>13</sup>. This variability is a problem and a more useful measure of performance is probably the cost per ton of lead (or ore) raised. At the AD Mines, between 1750 and 1756, this averaged £7.72 and a breakdown by category is given in Table 4. By 1755, however, there are signs that the rising cost and diminishing returns of waste dressing were bringing about some shifts in policy. For example, in 1752 the waste workers were paid about £3.28/ton and this had risen to £4.15/ton in 1755. In the latter year, James Simpson was working the wastes and paying £0.84 for each ton (£1.50 per 18 horse) of ore recovered. Earlier, veins, or parts of them, such as Freeman's Rake had been let on some form of agreement. A Mr Freeman was on the list of miners working at the latter place, in 1736, and the Misses Freeman were there in 1750. Likewise, a Caleb Readshaw had workings on the Old Rake in 1755.

The accounts also include interesting items relating to other mines and disputes with neighbours. For example, both Freeman and Readshaw had interests in mines at Grassington, in Wharfedale, some 30 miles to the south<sup>14</sup>. Also, a long dispute began in 1737 when, in order to raise cash, the Trustees of the Wharton estate sold the manors of Healaugh and Muker, but reserved the mineral rights, and continued working the mines. The ambiguous wording of the agreement, which only reserved those minerals under unenclosed or waste land, led to disputes which were not settled until the 1770s. In 1739 their new owner, Thomas Smith, laid claim to minerals under an area called Beldi Hill, on the west of Swinnergill, which he alleged was enclosed. In 1742, he leased it to two brothers, John and Thomas Parke, and Leonard Hartley. They drove a short level into the hill and developed a mine from it but soon found that the ore went deeper and pumps were needed. To alleviate this, they chose a much lower point from which Parkes' Level was driven for 366 metres to the mine. This cost £300 and took nearly three years (Raistrick, 1975, I pp.35-41).

The Beldi Hill Veins crossed the boundary between Smith's

and the trust's royalties and were also worked by the latter at Swinnergill Mine. Parkes' Level cut the veins near this boundary and, from it, a branch was driven under the trust's mines. By the late 1740's, however, the Beldi Hill mine was nearing exhaustion and the company was seeking payment from the trust for the drainage which it was providing. When this was refused, in the spring of 1751, the Parkes' Level was dammed and water turned into the Beldi Hill Shafts, thereby flooding the Swinnergill Mine. The trust's workmen destroyed the watercourses leading to the shafts and watchmen were set, with orders "to acquaint the agents with what they see done at different times". The flooding caused roof-falls in the mine, which also had to be cleared. The matter does not seem to have been resolved for, on June 6th 1751, a bargain was let for a new level to drain the Swinnergill shafts. This was 117 metres long, to the Sun Vein, and took eight miners, working day and night, until the 24th September 1752 to complete it. James Waggett and his partners were paid £130.00 for that contract.

After the trust was wound up, the mineral rights passed to Anna-Maria Draycott and, in 1769, her husband, the Earl of Pomfret, claimed the minerals at Beldi Hill, which belonged to Thomas Smith. The affidavits submitted in that case give a clear impression of the violent tactics employed by the mob protecting Pomfret's pretended interests. Smith's smelting mill was a short distance upstream from the three Pomfret mills on Barney Beck and its water supply was repeatedly cut. Moreover, his smelters had to take the bellows home with them to prevent their being slashed.

Over 300 of Pomfret's men assembled at the mines, on June 6th, 1769, and "there unlawfully riotously and routously beet wound and illtreat him the said William P'Anson (one of Smith's men) and did then and there with great force and violence throw him ... into a certain place there nine yards deep called a hush gutter"<sup>15</sup>. More of Smith's men were deposited in the same place, including three who were working in a shaft from which they were pulled "by the hair of their heads their arms and clothes"!

Miners also assembled through compassion, however. For instance, when James Perkin and his son were trapped by a roof fall at Fryerfold, 29 metres underground, upwards of 100 miners were employed in freeing them and the agent paid £1.80 for ale, bread and cheese for victuals<sup>16</sup>. The operation was a success because Perkin appears in the accounts for 1753. Even if they had been dead, it was a point of custom that men's remains were recovered.

From about 1735, a company of national importance took a lease of the trust's lead mines on the south side of Swaledale, between Spout Gill, Keldside and Sleddale. This was the Company of Mine Adventurers of England, which was a joint stock company, established in 1698, with extensive mining interests in Cardiganshire and Montgomeryshire (Jennings, 1959, p. 37). The company does not appear in the 1736 account, probably because its mines were only developing and had not gone into production. Between 1750 and 1755, however, the output of ore from its mines varied between 14 and 162 tons, on which a duty of one-eighth was levied<sup>17</sup>. The company had its own smelt mill, a drawing of which, dated 1735, is preserved in the Egerton MSS, at the British Library<sup>18</sup>.

The London Lead Company, which was expanding its holdings, also took an interest in the area and, in 1735,

**Table 2. James Close's Accounts 1st December 1750 - 1st December 1751**

Day wages		£ 109.74
Mining	1025.40 + 91.20 tons waste	3413.24
Materials		1406.80
Carriage of ore	1116.60 + 7.60 tons duty	6192.52
Smelting	778.73 + 12.99 tons slags	430.74
Carriage of lead	791.72 tons	655.75
Salaries		190.00
	Total	£6398.79

	Workers employed on				Cost £
	Bgtale	Fmtal	Wastes	Tons Ore	
01/12/1750 to					
01/12/1751	61.5	0.5	31.5	1116.60	3413.24

Average cost of mining each ton of ore (£ per ton)	= £ 3.06
Cost of producing each ton of pig lead	= £ 8.08
Lead sold = 1103.66 tons for £12898.29	= £11.69

Taking bingtale and fathomtale partnerships as two men	= £124
Ditto waste workers as individuals	= £31.5
Total	£155.5

Output per man year = 7.18 tons of ore.

**Table 3. James Close's Accounts 1st December 1751 to 1st December 1752**

Day wages		£ 113.03
Mining	1189.20 + 44.80 tons waste	3875.06
Materials		1391.80
Carriage of ore	1234.00 + 20.20 tons duty	230.03
Smelting	866.97 + 91.10 tons slag	766.81
Carriage of lead	958.07 tons	752.10
Salaries		190.00
	Total	£7318.83

	Workers employed on				Cost £
	Bgtale	Fmtale	Wastes	Tons Ore	
01/12/1751 to					
01/12/1752	61.5	2	20	1234.00	3875.06

Average cost of mining each ton of ore	= £ 3.14
Cost of producing each ton of pig lead	= 7.64
Lead sold = 1086.23 tons for £13691.95	= 12.61

Taking bingtale and fathomtale partnerships as two men	= £127
Ditto waste workers as individuals	= £ 20
Total	£147

Output per man year = 8.39 tons of ore.

**Table 4. Breakdown of the Average Cost of Getting One Ton of Lead at the AD Mines 1750-56**

Day wages	£ 0.165
Mining (inc. dead work and dressing)	4.133
Materials	1.435
Carriage of ore to smelt mills	0.255
Smelting	0.668
Carriage of lead to Stockton on Tees	0.871
Salaries	0.190
Total	7.717
Average price of lead per ton	£ 13.140
Total cost of getting one ton	7.718
Average profit per ton	5.422

leased ground running east from the junction of Old Rake and Merryfield veins to the Arkengarthdale boundary. By 1742, the company had also leased Lownathwaite and Swinnergill (Raistrick, 1973). Nevertheless, the accounts show that the London Lead Company made no duty payments in 1736 or between 1750 and 1756, when the Trustees, not the Company, worked these veins. Moreover, the bargain book from 1739 to 1772 shows that the Trustees also mined them in the 1740s<sup>19</sup>. One is forced to conclude, therefore, that the London Lead Company did little, if any, work here.

As the foregoing shows, these documents provide a microcosm of an industry which is of interest to the local historian. Nevertheless, with their references to such tangibles as transportation and prices, as well as inferences of concepts such as proto-industrialisation, they have also a contribution to make in the context of wider debates.

## ACKNOWLEDGEMENTS

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## NOTES

1. Chancery Lane PRO, Chancery Masters' Exhibits, C114/145. The case was between Benjamin Haskins Stiles Esq and other creditors by Judgement of Philip late Duke of Wharton, plaintiffs, and The Honourable Alexander Denton Esq one of the Trustees of the Court of Common Pleas, Thomas Gibson Esq, and his Majesty's Attorney General & others.
2. North Yorks Record Office ZQH 7/1/21, Swale and Barker's lease of 1669.
3. Mendels (1972); Thirsk (1974). These papers promoted a debate on the part of textiles in rural industry and proto-industrialisation. For the developed arguments see Coleman (1983) and Clarkson (1985).
4. Lead weights varied from area to area but were usually called a fother or, sometimes, a ton. Before the mid 19th century the value was seldom close to 2240 lbs. The nominal weight of a piece also varied, for example, in Swaledale, it was 145 lbs, in Wharfedale it was 123 lbs and in Nidderdale 168 lbs. Each one was impressed with a number or a letter which was changed every 400 pieces, or mark. See also Willies (1985) which discusses some of the problems of provenancing ingots which were recovered from a wreck off the Isles of Scilly.
5. Clwyd Record Office, Hawarden: Lowther MSS DD/L/63. "An account of ye disbursements as touching ye lead mynes since ye first of March 1677, dated April 30th 1679". The first known use of "powder" in a Yorkshire mine was c1678, at a small lead mine, called Dew Bottom, in Littondale. It was also used, in 1692, at a small colliery in Colsterdale, in Mashamshire, about 15 miles from the Old Gang (Feather 1966).
6. As early as 1669, it is clear that plans of the mines were being sent to Lord Wharton. Letter to Philip Swale, NYCRO R/Q/R/ 9/53 and 9/62.
7. In Yorkshire, it was common for the Mineral Lord to provide timber for use at the mines. Buddle boards were the planks used to make troughs, called buddles, in which the fine ore was washed to free it from clay and lighter materials.
8. "JAGGERS: This includes both Men and Horses, that are employ'd to carry the Ore on the Horses Backs, from the Mine to the Place where it is Smelted, yet we say separately Jagger-Lads, and Jagger-Horses".
9. E134//Geo.II/Hil.1 at the PRO, Chancery Lane. Richard Fenton and Timothy Dickinson, plaintiffs, and Anthony Alderson, James Galloway and James Hird, defendants.
10. I am indebted to the late Richard Doncaster, of the Historical Metallurgy Society, for showing me the results of such a survey in the Barlow area of Derbyshire. Here, he has demonstrated a strong relationship between the kilns and those areas of ancient woodland which lie along the outcrops of certain coal seams.
11. NYCRO: Indenture ZQX2/1/1 - The New Mill, in Farndale, had

a peat house by 1729 and many Yorkshire smelting mills switched to peat around the mid-eighteenth century.

12. Stamps were heavy poles, set vertically and shod with iron, they were lifted by cams on a shaft, which was rotated by a waterwheel, and allowed to fall back onto an iron plate. Very hard ore, or slags, were placed on this anvil and crushed to a powder. They were more common in Cornwall, where they were used from the fifteenth century. In 1737/8, the London Lead Company built them at its Jeffrey's and Acton smelt mills, near Blanchland, Northumberland. By May 1741, others were at work in Swaledale, probably at the High (Old) Moulds Mill, which were visited by the Grassington Barmaster, Solomon Bean, and Stephen Barrat (Bolton MSS, Grassington Mines Dues 1735-1743/Grants 1735-1753). They were added to the Buckden Low (Birks) Mill in 1742/3 (Raistrick MSS R/131-133).

13. North Yorkshire County Record Office, Gilpin-Brown Papers.

14. Extracts from the Duke of Devonshire's archives, at Bolton Abbey and Chatsworth, in NMRS Records.

15. BM Add MSS 62,943(B): Plan of Crackpot Hall and East Stonesdale Farms, the Estate of Thomas Smith Esq, Lord of the Manor of Healaugh. See also Beldi Hill Dispute in NCMRS, 1968.

16. C114/145 - page 10 of accounts for the period June-December 1752.

17. M.C. Gill, *The Yorkshire Mineral Statistics* - in preparation.

18. British Library, Egerton MSS 1,941 f2. Reproduced in A. Raistrick, (1975, Vol. 2) p.55.

19. North Yorkshire County Record Office, ZLK 3/2/1 Bargains let at the mines in Swaledale belonging to the Trustees of His Grace the Duke of Wharton (1739-1772).

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Chatsworth House  
Clwyd Record Office  
North Yorkshire County Record Office  
Northern Mine Research Society Records  
Public Record Office (Chancery Lane)