

THE LEAD MINING INDUSTRY OF SWALEDALE

by

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I : Hushes on the North and Sun Veins, Lownathwaite Mine, on the west side of Gunnerside Gill



II : The main limestone exposed in Bunting Hush, Old Gang Mine, on the east side of Gunnerside Gill

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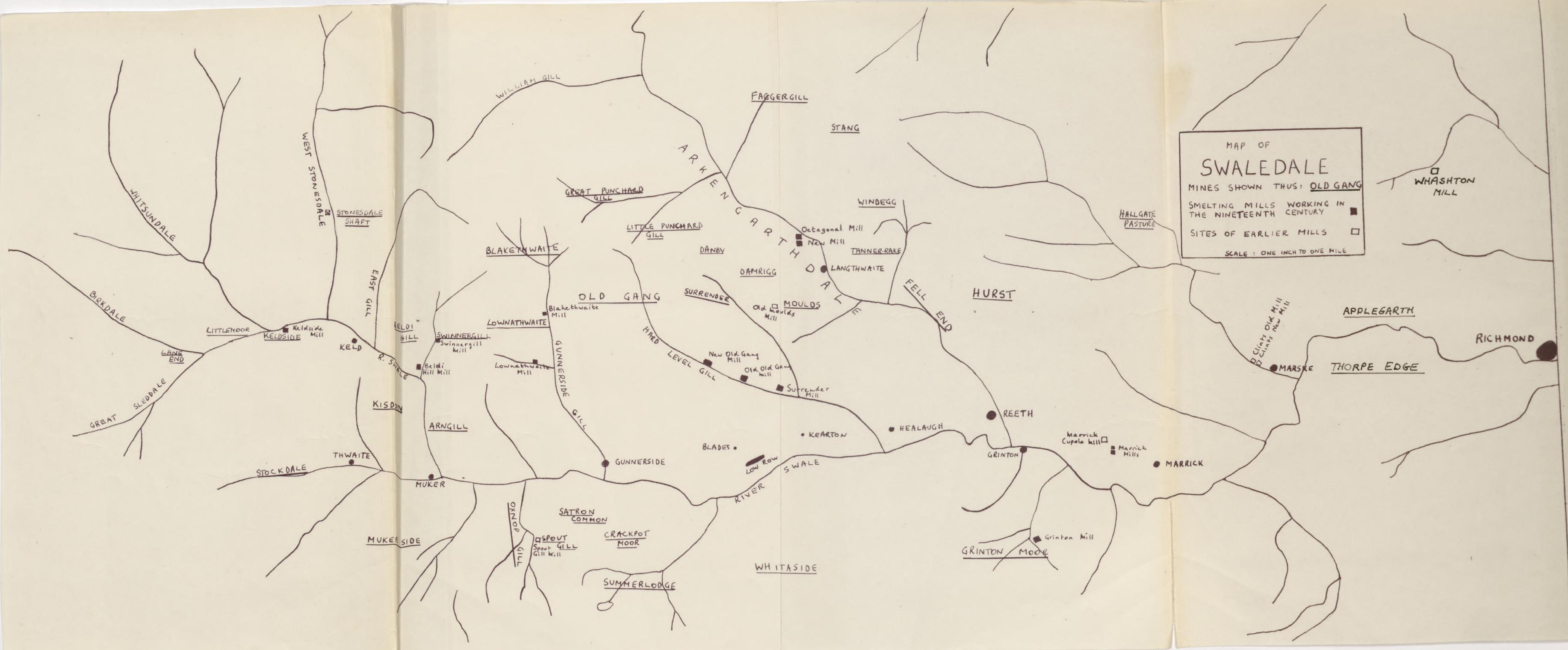
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Abbreviations

Y.A.S.R.S.	Yorkshire Archaeological Society Record Series
D.H.MSS	Draycott Hall MSS
K.L.MSS	Kirkleatham MSS



MAP OF
SWALEDALE
 MINES SHOWN THUS: **OLD GANG**
 SMELTING MILLS WORKING IN THE NINETEENTH CENTURY ■
 SITES OF EARLIER MILLS □
 SCALE: ONE INCH TO ONE MILE

□ WHASHTON MILL

Clints Old Mill
 Clints New Mill

Marrison Cupola Hill
 Marrison Mills

Grinton Mill
 GRINTON MOOR

SATRONS COMMON
 SPOUT GILL Mill
 CRACKPOT MOOR

SUMMERLODGE

Chapter I : Introduction.

The lead mining industry occupies a significant place in the economic history of Britain for four reasons. First, home produced lead played an important part in the national economy from pre-Roman times¹ until the end of the nineteenth century. Before the iron and coal era lead was the most important metal in use, with the possible exception of the coinage metals²; and of the latter almost the whole output of native silver was derived from argentiferous lead. More widely distributed and more easily smelted than either copper or tin, pliable, easy to mould and solder, and resistant to corrosion³, it was put to a wide variety of uses, including some to which it was not well suited⁴, and for which it was employed only in the absence of adequate supplies of more suitable materials, e.g., copper, brass and tinfoil.

Secondly, British lead entered into European and world trade. Although dwarfed by the dominant wool trade, it was one of the leading exports of medieval England⁵. In the first half of the nineteenth century Britain was the world's greatest

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1. Virtually nothing, however, is known about the exploitation of British lead between the end of the Roman occupation and the eighth century. W.H.Pulsifer, Notes for a History of Lead, (1888), pp.22-8, 48; I.F.Salzman, Medieval English Industries, (1923), p.42.
 2. A. and N.Clow, The Chemical Revolution, (1952), p.361.
 3. J.A.Smythe, Lead (1923), p.202; Pulsifer, op.cit., p.117.
 4. Leaden vessels included kettles, pans and milk churns, which were used "long after the poisonous nature of lead was recognised." Clow, op.cit., pp.386-7; Pulsifer, op.cit. p.175.
 5. G.R.Lewis, The Stannaries, (1924), p.xiii.

lead producer, and in some years her output exceeded that of the whole of continental Europe¹.

Thirdly, lead mining was part of the broad stream of British economic development, and reveals a series of forms of technical and commercial practice and change which can be compared with those of better known industries. And finally, the industry usually imposed a distinctive pattern on the economic and social life of lead mining areas, influencing much more than the working conditions and living standards of the miners.

The history of the lead mining industry, as of metal mining generally, coal mining and a number of other industries, is not the story of a long period of slow change exploding into a revolution in the second half of the eighteenth century. There was an earlier formative phase, during which an economy dominated by coal began to emerge out of the still vigorous wood-and-water age, and England ceased to be under-developed and technically backward by the contemporary standards of Western Europe². The period began in the middle of the sixteenth century, although the most important changes in the technique and organisation of metal mining were concentrated in the second half of the seventeenth century.

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1. Pulsifer, op.cit., p.58; Smythe, op.cit., p.6.
 2. J.U.Nef, Rise of the British Coal Industry, (1932), Vol.I, pp.165 et seq. "When Elizabeth ascended the throne, England was unquestionably one of the most backward among the nations of Europe in industrial technique and in scientific skill." Ibid., p.240.

Before this early industrial revolution the British metal mines were far behind those of Germany in technical development, particularly in methods of drainage, haulage, dressing, and smelting. In his book "De Re Metallica"¹ Georgius Agricola described the wide range of machines and methods in use in Germany and Central Europe, which represented a remarkable technical achievement within the limitations of a wood-and-water economy. Agricola was not a Leonardo da Vinci, creating inventions which were beyond the capacity of contemporary technology to apply to practical purposes, but an observer describing existing methods. It is significant that in Wolf's "History of Science, Technology and Philosophy in the Sixteenth and Seventeenth Centuries", the section on mining, metallurgy, and mechanical engineering is almost entirely devoted to a summary of "De Re Metallica", which was not superseded as a practical textbook for a hundred and eighty years². Several of the apparently new inventions tried in Britain in the seventeenth century, e.g., in mine drainage, were in fact borrowed from well-established German practice³.

During the first half of the sixteenth century the most neglected branch of British metal mining was copper. Little ore was mined, refined copper had not been made on a

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1. Georgius Agricola, De Re Metallica, (Trans.H.C. and L.H.Hoover, 1912); the first edition, in Latin, was published in 1556.
 2. Ibid., p.ii.
 3. R.L.Galloway, History of Coal Mining in Great Britain (1882), p.37; and Annals of Coal Mining and the Coal Trade, 1st Series (1898), pp.157-162; Nef, op.cit., Vol.I, p.26.

commercial scale in this country, and there was as yet no native brass industry¹. The principal technical problem lay in the complexity and expense of the smelting process². The successful development of copper mining and smelting required not only the introduction of new techniques but also an investment of capital which was substantial by the standards of the sixteenth century.

The government of Queen Elizabeth turned to Germany to supply both needs. There had been spasmodic attempts to borrow German mining skill from about 1450 onwards³, and Cecil tried to stimulate the development of the salt and glass industries by introducing labour from Germany and Lorraine respectively⁴. The new venture differed from the others not only in the scale of the operations, but also in the introduction of German capital as well as technique⁵, and in the formation of a monopolistic company for the purpose, the first to be established for manufacture as distinct from trade⁶.

The Company of Mines Royal, incorporated in 1568, developed copper mines⁷ in the Lake District and Cornwall⁸, and built smelting works at Keswick and Neath⁹. The venture proved

1. H.Hamilton, The English Brass and Copper Industries to 1800(1926) p.1.

2. Lead is the simplest non-ferrous metal to smelt, copper the most difficult. Pulsifer, op.cit., p.117; Lewis, op.cit., p.24
M.B.Donald, Elizabethan Copper (1955), pp.184-5.

3. Pulsifer, op.cit., p.55; Donald, op.cit., p.11.

4. Nef, op.cit., Vol.I, p.181.

5. There were English as well as German shareholders, Donald, op.cit., p.100. 6. Ibid., p.7.

7. The company also mined and smelted lead in the Lake District: Ibid., pp.161,166; Collingwood, Elizabethan Keswick, quoted in Hamilton, op.cit., p.98.

8. Donald, op.cit., Chapters 5,8,13.

9. Ibid., pp.112-3, 136, 343. Hamilton, op.cit., p.89.

unprofitable, at least during the sixteenth century,¹ but it was technically successful,² which stimulated the development of metal mining and smelting generally, as well as the manufacture of copper and brass ware. That its effects on the former were not more immediate and widespread is due to several causes.

In the first place, the technical problems facing tin and lead miners during the sixteenth century were less acute than those of copper mining and smelting. The tin miners were only just beginning to meet serious technical difficulties as the progressive exhaustion of the richer deposits of stream tin caused them to work the vein deposits and meet drainage problems³ as they went deeper. An inelastic demand was a more immediate obstacle to expansion.⁴ There is some evidence, including that of the "Valor Ecclesiasticus", to suggest that⁵ lead mining was stagnant in the early sixteenth century, and in well-developed fields the miners were no doubt reaching the limits set by the inadequacy of their drainage devices. But the organisation of the lead mines put a premium on simple methods which, if wasteful like bole-hill smelting,⁶ suited the small partnerships of independent miners which were strongly entrenched in the larger

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1. In 1576 the cumulative debit balance was £32,000. Donald, op.cit., p.54.
 2. Ibid., Chapter 7.
 3. Lewis, op.cit., p.9.
 4. See below, pp. 9-10. During the Tudor price inflation the price of tin fell in terms of the general price level. Ibid., Appendix J.
 5. Salzman, op.cit., p.67; J.W.Gough, The Mines of Mendip (1930), pp.64-5.
 6. See below, p.53.

mining fields¹. Furthermore, the large quantities of monastic lead thrown on to the market after the dissolution of the monasteries must have caused a depression in the mines, and delayed the introduction of new techniques.

The difficulty of passing on technical skill which depended upon long training and seasoned judgment², particularly in chemical processes like copper smelting, was a further reason why the methods imported from Germany did not spread quickly. Most of the skilled labour of the Company of Mines Royal was German, and no adequate arrangements were made for the training of English workers. The government ensured that Englishmen were well represented on the "Courts" or governing bodies of this and similar companies, but "no amount of observation by a non-technically-trained person will make him adequate to take over and develop new ideas. When the Germans died, their skill died with them and at the end of the Elizabethan period the mines languished."³.

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1. Salzman, op.cit., pp.43-9; Gough, op.cit., pp.96, 125-6.
 2. W.E.Minchinton, The British Tinplate Industry (1957), p.9.
 3. Donald, op.cit., p.3.

Associated with this technical problem was a financial one, the need for the accumulation of sufficient capital in the hands of investors who understood the conditions of metal mining.¹ The "get-rich-quick" attitude of some mining investors could lead them either to throw their money away in rash adventures, or to provide genuine endeavours with inadequate financial resources. To meet this attitude half-way, companies formed in the late sixteenth and early seventeenth centuries were often granted monopoly rights. Despite this policy, industries requiring increasing amounts of capital were handicapped until the second half of the seventeenth century, when a downward movement in the long-term rates of interest indicates that capital was becoming more easily available.²

During the sixteenth and seventeenth centuries wealth might be accumulated either from trade, or by acquiring land cheaply and realising it at a higher price.³ The former process was more important in the long run as a source of capital for secondary industry, but the latter played a prominent part in the development of coal and metal mining.⁴ A landowner who had profited by the purchase of cheap land at the dissolution of the monasteries, or after the sequestrations which followed the sixteenth century rebellions or the Civil War, might be well

1. "There were probably not more than fifty men in Elizabethan England with sufficient wealth to finance single-handed the largest colliery of the day, even if they had been able to realise all their assets." Nef, op.cit., Vol I, p.379.

2. Minchinton, op.cit., p.6. This was particularly the case after 1690. W.R.Scott, Joint-Stock Companies (1910-12), Vol II, p.440.

3. M.Dobb, Studies in the Development of Capitalism (1946), pp.177-182.

4. From the end of the seventeenth century, however, there was an increasing amount of merchant capital invested in copper mining. Hamilton, op.cit., pp.244-8.

placed to develop mineral resources, particularly on his own land, during the seventeenth century.¹ The Wharton family acquired a large part of the Swaledale mining field, and no doubt some of the capital with which to develop it, in this way.²

The Civil War had an uneven effect upon metal mining, and it is difficult to say, on balance, whether it stimulated or retarded its growth. There was an increased demand for many metal products, particularly for immediate military use. On the other hand, the war caused a waste of both national and private resources, including the actual destruction of mining plant at Keswick.³ Trade was dislocated, particularly by the blockades of the Tyne and the Humber.⁴ The sequestrations, although helping to accumulate capital in the long run, may have caused short-term interruptions in the prosecution of mining ventures.

Also doubtful is the effect of changes in the law relating to the ownership of metallic ore deposits. Until the Royal Mines Act of 1689 any mines of base metal which contained gold and silver, if the value of the latter exceeded the cost of refining,⁵ belonged by law to the Crown.⁶ Several joint-stock companies for metal mining were established during the first two decades after 1689,⁷ which might suggest that the Royal

1. Nef, op.cit., Vol I, p.142, Vol II, pp.4 and 52.

2. See below, pp.26-7. 3. Hamilton, op.cit., p.55.

4. Nef, op.cit., Vol I, pp.68-9.

5. According to another interpretation of the law, if there was more than a "negligible" trace of gold or silver.

6. Before 1566 the Crown sometimes claimed the ownership of all metal mines. Donald, op.cit., Chapter 6; Nef, op.cit., Vol I, pp.266-8. The 1689 Act provided that no mine of copper, tin, lead, or iron was a royal mine even if it contained gold or silver. Hamilton, op.cit., p.64.

7. Scott, op.cit., Vol II, pp.443-458.

Mines Act removed a serious obstacle to the progress of these industries. But the claims of the Crown had long been ignored in practice, perhaps because of the difficulty of determining for legal purposes whether the appropriate proportion of a precious metal was present, or perhaps because of the disinclination of the Crown to press its claims in the face of the growing individualist spirit of the age. In the lead mines of the north of England there is no evidence that the 1689 Act had any significant effect.

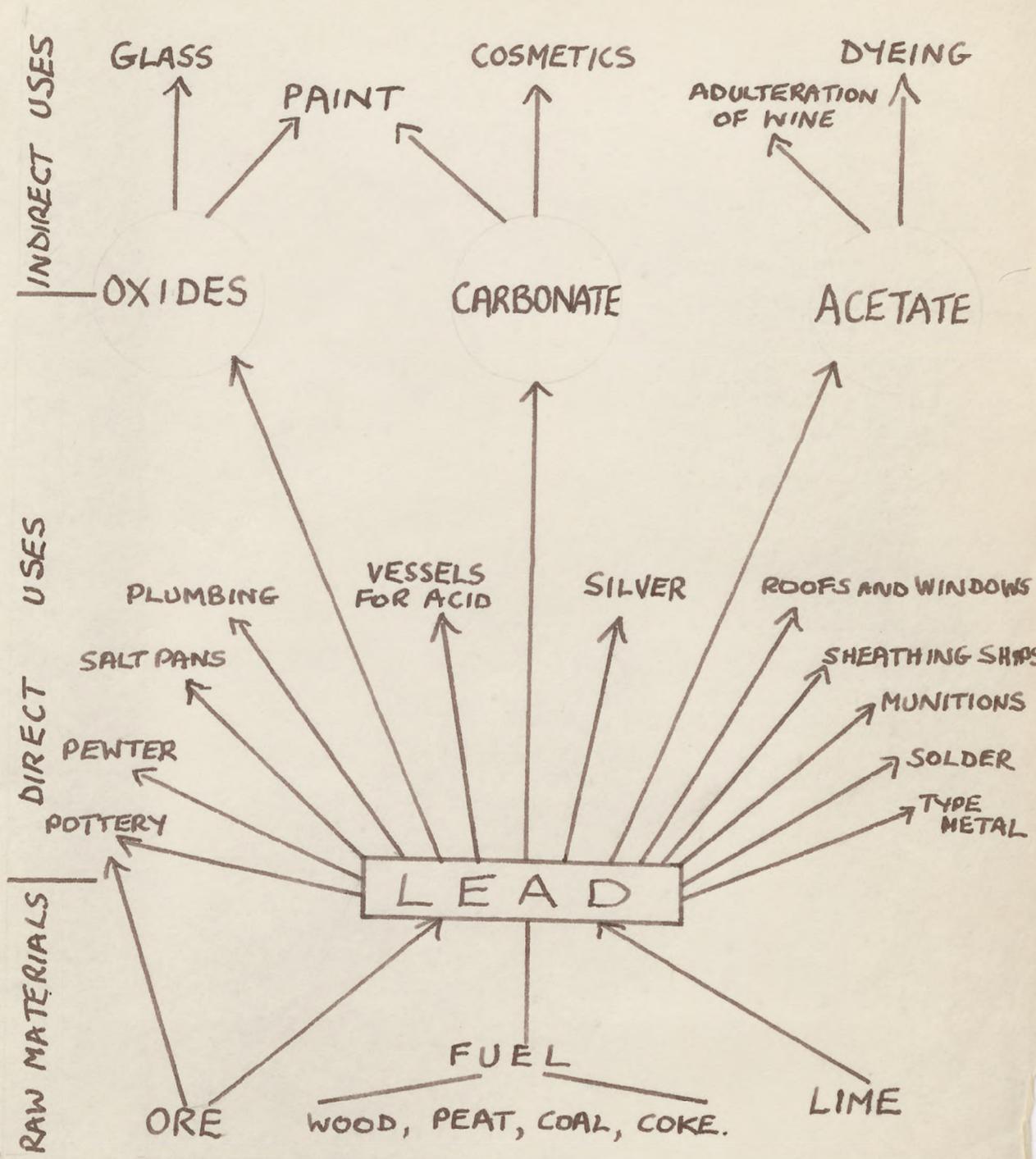
Finally, a most important reason why the full impact of the technical changes was not felt in most metal mining areas until well into the seventeenth century is to be found in the general progress of the early industrial revolution, and particularly in the development of some metal-using industries. The Company of Mines Royal had some difficulty in disposing of its copper output in its early years, because the copper manufacturing and brass industries were in their infancy. The period of rapid expansion in both copper mining and copper and brass manufacture began late in the seventeenth century. The Stannaries were relatively stagnant during the period, roughly from the late sixteenth to the middle seventeenth centuries, when some traditional uses of tin, e.g. for pewter and bronze, were

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1. Nef, op.cit., Vol I, p.266.
 2. There was a marked increase in copper mining activity after 1689, when some important new deposits of copper were discovered. The Royal Mines Act encouraged the formation of companies competing with the Company of Mines Royal and the Mineral and Battery Works (merged in 1668) which had hitherto had monopoly rights in certain counties. Hamilton, op.cit., pp.61-6,101.
 3. Nef, op.cit., Vol I, pp.169-171.
 4. Donald, op.cit., pp. 227,259 et seq.
 5. Hamilton, op.cit., pp.138-9. 6. Nef,op.cit. Vol I, p.166.

declining in importance, and new processes, creating new demands for tin, of which the most important was the manufacture of tins¹ had not yet been successfully developed.

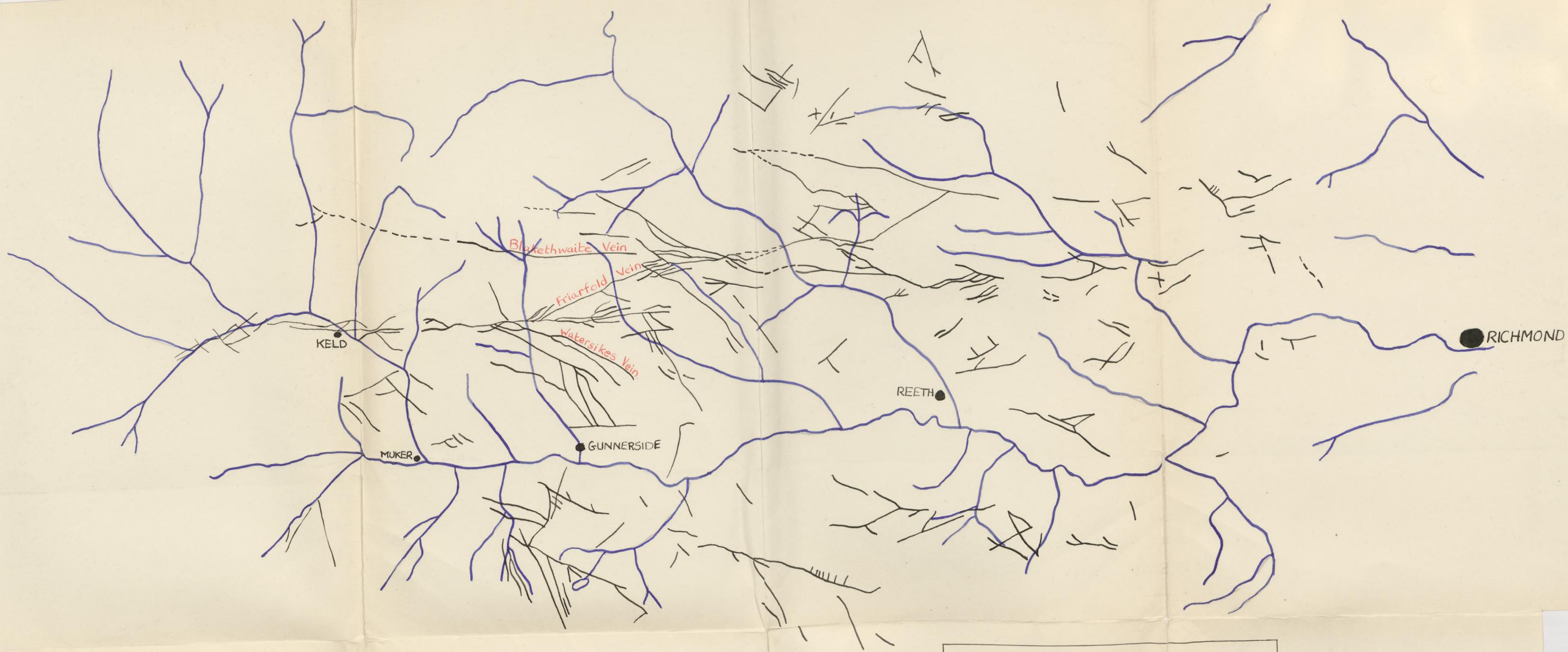
Similarly, the fortunes of lead mining, by far the largest branch of non-ferrous metal mining,² were closely bound up with the progress of several of the industries which grew rapidly during the early industrial revolution;³ In the manufacture of salt, glass, paint and pottery, and in shipbuilding, lead found a variety of uses, some of which involved the development of new processes, e.g., the rolling of lead to produce suitable sheet lead⁴ for sheathing the hulls of ships.⁵ The uses of lead which had developed by the eighteenth century are shown in the diagram on page eleven.

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1. Articles were being made in Britain from tins¹ imported from Germany by about 1500. From 1623 there were a number of attempts to manufacture tins¹ in this country. At least one of these was technically successful, but failed because of high production costs, and the industry was not established commercially until the beginning of the eighteenth century. Minchinton, op.cit., pp.1-13.
 2. During the reign of Charles I, the annual output of lead in England and Wales was estimated at 12,000 tons. Tin output was about 500 tons, and copper output probably less than 200 tons. In the early eighteenth century, after a period of expansion, only 500 or 600 tons of copper were produced annually. Nef, op.cit., Vol I, p.167; Lewis, op.cit., Appx J; Hamilton, op.cit., pp.103 and 144.
 3. Nef, op.cit., Vol I, pp.184-9.
 4. Known as milled lead.
 5. Scott, op.cit., Vol III, p.106.



THE USES OF LEAD

(Modified from Clow, op.cit., p.374)



THE PRINCIPAL MINERAL VEINS OF SWALEDALE
(SUPPOSED COURSE OF VEINS IN BROKEN LINES)
SCALE: ONE INCH TO ONE MILE.

Chapter II : The Early History of Lead Mining in Swaledale

- i -

Swaledale, the most northerly of the Yorkshire Dales,¹ is a narrow, steep-sided valley, stretching some 30 miles from the wall of high fells which forms the watershed between the Swale and the Eden on the west, to Richmond, where the river passes suddenly into the open plain. The valley has been created by the erosion by water and ice of a plateau built up of rocks of the Yoredale Series. A succession of beds of limestone, shale, and sandstone, with some chert, can be traced from the lowest observable bed, the limestone below the Harddraw Scar Limestone,² to the base of the millstone grit which caps the highest fells.

The upthrow of the Dent and Craven faults has tilted the Yoredale strata towards the north and east,³ but this pattern has largely been obscured in upper and middle Swaledale by the effects of faulting and by local inclinations of the beds. In general, the latter rise from the Lane End and West Stonesdale mines, west and north of Keld, to the west side of Gunnerside Gill, a feature which has markedly affected the problems and fortunes of mining.⁴

In some of the fault-fissures, which have vertical displacements ranging from a few inches to two or three hundred feet,

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1. Teesdale is partly in Yorkshire, partly in Durham.
 2. Memoirs of the Geological Survey, Mallerstang, (1891) pp. 103-126. Some representative sections are given in Appendix A.
 3. A. Raistrick and J.L. Illingworth, Face of North-West Yorkshire (1949), pp. 1 and 22.
 4. Especially in the Blakethwaite Mine. See below, pp. 123-8.

galena, the sulphide of lead, has been deposited. Other vein-filling materials are the gangue minerals, calcite, barytes, and quartz, with some witherite and fluorspar, and the breccia derived from the adjacent strata. Some ore has been deposited in flots or flats, horizontal deposits found in association with some of the veins, particularly on the south side of the Swale.

The productivity of the veins varies, in part, according to the throw of the vein and the nature of the strata. In the shale and softer sandstone the hade, or inclination from the vertical, of the vein usually increases and the fissure narrows. In a hard bed the vein is generally wider and less likely to be filled in by broken pieces of the adjacent rock. Most of the ore, therefore, has been deposited in the veins between walls of limestone and chert. When the throw of a vein is more than a few fathoms, the limestone beds may be opposite shale or sandstone and the fissure may have been choked by crushed shale or sandstone before mineralisation. In consequence, veins with a considerable displacement are usually unproductive, although there are exceptions to this rule of which the most notable is the Friarfold Vein, which, with a throw of about 28 fathoms, has been one of the richest in the area.

1. Geological Survey, Mallerstang, pp.165-181.
2. Memoirs of the Geological Survey, Special Reports on Mineral Resources, Vol 26, Lead and Zinc Ores of Durham, Yorkshire, and Derbyshire (1923), p.30.
3. In Swaledale shale and sandstone were known as "plate" and "grit", terms which are frequently used below.
4. K.C.Dunham, Geology of the Northern Pennine Orefield, Vol I (1948), pp.70-72

The ore-bodies in the veins are usually only a few inches wide. Their vertical extent is in most cases clearly delimited by the character of the adjacent strata and they are greatest, although extremely variable, in longitudinal direction. Some veins have been productive in one or perhaps two of the limestone and chert beds, while a few have had several ribbon ore-shoots, one above the other, in each of the favourable beds¹.

The thickest of the limestone beds in Swaledale, the main limestone², has been responsible for a large part of the output of ore. Apart from its thickness, the reason for this may be that it is a relatively pure and soluble limestone, in which the fissures have been enlarged by water action to carry larger ore-bodies³. The other productive beds are the "Crow" limestone and chert, the Red Beds, principally a soft limestone⁴, the Black Beds, a dark, hard chert⁵, and the underset limestone and chert. The sandstones have been occasionally, and the shales rarely, productive. The thin and widely separated limestone beds below the underset limestone have proved of little value⁶.

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1. Dunham, op.cit., p.78 and W.W.Varvill, A Study of the shapes and distribution of the lead deposits in the Pennine Limestones in relation to Economic Mining. Trans. Inst. of Mining & Metallurgy, Vol.46, 1936-7, pp.468-9.
 2. It is also known as the "Twelve-Fathom Limestone" although it varies in places from eight to sixteen fathoms in thickness.
 3. Varvill, op.cit., p.466.
 4. C.L.Bradley, An Enquiry into the Deposition of Lead Ore in the Mineral Veins of Swaledale, (1862), p.6.
 5. Memoirs of the Geological Survey, The Geology of the Country around Mallerstang, pp.110 & 116.
 6. See below, pp. 181-8.

The veins are particularly numerous on the north side of Swaledale between Keld and Marske¹, and have been most productive in a slightly smaller area, between the Beldi Hill and Hurst mines. East of Marrick, the veins are fewer and poorer and the mining enterprises have been, in consequence, smaller and less profitable. Lead mines within a few miles of Richmond, including one on the south side of the valley, were worked sporadically in the seventeenth, eighteenth and nineteenth centuries², but for practical purposes the mining field may be said to end at the Hurst Mines on the north side of the dale, and at Ellerton Moor on the south side.

The general trend of the major veins on the north side of the Swale varies between east-west and northwest-southeast³ and the principal group can be traced from the Lane End, Littlemoor and Keldside Mines, where the river runs parallel to and between the veins, through Beldi Hill, Swinnergill, Lownathwaite, Old Gang, Surrender, Arkengarthdale and Fell End to the Hurst Mines. Subsidiary veins and strings branch from these, and other east-west veins lying further north, especially in a south-easterly direction. The main veins are also traversed by a series of cross-veins, with a variety of

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1. Geological Survey, Special Reports, Vol.26, p.26.
 2. Philip Swale MSS. Vol.I, No.206. Vol.II. No.100.
C.Clarkson, History of Richmond, 1st edition (1814), pp.324-6.
Leases of Skelton and Thorpe-under-Stone Mines, 1865-74,
North Riding Records, ZAZ. Letter, J.R.Tomlin to Sir G.
Denys, 1 Feb 1873. Draycott Hall MSS. M.5.
 3. Geological Survey, Special Reports, Vol.26, p.26.

bearings, which have in general been found less productive. The major veins on the south side of the Swale, as in the neighbouring Wensleydale field, trend northwest-southeast.

The topography of Swaledale has been favourable to mining enterprise. In several places, steep-sided valleys have cut through the mineralised zone, making possible the driving of levels from the valley sides for access to the veins and for drainage. The topography and the rainfall have also encouraged the use of water power, while the isolation of the dale has discouraged the use of coal because of high transport costs.

-ii-

The economy of Swaledale has passed through three main phases¹. During the first, from the beginning of historic times until the seventeenth century, agriculture in one form or another was the chief occupation with mining as one of a number of subsidiary activities. From the middle of the seventeenth century mining grew to dominate the economy of the dale and at the height of this phase a large part of the agricultural land was held in smallholdings by men who were primarily miners. In the third phase, beginning with the decline of mining late in the nineteenth century, farming has once more become the leading element in the economy.

With the exception of one fragment of evidence, a pig of lead smelted in the reign of the Emperor Hadrian (117-138 A.D.)

1. See below, pp.229-240.

which was found at Hurst in the nineteenth century, the recorded history of the Swaledale mines begins in the twelfth century. Lead may well have been mined in pre-Roman times by the Celtic tribe of the area, the Brigantes,² whose metal workers were highly skilled,³ or in later centuries by the Angles, who settled in the lower half of Swaledale and whose kinsmen worked lead ore deposits in Derbyshire in the eighth and ninth centuries.⁴ But positive evidence is entirely lacking.

Swaledale was one of four areas in Yorkshire⁵ in which lead mining was prosecuted with some vigour in the early middle ages. In 1162-63 the Yorkshire mines yielded a profit to the king of £20, compared with £100 from Alston Moor in Cumberland.⁶ Between 1179 and 1184, 466 carretates, or perhaps about 700⁷ tons, of lead from Richmond-shire, and therefore from Wensleydale or Swaledale or both, were shipped from Yarm and Borough-

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1. H. Speight, Romantic Richmondshire (1897), p.207
 2. Who no doubt provided the labour force for the Romans.
 3. R.E.M. Wheeler, The Stanwick Fortifications (1954), pp.29-30.
 4. Pulsifer, op.cit., p.48; Salzman, op.cit., p.42; V.C.H., Derbyshire, Vol II (1907), p.323.
 5. The others being Wensleydale, Nidderdale, and Appletreewick in Craven. V.C.H. Yorkshire, Vol II (1912), p.351.
 6. Pipe Roll Society, Vol 31, Pipe Roll 28 Henry II, p.47.
 7. In 1295 a carretate of lead was reckoned in Richmondshire as equivalent to 10 or 11 horse loads. V.C.H. Yorkshire, Vol II, p.352. A horse load probably consisted of two pigs each weighing about $1\frac{1}{2}$ cwts., as it did in the eighteenth century. The average weight of the Roman pigs found in Yorkshire was the same as that of pigs smelted at the latter period, about 176 lbs. A Derbyshire carretate was reckoned by two different sources as 2340 lbs. and 1680 lbs. respectively. V.C.H. Derbyshire, Vol II. p.324.

1
bridge for use in the building of Waltham and Clairvaux
2
Abbeys. In 1219 a royal mandate was issued confirming the
right of the miners in Swaledale and Wensleydale to work unmol-
3
ested as they had done under Henry II, Richard I, and John.

The Arkengarthdale mines may have been the most consist-
ently worked during this period. An inquisition post mortem of
1285 put the annual value or profit of "the lord's mine" at £4
out of a total of £51.13.0 for the whole manor of Arkengarth-
4
dale. Several references to lead mined in Arkengarthdale occur
in the Pipe Rolls and ministers' accounts between 1294 and
5
1296. Seven lead merchants from the same area were involved
in a dispute about weights and measures in the reign of
6
Edward I. There is, on the other hand, no definite evidence
of lead mining in the main valley of Swaledale in the late
thirteenth century. There is no reference to mining in a
detailed inquisition in 1274 of the manor of Healaugh, which
included the Old Gang and other mines of great importance in

1. 100 carretates from Yarm, 366 from Boroughbridge. It is a reasonable assumption that most, if not all, of the lead sent to Yarm came from Swaledale. Both Swaledale and Wensleydale sent lead to Boroughbridge in later centuries.
2. Pipe Roll Society, Vols 29-33, Pipe Rolls 26-30 Henry II. The price varied from 12/6 to 13/4 per carretate at the ports. Shipping freights to London were 1/11½ a carretate from Yarm and 1/4 and 1/10 from Boroughbridge.
3. The mandate refers to workmen - "operarii" - but the only workmen in the area who might have attracted royal protection were miners. Record Commission, Rotuli Litterarum Clausarum, Vol I, p.409.
4. Y.A.S.R.S. Vol 23, Yorkshire Inquisitions, Vol II, p.38. There was no reference to mining in a similar inquisition in 1281. Lead mines were, however, mentioned in a summary extent of the Yorkshire lands of the Honour of Richmond, of which Arkengarthdale formed a part. Ibid., Vol I (Y.A.S.R.S Vol 12), pp.224 and 230.
5. V.C.H., Yorkshire, Vol II, pp.351-2.
6. Ibid., p.351.

later centuries¹. If there had been any regular income, either from direct working of the mines or from the lord's share of the output of any independent miners, one would expect it to have been recorded². This mining field may, of course, have been worked spasmodically. There is no reference to tithes of lead in three agreements made between 1272 and 1278 about the division of the tithes of Grinton parish between Bridlington Priory, the impropiator, and the vicar³. Less significant is the absence of any mention of mines or mineral rights in a grant made to Rievaulx Abbey, circa 1241, of pasture and various contingent rights in upper Swaledale, where the ore deposits were neither rich nor particularly easy to work.⁴

Little is known about mining in Swaledale during the next two centuries and it is not until the sixteenth century that any coherent picture emerges again. Most of the mines which were prominent in later centuries were working at this period.

1. Yorkshire Inquisitions, Vol.I, pp.137-8.

2. But Kosminsky has shown that sources of revenue of this kind were not infrequently omitted from inquisitions post mortem. E.A.Kosminsky, Studies in the Agrarian History of England in the Thirteenth Century, (1956), p.61. And see note 4 on previous page.

3. W.T.Lancaster (Ed), Chartulary of Bridlington Priory (1912), pp.432-4.

4. Surtees Society Vol.83, Cartularium Rievallense, pp.304-5.

According to Leland, the "Men of Sualdale be much usid in digging Leade Owre (from the) great Hilles on each side of Suadale."¹

The Hurst mines, although not mentioned by name, would yield most if not all of the tithes of lead ore of Marrick parish, which were valued at 24/- a year in 1535². The neighbouring Fell End mines and those of Grinton Manor seem to have been worked with some regularity and were together worth 40/- a year to the Crown in 1599³. The lease of a mine at Punchard Gill in Arkengarthdale was bequeathed by will in 1531⁴, and the rest of the Arkengarthdale field was included in a lease made to Sir James Metcalfe in 1533⁵. The royalties of this field had been farmed for £20 a year in 1527-1529⁶ and the tithes of lead ore were valued at 40/- a year in the Valor Ecclesiasticus⁷. The tithes paid in Arkengarthdale were probably far less than a true tenth of the produce as apart from the general difficulties of collecting lead tithes⁸, local custom ordained that tithe was paid only on pieces of ore which would not pass through a riddle with a one-inch mesh, which would appear to offer almost unlimited opportunities for evasion⁹. Some of the Arkengarthdale

1. L.T.Smith (Ed.), Itinerary of John Leland (1908), Vol.IV p26.
2. Record Commission, Valor Ecclesiasticus Vol.V, p.237.
3. Conveyance of Manor of Grinton from Crown to Wiseman & Fitch 10 Nov 1599. Copy in Barker MSS.
4. A.Raistrick, Mines and Miners in Swaledale (1955) p.23.
5. Ibid. 6. V.C.H.Yorkshire North Riding, Vol.I (1914), p.36.
7. Valor Ecclesiasticus, Vol.V, p.236.
8. J.W.Gough, Mines of Mendip (1930), p.61.
9. V.C.H., Yorkshire North Riding, Vol.I (1914), p.37.

lead was probably smelted at Clints Mill, near Marske, as was the case during the seventeenth and early eighteenth centuries¹. This mill was built some time before 1590².

At the beginning of the sixteenth century the Prior of Bridlington claimed that the yield of the impropiator's two-thirds share of the tithes of lead in Grinton parish, which the collector was unlawfully retaining, had amounted to £40 in three years³. In the *Valor Ecclesiasticus*, however, the total tithes of lead ore of this parish, which included the manors of Grinton, Fremington, Healaugh and Muker, were valued at only £5 a year⁴. There is no documentary evidence of mining in the Manor of Healaugh during the sixteenth century but the records of operations in the mines around Gunnerside Gill in the second half of the seventeenth century⁵ make it clear that these mines had already been worked for a long period, as the mineralisation and topography of the area would lead one to expect. The mines in the Rievaulx lands in upper Swaledale, now known as the Manor of Muker, were returned as yielding no income to the Abbey in the dissolution computus⁶.

1. See below, pp.57-8.

2. Y.A.S., R.S. Vol.7 Yorkshire Fines, Tudor, Part III, p.137.

3. Y.A.S., R.S. Vol.88. Monastic Chancery Proceedings for Yorkshire, pp.20-1.

4. Valor Ecclesiasticus Vol.V, pp.120, 147.

5. See below, pp.32-3.

6. Cartularium Rievallense, p.330.

The medieval Swaledale miners appear to have enjoyed privileges similar to those of the "free mining" districts of the Stannaries of Devon and Cornwall, the Forest of Dean, Alston Moor, Derbyshire and Mendip. The royal mandate of 1219 has already been cited. In addition the privileges of Alston Moor were extended to the mining fields of Yorkshire, implicitly by the affiliation of the two areas in the Pipe Rolls of 1162-63¹ and explicitly by letters patent in 1223². In the free mining districts, the affairs of the mining communities were governed by their own customary laws, derived from ancient usage and confirmed by royal decrees or statutes. A free miner could prospect at will in unenclosed ground and if he found a promising vein could claim the right to work a certain stretch of it, usually a meer, a customary measurement varying from twenty-nine to thirty-two yards, paying a proportion of the output to the lord of the soil. The claim was registered with the reeve or barmaster, the administrative officer of the mining community, and any disputes about ownership were settled in the local mine court³.

If any mine courts or officials existed in medieval Swaledale, no trace of them remained in the sixteenth century⁴. The customary rights of mining seem to have become integrated with the system of land holding by "tenant right", whereby the

1. Pipe Roll Society, Vol.6. Pipe Roll 9 Hen II, p.10.

2. Calendar of Patent Rolls, 1216-1225, pp.366-7.

3. Lewis, op.cit.; Chs.III-VI; V.C.H.Derbyshire Vol.II.pp.325-7
Gough, op.cit.; Ch.IV.; Salzman, op.cit., pp.43-50.

4. They still existed in Wharfedale in the middle of the eighteenth century. A.Raistrick, Lead Mines of Upper Wharfedale. Yorkshire Bulletin of Economic and Social Research, Vol.5, No.1, Feb. 1953, pp.4-5.

copyholders enjoyed secure tenures and inheritance, with fixed rents and fines, in return for the obligation of border service. In several lawsuits fought by the tenants in the sixteenth and seventeenth centuries to defend this status mining rights are usually listed with rights of common, turbary, quarrying and taking timber.

In circa 1530 the bailiff and tenants of the Crown manor of Arkengarthdale complained to the Star Chamber that William Conyers, a local landowner, had robbed them of their common rights "and also custom of lead mines by reason of their tenantry's time, whereof the contrary of mind of man is not, paying yearly unto your said highness the 9th part of the profits growing and coming by reason of the said lead mines".¹

One of the articles of tenant right and custom of the Manor of Muker, confirmed by a decree of the Court of Chancery in 1564 after the first of a series of lawsuits relating to Healaugh and Muker Manors, reads, "When any lead mines shall happen to be found within the lordship the finder thereof is to have the same, according to the law and custom of mines there²

1. "Profits" should presumably be taken to mean "produce". Y.A.S. R.S. Vol.41, Yorkshire Star Chamber Proceedings, Vol.II, pp.178-80.
2. E.Cooper, Muker, the story of a Yorkshire Parish (1948), pp.116-6.

A more ambiguous reference appears in a decree of 1617, applying to Healaugh Manor, after another dispute: "The lord to have all mines of lead and coal and all quarries of what kind soever and all other royalties (but he) shall not dig in meadow... and shall leave the tenants necessary stone for building and allow them to enjoy the custom of minery for mines which they shall find according to the custom so used"¹. This would suggest that it was open to the lord to work such mines as he wished and elsewhere the miners could prospect freely and take meers at customary rates of duty.

The differences between the mining organisation of Swaledale and that of the principal free mining areas were, in the sixteenth and early seventeenth centuries, less significant in practice than in theory. On the one hand, mining customs had already begun to lose their force and in some areas at least the mining communities were becoming more and more subject to the control of manorial lords and common law courts². On the other hand the initiative in the Swaledale mines still lay with the small man to whom mining was usually a secondary occupation and who, working singly or in small partnerships, continued to search for productive veins, which would then

1. Chancery Decree, 28 Nov 1617. Barker MSS.
2. Nef, op.cit., Vol.I, p.277.
Gough, op.cit., p.109.

be worked in meers on a bargain with the lord of the manor at a rate of duty which might be fixed by local custom or vary according to the expected productivity of the mine. This system under which knowledge of the veins and ore-shoots of Swaledale was gradually built up, held the field until the development of a large-scale capitalistic industry in the richer mines from the second half of the seventeenth century. Outside these mines, the independent prospector survived for a long time; in the poorer mines of south Swaledale until well into the nineteenth century.

Chapter III : The Growth of a Large-Scale Industry.

- i -

The main advances in technique and organisation which turned lead mining in Swaledale into a large-scale capitalistic industry and transformed the dale from a predominantly farming area into one primarily dependent on mining were concentrated in the period between the middle of the seventeenth, and the early years of the eighteenth centuries. The causes of this early industrial revolution were primarily those affecting the lead mining industry as a whole, such as the adoption of improved techniques borrowed from Germany and the rise in the demand for lead occasioned by the growth of the metal-using industries. Two factors of local importance were the marked natural increase of population¹ which led more men to seek at least part of their livelihood in mining, either in employment or in independent ventures, and the inheritance or purchase of local manors by men with the desire and the means to exploit their own mineral wealth.

Two such families were the Bathursts in Arkengarthdale and the Whartons in the manors of Healaugh and Muker. The expansion of the Arkengarthdale mines dates from the time of Dr. John Bathurst, who bought the manor in 1656², and of his

1. See below, pp. 232-4.

2. V.C.H., Yorkshire North Riding, Vol.I, p.36.

son Charles, by whose initials, C.B., the mines and smelting mills were afterwards known. In 1625 Philip, fourth Baron Wharton, inherited the manor of Muker and half the manor of Healaugh as part of a large and valuable estate¹. In 1635 he bought the other half of the latter manor, removing a potential obstacle to the development of the mines². The division of the manor was not geographical but financial and as the mineral rights were held jointly by the two lords³, any capital risk could only be undertaken by agreement between them⁴.

The growing importance of lead mines to these and other manorial lords in the late seventeenth and early eighteenth centuries is attested by disputes about the extent of their mineral rights and the boundaries between their manors. Until this period, boundaries running over moorland used only for rough sheep pasture and for sport were of minor importance, but their exact determination could be vital when a rich ore deposit was discovered in the area.

In one case, the determination was effected peacefully. In 1671 and 1676, the Marquess of Winchester, lord of the manor of Marrick which included the Hurst Mines, and Humphrey

1. Transcript of evidence Lyell v. Broderick, Chancery Division, June-July 1899; Sir F. Denys-Burton: "Notes on the Pomfret, Denys & Shuchburgh families & the Yorkshire Mines", 1908, D.H. MSS. W.4.
2. Ibid. 3. They were not related.
4. Manor of Healaugh Court Books.

Wharton, lessee of the Fell End mines, made agreements to survey and adjust the boundary between their properties¹. A dispute about part of the boundary between the manors of Healaugh and Arkengarthdale was decided in 1702, after a Chancery suit, in favour of Charles Bathurst, owner of the latter, and Thomas Lord Wharton was ordered to give up working a mine near the boundary which he was accused of trying to exhaust before the case could be decided².

There were two disputes about the ownership of the manorial and mineral rights of Grinton, which had their roots in the origin of the manor. In the twelfth century, the Gaunt family granted to Bridlington Priory first the church and vill of Grinton³, and later the right of pasture in Whitaside to the west of Grinton vill⁴. The ownership of the soil, and therefore of the minerals, in Whitaside was not included in the grant, and some land in Harkerside, part of the vill of Grinton, remained in the ownership of the lords of Healaugh Manor and was still held as copyhold of the manor at the time of the disputes⁵. With the exception of

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1. North Riding Records, ZAZ Mining.
 2. Chancery Injunction, 22 Dec 1702. Peacock MSS.Pkt.6.No.11.
 3. Chartulary of Bridlington Priory, p.249.
 4. Ibid.
 5. Healaugh Manor Court Book "A".

this land the Priory came, in the course of time, to exercise full manorial rights over the whole property¹, rights which were recognised in 1409 by one of the two lords of the divided manor of Healaugh² who quitclaimed to the Priory his hunting rights and "all manner of profit below or above ground"³.

At the dissolution of the monasteries, Grinton Manor, as it had thus become, passed to the Crown, which sold the manor in 1599, reserving the mineral rights⁴.

The latter were leased by Humphrey Wharton in 1628 for a period of twenty-one years. This lease expired during the Civil War and, presumably because of the disturbed condition of the country, no new lease was issued. A local landowning family, the Swales, took advantage of this and worked some of the mines themselves for almost half a century. Eventually Reginald Marriott⁵ discovered this state of affairs and in 1696 he secured, through a nominee George Tussingham, a lease of the mineral rights, for thirty-one years, at a royalty of one-tenth, on the condition that he was to defend the Crown's title.⁶

1. Chartulary of Bridlington Priory, pp.254-6.
 2. Divided on the death of the fourth Gilbert de Gaunt in 1298.
 3. Chartulary of Bridlington Priory, p.248.
 4. Conveyance of Grinton Manor from Crown to Wiseman and Fitch. Barker MSS.
 5. In 1720 Marriott was a director of the Court of the Company of Mine Adventurers. Company Minutes, 1720-21. Rawlinson MSS., D.916.
 6. Report of R.Eyre to the Earl of Godolphine Lord High Treasurer. In the possession of Mrs.Nathan of Healaugh; Court of Exchequer, Order for trial in Marriott v. Wharton, 1705, Barker MSS.

Sir Solomon Swale countered by claiming the lordship and mineral rights of the "manor of West Grinton". His claim rested on his supposed descent from Alured de Swaledale, who held land of the Gaunts in the twelfth century.¹ William Overswale, who may have been a descendant of Alured, was one of the principal free tenants of Gilbert de Gaunt in 1274,² and a man of the same name was one of the two leading lay taxpayers of Grinton vill in the Lay Subsidy of 1301.³ Robert Swale was returned as joint holder, with Bridlington Priory, of the vill in the Nomina Villarum in 1316,⁴ but there is no evidence that manorial rights were ever granted to the Swales, or exercised by them, during the middle ages. The manor of West Grinton was a figment of the Swales' imagination.⁵

Sir Solomon's claim failed, but in 1705 Lord Wharton asserted that Harkerside and Grinton Moor were still part of the manor of Healaugh, and sent his men to sink a shaft near to some of Marrioot's workings. After a dispute lasting for three years, the Crown's rights were confirmed, and Marriott was left

1. Record Commission, Pipe Rolls 2-4 Henry II, p.148; Pipe Roll Society, Vol I, Pipe Roll 5 Henry II, p.30.
2. Yorkshire Inquisitions, Vol I, p.138.
3. Y.A.S.R.S., Vol 21, Yorkshire Lay Subsidy 1301, p.92
4. Surtees Society, Vol 49, p.336.
5. Plantagenet-Harrison, who may have sympathised with the Swales because he himself claimed to be Duke of Lancaster, Normandy, Aquitaine, and Scandinavia, prints a charter purporting to be the grant by Walter de Gaunt to Alured of the manor of West Grinton, including the township of Reeth. The V.C.H. says that it has "every sign of spuriousness", and it is flatly contradicted by all the available evidence. G.H.Plantagenet-Harrison, History of Yorkshire: Wapentake of Gilling West, (1885) p.234; VCH. Yorkshire North Riding, Vol I, p.239.

in undisturbed possession of the mines.¹

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Parallel with these disputes, changes were taking place in the organisation and scale of mining operations. The initiative was passing from the partnerships of tributing miners who had hitherto been the primary risk-bearers to lords or lessees with capital to invest. Some leases of large tracts of ground had been granted by the Crown in the sixteenth century,² but it is likely that such lessees were interested in receiving the lord's share of the independent miners' output and not in investing capital in the mines themselves, that is to say, they were farmers of mining revenue and not mining entrepreneurs.

In the later seventeenth century, a number of mines were leased to entrepreneurs who employed men on day wages or piece work to sink shafts, drive drifts, and do other ancillary work, leaving the partnerships of ore-men to work in defined veins or stretches of vein at a price per bing of ore raised.³ About 1676 the meers of ground let to independent miners in the Lownathwaite and Old Gang mines were bought in, and the ground leased to Philip Swale, Lord Wharton's steward, Robert Barker of Richmond, variously described as "yeoman" and "shoemaker", and their

1. Court of Exchequer, Order for trial in *Marriott v. Wharton*, Barker MSS; Court of Exchequer, Mandate for Quiet Enjoyment, 24 Oct 1705, Peacock MSS, Pkt VI, No.12; Attorney-General v. Wharton, Verdict of jury, 1708, D.H.MSS RB15. Marriott had meanwhile bought either Grinton manor, or a share in it, from the family of Hillary, into whose possession it had passed from Wiseman and Fitch. V.C.H., Yorkshire North Riding, Vol I, p.239.

2. See above, p.20.

3. A bing is 8 cwts.

partners, for twelve years at a royalty of 22 shillings a fother¹. In 1675 Swale and Barker leased from Sir Thomas Wharton² all the mines of coal and lead in Ravensworth, Kirkby Hill, Feldom, Applegarth and Thorpe Edge³. In both cases the lessors were themselves partners in the enterprises, for each of which a joint stock amounting, apparently, to two or three thousand pounds was kept⁴.

The trials of Sir Thomas Wharton's ground which lay outside the main mineralised area, were generally unsuccessful, although some ore was raised at Thorpe Edge. Those in the Lownathwaite and Old Gang mines, in the heart of the mining field, proved more rewarding. These mines, with rich veins exposed by the steep sided valley of Gunnerside Gill had already been heavily worked, at least near the surface. The reports of operations in the sixteen-seventies-and-eighties mention the discovery, particularly in the Lownathwaite mine, of a good deal of ground worked out by the "old man", a term used to describe the miners of an earlier period, whether one generation or ten

centuries before⁵. According to Philip Swale's correspondence

1. A fother was 22 cwts. Philip Swale MSS. Vol. I, Nos. 186, 193; Vol. II, No. 121.

2. Brother of Philip Lord Wharton.

3. This lease ran for 13 years. Ibid. Vol. I, No. 186.

4. Ibid., Vol. I, Nos. 187, 190, 198, 206. Vol. II, No. 46.

5. Ibid. Vol. I, Nos. 192, 205; Vol. II, No. 26.

the trials were expensive and not at first very promising¹. Before the end of the century, however, the mines were producing well. Between 1696 and 1700 the average annual output was about 440 tons of lead, and the difference between the value of the lead and the total amount paid out on the field, over a period of eighteen months, was £5117². Transport costs and overhead charges, including possibly the salaries of the agents, had to be met out of this, and the extent of the capital investment at this time is not known, but the enterprise appears to have been very profitable. The only other figures of output covering a period of more than a few weeks, of the ore raised during the first six months of 1684, are equivalent to an annual output of a little over 300 tons of lead³.

The development of the Lownathwaite and Old Gang mines caused an influx of labour into that part of Swaledale⁴ and special measures had to be taken to feed them. A small intake near Gang Hall⁵, on Melbecks Moor, was offered to let

1. Philip Swale MSS., Vol.I, Nos.206 & 219.

2. Accounts of Adam Barker. Peacock MSS.B.11.

3. P.Swale MSS. Vol.II. No.129.

4. How far from other parts of the dale and how far from further afield is not clear.

5. This intake may be Moorhouse Intake. O.S. 6" Map, Sheet 36 SE.

"to him that is to diet the miners that are at Gang Hall"¹, which was apparently used as a lodging shop by the miners. Another proposal made by Lord Wharton was that "the landlord at each (public) house or some else" should be advanced money out of the joint stock of the mining company to "provide beef, pork, cheese and bread etc.... for the miners... for ready money (or) to them they are sure will pay."².

The neighbouring mines of Arkengarthdale were let by the lord of the manor, John Bathurst, in 1672, for £150 a year. In the course of a lawsuit about the terms of the lease in 1682 the lessee's agent stated that after spending a considerable amount of money over a period of two years opening and draining mines at Windegg and at several places on Moulds Side the mines were yielding a profit equal to twice the rent³.

At some time before November 1682, the Spout Gill mine, on the south side of the Swale, was leased to Alderman Edward Thompson of Richmond and his partners and at that date they were granted leave to make trials in the adjacent ground of Satron Hangers if Lord Wharton and his partners did not

1. P. Swale MSS. Vol. II. No. 121.

2. Ibid., Vol. II, No. 76.

3. V.C.H., Yorkshire, North Riding, Vol. I, pp. 36-7.

do so within three years¹. In 1700, a new draft lease to Thompson and company was drawn up which included² the ground west of Spout Gill as far as Keldside and Sleddale. The lease was to run for 21 years and stipulated, inter alia, that a joint stock of £300 should be raised by the lessees³.

Nothing is known of the workings at Spout Gill at this time, except that there were at least two shafts there in 1678⁴. A later Swaledale legend that three brothers raised £40,000 worth of ore from this mine in one year⁵ may date from this period, although only two of the three lessees of the 1700 draft lease bore the same name. While the figure itself is quite beyond belief, it is not impossible that a considerable quantity of ore was raised from this mine in a short time as much of the ore in this part of Swaledale is found in "flats" or "flots", horizontal chamber deposits which make for easy and speedy extraction.

In 1718 the Hurst mines, which had hitherto been worked directly by the lord of the manor, Lord William Powlett, were leased for twenty-one years at a duty of one-seventh to Samuel Mellor and Thomas Jones of Flintshire and John Halsall and William Thompson of London.⁶ To ensure that

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1. P. Swale MSS., Vol. I, No. 189.
 2. As the original lease may have done.
 3. The duty was to be 22/- per fother after the first five fothers. North Riding Records, ZAZ Mining.
 4. P. Swale MSS., Vol. II, No. 140.
 5. Fawcett MS., p. 113.
 6. Bower MSS. North Riding Records, ZFY.40. Mellor & Halsall each held a one-third share, Jones & Thompson a one-sixth.

the mines were effectually worked, it was stipulated that at least 147 labourers should be employed. This is the first known example of a provision that was common in nineteenth century leases. The number of miners to be employed and the schedule of workings to be kept open which was attached to the lease show that the Hurst mines had become, and had probably been for some time, a large-scale capitalist undertaking.

Two small leases of ground in Marske Manor which have survived are comparable to duty bargains rather than to leases to men of substance. In 1683 mines on Marske Moor were granted for nine years to a miner and a blacksmith and in 1729 mines in Cliburne Pasture, west of Marske, were leased for seven years by four yeomen of Grinton. The duty in each case was one-seventh.¹

There are only scattered records of the principal mines in the manor of Healaugh during the first three quarters of the eighteenth century. Accounts and correspondence in 1705 and 1716 suggest that Lord Wharton was the sole or chief investor in the Old Gang and Lownathwaite mines, and also in the Swinnergill mines to the west of the latter². The subsequent decline in the fortunes of the Wharton family may have affected adversely the development of the mines.

1. North Riding Records, ZAZ, Mining.
2. D.H. MSS., R.D.18.

The sixth Baron Wharton, Philip, who became the first Duke of Wharton, succeeded to his estates in 1715. He squandered his wealth and was later attainted for treason. His estates were conveyed to a trust headed by Alexander Denton¹, to pay his debts and to provide for his two sisters. In 1738, the trustees sold the manors of Healaugh and Muker to Thomas Smith, reserving the right to certain minerals, including lead, on the commons and wastes of the manors. When the second of the two sisters died, the mineral rights passed to Anna Maria Draycott, who married the second Earl of Pomfret in 1764². If the trustees were cautious in their dealings, it is possible that the mines would have been starved of capital for development work until they passed into the hands of Lord Pomfret.

Meanwhile, two large companies of national importance had leased mines in Swaledale. The Company of Mine Adventurers, established in 1698, with extensive mining interests in Cardiganshire and Montgomeryshire³, leased the ground formerly held by Thompson and company⁴, at a duty of one-eighth, early in the seventeen-thirties. They worked the mines of Spout

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1. By whose initials, A.D., the mines of the Wharton Trust Estate were later known.
 2. D.H. MSS. W.4.; V.C.H. Yorkshire North Riding Vol.I, p.237.
 3. W.R.Scott, Joint Stock Companies, Vol.II, pp.443-5; and Minute Books of Company of Mine Adventurers, 1707-10 and 1720-21. Rawlinson MSS.C449 & D916.
 4. I.e., the ground demised in the 1700 draft lease.

Gill, where they probably built a smelting mill, Satron Pasture and Keldside. The duty for the period May 1737 to April 1740 amounted to £600, giving a value for the whole output of £1600 a year. Several reliable witnesses, in a lawsuit in 1740, one of them James Harries, agent to the Company, said that several thousand pounds worth of lead had been raised, particularly from Spout Gill, but that the current output there was poor¹. However, the Company remained in possession of Spout Gill, if not of the other mines, until 1766.²

The second company was the London Lead Company, a Quaker association, formed in 1692 as "The Governor and Company for smelting down lead with pit and sea coal"³. In 1733, they bought the lease of the mines of Grinton Manor, and later rebuilt the Grinton Moor smelting mill. They also leased the Swinnergill mines in 1742 and the Hurst mines in 1747, each for thirty-one years, at duties of one-seventh and one-eighth respectively⁴. Nothing is known of their operations at the latter, but they had given up the former before the miners of the Wharton Trust Estate began to work the Swinnergill mines again in 1749⁵.

1. Depositions of witnesses in Gibson (for Wharton Trust Estate v. Smith and Jacomb. Barker MSS.
2. Deposition of Thomas Smith in Beldi Hill dispute, 1768. D.H. MSS., RBL6.
3. A. Raistrick, Two Centuries of Industrial Welfare, (1938)p.13
4. Minutes of London Lead Company. I am indebted to Dr. Raistrick for this information.
5. See below, p.51.

In 1742 Thomas and John Parke, local men who had engaged in both lead mining and the hosiery trade, and Leonard Hartley, a Richmond solicitor, leased the Beldi Hill mine from Thomas Smith, the lord of the manor, at a duty of one-eighth. Their venture was only moderately successful. Between 1746 and 1755 they produced about 120 tons of lead¹. In 1765 the Parkes² and Hartley granted a bargain to prospect on Beldi Hill to Metcalfe, Scott and company³ and in the following year sublet ten meers to them. The sub-lessees agreed to pay the duty, which was now one-sixth, plus £2 per fother of lead, which with lead at £15 a fother was equal to a royalty of thirty per cent⁴.

By October 1768, according to their own testimony, the sub-lessees had spent £1800 in the mine⁵ but they had discovered a rich vein from which they raised several hundred tons of lead in three years⁶. Their success led Lord Pomfret to claim the ownership of the Beldi Hill mines, asserting that they were part of the commons and wastes of the manor of Healaugh. This was the most serious of the disputes which arose out of the loose wording of the reservation of certain

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1. Depositions of witnesses in Beldi Hill lawsuit, Barker MSS.
 2. Thomas & John Parke had died and their interest had passed to John and Ralph, sons of Thomas. D.H.MSS. RB16.
 3. The partnership included a shopkeeper and several yeomen.
 4. D.H. MSS. RB16.
 5. Ibid.
 6. Depositions of witnesses in Beldi Hill lawsuit, Barker MSS.

mineral rights in the commons and waste in the conveyance of the manors of Healaugh and Muker in 1738. The respective boundaries of the enclosed and common land were not specified. This allowed Thomas Smith in 1739 to claim the ownership of the mines in the common stinted cow pastures on the specious grounds that they were "enclosed" for part of the year, i.e., fenced off from the moor and cleared of stock for a month in spring¹. Pomfret's case was that Beldi Hill was not enclosed but was a part of the moor which was used, for geographical reasons, only by the tenant of the adjacent farm, Crackpot Hall. Both claims failed, the second after a long and expensive lawsuit accompanied by violence on the spot from the supporters of the disputants².

The paucity of production statistics makes it quite impossible to trace any intimate relationship between the changing fortunes of the Swaledale mines and the level of demand for lead, in the century after 1670. There are, in any case, no continuous figures of pig lead prices before 1782. The prices of various kinds of manufactured lead, pipe, sheet, milled etc., used by the Navy, the Office of Works, Greenwich Hospital and Westminster School and Abbey show a rise from the sixteen-fifties, which may reflect the growing demand for lead

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1. Usually from 1 April to 1 May. The common pastures were laid open to the moor and grazed without stint from Holy Rood Day to the beginning of April.
 2. Depositions of witnesses in Beldi Hill lawsuit and Gibson v. Smith and Jacomb, Barker MSS., D.H. MSS. RB16; and Parke MSS., copy in Fawcett MS.

created by the expansion of the industries concerned in the early industrial revolution, and a fall in the sixteen-seventies which may have been the result of an increase in the output of the mines. The price movements of the first half of the eighteenth century were much slighter, with the first two decades a period of relatively low prices.¹

-iii-

Associated with the changes in the organisation of the lead mining industry was a series of technical improvements. The evidence on this subject is scanty and some of the details are obscure. The dates of the most important innovations are not known, nor is it clear how far the growth of capitalism was a direct response to the need for new techniques. The general picture, however, is of a slow development of technique up to the second half of the seventeenth century, followed by a quickening of the pace with the introduction of gunpowder and improved methods of drainage and haulage, followed in turn, at least in some of the mines², by a period of stagnation in the middle or late eighteenth century as the deposits accessible to the techniques of the early industrial revolution became gradually exhausted.

The three basic methods of mining lead ore in Swaledale

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1. W. Beveridge and others, Prices and Wages in England, from the Twelfth to the Nineteenth Century, Vol. I, Price Tables, Mercantile Era, (1939), passim.
 2. E.g., in Arkengarthdale. See below, pp.74-6.

have been hushing, sinking pits or shafts from the surface, and driving levels horizontally into the hillside. The simplest method, hushing, was used for both prospecting and mining. Water was collected behind a dam, usually of turf, and then released down a V-shaped gutter along the line of a vein or across ground where productive veins were thought to lie. The force of the water removed the dead rock and exposed whatever ore there was for the miners to dig out, or washed pieces of ore down to the bottom of the hush. Hushing has probably been carried on from the earliest days of mining in Swaledale and has left hundreds of scars on the landscape. The method was still used in a few places in the nineteenth century, at which time the hush dam was usually made of wood, with a gate lifted by a rope and pulley.

Vertical diggings from the surface developed from shallow trenches and bell pits to shafts four hundred feet deep with long drifts radiating from them. The depth to which shafts could be sunk and the length of the drifts were governed at any period by the state of technical progress in the methods of sinking and driving, haulage, drainage and ventilation.

The most serious limiting factor in the seventeenth century was probably drainage. The shallower workings of earlier periods may not have been much troubled by water. In mountainous country the water table is often well below the surface¹.

1. A. Raistrick, Mine Drainage in the Eighteenth Century, Mine and Quarry Engineering, Vol.3, Sept 1938, p.337.

and particularly in summer drainage by buckets drawn up by a windlass would have been adequate. By the sixteen-seventies and-eighties, however, the workings in the Old Gang, Lownathwaite, Arkengarthdale and Hurst mines had reached depths at which drainage was becoming expensive and difficult.

In the trials of the Old Gang and Lownathwaite mines in the years 1683-1685, the success of operations depended partly upon the weather. A report on the workings at Merryfield, Old Gang, in November 1683, says "The season have been very wet and sometimes driven us out"¹. By contrast, in March 1685 at Lownathwaite, "they are sinking the shaft and goeth pretty well down but we think the weather favours us for water"². In the same year, in sinking a shaft at Merryfield, the miners cut a strong feeder of water at a depth of 14 fathoms. After sinking a further 8 fathoms they could no longer cope with the flow of water, and so they put down a 2½ inch borehole into some workings 13 fathoms below, which were connected with a shaft up which the water was pumped 35 fathoms to the surface³. The method used is not known, but the rag-and-chain pump was used at the same period to drain from similar depths in coal mines in the North of England.⁴

1. P.Swale MSS., Vol.I, No.192.

2. Ibid., Vol.I, No.205.

3. Ibid., Vol.II, No.26.

4. R.L.Galloway, Annals of Coal Mining, First Series, pp.157-8.

The schedule of workings attached to the 1718 lease of the Hurst Mines gives the most detailed picture of a large mine that we have at this period. There were fifteen working shafts, varying in depth from 13 to 22 fathoms, with drifts and sumps going down from them in steps to depths ranging from $25\frac{1}{2}$ to $37\frac{3}{4}$ fathoms. All of these steps ended in one of six water levels, which were connected so that all the water drained into the lowest level which was 500 fathoms long. The method of drainage from this level is not recorded but it is likely that the water was pumped up two shafts which were sunk directly on to the low level at points where the latter was 24 and 16 fathoms respectively from the surface¹.

Sinking in steps, as was the practice in all the mines of which we have any record at this time, made the haulage of ore and any dead rock that could not be stored underground technically possible, but tedious and expensive. The ore was usually dragged along the drifts by a boy wearing a harness², carried or hauled up the sumps, and finally lifted up the shaft by a windlass and bucket. The weight of the ore and bucket and of the rope when unwound limited the depths to which working shafts could be sunk. To meet this difficulty as well as that of drainage, the horse gin was introduced.

1. Bower MSS. North Riding Records, ZFY.40.

2. This method was still used in some mines in the early nineteenth century. Evidence of Adam Barker, Kinnaird Commission, Minutes of Evidence, No.17076.

Several forms of the horse gin are described in De Re Metallica¹. The cog-and-run gin, which was in use in coal mines in the North of England by the middle of the seventeenth century, was essentially an enlarged windlass set over the shaft mouth and geared to a horizontal wheel turned by a horse or horses². The more efficient whim-gin, which consisted of a drum on a vertical axis set by the side of the shaft, with the rope run over pulleys fixed over the shaft head³, was in use in coal mines by about 1700⁴. It was introduced into the Cornish metal mines about 1720⁵ and was coming into general use in Swaledale by the middle of the century, if not earlier⁶.

The whim could be used for drainage by large buckets, by chains of buckets or by the rag-and-chain pump. Whims were used in Swaledale in large numbers for haulage and drainage in mines 60 fathoms deep and more⁷.

There is no record of the use of any water wheels for drainage⁸ in Swaledale before the second half of the eighteenth

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1. Agricola, op.cit., pp.163-8.
 2. Galloway, op.cit., p.168.
 3. W.Pryce, Mineralogia Cornubiensis (1778), p.150.
 4. Galloway, op.cit., p.178.
 5. J.Rowe, Cornwall in the Age of the Industrial Revolution, (1953), p.8.
 6. Parke MSS, in Fawcett MS.
 7. See below, p.102.
 8. They were used for driving the bellows of smelting mills.

century, at which period they were used in the West Swaledale¹ mines, and probably in the Hurst mines also. The water wheel could generate more power than a horse-gin, but required the provision of an adequate and regular water supply, which limited its use on high ground.

The Newcomen engine, which was widely used in the eighteenth century to drain coal mines², and metal mines in North Wales³ and Cornwall⁴, does not seem to have been tried in Swaledale. The London Lead Company experimented with it in the north of England between 1720 and 1750, but found that, although the engine worked satisfactorily, its heavy fuel consumption made its running costs prohibitive if coal had to be carried any distance overland. Their experience confirmed them in their policy of using deep drainage levels wherever⁵ the topography allowed.

As the depth of working increased, some form of artificial ventilation became necessary. The normal practice in Swaledale from the late seventeenth century was to make a connection with other workings or drive air drifts to allow the free movement of air through the main waygates, and use some means of blowing

1. See below, p.137.

2. Galloway, op.cit., pp.261-2, 289.

3. A.H.Dodd, Industrial Revolution in North Wales (1951), p.21.

4. Pryce, op.cit., pp.153-9.

5. Raistrick, loc.cit., pp.338-9. Levels were used in Cornwall, too, but some of the deeper copper mines could not be drained in this way, and steam engines were needed. The ships which carried Cornish copper to smelting works in the Swansea area brought back coal at cheap rates. Rowe, op.cit. pp.42-55; D.J.Davies, Economic History of South Wales Prior to 1800 (1933), p.134.

air from the latter to the foreheads¹. The most common device both at this time and in the nineteenth century was the "windy king", a four-bladed wooden fan in a wooden box, which blew air along wooden pipes. The range of the windy king was limited, however, and it is probable that at this period, as was certainly the case in the eighteenth and nineteenth centuries, dead-ends were badly ventilated. In the Lownathwaite mine in 1685 a pair of bellows, presumably worked by hand, was put under ground to replace a fan that had proved inadequate².

Before the introduction of gunpowder for blasting, the work of sinking shafts and driving drifts through hard rock was laborious and slow, and extensive "dead" work unprofitable. The most common method used for breaking rock was the "plug-and-feathers." A series of holes was drilled in the rock face and the feathers, two half-rounded pieces of iron or steel, placed in each hole in turn, to be forced apart by the plug, a metal wedge. Less frequently, lime cartridges, saturated with water to crack the rock by their expansion, were used³.

A third method was rock-burning, and at least one example of this has been found in Swaledale, in Morsgail Level driven into the north-west corner of Kisdon Hill in 1867.

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1. P.Swale MSS., passim; Lease of Hurst Mines 1718, Bower MSS, North Riding Records, ZFY.40.
 2. P.Swale MSS., Vol.II, No.26.
 3. A.Raistrick, Lead Mining and Smelting in West Yorkshire. Trans. Newcomen Soc., Vol.VII, 1927, p.88.

The miners driving the level broke into some old workings and found "several wooden shovels, along with an old wooden bearing barrow.... All around the base of their level foreheads was a thick layer of charcoal over one feet deep, the residue from wood which had been carried into the mine and fired close to the face of the limestone.... These fires would probably be lighted at the close of the day's work and left burning during the night".¹

Gunpowder was first used in English metal mines, before 1638, by some German miners employed in a copper mine at Ecton Hill in Staffordshire². The technique of blasting was described in the Philosophical Transactions of the Royal Society in 1665³ and was applied in several metal mining fields before the end of the century. Introduced into the Mendip mines about 1684⁴, it was tried in Cornwall in 1689⁵ and was in use in a small lead mine at Colsterdale, near Masham in ~~lower~~ Wensleydale, in 1699⁶. It was probably tried in Swaledale at the same period. The correspondence between Lord Wharton and his agents in Swaledale, although containing no reference to

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1. Fawcett MS., p.108. One of the miners concerned was Fawcett's father.
 2. R.Plot, Natural History of Staffordshire (1686), p.165.
 3. R.Galloway, History of Coal Mining in Great Britain, p.61.
 4. Gough, op.cit., p.166.
 5. Rowe, op.cit., p.10.
 6. Cunliffe-Lister MSS., Mashamshire Bundle, Nos.16 and 18.

gunpowder, suggests that both he and they were in touch with developments in other mining fields¹.

The introduction of gunpowder opened the way for the driving of cross-cut levels. Short drifts had probably been driven in the veins exposed on valley sides at an early date. They could be extended from time to time without presenting any serious financial or technical problems except that of ventilation. Two such drifts, no doubt begun by independent tributers, were being worked in veins on the west side of Gunnerside Gill in the sixteen-eighties².

Long drainage levels had been driven, before the invention of gunpowder, in the Derbyshire lead mines³ and in the coal mines of north-eastern England. Galloway quotes an observer in the Newcastle area in 1676 as saying, "When they are by the side of a hill they drain by a level carried a mile underground and cut through rock to the value of £5000 or £6000", and adds, "The long water levels of this period were executed solely by means of pick work and were made as narrow as possible", as narrow as eighteen inches in places⁴.

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1. Particularly Adam Barker, who came from the Wirksworth district of Derbyshire to manage some of the Swaledale mines about 1680, and frequently revisited the Derbyshire mining field. P. Swale MSS., passim.
 2. P. Swale MSS.
 3. Cromford Sough, driven to drain the Dove Gang mines, was completed in 1688, at a cost of £30,000. The venture was unprofitable. V.C.H. Derbyshire, Vol. II. pp. 331 & 342.
 4. R.L. Galloway, History of Coal Mining in Great Britain, p. 58, and Annals of Coal Mining, First Series, p. 161.

The first known cross-cut level in Swaledale was driven, like the levels mentioned above for drainage purposes only, between 1746 and 1749, in the Beldi Hill mine. The lessees of this mine, which had been little exploited before, tried it by hushes and shafts in 1742-1745 and found a rich ore-shoot in a shaft sunk on the south vein. As the depths of their working increased, so did the volume of water. The lessees took advantage of the steep slope of the hillside at this point and drove a level 50 yards long into which water was lifted from the lowest workings by three sets of manually operated pumps, which had to be worked round the clock. This method was not fully adequate and the labour cost was high, so a level, called Parkes Level after two of the lessees, was driven at an horizon low enough to drain the whole mine without any pumps. It was 400 yards long, cost £300 to drive, and took nearly three years to complete.¹

A second drainage level was driven a few years later in the Swinnergill mine, which is separated from Beldi Hill by Swinnergill or Hind Hole Beck, and which lay outside the land enclosed in 1738. When Parkes Level had been driven to the

1. Depositions of witnesses in Beldi Hill lawsuit, Barker MSS., and Draycott Hall MSS. RB16.

Sun¹ Vein, the agents of the Wharton Trust Estate sank shafts on the same vein east of Swinnergill beck and found that these were drained by Parkes Level. About a year later the output of the Beldi Hill mine fell off, and the lessees stopped working Parkes Level. They asked for a consideration from the Wharton Estate for keeping the level open. When this was refused, they closed it and the Swinnergill mine had to be abandoned until a drainage level could be driven on the east side of the beck². This was begun in June 1751, and had been driven 250 yards to the Sun Vein, at a cost of £130, by August 1752. This level was not low enough to drain all the workings and water had to be pumped up into it³.

These levels were driven as drains only, and the mines still worked through a number of shafts, because the cost of driving a level wide and high enough to be used for haulage purposes would have been several times as great⁴. The first horse levels, so called because they were big enough to take a horse pulling a train of mine tubs, and which eventually supplanted most of the shafts, were not begun until later in the century.

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1. In mining terminology, "sun" means south.
 2. One of Parkes' and Hartley's workmen turned a stream of water down one of their own shafts on the empty pretext that it was necessary to see whether the level was effectually stopped. This helped to flood the neighbouring mine, and caused bad feeling which may have contributed to the dispute of 1768-71. See above, pp.39-40
 3. Depositions of witnesses in Beldi Hill lawsuit. Barker MSS; and D.H. MSS., RB16.
 4. Compare the cost per fathom of driving Hard Level; see below, p.89.

Developments in mining technique were matched by improvements in the methods of dressing and smelting. Before the sixteenth century the only preparation which ore received in English mines was probably breaking and washing in a stream. The dressing and smelting techniques described by Agricola¹ were brought to England in the fifteen-sixties by the Company of Mines Royal² and spread gradually over the country during the next century and a half³.

All methods of ore dressing rest on the same principle, the difference in density between lead ore and the stone and spar from which it has to be separated. The method generally in use in the North of England until the end of the eighteenth century⁴ is described as follows by Westgarth Forster:

The bouse, as the ore mixed with other minerals and rock was known, was placed in a buddle, an oblong box with one of the longer sides raised to give a gentle slope. A strong current of water flowed over the bouse, which washed it and helped the washing workers to distinguish the ore from the stones, and also effected a rough separation, as the denser ore remained

1. Agricola, op.cit., Book VIII.

2. M.B.Donald, Elizabethan Copper, Chapter VII and VIII.

3. A.Raistrick, Ore Dressing in the Eighteenth and Early Nineteenth Centuries. Mine and Quarry Engineering, Vol.4 (1939) pp.161-3.

4. "Systematic washing of ores was only introduced here during the sixteenth century and until about 1800 little advance or change in method was made." Ibid., p.161.

near the top of the slope while the lighter stones were carried to the bottom. The pure ore then went to the "bingstead", ready for the smelt mill, the stones to the dead heap, and the mixed pieces remaining were crushed on stones by buckers, or metal mallets. The crushed material was put into a sieve and jerked by hand up and down just under the surface of the water in a tub, so that the material was sorted according to density¹.

The smelting hearth in use in the Pennines during the seventeenth and eighteenth centuries was a product of two lines of development, from the medieval bole hill and from the German ore hearth introduced in the sixteenth century. The bole in its simplest form, examples of which have been found in Swaledale, depended upon the wind for its draught. It was built, usually on a hill, in the form of a low circular well of stones, a few feet in diameter, with openings facing the direction of the prevailing wind. The inside was hollowed out and lined with clay with a run-off channel for the molten lead. The ore was placed on top of the fuel, usually wood, inside the furnace which was fired when a steady wind was blowing. As early as the beginning of the fourteenth century, bellows were used for bole smelting, providing a better blast and more efficient reduction as well as allowing more regular working².

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1. W.Forster, Treatise on a Section of the Strata from Newcastle-upon-Tyne to Cross Fell, Third Edition, ed.W.Nall, (1883), p.174.
 2. A.Raistrick, Ore Hearth Lead Smelting in the Seventeenth and Eighteenth Centuries. Proc.Univ.Durham Phil.Soc.Vol.X,Pt.7, (1948), pp.529-30.

The German furnace, which was brought to Keswick in the fifteen-sixties¹, is described by Agricola as a narrow brick structure about five feet high, with a workstone or forehearth in front, and two bellows at the back worked alternately by water to give a continuous blast. Charcoal was used as fuel and limestone or iron slag as the flux².

A hearth in use at Wirksworth near Derbyshire in 1729, "consisting only of some large rough stones placed in such a manner as to form a square cavity" with "two great bellows continually blowing the fire being moved alternately by water" seems to derive from the bellows-blown bole rather than from the German furnace.³ The influence of the latter is seen more clearly in the form of a mill "used by the Company of Mine Adventurers and others in Yorkshire, 1735" which is here illustrated. The mill is almost certainly the Spout Gill mill in Swaledale⁴.

The German furnace was also adapted for slag smelting. The slag hearth was deeper than the ore hearth, had a stronger blast and worked at higher temperatures.

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1. Donald, op.cit., pp.112-3, 184-5.
 2. Agricola, op.cit., pp.355-7, 366, 378, 390, 408.
 3. Raistrick, loc.cit., p.530.
 4. See below, pp.59-61.

In the ore-hearth, the ore was heated just sufficiently to sweat out the greater part of the lead, but when the slag was re-smelted in the slag hearth to extract the lead remaining in it, the whole was completely liquified¹. The earliest reference to a slag hearth in Swaledale is to one at Ellerton Mill in 1683. Another was built at another of Lord Wharton's mills, probably Surrender, in 1684-85².

Coke was the normal fuel used for slag smelting and there is an account of the supply of coal for use, presumably after coking, in one of the slag hearths mentioned above³. For ore-hearth smelting, wood, either kiln-dried or as charcoal, was in general use until the early eighteenth century. Kiln-dried wood was used at the Grassington mill in Wharfedale in 1658 and again in 1701-1702, and in the Wirksworth furnace in 1729⁴. Swaledale was apparently short of timber as early as the fifteen-forties, when Leland reported that wood for smelting was being brought in from other parts of Richmondshire and from County Durham⁵. The correspondence between Lord Wharton and his agents in the sixteen-seventies and eighties contains several discussions of the problem of obtaining enough wood for the

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1. Raistrick, loc.cit., p.536; Forster, op.cit., 3rd edn.p.192.
 2. P.Swale MSS. Vol.I, No.245, Vol.II, Nos.128 & 26. Dr.Raistrick writes "A form of blast furnace or slag hearth was in use in North Wales... before 1702", loc.cit., p.534.
 3. P.Swale MSS., Vol.I, No.255.
 4. Raistrick, loc.cit., pp.530-3.
 5. L.T.Smith (Ed), Itinerary of John Leland, Vol.IV, p.32.

smelting mills. Lord Wharton suggested the planting of trees on his own land and on the waste to provide for future needs¹. Wharton, and presumably other lords, had made good use of the right to take timber from the commons for use in the mines and mills². The exhaustion of these supplies meant that they either had to buy wood and transport it from a distance, or use another fuel, peat, over which they enjoyed similar rights and which could be had for the cost of cutting and carting it. There were no serious technical difficulties in the way of the change. Peat needed a strong draught, and care had to be taken not to compress it with too heavy a charge of ore so that it would not burn³. Peat seems to have come into general use during the first half of the eighteenth century. The lease of the Hurst mine in 1718 included the right to take peat, but made no reference to supplies of wood⁴. When the manors of Healaugh and Muker were sold in 1738, the right to take as much peat as was needed for the mines and smelting mills was reserved along with the minerals under the commons and waste⁵. Subsequently, whenever a mine which had a smelting mill was leased, this right of turbary on the

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1. P.Swale MSS. Vol.I, No.252; Vol.II, Nos.72 & 76.
 2. Confirmed by the Chancery Decrees of 1617-8 relating to Muker and Healaugh Manors. Barker MSS.
 3. Information from Dr.Raistrick.
 4. North Riding Records, ZFY.40.
 5. Depositions in Beldi Hill lawsuit, DH. MSS. RB16. & Barker MSS

appropriate part of the moor was always included.

There were at least seven mills, most of them small¹, serving the Swaledale mines in the sixteen-eighties. Lord Wharton had a "High Mill" and a "Low Mill" which are probably identical with the old Old Gang Mill, replaced at the end of the eighteenth century, and the old Surrender Mill, pulled down in 1839. Some of his ore was smelted at Ellerton Mill, which also served the Grinton Mines during the Swale family's tenure of them². Sir Thomas Wharton also had a "High Mill" and a "Low Mill", one of which can probably be identified with the mill which stood half a mile east-south-east of Whashton village, near to Jagger Lane, an old pack-horse track which offered the most direct route from many of the Swaledale mines and especially from Sir Thomas Wharton's estate, to Darlington and Stockton³. Arkengarthdale ore went to Clints Mill⁴ by a track still known as Orgate, and to another mill "at Gilling"⁵. This may be the same as the mill near Jagger Lane, as it is only a mile and a half from Gilling. It is probable also that mills were working at this period in Grinton and Marrick, although there is no direct record of them before 1733 and 1718 respectively.

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1. The terms "hearth" and "mill" are used interchangeably in several cases.
 2. Report by R.Eyre to the Earl of Godolphin.
 3. P.Swale MSS., Vol.II, Nos.46, 52, 127, 128.
 4. A map of the Clints estate dated 1759 shows two mills, one in use and the other, presumably the one standing there in 1590, in ruins. North Riding Records, ZAZ.
 5. V.C.H., Yorkshire, North Riding. Vol.I, p.37.

There were some changes in the distribution of the smelting mills during the first half of the eighteenth century. The water power needed for the bellows could be made available without great difficulty or expense at innumerable sites in Swaledale and the packhorses which carried the ore and lead had a wide choice of routes. It was, therefore, the organisation of the mines which determined the location of the smelting mills. When the workings were small and scattered a mill might be built, as at Clints or Whashton, some distance from any particular mine at a convenient collecting point along the routes taken to market. With the more intensive development of the major mines in the late seventeenth and early eighteenth centuries, it became the practice for each royalty or company to have its own mill, situated near to the centre of mining operations.

In Arkengarthdale a mill was built, late in the seventeenth or early in the eighteenth century, at Moulds, where several shafts had been opened by the lessees of John Bathurst's mines. Another mill, the Octagonal Mill near Langthwaite, dates from the first half of the eighteenth century¹. It was similar in layout to the mill of the Company of Mine Adventurers illustrated above except that it had four hearths instead of two². The second Clints mill ceased smelting Arkengarthdale ore at some time between 1759 and 1783³.

1. K.L. MSS., Pkts.14(a); 15.
2. See illustration, p.62.
3. K.L. MSS., loc.cit.

The Spout Gill Mill was built, there is little doubt, by the Company of Mine Adventurers which leased the Spout Gill and several other mines about 1730¹. A draft lease of these mines to Thompson and Company in 1700 had stipulated that a mill should be built by the lessees at some place within the area leased as soon as 200 fothers of lead had been raised, but there is no evidence that this was done, or even that the draft lease was executed.².

The lease of the mines in the manor of Marrick (the Hurst Mines) in 1718 included a smelting mill situated somewhere within the manor³ and a mill at Grinton Moor passed to the London Lead Company when they bought Hugh Marriott's lease of the mines of Grinton Manor in 1733⁴. Shortly afterwards, the Company rebuilt the mill with reverberatory furnaces, which they used in all their smelting mills in the north of England⁵. These were the first furnaces of this type to be introduced into Swaledale.

The distribution of the known smelting mills in Swaledale in the middle of the eighteenth century was therefore as follows. On the south side of the Swale were Spout Gill, smelting the ore from the adjacent mines and from West Swaledale and Beldi Hill, and Grinton Moor, serving the mines of that manor. On the north side of the Swale, from west to east, were Old Gang, Surrender, Marrick and Clints, and, in Arkengarthdale,

1. Depositions of Witnesses in Gibson v. Smith & Jacomb.

Barker MSS; and D.H. MSS., RB16.

2. North Riding Records, ZAZ Mining.

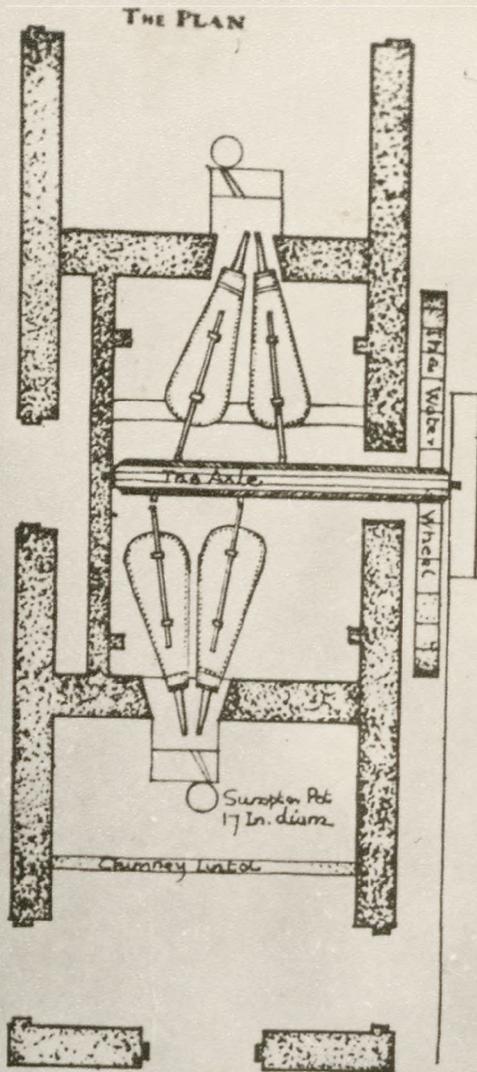
3. See below p.153 for the location of mills in Marrick manor at a later period. 4. London Lead Company Minutes 31. Aug 1733

5. I am indebted to Dr Raistrick for this information.

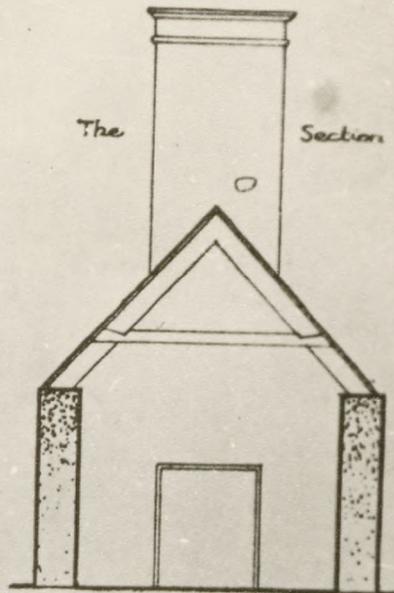
5. A. Raistrick, Mines and Miners of Swaledale, p.48.

Moulds and the Octagonal Mill. There is no record of the Ellerton, Waitwith or Whashton Mills at this period¹.

1. There is no trace of the sites of the former two.

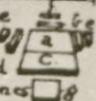


The Draught of a Smelting Mill used by the Company of Mine Adventurers of England and others in Yorkshire, 1735



- A Frack A Sumpston Pot A Ladle holding 4 stons of Lead into which the Pot.
- A Bucker Lead Runs with which it is taken out of the Sumpston Pot.
- A dressing Knife Length 2. ft. Breadth 6 In Depth 3 1/2 this is hung to one Arm of a Ballace or the pigs of Lead are cast in.
- An Axe A Bruce Shovel A shovel to throw ore into hearth A shovel to throw ore into Bingsteads A Gavelock

A HEARTH consists of nine Parts all of cast Iron and called in General Iron Stones



The Parts of a Hearth are these

- a. Pan Bottom 3 ft long 20 in wide
- b. A Buck 2 ft long 9 in broad 4 "
- c. A Ricket Plate 3 ft. 10 in { 5/8 "
- d. two Bezzers 20 in 6 in square
- e. two cubbs called Key Shovels 10 in
- f. a Pipe stove covering Bellows 2 ft 10 in 4 1/2 in 4 1/2 in
- g. A fore Stove 2 ft 11 in 4 in 4 in

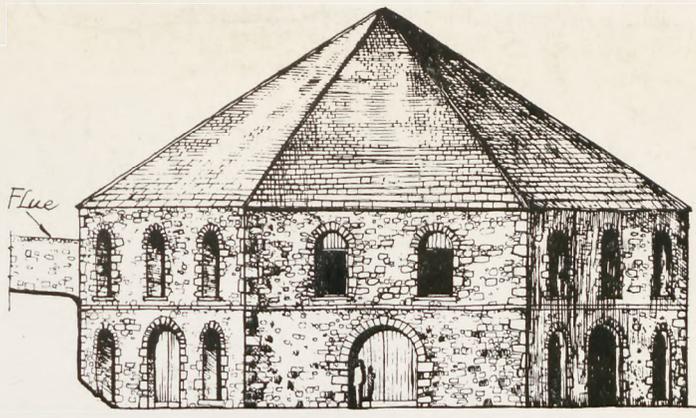
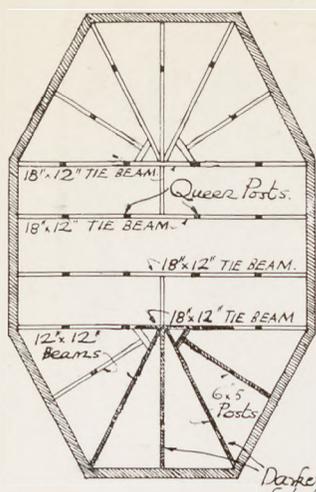
R.T. CLOUGH '55.

109876543210

10 Scale of Feet 20

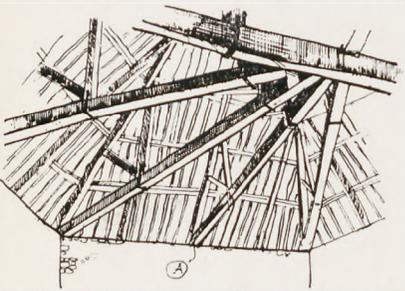
30

"The Draught of a Smelting Mill used by the Company of Mine Adventurers of England and others in Yorkshire, 1735", which is probably the pattern of the mill built by the Company at Spout Gill. (Reproduced by Mr R.T.Clough from the original in the Egerton MSS).

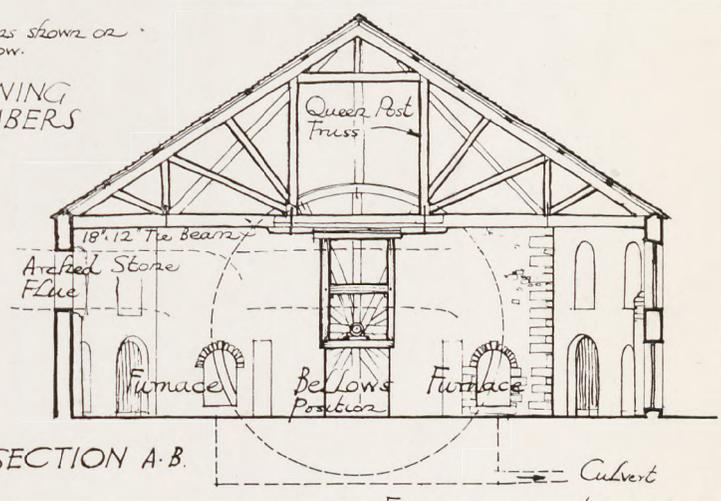


END ELEVATION (SOUTHERN)

PLAN OF THE MILL SHOWING POSITIONS OF ROOF TIMBERS

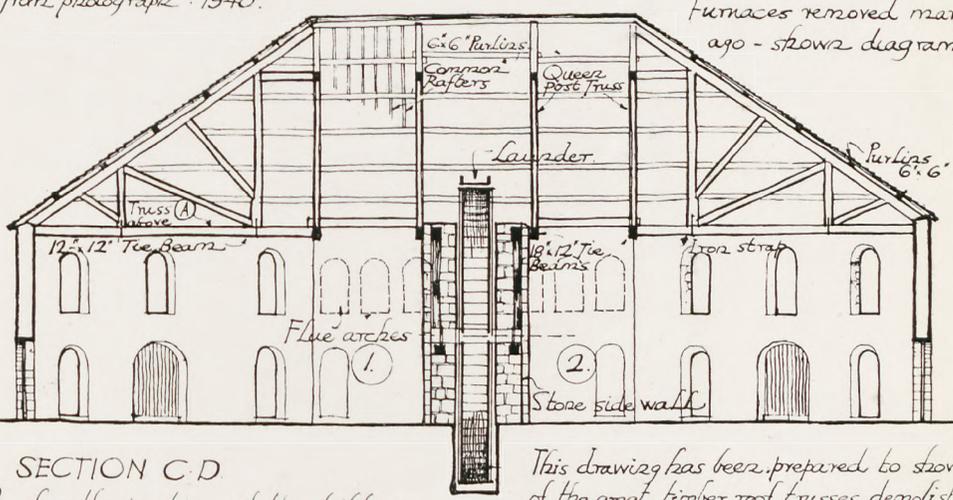


ROOF TRUSSES AT SOUTH END OF MILL
Details from photograph - 1940.



SECTION A-B.

Furnaces removed many years ago - shown diagrammatically



SECTION C-D

1 & 2 show the position of the bellows
Scale 10 0 10 20 FEET.

This drawing has been prepared to show details of the great timber roof trusses demolished in 1942. Details of the bellows & furnaces are now lost these being removed many years ago

THE GREAT SMELTING MILL NEAR LANGTHWAITE ARKENGARThDALE YORKSHIRE

Measured by Robert J Clough & Christopher Wells A.I.A.R.I.B.A. 1949

Robert J. Clough
SE 1950.

This magnificent eight sided building (built c. 1700) is situated half a mile NW of Langthwaite village on the south bank of the Arkle Beck. Owing to the collapse of part of the main wall in 1942 it was thought impossible to carry out the extensive repairs necessary with the result that this great structure with its fine stone slated roof is now only a ruined shell on the hillside.

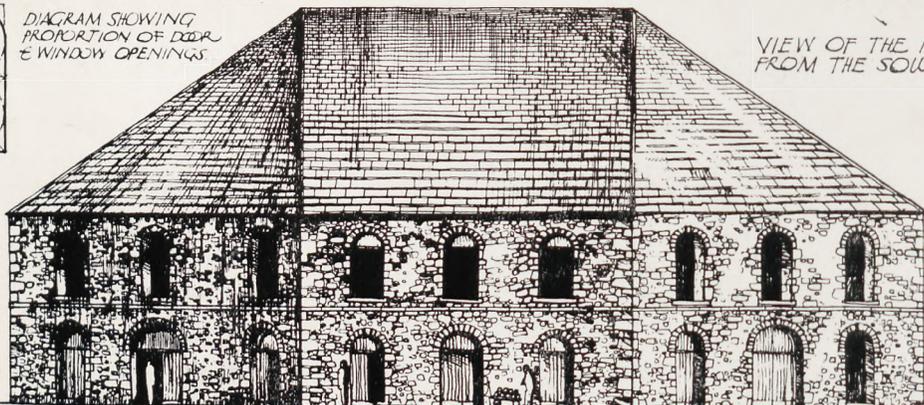
When complete the elements of design in both the wall treatment & the roof were most successful, the regularly spaced windows & doorways possessing a pleasing rhythm. All the openings are based on a proportion in the ratio of two circles in height to one in width.



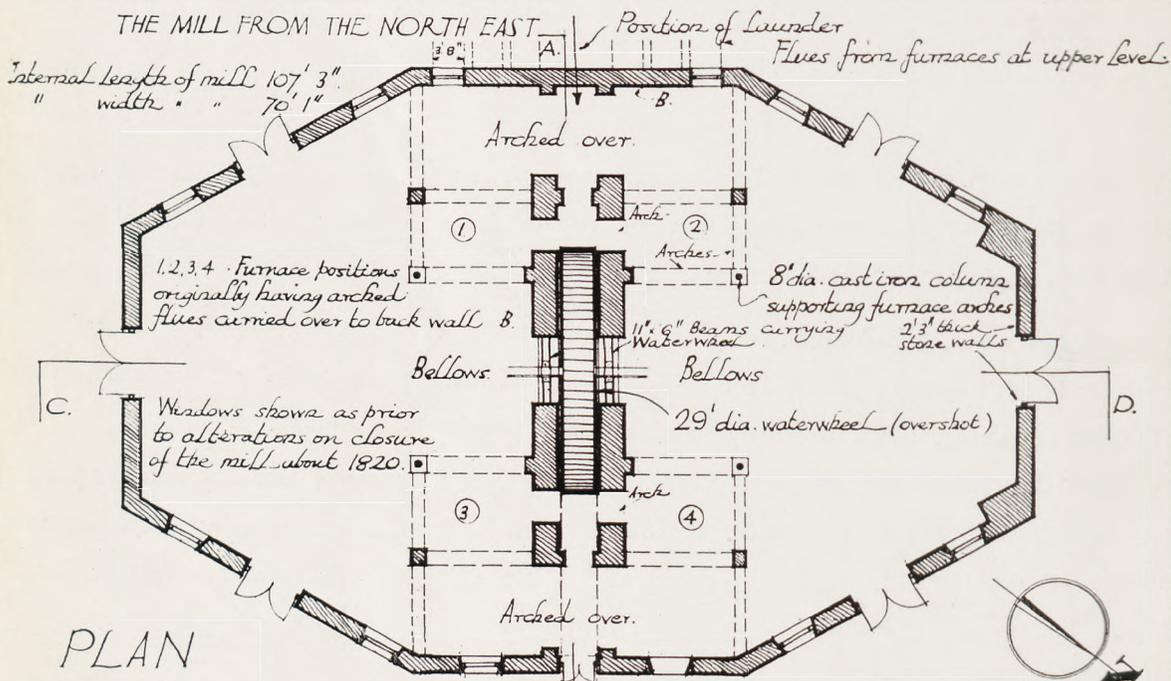
VIEW OF THE MILL FROM THE SOUTH. (1940)



DIAGRAM SHOWING PROPORTION OF DOOR & WINDOW OPENINGS



THE MILL FROM THE NORTH EAST

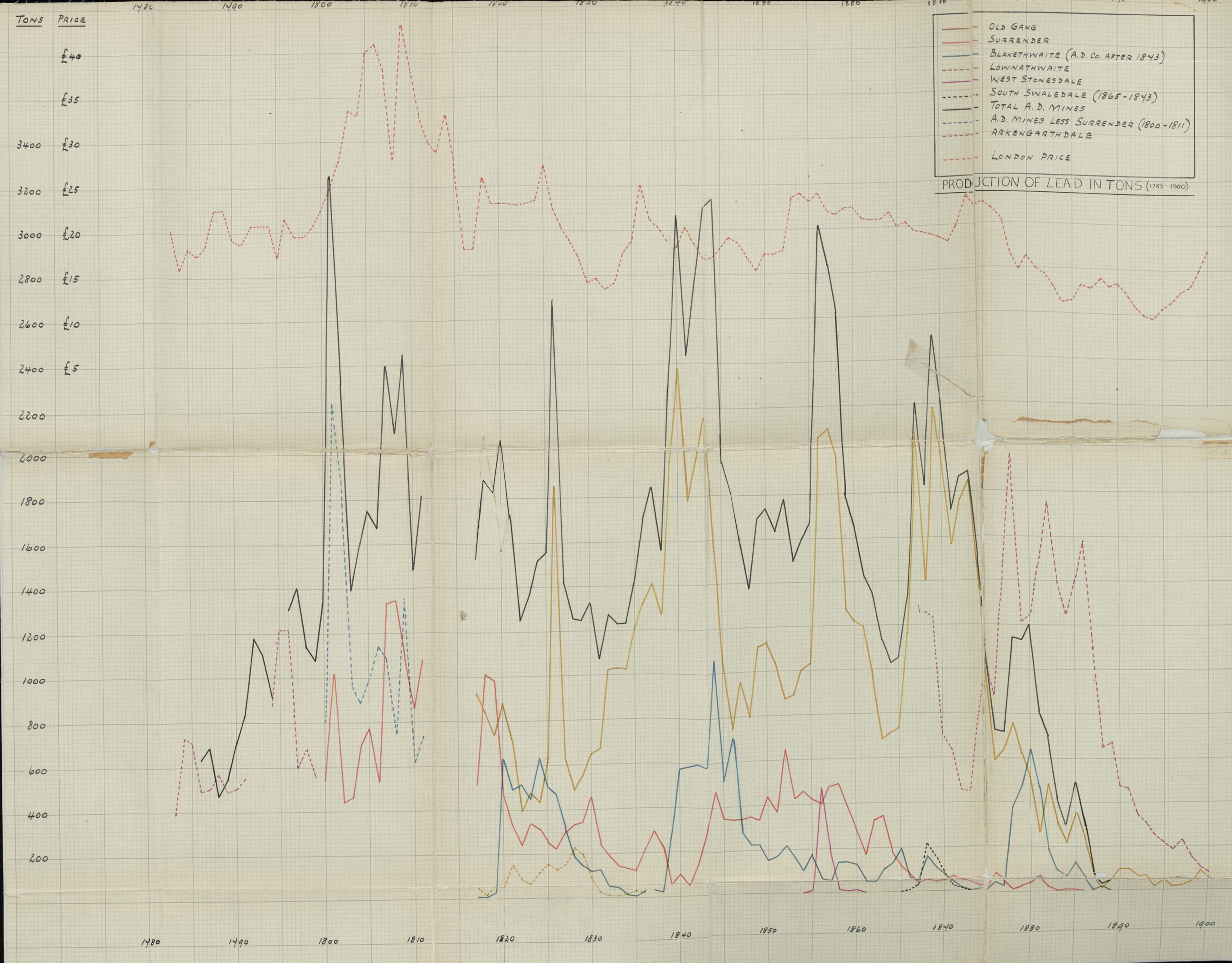


THE GREAT SMELTING MILL.

NEAR LANGTHWAITE,
ARKENGARThDALE. YORKSHIRE.

Measured by Robert J. Clough & Christopher Wells A.I.A.R.I.B.A. 1949

Robert J. Clough
DELT.



TONS PRICE

£40

£35

3400 £30

3200 £25

3000 £20

2800 £15

2600 £10

2400 £5

2200

2000

1800

1600

1400

1200

1000

800

600

400

200

1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1900

1780 1790 1800 1810 1820 1830 1840 1850 1860 1870 1880 1890 1900

1780 1790 1800 1810 1820 1830 1840 1850 1860 1870 1880 1890 1900

Chapter IV : The Industrial Revolution in Swaledale.

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During the last quarter of the eighteenth century and the first quarter of the nineteenth, the Swaledale lead mining industry went through its second, and quantitatively more important, economic revolution. The key developments were the driving of long levels, and improvements and reorganisation in dressing and smelting. There were several innovations in the latter processes, and some useful improvements in the methods of ventilating levels. There was, however, no significant advance in the technique of driving levels, which changed little from the beginning of the eighteenth century until about 1870, when mechanical rock borers and dynamite were first used. The outstanding need at this period was for capital to meet the heavy cost of driving the levels, and the pace of change was governed more by such factors as the availability of capital and the demand for lead than by the progress of technical invention.

The development of lead mining during this period was closely associated with the general increase in the rate of growth of industrial output which took place about 1780¹. Lead was a raw material for a number of expanding industries. The growth of population, and consequently of housing, meant an increased demand for lead not only from builders and plumbers but also from paint manufacturers, who used white lead as a base for their paint and various lead compounds as pigments².

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1. T.S.Ashton, The Eighteenth Century (1955), p.125;
W.G.Hoffman, British Industry, 1700-1950 (1955), pp.29-32.
 2. F.S.Taylor, A History of Industrial Chemistry (1957), p.88.
Pulsifer, op.cit., Chapter XIII.

The decline in the production of pewter¹, of which lead was a constituent, was more than offset by the expansion of the pottery industry. Dry and liquid lead glazes held their own for all but the cheapest pottery throughout the nineteenth century². In the glass industry, red lead (lead oxide) was used as a flux to make flint glass, the production of which grew rapidly in the early eighteenth century³. According to Clow, "the making of this glass created a demand for large quantities of red lead, the manufacture of which became a separate industry⁴". The glass trade was, however, stagnant at the beginning of the nineteenth century because of heavy excise duties and the attendant restrictions⁵.

Lead had an important role in the chemical industry. It was replaced by iron for making salt pans by the beginning of the eighteenth century⁶, but found an important new use when Roebuck developed the technique of making sulphuric acid in lead chambers instead of glass retorts⁷. During the late eighteenth and early nineteenth centuries, there was "a vastly increased demand for chemicals, a demand which could be satisfied only by the production in tons of what was formerly

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1. Clow, op.cit., p.361.
 2. J.C.Wedgwood, Staffordshire Pottery and Its History (1913), pp.9,11,18,66-7,158-60.
 3. Taylor, op.cit.,p.79. Clow, op.cit., p.273.
 4. Ibid,p.290. 5. Ibid., p.278-9.
 6. Ibid, p.53.
 7. Ibid., p.133, and L.F.Haber, The Chemical Industry during the Nineteenth Century, (1958), p.3.

made in pounds"¹. Sulphuric acid was one of the key products in this expansion,² and there was a rapid growth in the number and size of the lead chambers. The earliest ones used about 200 square feet of sheet lead, but by the eighteenth-twenties the average was about 2,250 square feet, and some chambers as large as 100,000 cubic feet, using nearly 15,000 square feet of sheet lead, were in use in the following decade.³

Lead oxide was employed in the Scheele process to produce caustic soda, with lead oxychloride, a yellow pigment, as a by-product. The method declined early in the nineteenth century because of high costs.⁴ Lead acetate, made by dissolving lead oxide in acetic acid, was used in calico printing to prepare cloth for dyeing, and afterwards for fixing the dyes.⁵ Lead acetate, which is one of the sweetest substances known as well as being highly poisonous, was used also to adulterate wine which had soured.⁶

Another major outlet for British, including Swaledale, lead

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1. Taylor, op.cit., p.181.
 2. Ibid., p.99; Haber, op.cit., p.ix.
 3. Taylor, op.cit., pp.98 and 188.
 4. Ibid., p.183; Haber, op.cit., p.17.
 5. Clow, op.cit., p.384.
 6. Ibid., pp.384-6.

was the export trade. Although a large part of the Swaledale lead which passed through the port of Stockton was shipped coastwise to Newcastle or London, there was an important trade with the Netherlands, North Germany and Russia¹. A brisk foreign demand kept up the price of lead after the Peace of Amiens in 1801². The drying up of this demand through the operation of the Continental System brought the price down in 1807 but there was a revival in the activity of neutral traders in 1809³. The struggle in Europe continued to affect the Stockton market and, through it, the Swaledale mines. In February 1811, Matthew Wadeson, the lead-shipper who handled most of the Swaledale output, wrote that the lead trade was very bad, but that some relief would come if there was a change in Russian policy. Two years later, he reported, "From the ports of the Elbe and near to it being shut against us, lead has become bad to sell and in consequence declining in price"⁴.

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1. Mr. Wadeson: Accounts and Correspondence, 1800-12, D.H. MSS., CA2; and Account of Lead Weighed and Shipped, 1796-1809, D.H. MSS., ADX.
 2. Ibid.
 3. Wadeson: Accounts and Correspondence, 25 March 1809.
 4. Ibid., 11 June, 1813.

In the last two decades of the eighteenth century, the mining industry in Swaledale was facing growing problems. In a number of mines, the ore which could be worked at a reasonable cost by the methods developed in the late seventeenth and early eighteenth centuries was approaching exhaustion. The Blakethwaite Vein, for example, seems to have been worked out in the main limestone, in which most of the ore in this vein was found, in the stretch near the Arkengarthdale boundary¹, and the deposits could not be followed to the west by existing methods, because a dip in the strata put the ore too far below the surface. In Arkengarthdale, the eastern part of Moulds, which had first been systematically developed in the late seventeenth century, had been heavily worked through a series of whim shafts, and the main bearing beds to the west could not be reached economically in the same way, because of a steep rise in the surface of the ground². Similar difficulties existed elsewhere in the area.

It was possible to solve this problem in one of two ways, either by installing steam engines for pumping and winding so that shafts could be sunk to greater depths, or by driving horse levels which would provide free drainage and, by means of trains of waggons drawn by horses, cheap haulage. The key

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1. Blakethwaite Mine Plans, 1811, 1823, 1836. D.H.MSS.P/B.1-3; and see below, p.103.
 2. Report of Robert Clarke, K.L.MSS., Pkt.3; and accounts &c., K.L.MSS., Pkts.1 and 15.

factors proved to be the high cost of coal in Swaledale and the topography of the mining field. The bulk of the coal needed for smelting and other purposes was carried by road from pits in the Auckland area of South Durham, a distance of thirty or forty miles. Coal of an inferior quality was mined locally, at Tan Hill, William Gill and other small mines, but at the end of the eighteenth century most of it was still carried by packhorse, and it cost three times the pit head price at a distance of only ten miles¹. In consequence the running costs of steam engines which were tried in a few mines early in the nineteenth century proved to be high, and only at Hurst, where the mine lay too far from the valley side for levels to be used to any great advantage, was steam power employed for very long.

On the other hand, in most of the mines the deep valleys which have been cut through the main bearing beds afforded ideal conditions for the driving of levels. A major cross-cut, with extensions and branches in the veins, could replace a large number of shafts. Dressing operations, formerly scattered among the shafts, could be concentrated at a dressing floor at the level mouth, reducing transport costs and making it possible to invest in improved equipment. The only technical problem involved, once gunpowder was in general use, was the provision of adequate ventilation. Normally airshafts

1. See below, pp.207-8.

were sunk at intervals of from 70 to 100 fathoms along the cross-cut, until a connection could be made with other workings¹. A useful development of the later years of the eighteenth century was the waterblast, which consisted of a pipe in a shaft down which water was poured, drawing in air through holes near the top of the pipe, and forcing it out on falling on a board at the bottom of the shaft². This device was, of course, useful only where there was free drainage.

If there were no marked technical difficulties, however, there were serious financial problems. Long levels were not only expensive in money, but they also took a great deal of time to drive. A company leasing a mine for twenty-one years could not be expected to undertake a major development which would not be completed, and repaying their investment, before the end of the lease. The longest levels in Swaledale were begun either by the mineral owners themselves, as in the case of Hard Level and Barras End Low Level, or by companies which had a special arrangement with the lessors, to ensure that they would enjoy the fruits of their labours, as in the case of Sir Francis Level³.

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1. Sir G. Denys, Machine versus Hand Labour in Mining, (1877), pp7-8.
 2. Agent's Survey Book, Old Gang and Lownathwaite, 1824-32, DH. MSS. SC.7; Blakethwaite Mine Plan 1811 and Lownathwaite Mine Plan 1821; DH. MSS. P/B1 and P/L1. Kinnaid Commission Report, Appendix A, p.18.

Two factors deterred the mineral owners from undertaking the full development of their mines themselves. In the first place, as the scale of operations increased, the amount of capital needed tended to strain their resources, and they became increasingly conscious of the advantages of foregoing the prospect of maximum profits in favour of a relatively steady income from royalties. Secondly, as they rarely lived near the mines¹, they failed to provide for their efficient management.

The detailed direction of mining operations was usually left almost entirely in the hands of the mining agents. These men, who were normally recruited from the ranks of the miners, or were the sons of agents, were in most cases good practical men but poor mining engineers, good tacticians but poor strategists. Mining for lead ore was a difficult science even for skilled and trained managers. The deposition of ore in the veins is governed by a number of variable factors such as the width of the vein, its throw, the nature of the adjacent rock, and the presence of different vein-filling materials, but even if all these factors are known, a vein might be rich in one place and barren a short distance away, for no clear reason. Even in the nineteenth century, mining agents in

1. Peter Denys and Lord Pomfret, for example, spent most of their time in London and at the Pomfret seat in Northamptonshire. They bought Low Fremington Hall, near Reeth, renaming it A.D. Hall, but it was only a pied-a-terre to accommodate them on their visits in the absence of any suitable hotels in the locality. It did not become a regular residence until 1851.

Swaledale received no proper technical training. As a mining engineer wrote in 1861, there was "no suitable training for those whose province it is to investigate the most difficult problems of geology and mineralogy... While the art of mining has attained great perfection, the science of mining scarcely exists and the opinions of practical men on the subject are based upon an empiricism of the lowest order".¹

The knowledge acquired, by trial and error, of the varying thickness of the strata, the throw of the veins at different places, which veins had been tried in which beds and with what results, might have grown into something very valuable if it had all been preserved. Some of this information was recorded in notes and plans but most of it was lost. Plans usually showed only the main waygates, and current or recent workings, and some of the plans and cross-sections were very inaccurately drawn, with the result that trials in the nineteenth century not infrequently broke into workings which were no more than fifty or seventy years old.

By contrast, the London Lead Company, which worked a large mining field to the north and north-west of Swaledale, including Alston Moor, Teesdale, and part of Weardale, paid careful attention both to the accurate surveying and recording of its workings, and to the training of its technical staff, particularly those concerned with assaying and smelting.

1. W.Wallace, The laws which regulate the deposition of lead in veins., (1861), p.3.

In 1834 a series of lectures on chemistry was given at Middleton in Teesdale to the agents and assistants of the Company by Professor Johnston of Durham University, and some years later promising young men were sent to Newcastle for instruction in the same subject. The Company was repaid handsomely for its attention to training and research by improved efficiency in mining and smelting. During the half century after Waterloo, the Company was "the largest single contributor to the science and technique of mining and smelting of lead and refining of silver in Europe."¹ It was partly the enlightenment and far-sightedness of the predominantly Quaker governing body of the London Lead Company, and partly the size of the concern and the security of tenure which it enjoyed, which explain the striking contrast to Swaledale².

Lord Pomfret set down his views about the shortcomings of agents in a memorandum written, according to Fawcett, in January 1773, after he had dismissed an agent for prosecuting a trial without permission.

"The only way to have a just account and to make a full profit of the estates in Swaledale is not to employ anyone as steward who is a Yorkshireman, and particularly of that neighbourhood.

1. A. Raistrick, Two Centuries of Industrial Welfare, p.76.
2. Ibid., pp.57-76.

"The custom that has been practiced is to work the mines by Bing Tale (that is so many Bings of rough ore before it is smelted) opening the door to the principal agent and under-agents to cheat without a possibility of detection; because if let to any of their friends and relations they will pay for the ore when but half drest, or mixed with dirt, as if it was pure ore, whilst they will compel others to whom they owe no good will to sift out all the dross, so that one Bing of the latter shall be worth nearly two of the former's getting¹. Besides they have the power to serve some shafts better with wood and material for mining than others; which causes great heart-burnings in the fields, and gives the agents an absolute power of enriching themselves and their friends, at the loss of the proprietors and the ruin of the credit of the mines.

"I therefore would recommend it to let all the mines at a certain fixed duty to adventurers."²

There is reason to believe that John Davies, agent to the Pomfret-Denys family from 1802 to 1822, was no more honest than the men to whom Lord Pomfret refers. One of his assistants, James Littlefair, kept a very detailed record of Davies' peculations. The details given include Davies having work done at his farm on the mines account, recording payments to workmen in excess of those actually made and pocketing

1. In the nineteenth century the ore dressers were usually paid by the Company and the cost deducted from the wages of the miners.
2. Fawcett MS., pp.87-8.

the difference, and cheating on the timber account and personal expenses¹. His account rings true, and there is a reference to the dishonesty of Davies in a letter to Sir George Denys from his uncle, Sir Francis Shuckburgh, in 1861².

The petty swindling of agents was, however, much less detrimental to their employers' interests than their general incompetence. There is at least as much reason to doubt Davies' efficiency as there is to doubt his honesty³.

The Arkengarthdale mines in 1798-99 provide an example of the problems caused by the inadequacy of the agents, combined with some marked technical and financial difficulties. The manor and mines were owned at this time in equal shares by three partners, Turner, Forster and Sleigh, who had each married a daughter of the last Charles Bathurst. They were absentee owners, and although none of them lived more than fifty miles away, this relative proximity was offset by the division of the estate. In June 1799, Robert Clarke of Stockton, a land agent, made a report on the mines to Sir Charles Turner in these terms:

An inspection by Mr. Sleigh and A. Clarke in April 1799 showed that the underground agents in Arkengarthdale were "by no means equal to the conduct of the mines there under the present difficulties". There was "a want of union and concert"

1. J. Littlefair: Memo. Book. D.H. MSS. RD21, Part 2.

2. D.H. MSS. M2. This may, of course, derive from Littlefair's diary.

3. See below, pp. 109-110.

Wasteful trials had been undertaken: e.g., a shaft sunk late in 1797 or early in 1798 at a cost of £800 was deemed useless by a skilled agent recommended by Mr. Breare of Middleham¹. The agents prosecuted expensive works in bad times instead of just letting the mines on ore bargains. Waygates - the underground passages - were made too narrow, although the miners were paid as for the proper width. A good deal of timber had been wasted or stolen. When a new shaft was timbered, frequently too much wood was taken to it, and the surplus left to rot. A. Clarke promised to save £70 to £100 a year on timber alone, or "give all his trouble about the mines for nothing." The report recommended that some of the agents be dismissed, and that the ground to the north of Arkle Beck should be let off on duty bargains at the rate of one-fifth or one-sixth. In one Swaledale mine (which was not named) the lessees were said to have spent more than £20,000 and made no profit, whereas Lord Pomfret had gained £4,000.²

The mines had made an average annual profit of over £2,500, "nearly equal to one-fourth of the produce" during the previous five years, but current production was low - 559 tons in the year ending 31st Oct 1799, as against 1218 tons

1. A land agent and an investor in a number of lead mines.
2. K.L. MSS., Pkt.2.

in both 1795 and 1796. Commenting on the recent rise in the price of lead, Matthew Wadeson, who handled the Arkengarthdale output, wrote in July 1797, "Lead is now beginning to be sought very much. The (Arkengarthdale) mines alas are very poor"¹. Most of the output came from the east part of Moulds, and West Moulds could not be effectually tried, "through want of money to carry up a horse level", which would cost £2000 and take four or five years to drive. In the opinion of Mr. Breare, West Moulds was as valuable as east Moulds, and "the mine may in four or five years, by being worked by levels instead of shafts as at present (more especially if the underset beds at Moulds which have not been tried within memory shall be productive) be restored to their former state of affluence"²

In the spring of 1798, there was some doubt as to whether the sales of lead would yield enough money to meet the half-yearly pay bill in April. Wadeson wrote to Sir Charles Turner's steward, "To find that we shall have little or no more than what is necessary to meet the pay adds to one's inquietude"³; and shortly afterwards, "I am so anxious about the money for the pay (that our credit may be kept up in the neighbourhood) I cannot refrain from saying you would do well

1. Wadeson to Mowbray, 8 July 1797. K.L. MSS., Pkt.7a/36.

2. K.L. MSS., Pkt.2.

3. Wadeson to Mowbray, 28 March 1798. K.L. MSS. Pkt.7/48.

to come and take a bed with us this night, as I fear we have difficulties to encounter. God bless you come, for if we fail to be at Richmond, with Mr. Sleigh and Mr. Hutchinson tomorrow noon, we shall be suspect and the miners mobbish."¹

The difficulties of management, and the inability or unwillingness of the proprietors to find the money needed to develop new techniques at a time when the old ones had proved inadequate, led the latter to think of letting the mine to adventurers, at a duty or rent². Breare prepared an estimate of the profits yielded by the production of sixteen marks³ of lead. If the mines were worked directly, there would be a profit of £630 when the price was £17.5.0 a fother⁴ and a loss of £70 at a price of £15. Let at a duty of one-fifth, the figures would be £1185 and £1091 profit respectively⁵. The proprietors finally let the whole field at a rent of £4,200 a year to Easterby, Hall and Company, who were lead merchants and manufacturers of Newcastle⁶. They took over

1. Wadson to Mowbray: undated. K.L. MSS., Pkt.7a/50.

2. K.L. MSS., Pkt.3.

3. A mark was 400 pigs. A mark of C.B. (Arkengarthdale) lead weighed, on average, 24 Stockton fothers, each of 22 cwts, or 422 tons 8 cwts. Memorandum by John Mowbray, 26 Dec 1795, K.L. MSS., Pkt.7a/50.

4. Unless otherwise stated, a fother is a Stockton fother of 22 cwts.

5. These figures should be treated with caution. Arkengarthdale MSS.2.

6. They were described in Mitchell's Directory of Newcastle-upon-Tyne, (1801) as manufacturers of red and sheet lead.

the mines on 1 January 1800 and installed one of the partners, Frederick Hall, as resident manager¹. It was unusual for a mine to be let at a straight money rent instead of a royalty in kind. The arrangement may have been made in this case because the lessees' confidence in their own ability to develop the mines and the prospect of rising wartime demand² allowed them to make an offer which was sufficiently tempting to the proprietors and yet satisfactory to themselves.

Between 1792 and 1811 all the mines of consequence in Swaledale³, most of which had previously been worked directly by the mineral owners, were similarly let to adventurers. In 1792⁴ the Surrender mine was let to William Chaytor, a wealthy landowner of Spennithorne, his son Sir William, and John Breare, at a duty of one-fifth. The lessors had for a time a quarter share in this enterprise, which they sold to

1. K.L. MSS., Pkt.5.

2. In the same year, John Locke and Co., London Lead merchants, contracted to pay a premium of 12/6d. a fother, in addition to the ruling market price at Stockton, for up to 50 marks of lead each year, in return for receiving the whole output of the A.D.mines. Wadson, Accounts and Correspondence, 1800-12, D.H. MSS., CA.2.

3. Except possibly Hurst, of which there is no record at this time.

4. According to a subsequent agreement about this mine, dated 27 May 1797, North Riding Records, ZAZ.Mining; the output of Surrender was not distinguished from that of the other A.D. mines in Wadson's accounts until 1799. Wadson: Account of lead weighed and shipped, 1796-1809.DH.MSS. ADX.

the Chaytors in 1819 for £350¹.

In 1804, Thomas Hopper, a Newcastle merchant², and Teesdale Hutchinson, a gentleman farmer, leased the Swinnergill mine at a duty of one-sixth, and an annual rent of £50, plus another £50 payable yearly after the lessees had recovered all their outlay³. Four years later Hopper and Miles Monkhouse took over the Beldi Hill mine from Parke and Company, paying one-sixth to the lord of the manor⁴, and in 1812, together with Hutchinson and Anthony Hopper, they added Lownathwaite and Keldside to Swinnergill, paying for the combined field a duty of one-sixth and an annual rent of £100⁵.

The Blakethwaite mine was let in 1806 to Thomas Chippendale, described as "of the Temple, London, Esquire", Robert Clarke of Stockton, and John Breare⁶. In 1811, the Old Gang mine, the richest in Swaledale, was taken at a duty of one-fifth and a rent of £2163⁷ by George (later Sir George) and Thomas Alderson, lead merchants of London⁸ who had bought most of the Old Gang lead produced during the previous two years⁹.

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1. W. Richards to J. Davies, 22 Jan 1819. D.H.MSS. RD13.
 2. Hilton's Directory of Newcastle and Gateshead, (1795) and Mackenzie and Dent's Directory for Newcastle-upon-Tyne, (1811). Hilton's Directory described Hopper and Monkhouse as wine merchants. In Mackenzie & Dent's Directory Hopper and company appear as lead merchants, with a lead yard in Newcastle.
 3. D.H. MSS., LB2. 4. Thomas Smith to Thomas Butson, 5 July 1808 and 25 Aug 1808. Clarkson MSS.
 5. D.H. MSS., LB2. 6. D.H. MSS., LB2.
 7. According to Davies this rent was fixed as interest upon the lessors' investment in the partly driven levels. J. Davies to Lady C. Denys, 30 Sept 1819. D.H. MSS., RD13.
 8. D.H. MSS., L.A.1.
 9. Wadson: Accounts and Correspondence. D.H.MSS., CA2.

The mines of Grinton manor, which belonged to the Crown, had been leased before 1796 by John Knighton of Grenosen in Devon. In 1810 the lease was held by Mary Knighton of Grenosen, who was at the same time an investor in some Cornish mines, and Josias Morley, lord of the manor of Marrick¹. In 1813 Morley is again mentioned as one of the lessees, paying to the Crown a duty of one-eighth². These lessees were not primarily mining adventurers, but let off tracts of ground to sub-lessees. In 1796 20 meers of ground on Whitaside Moor were let to a partnership of miners³ and in 1813 part of the field was sub-let at a duty of one-third, Morley having a quarter share with the adventurers.⁴

The Lane End Mine was leased in 1801 to a partnership similar in character to those of the small duty bargains mentioned below rather than capitalists like the Aldersons and Easterby, Hall and Company. There were ten partners, Thomas Butson, who was mining agent to the lord of Healaugh and Muker manors, together with a solicitor, a man from Kirkby Stephen described as a gentleman, but who may have had some profession, a hosier, and six miners. The duty was one-sixth, and the annual rent £10 with a further £10 if the mines made a profit⁵.

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1. Receiver-General's receipt for rent due to Crown, 20 Dec 1810. Clarkson MSS.
 2. J.Davies to P.Denys, 2 May 1813. D.H.MSS., RD13.
 3. Articles of Agreement for trial, Clarkson MSS.
 4. J.Davies to P.Denys, 2 May 1813.
 5. Lease in the writer's possession.

The mines of South Swaledale, where the veins were both fewer and poorer, than north of the river, offered fewer opportunities for the profitable investment of capital. They were still let, on the whole, in small parcels for periods of 14 years or less, to independent working miners, sometimes in partnership with men with a little capital. In 1805, for example, Richard Metcalfe, a prosperous yeoman (one-fifth share) and eight others (one-tenth share each) took a piece of ground on Satron Common. They gave up their bargain after a year. Twelve partners took the Satron Walls ground in 1808, and there were several other partnerships of a similar size¹. In 1820, the proprietors took a quarter share in the First Chance mine on Crackpot Moor, worked by twelve partners. John Davies had written of it, "It may be a very good mine and will be tried for £200 in all at most"². If this figure proved to be accurate, the average commitment of each partner, allowing for the lessors' share, was only £12.10.0.

The Spout Gill mine had been let for twenty-one years from 1778 at one-fifth duty to a Richmond woolstapler and a small landowner, in partnership with Richard Metcalfe, a farmer, and John Scott, a Reeth shopkeeper, who had been partners in the

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1. A.D. Mines Bargain Book, 1800-50. D.H. MSS., S.A.1.
 2. J.Davies to W.Richards, 23 Aug 1820, D.H. MSS., RD13.

Beldi Hill sub-lease of 1766.¹ After the expiry or surrender of this lease, Spout Gill, which was never subsequently very productive, was let on short-term bargains².

-iii-

When a mine was let to adventurers, the mineral owners were concerned with two things: their income from the mine during the period of the lease, and its long-term development. The former was secured by a duty, or rent, or both, together with stipulations about the regularity of working and the number of men to be employed. To ensure that the mine was not left in an exhausted state at the end of the lease, in which event it would be difficult to attract new lessees on terms favourable to the owners, the adventurers were usually committed to the prosecution of certain development work.

To illustrate these points, and the standard provisions of the leases, two of them are here summarized.

(a) Lease of the Old Gang Mine to George and Thomas Alderson,

31 July 1811.

The mine was leased for a period of twenty-one years, at a rent of £2163 a year, and a duty of one-fifth, free of all rates and taxes, except the landlord's parts of the property tax. The buildings included in the lease were "the new smelt mill and warehouse thereunto belonging, the blacksmiths' smithies,

1. See above, p.39.

2. A.D.Mines Bargain Book, D.H. MSS., SAL.

grinding mills, Level House and warehouses, Moor House and land and all buildings... standing thereon for the... purpose of mining (except the old smelt mills)", and also the woodyard and offices, and the A.D. Inn, all in Fremington.

The lessees were granted full liberty to dig and search for ore, make shafts, levels, and watercourses, work the waste hillocks, except those let to Thomas Butson and Thomas Dolphin¹; and to have full right of passage over mining ground.

They were to keep in adequate repair all the buildings included in the lease, all roads and bridges belonging to the mines, except those for which the parishes were responsible. Roads used also by the lessors or other lessees would be repaired according to use. The main levels and shafts were to be walled and arched with stone, as North Rake Shaft and the main levels already were.²

The lessees were to take over existing and unexpired fathom-tale and fother-tale bargains³ let by Lord Pomfret etc.

The lessees undertook to drive Force or Hard Level to cut Friarfold Vein; Drawwell⁴ and Bunting Levels to Merryfield Smithy; and Barras End Level to the boundary of the Surrender Mine, "and keep constantly employed in (each of these four

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1. Improvements in dressing technique made it profitable to re-work the debris left from earlier operations.
 2. One of the changes of this period was the substitution of stone for timber supports in the waygates.
 3. Dead-work and ore-bargains respectively.
 4. The branch of Hard Level running westward in Old Rake Vein.

levels) six able working miners at least; to work two together and make six-hour shifts."

The lessees were to buy existing "materials, implements and machinery at the mills" and the stock of timber, at a fair valuation. The lessors had the option to purchase equipment and stocks at a fair valuation at the end of the lease. The lessees could have eight weeks after the expiry of the lease to deal with outstanding stocks of ore. The lessors had the right to inspect the mines on all reasonable occasions.

The lease could be determined by the lessors for any breach of the agreement by the lessees, or by the latter on giving five years' notice in writing¹.

A further indenture dated 31 July 1812 confirmed the lessees' right to "certain ancient water races".²

(b) Lease of the Lownathwaite, Swinnergill and Keldside Mines to Hopper and Company, 4 August 1812.

The mines were leased for twenty-one years at an annual rent of £100 and a duty of one-sixth, free of all charges except parliamentary taxes. The lessees might mine by the usual methods, including hushing in "Lownathwaite Rake"³ or any

1. D.H. MSS. L.A.1.

2. Ibid.

3. This term is apparently applied to the North and South Veins at Lownathwaite, which run close together.

part of the commons and waste, doing as little damage as possible to the commons, and paying compensation for any damage done to the enclosed lands. Other rights included making watercourses and taking water, except from a certain area near the head of Gunnerside Gill; taking peat, stones for building, and lime for burning; and rights of passage, paying for the repair of roads according to use.

All main levels were to be driven as horse levels, six feet high and three feet wide¹, and to be arched and walled with stone, unless in solid rock. Timber was not to be used. The lessees were not to stop working for more than twenty days unless prevented by weather or accident.

The lessors had the right of inspection and the option to buy machinery etc., at the end of the lease. The lessees were to have nine months after the expiry of the lease to complete the dressing and smelting of their ore.²

A common provision omitted from both of these leases was that governing the minimum number of miners to be employed. The Hurst lease of 1718 had stipulated 147³, and the Old Gang lease of 1828 fixed 200 as the minimum⁴. The smaller mines

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1. The usual dimensions fixed in later leases were 6 feet by 4 feet. Sir G. Denys, Rules to be observed in driving horse levels, D.H. MSS. S.G.4/37.
 2. D.H. MSS. LB2.
 3. See above, p.36.
 4. D.H. MSS., A.5.

at the beginning of the nineteenth century usually had to employ from four to eight miners.

The negotiations about proposed leases often centred on the covenants relating to dead work rather than the duty to be paid. Sometimes prospective lessees declined to take a mine on terms that would involve them in too heavy an expenditure for this purpose. In 1825, for example, Robert Jaques, Ottiwell Tomlin, William Metcalfe and Thomas Bradley¹ proposed to take a lease of the Lane End and Keldside mines. A duty of one-seventh was agreed, but the prospective lessees refused to accept the onerous conditions proposed by the proprietors. The covenants of the draft lease included the driving of a horse level from Cat Rake Force, just west of Keld, to the Lane End Shaft, a distance of over a mile and a half². There were to be four foreheads working at once, as the lessees were to deepen shafts at Keld Side and Lane End, draining them by steam engines, and then drive east and west from the former and east from the latter to complete the horse level connection. Each forehead was to be driven by eight miners working in pairs and making six-hour shifts, and by the end of eighteen months a total of fifty miners was to be employed. The negotiations

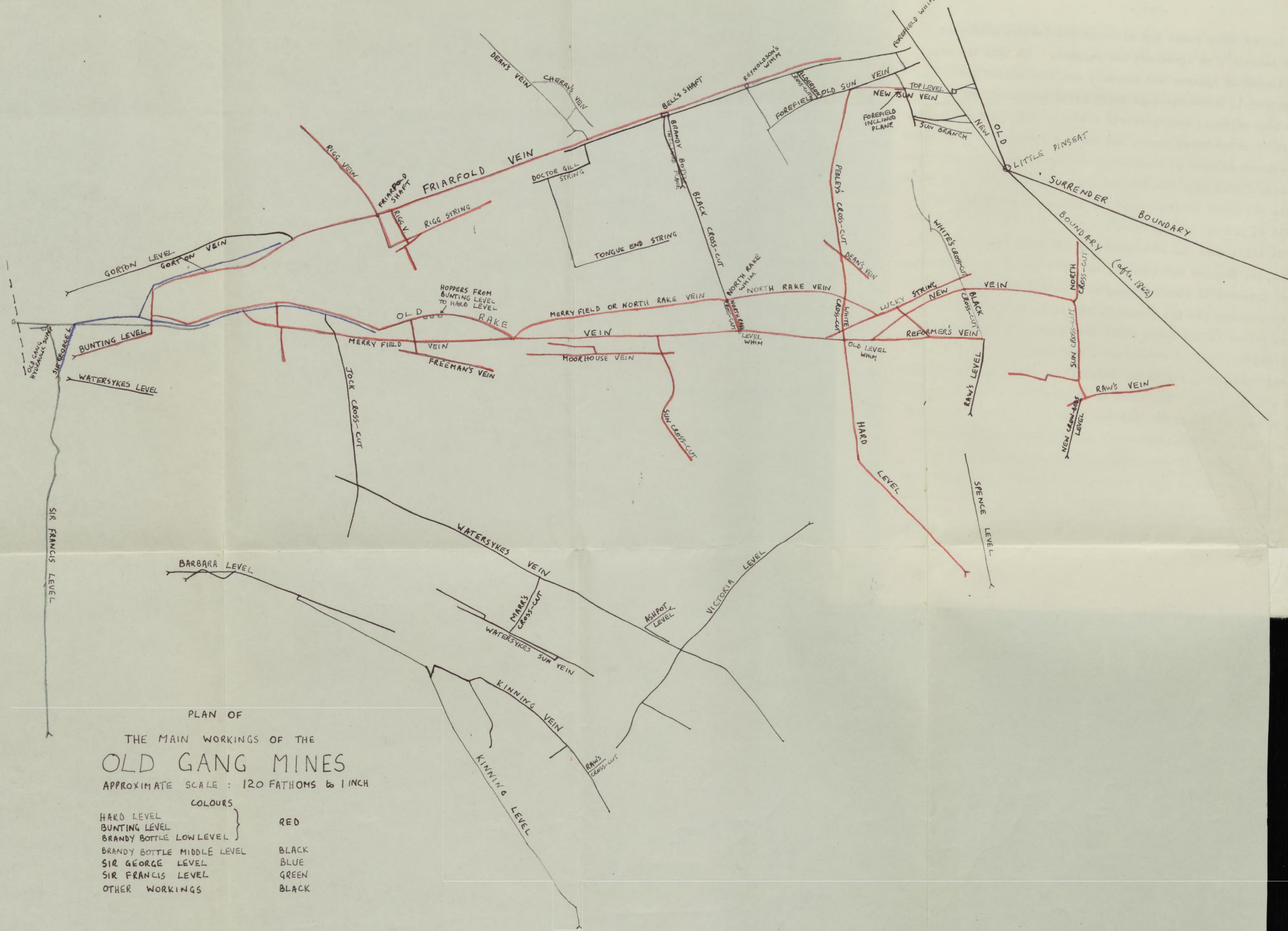
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1. For the background of these men, see below, Chapter IX.
 2. These mines were situated in the bottom of the main valley so that to work a mine in depth a level had to be started a long way further down the valley.

went on for three years and although the lessors moderated their demands¹, no agreement was reached. In 1829 the mines were leased to Jackson and Company, who were spared the obligation to drive Cat Rake Force Level but undertook to install two steam engines, employ thirty miners within eighteen months and fifty after three years, and build a smelting mill at their own expense as soon as enough ore was raised to yield six marks of lead. This mill had been mentioned in the 1825 draft lease, but it was there provided that the lessors should pay £300 for it at the end of the lease².

In 1828, when the Aldersons gave up their lease of the Old Gang mine, Chaytor and company, who were lessees of the Surrender mine, proposed to take Old Gang at a duty of one-fifth with no rent except for the woodyard, inn etc., and to have no stipulations in the lease about dead work. The lessors declined to treat on those terms, and shortly afterwards opened negotiations with Mr. Raisbeck, a Stockton lead merchant, and his partners. The draft lease sent to Raisbeck provided for a duty of one-fifth, and the commencement or continuation of six horse levels immediately and a further six within two years. A total of seventy-four fathom workers was to be employed in driving these levels, as well as three hundred and

1. This is shown by the correspondence which does not, however, make clear which covenants had been dropped.
2. Correspondence and leases, 1825-28. D.H.MSS. ~~AN~~, A6, LB5, LC2.

A. D. Co.
GROUND



PLAN OF
THE MAIN WORKINGS OF THE
OLD GANG MINES
APPROXIMATE SCALE : 120 FATHOMS to 1 INCH

- COLOURS
- HARD LEVEL } RED
 - BUNTING LEVEL } RED
 - BRANDY BOTTLE LOW LEVEL } RED
 - BRANDY BOTTLE MIDDLE LEVEL } BLACK
 - SIR GEORGE LEVEL } BLUE
 - SIR FRANCIS LEVEL } GREEN
 - OTHER WORKINGS } BLACK

fifty other miners. These provisions were so outrageous that Raisbeck did not even treat them as an opening move in the bargaining game, but withdrew his proposal immediately. A few months later, the mine was let to Jaques and company for one-fifth duty and £50 rent, with the driving of three levels and the building of 600 yards of smelt-mill chimney as the only dead work covenants. Two hundred miners, including fathom workers, were to be employed¹.

-iv-

During the late eighteenth and early nineteenth centuries there were far-reaching changes in the methods of mining, dressing and smelting. The progress of this technical revolution can be shown most clearly by a detailed examination of the development of the two largest concerns, the Old Gang and Arkengarthdale mines.

Before the horse level era, the Old Gang mine was worked by a series of whim shafts sunk principally on the major veins, Friarfold and Old Rake. There were dressing floors at several of these shafts, including a major one at Merryfield on Old Rake Vein, where there was also a smithy. The ore was smelted at the mill in Hard Level Gill, half a mile above Surrender Bridge².

The central feature of the reorganisation of this mine was the driving of Hard Level and the building of an up-to-date

1. Correspondence and leases, Old Gang, D.H. MSS., A5.

2. Ibid; Correspondence of John Davies, D.H. MSS., RD13.

dressings floor at its mouth. The exact date at which the level was begun is not known. By 1811 it had been driven¹ 575 fathoms to the Old Rake Vein, westwards in the vein to Level Whim, a distance of about 195 fathoms, and then northwards as a crosscut for a further 60 fathoms to North Rake Whim Shaft². The first crosscut section was very expensive to drive³ and the name of the level was changed from "Force" to "Hard" in the driving⁴. It is unlikely that the average rate of progress was more than three fathoms a month⁵, in which case 575 fathoms would have taken at least sixteen years. Allowing five years for driving the other two sections which had been completed by 1811, the latest date at which the level would have been started is 1790. Progress may have been much slower than this, however, and one cannot rule out a starting date as early as 1780.

If it was begun about 1790, the level was probably planned by Peter Denys, who took over the direction⁶ of Lord Pomfret's

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1. In the "27 fathoms grit and plate", the bed below the under-set limestone.
 2. 1811 lease, D.H. MSS., LA.1 and Plan D.H. MSS., P/D.G.1.
 3. It cost £10 a fathom, including arching but excluding airshafts, according to the valuation "set by Mr. Spenseley (a mining agent) and confirmed by other witnesses", quoted in a letter from G.H. Wilkinson, arbitrator in Pomfret & Denys v. Alderson, to O. Tomlin, 30 May 1828. DH.MSS.LA3.
 4. Agent's survey book, Old Gang & Lownathwaite, 1824-32. DH.S.C.7
 5. This estimate is based on a comparison with the rate of driving a number of other levels. E.g., The first 200 fathoms of Sir Francis Level were driven by four men, working two six-hour shifts a day, at a rate of 10ft a month, and a cost of £8.10.0 a fathom. See below, (p.166). At £10 a fathom 80 years earlier, Hard Level seems to have been a more difficult and expensive job.
 6. By remote control.

mines a short time after his marriage to the latter's daughter, Lady Charlotte Fermor, in 1787¹. As part of the same plan, Bunting Level was driven from Gunnerside Gill into the Old Rake and Friarfold Veins, to connect ultimately with the branches of Hard Level in the same veins². The latter, and the other veins and strings in the mine, could then be worked in all the main bearing beds from below³, and most of the ore drawn out to the Hard Level mouth, where the dressing floor and smelting mill were situated. By an error which was attributed to John Davies, however, Bunting Level was driven at a steeper inclination than the 1-in-100 which was regarded as ideal, rose through the underset beds, and was four fathoms higher than Hard Level at the junction of the two in Old Rake Vein⁴.

An important feature of the Old Gang rationalization was the provision of a new dressing floor and smelting mill at the mouth of Hard Level, which conferred two benefits.

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1. Sir F. Denys-Burton: Notes on the Pomfret, Denys and Shuckburgh families and the Yorkshire mines. D.H. MSS., W4, and see below, Chapter V.
 2. Correspondence of J. Davies. D.H. MSS., RD13.
 3. "Rises" were put up from the main levels and drifts driven from those in the vein at different horizons. This method was much more economical than working downwards in steps from above, as any water drained away freely, and the ore was tipped down into hoppers at the side of the main level.
 4. W. Richards to J. Davies, 8 Nov 1816, D.H. MSS., RD 13. and Plan D.H. MSS., P/OG1.



III : The Old Gang Smelting Mill

On the extreme left is the mouth of Hard Level and the dressing floor. Above them on the ridge is the peat house. The mill itself is in the middle-ground, with the refining furnace (the building with the chimney) on the right, and the blacksmith's and joiner's shops behind.

Transport costs were reduced as instead of being carried above ground by packhorses, the ore was brought in horse-drawn waggons out of the level mouth and straight on to the dressing floor; from there it went to be smelted at the adjacent mill, and was then on the road to Richmond.

Secondly, as the dressing floor replaced several smaller ones, with the extension of the level network, it was profitable to invest in improved equipment¹. For crushing the bouse, hand-buckers were replaced by rollers worked by a water-wheel.

A hotching-tub, with a sieve operated by a lever, was used instead of the hand sieve, treating four or five times as much material in the same period². A number of other improvements were designed to prevent the loss of fine pieces of ore in the dressing processes. The small pieces of ore and dross, called "smiddum" or "smitham", which fell through the mesh of the sieve into the hatching tub, were treated in a running buddle, in which a rake was used to keep the smiddum in suspension in gently flowing water until the ore, being denser

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1. As far as can be determined some of this equipment, including crushing mills, was already in use on other Old Gang floors before the building of the floor at Hard Level, while other equipment, like slime pits, was used on that floor for the first time. A.D.Mills Accounts, 1805-85.D.H.MSS.S.D 5
 2. For a description of the earlier methods, see above (pp.52-3.) As a further refinement, the middle layer of the "hotched" material (ore being at the bottom and dross at the top) which was called "chatts", was crushed to a powder by a stamp mill, on the rollers of a chatt mill, and was then hotched again.

than the dross, could settle. When this ore had been removed, the "smiddum tails" which had drifted to the lower part of the buddle were re-worked in a trunk buddle, in which the material was worked about in a small compartment at the head to help separation in the body of the buddle. Finally, the water used in all these operations was run into slime pits¹, to allow any particles of ore still carried in suspension to settle. The water escaped, or flowed into another slime pit through a small opening near the top of the end wall of the pit; at intervals it was turned off, and the slimes taken out to be dollyed² or buddled³.

According to Westgarth Forster, writing in 1821, "the washing of lead ore etc... has received very great improvements during the last twenty-five years... and has enabled many miners to try and work very poor mines which could not have been worked without these improvements"⁴.

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1. The dimensions of the slime pits at the Old Gang dressing floors in 1871 varied from ten to fifty feet in length and from two to six feet in depth, with an average width of three feet. Copy of return to Rivers Pollution Commission, in Old Gang Agent's Notebook, 1871. D.H. MSS., F3.
 2. In this process the slimes were stirred in a large tub called a dolly-tub and then allowed to settle while the sides of the tub were beaten with hammers to keep the lighter material in suspension as long as possible. "The operation of dollying the slime ore is a most excellent method as the ore is both made purer and more of it saved than by any other means."
 3. Forster, op.cit., second edition (1821), p.362.
A.D.Mills Account, 1805-85; Correspondence of J.Davies; Forster, op.cit., 2nd edn., pp.338-362; 3rd edn (ed.W.Nall 1883) pp.174-7.
 4. Ibid., 2nd edn., p.355.

The smelting mill built at Hard Level replaced an older one situated half a mile lower down the beck¹. The new mill was in partial operation before 1801, but was not finally completed until 1807, and meanwhile the old mill was still used². The latter was reserved by the lessors in the 1811 lease, and was probably dismantled not long afterwards. It was not mentioned in the draft lease of 1828 or in the lease of 1839³.

The new mill had four ore-hearths standing in one line, an arrangement which was possible because the draught was provided by an air pump, instead of bellows⁴. It had also a slag hearth and a calcsiner or roasting furnace⁵. The latter was used to drive off part of the sulphur and antimony present in the ore before smelting, and also to bake the slime ore for easier handling in the ore-hearth. The technique of roasting involved playing a "copious smoke" from a coal fire over the surface of the ore without heating it sufficiently for the ore and slag to begin separating⁶.

A horizontal flue which carried the smoke from the hearths ran up the hillside behind the mill. Lead is highly volatile and if the smoke from the smelting hearths is allowed to escape

1. D.H. MSS., P/OG1.

2. A.D. Smelter's Mills Account, 1801-7. D.H.MSS. RD21, Pt.I and A.D. Mills Account, 1805-85.

3. D.H. MSS., LA1, A5, LB4.

4. See plan, facing p.98.

5. There was a calcsiner at the old mill too. A.D. Mills Account, 1805-85.

6. Forster, op.cit., third edition, p.189.

it not only injures the vegetation but also wastes some of the lead. The horizontal flues were designed to trap the lead in the fume. Writing in 1778, Bishop Watson described their recent introduction into Derbyshire¹, and the flues at the Grassington Mill in Wharfedale, and Keld Heads in Wensleydale were begun in the same year². The flue of the Octagonal Mill in Arkengarthdale was probably the earliest to be built in Swaledale³. The flue of the Old Gang Mill was first mentioned in 1805 when it was extended by 109 yards, and a further 60 yards were added in the following year⁴. A series of later extensions brought its final length to about half a mile. The flues consisted of trenches lined with stone and either arched or roofed with flags. At intervals the soot was swept from the roof and sides into the bottom of the chimney⁵ and then washed down by a stream of water from a small reservoir at the top of the flue into settling pits at the mill⁶.

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1. Chemical Essays, quoted in: J.Percy, Metallurgy of Lead (1870) pp.434-5.
 2. A.Raistrick, Lead Mining and Smelting in West Yorkshire, Trans Newcomen Society, Vol.VII, p.92.
 3. It was almost certainly built before 1800 and possibly before 1783. K.L.MSS, Pkts.1 & 15. Its final length was a little under a mile.
 4. A.D. Mills Account 1805-85.
 5. An unhealthy and dangerous job. At the Arkengarthdale Mill, the flue was swept twice a year.
 6. The method of treating the soot at Arkengarthdale Mill was as follows: The water was drained off from the settling pits and some fine ore dust from the dressing floor mixed with the soot. The latter was roasted, then crushed, washed to get rid of any foreign matter, e.g. stone dust from the flue, and smelted. Information from Mr.G.B.Harker, who was agent to the last lead mining company in Arkengarthdale.

The operations of dressing and smelting, as well as hushing and the use of some waterwheels in mining, created a great demand for water. One of the features of the industrial revolution in Swaledale was the creation of artificial reservoirs like Moss Dams on Melbecks Moor, and the enlargement of natural lakes, like Summerlodge Tarn. Many miles of watercourses were constructed, running across the moors from these reservoirs and from streams. Partly because of the high cost of coal, water remained the most important source of power in the Swaledale mines until their final closure¹.

Another building of importance at the Old Gang mill was the peat house, which measured 391 feet in length and 20 feet in width². The long walls consisted of pillars with open bays to facilitate the drying of the peat. A year's supply was cut from the peat moors in late May or June. The peat accounts of the Old Gang mine in the years 1807 to 1810 describe an operation lasting seven or eight days and involving some two dozen carts and over a hundred men, women and children. The total cost ranged from £145.0.11 in one year to £356.9.3 in another³.

1. See below, pp.184-5.

2. These are the measurements of the present ruin. R.T.Clough, Lead Smelting Mills of Yorkshire, Cave Science, Vol.2, No.10, p.81. The dates of the original building and any extensions are not known.

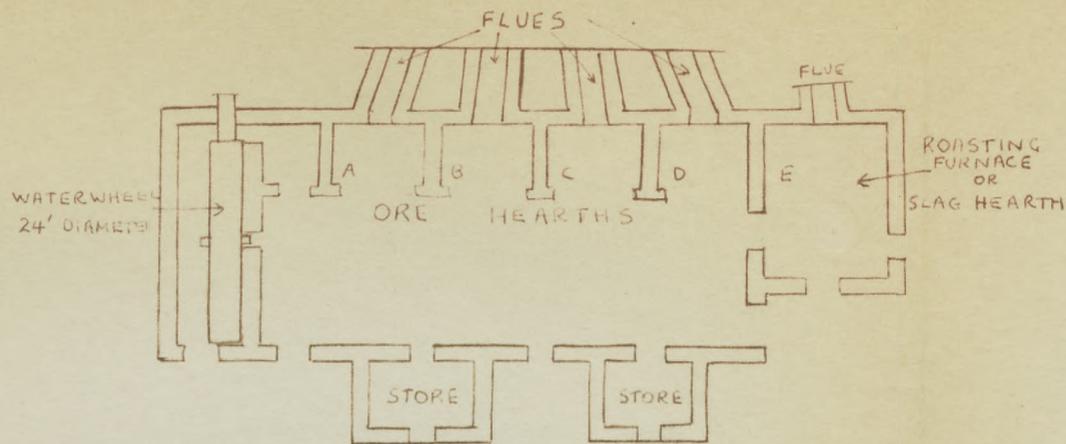
3. A.D.Mills Account 1805-85.

The Arkengarthdale Mines.

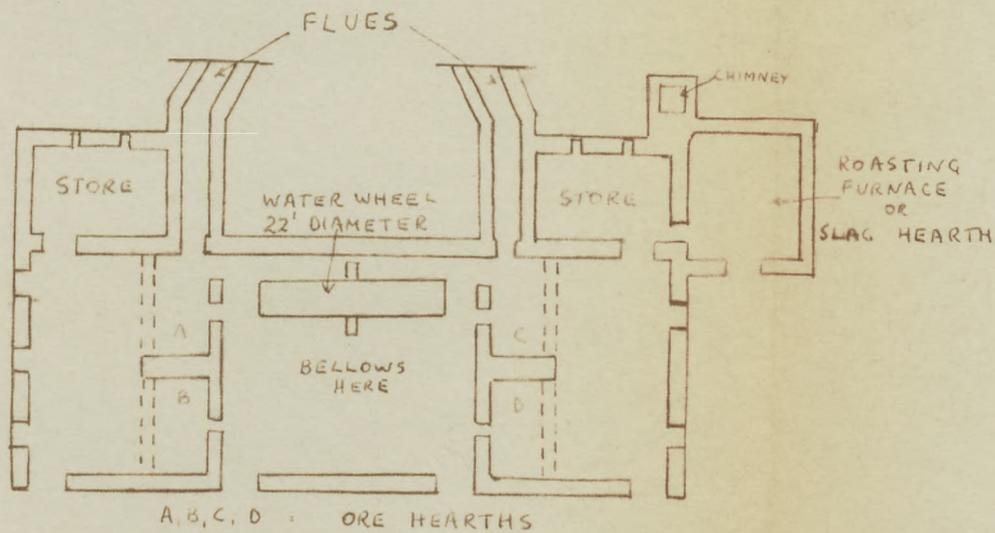
The reorganisation of the Arkengarthdale mines was begun by Easterby, Hall and company who leased this field in 1800. They were able to provide both the capital and the skilled management which the report of 1799 had found to be lacking. As lead manufacturers they were no doubt particularly interested in the smelting process and one of their first moves was to pull down Old Moulds mill, which stood on the hillside near to the shafts through which Moulds had hitherto been worked. In its place they built a larger mill a short distance to the south of the Octagonal mill, apparently to make use of the horizontal flue of the latter¹. As so enterprising a management would not have built an entirely new mill so close to the old one if the latter could have been suitably modified, one may assume that the Octagonal Mill soon went out of use, or perhaps was held in reserve for very busy periods when the new mill could not handle all the ore coming forward².

Nothing definite is known of the original design of the mill.

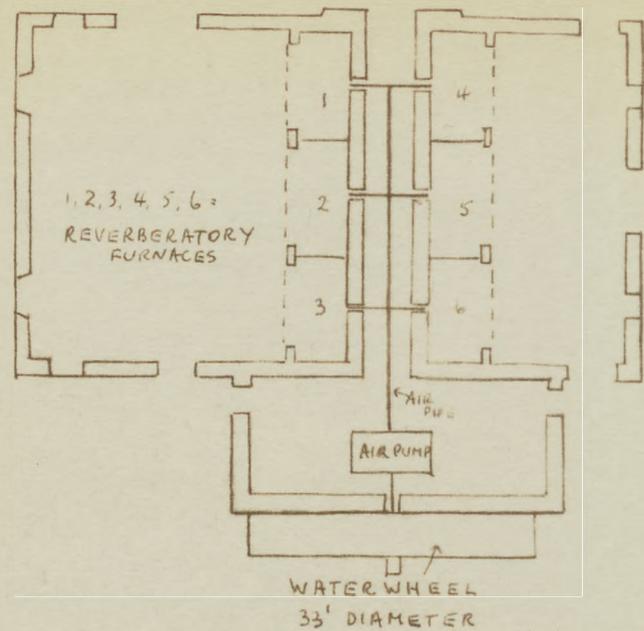
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1. Lease of Arkengarthdale Mines (executed a year after the lessees had entered upon the mines and had already begun the new mill). K.L. MSS. Pkt.4.
 2. In the late nineteenth century, this mill had been out of use longer than anyone could remember. Information from Mr.G.B. Harker.



OLD GANG MILL



SURRENDER MILL



NEW C.B. MILL
(ARKENCARTH DALE)

According to Routh¹, it was remodelled by the next lessees about 1824. Assuming that there were no major changes later in the century, the mill then consisted of six reverberatory furnaces blown by an air pump, two roasting furnaces and a slag hearth². It is not unlikely that this was substantially the original form of the mill, and that the 1824 remodelling involved no more than minor changes. The air pump could not have been substituted for bellows without a complete internal rebuilding, and the reverberatory furnaces are more likely to have been introduced by Easterby, Hall and company than by the next lessees³.

The reverberatory furnace had replaced the ore hearths in many areas before the end of the eighteenth century. The relative merits of the ore-hearth and the reverberatory are discussed in a paper by Dr. Raistrick: "It seems a fair generalisation.. that the ore hearth with its extremely simple structure and its easy processing was ideally adopted to smelting small quantities of variable ores. The amount at one shift was small, easily handled by one or two men at the most, and the resultant lead was of good quality. The reverberatory furnace was a much

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1. J. Routh, Rambles in Swaledale, second edition. (1897), p.57.
 2. See plan facing this page; and ; information from Mr. G.B. Harker.
 3. Several of the latter were partners in successive Old Gang leases after 1828, but they did not try reverberatories there. Easterby, Hall and company seem to have paid particular attention to improvements in smelting.

larger structure, dealt with far larger quantities, could be run as a more continuous process, and demanded far more skill and more uniform ores. Essentially the ore hearth remained the mill of the small tributing miner, the reverberatory being the concern of the larger companies¹. Where silver rich ores occurred and lead refining was of prime importance, the reverberatory again had considerable advantages over the ore hearth". Dr.Raistrick concludes "On the score of overall efficiency, when the case of obtaining fuel and the fuel requirements of the two types are borne in mind, there is little to choose between them"².

This was the case in Swaledale, where the reverberatory was adopted only at the new mill in Arkengarthdale, at Grinton Moor Mill during the lease of the London Lead Company³, and possibly at one of the Marrick mills⁴. At the Old Gang mill, the output of which was comparable to that of the Arkengarthdale mill, it was not tried until 1872⁵. The major development of Easterby, Hall and company in mining was the driving of Moulds Level, which was probably begun soon after the lease commenced in 1800. By 1813 a branch of this level in Waterblast Vein had been driven near to the boundary between Arkengarthdale and

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1. This was only partially true for Swaledale.
 2. A.Raistrick, Ore hearth lead smelting in the seventeenth and eighteenth centuries.. Proc.Univ.Durham Phil.Soc., Vol.X, Part 7, 1948, pp.534 & 540.
 3. See above, pp.59.
 4. One of these mills is marked on the six-inch O.S. map as "Marrick Cupola Mill" (Sheet 52 N.E.) Cupola was a name used to describe a type of reverberatory furnace.
 5. See below. pp191.

the Surrender Mine¹. Three other levels, Damrig, Little Punched Gill and Tanner-rake, were started between 1800 and 1828².

-vi-

In the absence of a continuous series of production figures for the period before 1817, it is difficult to relate fluctuations in output on the one hand to changes in methods and organisation and on the other to movements in the price of lead. The available figures are: Arkengarthdale 1783-1799; the A.D. group³, which included all the mines of any consequence except Arkengarthdale, Hurst, Grinton and Beldi Hill, 1786-1799; and separate figures for the Surrender Mine and the remainder of the A.D. group, of which Old Gang would account for three-quarters or more of the output, for 1800-1811⁴.

One generalisation may be made which is valid for the whole of the period covered by production records. The output of the individual mines, and of the Swaledale field as a whole, was subject to marked short-term fluctuations which bore little relation to price movements or to cycles in the economy⁵, but were due primarily to the fortunes of discovery. When a rich deposit was cut, it was worked as vigorously as possible until it was exhausted. Other development work went on but no

1. J. Davies to P. Denys, 6 June 1813. D.H. MSS. RDI3.

2. 1828 lease, Arkengarthdale MSS.4.

3. That is, the mines in the commons and wastes of Healaugh and Muker.

4. For the sources of these figures, see Appx.B.

5. See the graph, Appx.

attempt was made to stabilise the output.

There is some evidence to suggest that the efforts of the new lessees in Arkengarthdale led to an appreciable increase in production. Matthew Wadeson made several references to such an increase in 1803-1804. If his comparison with the A.D. output is correct, Arkengarthdale was producing at an annual rate of some 1200 or 1400 tons¹. In 1814, Clarkson, a local historian, estimated the output at 2000 tons. This figure may be an exaggeration, as his estimate of 3000 tons for the A.D. group seems to be wide of the mark².

The A.D. output for 1792-1799 showed a big increase over that for 1786-1791, but the causes of it are obscure. There is no positive correlation between the production curve and the price curve, and the driving of horse levels would not have yielded a return much before 1800. It is possible that the assumption of the management of the mines by Peter Denys about 1790 led to an increased rate of investment in other forms of dead work which resulted in increased production. After 1800 there was a marked rise in output which was only partly due to the increase in the price of lead, from £20.10.0 per London fother of 19½ cwts in 1799 to £25 in 1801. Wadeson's correspondence shows that the Old Gang mine was working some rich deposits³

1. Wadeson: Accounts and Correspondence.

2. C. Clarkson, History of Richmond, first edition (1814) pp. 239-40.

3. The A.D. figures for 1811 and 1817 were 1,815 and 1,532 respectively.

3. Whether by the new levels or by shafts is not known.

in 1801 and the early part of 1802, but when these were cleaned out, the prospect was "a barren one indeed", and the output declined despite further price increases¹. From 1805 production rose again, but not steadily, to a peak which coincided with the record prices of 1809.

The Surrender output tended to follow the price curve fairly closely, especially from 1804~~†~~ to 1808. This mine, which was situated on Reeth High Moor and was difficult to reach with a horse level, was worked by two whim shafts, 67 fathoms and $60\frac{1}{2}$ fathoms deep respectively. Because of the dip of the beds², the ore had to be followed to the south and west by step-like series of sumps and drifts. The water from these workings was drained into two swallow holes, and the bouse and such dead rock as could not be stored underground had to be lifted up the sumps and then hauled up one of the shafts³. The production costs of this mine were therefore higher than the average⁴, and a substantial increase in prices could have an immediate effect upon the amount of ore that could be raised with profit. By contrast, in mines where any substantial bodies of ore in sight could be worked at lower costs, an increase in price would not by itself call forth an improvement

1. Wadson, loc.cit.

2. Or the cumulative effect of a series of faults.

3. Surrender Mine Notes and Bargains, 1818-28. D.H. MSS., E2; Correspondence of J.Davies, D.H. MSS., RD13.

4. An account of three-quarters of the expenses of this mine between 1808 and 1813, when the price was generally high, shows £58,060 worth of lead produced at a total cost of £60,267: D.H. MSS., R.D.22.

in output¹. Development work might be intensified but no immediate results could be guaranteed.

The effect of the new technique upon output is shown most clearly in the case of the Blakethwaite mine. Here the yield was low until 1812, because the ore which could be mined economically through shafts was more or less exhausted². In 1812 or early 1813, the lessees began to drive Blakethwaite Level under the main limestone from Ewe Leap Scar, in Gunnerside Gill, northwards to the Blakethwaite Vein, a distance of over 400 fathoms³. Between 1819 and 1821, the southern, main, and northern branches of this vein were reached⁴. Production rose from 27 tons in 1819 to 632 tons in 1820, and remained high until technical difficulties combined with a sharp fall in price to reduce output after 1827.

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1. Except marginally, if the bing-tale rate was raised, by making it profitable for the miners to work poorer ore which they might otherwise leave.
 2. This mine had previously been worked by shafts and four short drifts, the lowest of which was driven in the Ten Fathoms Plate, above the Red Beds. (See sections in Appx A.): 1811 Plan. D.H. MSS., P/B1.
 3. Ibid; Leases of 1812 and 1814. D.H. MSS., LB3.
 4. Correspondence of J.Davies.

It is inevitable that it should be easier to analyse the economic functions of the people - proprietors and lessees, agents, miners and smelters - involved in these changes in technique and organisation than to discern their ideas and outlook. A few of them however, are more than faces glimpsed in a crowd, among them four men concerned with the development of the Old Gang mine. They are George and Thomas Alderson, who leased the Old Gang mine in 1811; John Davies, the mining agent of the Pomfret-Denys family from 1802 to 1822, who was also employed as agent to the Aldersons between 1811 and 1814; and Frederick Hall, who had already made a great contribution to technical progress in the Swaledale mining industry by his work in Arkengarthdale.

In 1814, the Aldersons dismissed Davies from their service and appointed Hall as their manager. With characteristic vigour, the latter attacked the main technical problem in the mine, the driving of a cross-cut 400 fathoms long from North Rake Whim Shaft to Friarfold Vein, an extension of the Hard Level network to which the Aldersons were committed under the terms of the 1811 lease. According to W.Richards, the London steward of Lord Pomfret's estates, the level at North Rake Whim Shaft was standing in "very hard beds", presumably the under-set limestone. "It was calculated that it would cost £20,000 and take ten years to drive it. Mr. Hall therefore rose the level

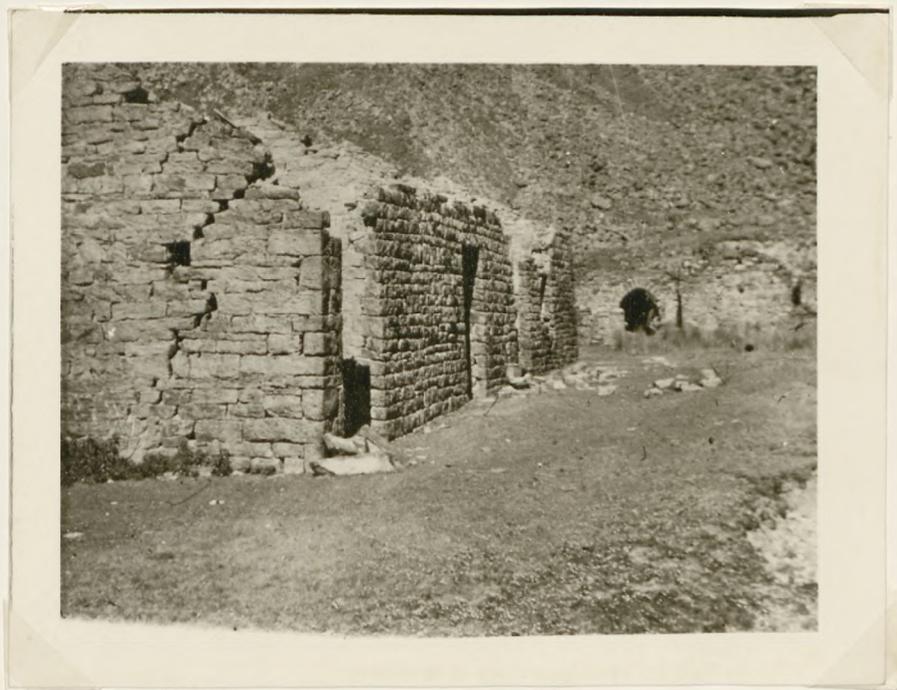
five fathoms by which he got into the softer beds¹ and was enabled to complete it in two years at an expense proportionately less". Even if the level had been driven through the hard beds, by the time it reached Friarfold Vein it would have been "above the water level"², and though it would require pumping to raise the water into the level, the expense of a steam engine for that purpose was greatly overpaid by the saving in cutting the level".

In Hall's view the length of the level made it unsuitable as a waygate. He planned to use it for drainage only, and drove part of it³ with smaller dimensions than those of a horse level. To draw the ore to the surface, he sank two inclined planes at Brandy Bottle, northwards towards the Friarfold Vein. One plane is still open and in good repair; the other is filled with debris to within eighteen inches of the crown of the arch and there is no record of how far it was driven, or whether it was ever used. From the former plane, three levels were driven to the east and to the west in the Friarfold Vein, the low level working the underset beds and the middle level the main limestone.

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1. The shale above the underset chert.
 2. I.e., too high to drain the underset beds.
 3. About 50 of the 400 fathoms.



IV : Brandy Bottle Inclined Plane, Old Gang Mine



V : Bunting Level Mouth and Lodging Shop, Old Gang Mine

To quote Richards again, "The inclined planes were cut for the purpose of drawing the work up with greater quickness and facility and to save a great deal of manual labour by allowing the horses to walk down to the very forehead of the workings and to draw it up by less power than a perpendicular shaft, and also to bring it out at once to the place of washing and dressing¹; and for the purpose of bringing up the ore, house and deads faster, a steam engine is ordered".²

Hall's plan for working the Friarfold Vein therefore involved the use of two steam engines, one to pump the water from the low level into Black Cross-cut, as the level from North Rake Whim Shaft was called, and the other to draw the work up Brandy Bottle inclined plane. There is no evidence that the latter engine was ever used³. Fawcett refers to a whim in use at Brandy Bottle later in the century⁴, and there are signs of a whim-round on the surface.

Hall used iron rails in the levels in place of wooden ones, as he had done in Arkengarthdale⁵. Davies reported, "About thirty tons of cast iron rails is arrived and a vast more to come." Hall also bought "two large water wheels"⁶, although for what purpose is not clear.

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1. A small dressing floor was built at Brandy Bottle.
 2. W.Richards, Memorandum on dispute with Aldersons, 1820. D.H. MSS., A1.
 3. Neither engine is mentioned in a survey of the mine in 1824, Survey Book, Old Gang and Lownathwaite, 1824-32. D.H.MSS. SC7.
 4. Fawcett MS, p.137.
 5. 1828 Lease. Arkengarthdale MSS.9.
 6. J.Davies to P.Denys. 20 April 1815. D.H. MSS., RD 13.

It is not surprising that Hall's severest critic was John Davies, who seems to have had all the shortcomings attributed to the agents of his time. Conservative in his ideas about methods of mining, and resenting his dismissal from the Aldersons' service to make way for Hall, he attacked the innovator frequently in correspondence.

"The mines of Messrs. Alderson is uncommon poor, and the way it is conducted will have no chance to do any good but harm. Frederick Hall has bought 6 or 8 horses to carry timber and cast iron etc., the horses will have no fear of being troubled with neither ore nor lead, as there is none to be seen..... I hope that you will be able to come into this part this summer to see what great alterations are making on the A.D. mines. The people in London should have a gold mine somewhere to answer the unnecessary workes and useless inventions are making here. I am only telling you this truth, and I do not pretend that I take any notice of what Hall do to the people here. Hall and me agrees very well, we never speaks when we meets each other."¹

"Alderson's mine is very poor, it is reported here that one of the York bankers is a partner with Alderson, it is well if it is so, Hall will keep them employed in printing notes."²

1. J.Davies to Peter Denys, 20 April 1815. D.H. MSS., RD13.
2. Ibid., 25 June 1815.

Davies' criticisms did not go unanswered. Hall and the Aldersons defended their works, and in turn accused Davies of incompetence.

"Bunting Level was carried on by Messrs. Alderson under Davies' management and for some time afterwards; but they state that it was ill-planned and rose above the bearing beds¹, which indeed Davies states in his letter to them" Although much lead was raised from Bunting Level, it cost almost £40 a fother. Davies had complained that Forefield Whim Shaft² was closed up. But the Aldersons planned to work this ground by their levels from the inclined plane, better designed for the purpose than the old works. "And when (Davies) speaks of the great quantity of ore which may be got (at Forefield Shaft) one cannot but remark the very little he raised at great cost - 33 Fodder for £993, cost with carriage - with every facility to do it, and that he himself had abandoned the place"³.

The Aldersons, under Hall's management, had "confirmed their exertions almost entirely to the Friarfold Vein, from which they are now getting lead; and they are proceeding upon that with all the miners they can procure". It seemed a good idea to concentrate upon one place at a time. "Davies' workings were always scattered and always unsuccessful." Under his

1. See above, p.90.

2. On Friarfold Vein, near the Surrender boundary.

3. W.Richards to General Fermor, 16 Jan 1817. D.H. MSS., RD.13.

management, the Aldersons had spent £20,000 more than they had received, and except for "carrying forward Bunting Level according to their covenant, the money has been wasted."¹

The arguments of Davies were apparently heeded by Lady Charlotte Denys, who wrote to the Aldersons that she and her co-lessors "have witnessed with great concern how unprofitable have been your speculations in the Old Gand Mines, and the large sums.... uselessly and wastefully expended by the heedless extravagance and improvident management" of Hall². The Aldersons replied that these accusations had been made "in order to remove the stigma from those to whom it really belonged... those on the spot (who have) in the most wanton manner expended such large sums of money, which they do not regret but absolutely boast of."³

The partnership between Hall and the Aldersons lasted for only four years. In April 1818 a dispute occurred about the terms of Hall's contract. He was to be paid £500 a year for a term of seven years, and claimed that he was also to receive one-tenth of the produce. According to the Aldersons, one tenth of the profit was agreed. Hall sued the Aldersons for breach of contract and claimed £60,000 damages. The case was eventually referred to arbitration and Hall lost⁴.

1. Ibid.

2. Lady C. Denys to G. & T. Alderson, 27 July 1819. D.H. MSS., Al.

3. G & T. Alderson to Lady C. Denys, 7 Aug 1819. Ibid.

4. Correspondence of J. Davies. D.H. MSS., RD13.

The Alderson brothers were very unfortunate in their investment in the Old Gang mine. They leased it at a high rent, as well as a substantial duty, when the price of lead was high because of wartime demand, and had to carry the burden into a period of much lower prices. More serious than this was their failure to provide for the efficient management of the mines. They were "absentee lessees", who visited the mines infrequently and for short periods and were no better placed to direct operations than were absentee proprietors. After three years of the costly and inefficient management of John Davies they had to pay a substantial salary, and in addition the disputed bonus, to a man on the spot who was competent to manage the mines. They finally gave up their lease in 1828, and after a legal action were ordered to pay to the lessors over £2,000 in damages for breaches of the covenants of their lease, particularly in failing to keep levels and shafts in proper repair.¹

In 1818, Frederick Hall wrote a pamphlet entitled "An Appeal to the poor Miner and to every Nobleman... interested in a miner's fate." In it he describes the discomforts and dangers of mining and the poor wages earned, "... for several years past, for 8/- to 12/- per week, frequently for much less, alas!, for 2/6 to 3/- per week". He writes of the wretched and overcrowded houses of the miners, and of their poor diet. These hardships

1. Award of G.H.Wilkinson, arbitrator, 27 March 1828.D.H.MSS. LA3.

he lays at the door of Mr. Maltby, of Walker, Maltby and Co., London lead merchants, and the largest manufacturers of lead in the country¹. To combat this dragon, St. George had appeared in the person of "Mr. Arthur Emerson, a merchant of respectability in London", who was trying to raise the price of lead above the £25 a ton at which Mr. Maltby had offered to "supply every plumber in the Kingdom"².

The pamphlet is, in fact, an appeal to the proprietors and lessees of lead mines to combine to maintain lead at a high price.. "adventurers should associate and fix a certain price below which lead shall not be sold"³ Hall dismisses the problems of maintaining a price ring in an industry with a large number of producers with this sentence: "Let us however have a long pull, a strong pull and a pull altogether, and we shall see the price of lead £60, and it will be time enough to find out our error in having it at that price when it shall be found it cannot be supported"⁴.

Between the publication of the first and second editions of the pamphlet, during the last week of January 1818, meetings of miners were held in support of Hall's initiative. The first

1. F.Hall, An Appeal to the Poor Miner, and to every Nobleman, Gentleman, and Tradesman in the Kingdom who feels interested in a miner's fate. (1818), pp.1-8.

2. Ibid. pp.3-4.

3. Ibid. p.18.

4. Ibid. p.15.

meeting was at Reeth, where a large attendance supported Hall and formed a committee to collect subscriptions for a presentation to Mr.Emerson. The best comment on this peculiar move comes from John Davies: "As Emerson is a buyer, will he not buy lead as low as he can get, after all?"¹ An address of support from Arkengarthdale, signed by 261 miners, was sent to the Reeth meeting. During the next few days, meetings were held at Richmond, Middleton-in-Teesdale, Stanhope in Weardale, St. John Chapel in Weardale, Alston and Hexham². Nothing more is known of Hall's projected cartel.

The pamphlet shows Hall to be a vigorous advocate of the mining methods which he applied: "The mining interests of this Kingdom are so ill-understood, so few men of science attend to them, that many mines are left, it may be said, almost to chance, with the most heedless, the most astonishing neglect; but perhaps the day is approaching when the proprietors of mines will attend a little more to their interests and endeavour to put them on a more scientific footing."³

Frederick Hall ends with a homily for the miners which shows that he is a true representative of his day and his class in his social, as well as his technical, ideas:

1. J.Davies to W.Richards. 23 Jan 1818. D.H. MSS. RD13.

2. Hall, op.cit., Appendix.

3. Ibid., p.15.

"While I advocate the cause of the miner, I by no means intend to induce him to be idle. I have always said I thought he could work an hour or two longer in the day in the mine. Labour is bountifully offered to the majority of the population as salt is to the sea, to keep it from putrefaction and filth. And the labourer when he contemplates those whom he regards as rolling in wealth would stifle his envy, if he could know the real situation of many who abound in luxuries, attacked with gout and flatulence and plethora, worn down by disease and vexations arising from pride and fatal ambition, sitting down to tables spread with Eastern luxuries, without appetite to taste a morsel with satisfaction and envying the poor man the gratification of enjoying his humble fare with delight; the labourer I say would bless his situation and sit down with gratitude at his humble fireside."¹

Chapter V : The Heyday of the Industry.

I.

Frederick Hall left Swaledale in 1821, John Davies died in 1822, and the Aldersons surrendered their lease of the Old Gang mine in 1828. Their departure from the scene marks the end of the period of innovation and experiment which had laid down the main lines of development for the next few decades. During that period the exploitation of the major mines by the use of horse levels and water power raised production to its peak in the eighteen-forties and fifties. It was not a steady rise, however. In some mines there were serious physical difficulties in the way of driving horse levels, and all the mines were affected to a greater or lesser degree by the depression of the early eighteen-thirties.

The depression was both severe and prolonged. The annual average price of pig lead, which had remained above £20 a ton from 1818 to 1827, fell in 1832 to £13.10.0, lower than at any time during the preceding or succeeding half-centuries. For four consecutive years it was less than £15. The current downturn in national industrial activity was one of the causes of this slump¹. Another factor was Huskisson's reduction of the duties on imported lead and ore. Lead had reached £29 a ton, a record peace-time price, in the boom of 1825, and this prompted the President of the Board of Trade to propose a reduction in the ad valorem duty from 20 per cent² to fifteen

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1. A.D.Gayer, W.W.Rostow, and A.J.Schwartz, The Growth and Fluctuation of the British Economy, 1790-1850. pp.177, 212, 247.
 2. E.J.Mascall, Digest of the Duties of Customs and Excise. (1814), p.47.

per cent, "which I hope will be sufficient to admit of a foreign import and check the present high price of that metal."¹. The persistence of a high price during the later stages of the bill led to further reductions², and the rate was finally fixed at £2 a ton on lead and 10/-, instead of £1.16.0, a ton on ore³. Tooke attributed the depression to "an increase in the produce of our own mines by the application of increased power and improved processes", combined with "a competition in the export trade with foreign sources of supply; for instance, lead from Spain..."⁴ In 1825, the Spanish Government had adopted a policy of encouraging both native and foreign capital to invest in the mines of that country, and according to Pulsifer the resulting increase in Spanish exports contributed to the depression in both England and Germany⁵.

The mines in Swaledale most seriously affected were Blake-thwaite and Lownathwaite⁶, which were abandoned by their lessees. At the former increasing technical difficulties, which will be examined later, coincided with the period of low prices. For a few years both of these mines were idle except for a few duty

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1. Hansard, 1st series, Vol.12, 1206.
 2. Ibid., Vol.13, 1217 and 1461-2.
 3. CMD 8706 of 1897; Customs Tariffs of the United Kingdom, 1800-1897, pp.329 & 474-5. In 1842, the duty on pig & sheet lead was reduced to £1, and to 5/- for imports from British possessions. Both these rates were reduced to 2/6 in 1848, and abolished in 1853. A duty of 2/- per ton on certain manufactures of lead remained until 1860. Ibid, pp.680-1,746-7,820-1.
 4. T. Tooke, History of Prices, Vol.II (1838), p.212.
 5. W.H.Pulsifer, Notes for a History of Lead, p.62.
 6. Including Swinnergill.

bargains let directly by the proprietors to working miners. The mine least affected was the Old Gang, where the depression did no more than check the recovery from the stagnation caused by starvation of capital during the last years of the Aldersons' lease.¹

II.

The relationship between physical conditions, technique, and output during the middle four decades of the nineteenth century can best be shown by analysing the development of some of the individual mines of Swaledale. For this purpose they fall into two groups. In one there were no serious technical obstacles in the way of the extension of a network of horse levels to work the veins in the principal bearing beds, i.e., down to the underset limestone. The Old Gang mine will be taken as an example of this group, which also includes Lownathwaite, Swinnergill, and most of the Arkengarthdale field. In the second group, including Surrender, Blakethwaite, Hurst, and the West Swaledale mines, the topography or geology created special problems or demanded a different approach.

The Old Gang Mine

By 1828, when Jaques, Tomlin, Knowles and company began their long and profitable association with this mine, the two main veins, Friarfold and Old Rake, had been laid open down to the underset limestone by a network of levels extending from three

1. The Old Gang output for 1826 was treble that for 1825 and 1827. This was presumably due to the discovery of a rich, but not particularly extensive, deposit.

points. Hard Level had been driven through dead ground to the eastern section of the Old Rake, Bunting Level had been driven into both Old Rake and Friarfold from the West, and the Brandy Bottle Inclined Plane had been sunk directly on to the Friarfold Vein, about a mile and a half east-north-east of Bunting Level mouth.

During the next thirty years these workings were extended for the whole length of the two major veins, and into many branches, cross veins, and minor veins and strings, in the ground between and near to them. First, in 1828, Bunting and Hard Levels were joined in Old Rake Vein by a sump four fathoms deep from the former¹. Subsequently the Hard Level workings were continued to the east in Lucky String, which branches to the north-east from Old Rake, Reformer Vein, apparently an eastward extension of the latter, and Providence Vein. The last-named was working in the eighteen-fifties.²

From Brandy Bottle, two main levels were driven east and west in the Friarfold Vein, Low Level, which worked the underset beds on the south side of Friarfold Vein³, and Middle Level,

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1. Sir G. Denys to O. Robinson, 8 Sept 1828, and Memorandum on lease of Old Gang Mine, 1828. D.H. MSS., A2 and A5.
 2. Agent's diary, Old Gang, 1853-54; Old Gang Dead Work Book, 1854-5; 1855 and 1887 Plans. D.H. MSS. E3, S.C.6, P/OG1 & 9.
 3. Friarfold Vein has an average throw of 28 fathoms, north side up.

which worked the main limestone. To the east the Low Level had reached Old Forefield Shaft by 1832, but how much further it was driven is not known¹. The 1839 lease stipulated that the westward extension of this level must be carried forward to connect with Bunting Level, and this had been done by 1855². From the eastward extension of Middle Level, Alderson's Cross-cut was driven south-eastward to Forefield Old Sun Vein and Forefield New Sun Vein, branches of the Friarfold Vein which divides near the Surrender boundary. It was continued as Forefield Top Level to the boundary, and before 1855 had been connected with the Surrender workings³.

At Brandy Bottle, the inclined plane was not worked in the way that Frederick Hall had planned, and there is no evidence that a steam engine was even installed⁴. In 1824 the plane was used only as a travelling way for the horses which hauled in Low and Middle Levels, and the work from the latter was drawn up two whim shafts sunk by the Aldersons⁵. Later in the century, a whim was installed at the mouth of the plane, and the shafts seem to have gone out of use⁶.

Hard Level was also continued to the north from North Rake Vein, which it had reached before 1811, as Pedley's Cross-cut to Forefield Sun Vein, cutting the latter at a lower horizon

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1. Agent's Survey Book, Old Gang and Lownathwaite, 1824-32., D.H. MSS., S.C.7.
 2. D.H. MSS., L.C.5 and P/OG1.
 3. Old Gang Plans 1855 and 1887.
 4. See above, p.107 for IV.
 5. Willan's Shaft and Bell's Shaft respectively, Agent's Survey Book, 1824-32.
 6. Traces of the Whim-round can be seen on the ground.

than had the Middle Level from Brandy Bottle. In 1875 an inclined plane was put up from this cross-cut into Forefield Top Level, which completed the horse-level connection between Hard Level and the Surrender Mine¹.

These developments made possible the systematic and economical exploitation of a larger part of the Old Gang ground. As a result the output of this mine rose to the highest level ever recorded in the years 1839-1843. Later, when the richest deposits in this ground had been worked out, production fell off sharply. From 1835 to 1844 it was never less than 1200 tons a year, but for the next twelve years it never reached that figure. A secondary cause of the particularly low output of 1846-1848 may have been a slackening of effort by the lessees until their lease, due to expire in 1849, was renewed. There is, however, no positive evidence about this.

The company now turned its attention to the ground which lay to the south of the Old Rake Vein, and which had not been heavily worked except near Gunnerside Gill. A horse level driven from the south cut Kinning Vein in or about the year 1855². The level was continued in the vein to the south-east and to the north-west, and the latter branch connected with

1. A.D.Co. Report, Sept 1875. D.H. MSS., R.A.10.

2. Agent's Diary, 1853-54; Dead Work book 1854-55; 1855 & 1887 Plans.

Barbara Level, an old level re-opened about 1857¹. For three years the produce of Kinning sent the Old Gang output up to an average of 2000 tons. The output of ore from the various levels of the mine for the period March-December 1857 was:

<u>Hard Level.</u>	<u>Forefield.</u>	<u>Bunting.</u>	<u>Kinning.</u>	<u>Others.</u>	<u>Total.</u>
Bings. Cwts.					
1478 - 7	294 - 1	633 - 7	2915-6	36-6	5439 - 3 ²

When the Kinning Vein was worked out, the Old Gang mine entered upon another lean period. Meanwhile, before 1850 a long cross-cut had been started from Bunting Level at a point where the latter was below the underset limestone, to explore the principal beds of the Watersykes Vein, about 350 fathoms to the south³. The vein was cut in the early eighteen-sixties, and the level continued in the vein to the south east through a considerable stretch of barren ground until in 1866 good ore was finally reached⁴. A year or two later the same deposits were cut at the opposite end by Victoria Level, started from Ashpot Gill in 1859⁵. This stretch of the Watersykes Vein was very productive in all the limestone and chert beds from the Black Beds to the underset limestone⁶. Within a short

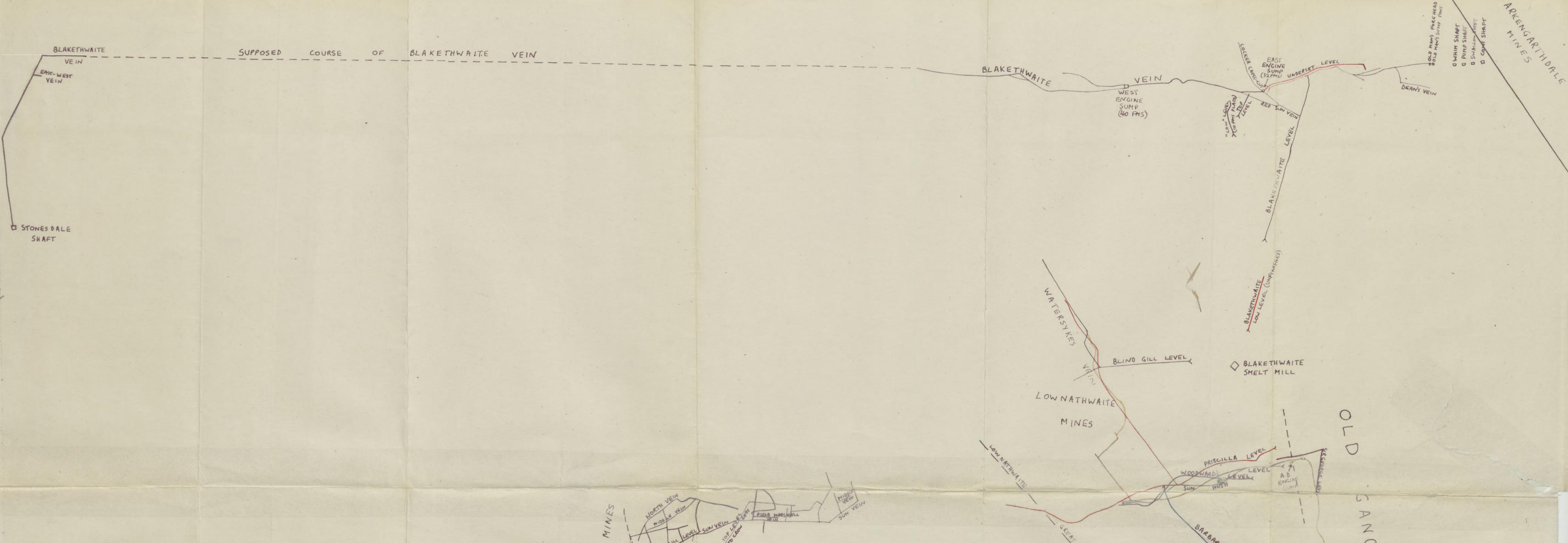
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1. Old Gang Ore book and labourage account, 1857-8. D.H.MSS. E.4.
 2. Agent's Ore-book, Old Gang, 1857-58. D.H.MSS., E.4.
 3. Dead Work book, 1854-55.
 4. Agent's rough dead work book, 1865-73. D.H. MSS., E.6.
 5. 1887 Plan.
 6. R.Place to Sir F.Shuckburgh, Lessor's agent's six-weekly reports, 1867-72. D.H. MSS., SD5/R.

time, Marr's Cross-cut to the south-west cut a rich parallel vein, which was named Watersykes Sun Vein. The output of these two veins gave the Old Gang mine its last wave of prosperity, which lasted from 1867 to 1874. The dependence of the mine on these two veins is shown by the following figures of ore yields, (in bings and cwts).¹

	Hard Level	Fore-field	Bunting	Ashpot & Victoria	Kinning	Sir George	Others	Total
June 66	182-1	440-6	3744-5	-	36-3	-	9-7	4413-6
-Feb 67								
Aug 69	80-2	116-0	3280-3	625-0	-	202-6	-	4304-3
-Mar 70								
Mar 71	70-4	47-4	884-6	1420-7	9-3	112-7	-	2545-7
-July 71								

Sir George Level had apparently been started shortly after Jaques and company had leased the mine in 1828, and later suspended.² It was re-opened and driven further in the early eighteen-sixties. It was driven in the "27 fathoms grit and plate"³ from a point in Gunnerside Gill near to the mouth of Bunting Level, but about 20 fathoms deeper, northwards for 112 fathoms to the Friarfold Vein, here united with Old Rake.⁴ In the combined vein the grit below the third limestone was on the north side of the level, the grit below the underset limestone on the south side. The level was driven in the vein to the west as far as the boundary of the Blakethwaite mines, and to the east for 260 fathoms in the combined vein

1. Agents' ore-books, Old Gang, D.H.MSS D7, D2, E5.
2. James Backhouse, in his MS notes on mining in Swaledale, quotes the diary (1828-34) of an Old Gang miner as saying that the level was given up on 21 June 1833.
3. S.Cherry, Report on levels at Old Gang, 10 Dec 1887. D.H. MSS P3.
4. T.Raw, Report on Old Gang mine, 1863. D.H.MSS P2.



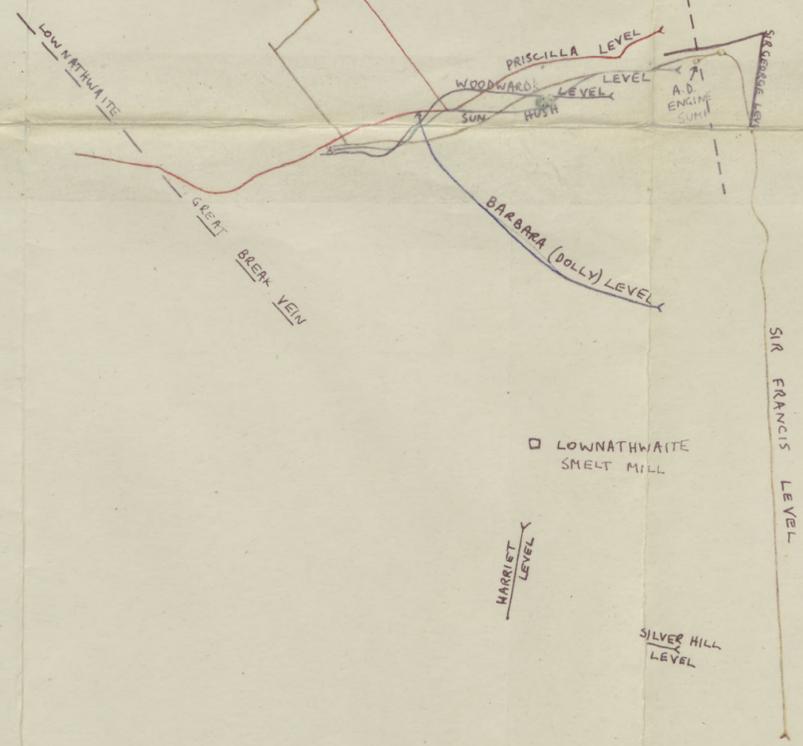
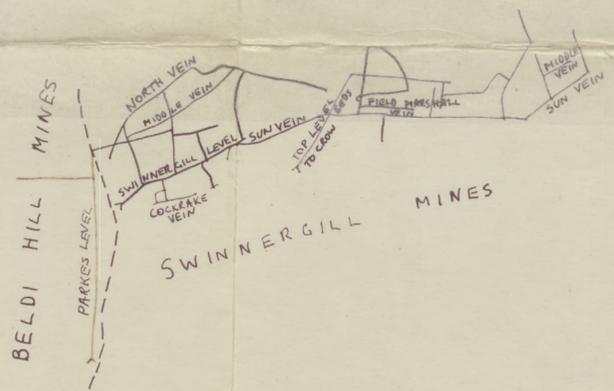
PLAN OF
LOWNATHWAITE, SWINNERGILL
BLAKETHWAITE AND STONSDALE
MINES

APPROXIMATE SCALE: 120 FATHOMS TO 1 INCH

COLOURS

BARBARA (DOLLY) LEVEL	BLUE
SUN HUSH LEVEL	GREEN
PRISCILLA LEVEL	} RED
BLAKETHWAITE LEVEL IN UNDERSSETS	
BLAKETHWAITE UNFINISHED LOW LEVEL	
PARKES LEVEL	} YELLOW
SIR FRANCIS LEVEL	
OTHER WORKINGS	BLACK

(THE COURSES OF BARBARA AND SUN HUSH LEVELS ARE NOT KNOWN WEST OF XX. BARBARA LEVEL IS DRIVEN BEYOND THE GREAT BREAK, SUN HUSH LEVEL ALMOST TO IT)



OLD GANG MINES

ARKENGARTHDALE MINES

and then in the Old Rake, with a cross-cut from the latter to the Friarfold vein¹. Sir George Level raised some ore in the 3rd limestone and in the grits², but its principal function was to drain the soles of Bunting Level, which had been allowed to rise too high to work the undersets of the Old Rake Vein³.

Blakethwaite Mine.

This mine offers a good illustration of the problems caused by a dip, or series of down-throws⁴, in the strata. Its principal workings were in the Blakethwaite Vein, which runs from east to west across the head-waters of Gunnerside Gill. The systematic exploitation of this mine began early in the nineteenth century with the driving of Blakethwaite Level, which was started in the grit under the main limestone from a point on the east side of Gunnerside Beck, about 400 fathoms south of the vein⁵. As a foretaste of the physical difficulties that were to be met later, the level cut the main vein near the top of the main limestone instead of just below it, apparently because the beds dipped unexpectedly to the north⁶.

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1. S.Cherry, *loc.cit.*, and 1887 Plan.
 2. T.Raw, *loc.cit.*
 3. R.Place to Sir F.Shuckburgh, 4 Feb 1868: Lessors' agent's six-weekly reports 1867-81. D.H. MSS., SD5/R.
 4. Agents' reports and plans do not usually distinguish between the two.
 5. It was begun in 1812 or 1813. Blakethwaite Mine Leases 1812 & 1814. D.H. MSS., LB3.
 6. Blakethwaite Plan 1823. D.H. MSS., P/B2. T.J.Bewick: Report on Blakethwaite and other mines, 1873. DH.MSS., SG4/31.

The level was continued in the vein in both directions, and for about eight years the mine produced well. Then the company found itself overwhelmed by difficulties. The level to the east reached¹ the stretch of vein already worked out through the shafts sunk in the eighteenth century and earlier². The trials of the underset beds proved unprofitable. The company had originally planned to work these beds from a level started about 200 fathoms further down Gunnerside Gill than the main level³. After being driven a short distance, this level was abandoned⁴ in favour of a sump sunk from the main level in the vein to a depth of 32 fathoms, with a waterwheel to work pumps and winding gear⁵. Only a small quantity of ore was raised, however, and these trials showed that nearly all of the wealth of the Blakethwaite Vein was concentrated in the main limestone⁶.

This wealth was very elusive. The dip of the beds along the line of the vein to the west soon put the main limestone, and the ore in it, well below the level, so that it was

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1. At a point 143 fathoms short of the Arkengarthdale boundary. 1862 Plan D.H. MSS. P/L6.
 2. See above, p.103.
 3. 1814 lease.
 4. Addendum to lease 14 March 1818. D.H.MSS., LB3.
 5. 1836 Plan and Valuation of Blakethwaite Plant 1861. D.H.MSS, P/B3 & RA11.
 6. Sir G. Denys: Rough Mining Notebook. D.H. MSS., W3.

necessary to sink a series of sumps of increasing depth, and increasing cost in sinking, haulage and drainage. In these circumstances the company could not survive the depression of the eighteen-thirties, and abandoned the mine in 1834¹.

A new company was formed in 1836 to take over the combined Blakethwaite and Lownathwaite ground². In Blakethwaite west end its miners sank a sump 40 fathoms deep from the level, which at that point was standing in the plate above the Red Beds, down into the underset chert and therefore well below the base of the main limestone. An hydraulic engine was installed at the head of the sump for pumping and haulage³. From the bottom of the sump the level was driven to the west for nearly 500 fathoms. The output from this stretch of vein gave the company seven prosperous years, from 1840 to 1846. In 1844 production rose to the record figure of 1060 tons, which included a small output from the old Lownathwaite ground.

The beds continued to dip to the west, however, and eventually the ore in the main limestone was too far below the level for economic working. In 1850 the company stopped driving the level, and decided to try the vein from West Stonesdale, about two and a half miles further west⁴.

Because of the topography of West Stonesdale, a level deep enough to work the vein would have to be excessively long,

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1. Lead Weighing Book. D.H. MSS., ADM2.
 2. Correspondence about new lease, 1835-36. D.H. MSS., A.7.
 3. Vertical section of strata and relative position of levels at A.D. Mines 1875; 1861 Valuation; and T.J.Bewick: Report on Blakethwaite and other mines 1873. DH.MSS. P/AD2, RA.11 and SG4/31.
 4. There may also have been a ventilation problem. T.J.Bewick, loc.cit; Plan of Blakethwaite & Stonesdale Mines 1882., DH. MSS., SG4/69.

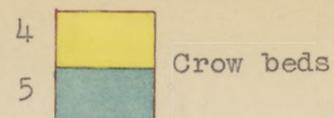
VERTICAL SECTION OF STRATA
and
RELATIVE POSITION OF LEVELS
at A.D. Mines
1875

(D.H. MSS/P/AD2)

Vertical Scale 60' : 1 inch

(The figures by the levels
relate to the number of the
beds in the section)

EAST GILL



SECTION - EAST END A.D. MINES

Vertical
distance
between
levels

Fms ft ins

Line of Blakethwaite Level

	Fms	ft	ins
4 Crow beds	2	3	0
5	2	3	0

Grit	8	2	2
Red beds	2	1	6
Black beds	2	1	6
Lime		4	0
Plate	3	0	0
Grit	1	0	0
plate chert	4	0	0
Main chert	4	2	0
Main lime	8	0	0
Grit	14	0	0
Plate	1	0	0
Underset chert	4	0	0

Horizontal scale
broken west of
here

15 WEST ARNGILL	16' 5"
10 SWINNERGILL	
15 EAST ARNGILL HIGH	
17 PARKES	
21 EAST ARNGILL LOW	
15 EWE SCAR	29'

Line of Blakethwaite Engine Sump Foot

Line of Sir Francis Level

BLAKETHWAITE ENGINE SUMP 40 fathoms

BLAKETHWAITE	15
BLIND GILL	17
DOLLY	17
SUN HUSH	20
PRISCILLA	21
SIR GEORGE	21
SIR FRANCIS	26

1 Millstone grit	8	0	0
2 Plate	10	0	0
3 Flint		2	0
4 Crow chert	2	3	0
5 Crow lime	2	3	0
6 Grit	10	0	0
7 Plate	10	0	0
8 Red beds	3	0	0
9 Plate	1	3	0
10 Black beds	4	0	0
11 Plate			9
12 Lime		4	0
13 Plate		2	0
14 Main chert	4	3	0
15 Main lime	12	0	0
16 Grit	4	3	0
17 Plate	4	3	0
18 Underset chert	3	3	0
19 Underset lime	4	0	0
20 Marl		4	0
21 Grit and plate	27	0	0
22 Snake chert		2	0
23 3rd lime	2	3	0
24 Grit	10	0	0
25 4th lime	2	3	0
26 Grit & white jammies	12	0	0
27 Cockleshell lime	4	0	0

The thickness of bed 26 was
later found to be 27 fathoms.

and a shaft on the line of the vein would be excessively deep. The ground falls away steeply to the south from the line of the vein, however, and at a distance of 375 fathoms it was possible to get into the underset chert with a shaft 48 fathoms deep¹. The bottom of Startingill Shaft was 45 fathoms below the bottom of the Blakethwaite west sump. A water wheel provided the power for pumping and haulage and also for the crushing-mill on the adjacent dressing floor².

The course of the operations from West Stonesdale shows how important in lead mining was the element of luck, both good and bad. From the shaft a cross-cut was driven northwards towards the Blakethwaite Vein. After it had gone 217 fathoms, it cut a vein bearing N 69° E. The level was continued in this vein for 233 fathoms to the Blakethwaite Vein, which not only reduced the cost of driving but also produced an unexpected windfall in the form of a rich ore-shoot, principally in the main chert, in 36 fathoms of this cross vein³. In 1856 and 1857 over 650 tons of lead were produced from this source. The Blakethwaite Vein, however, was found to be almost completely unproductive, and was followed to the east for 100 fathoms without any change in its appearance⁴.

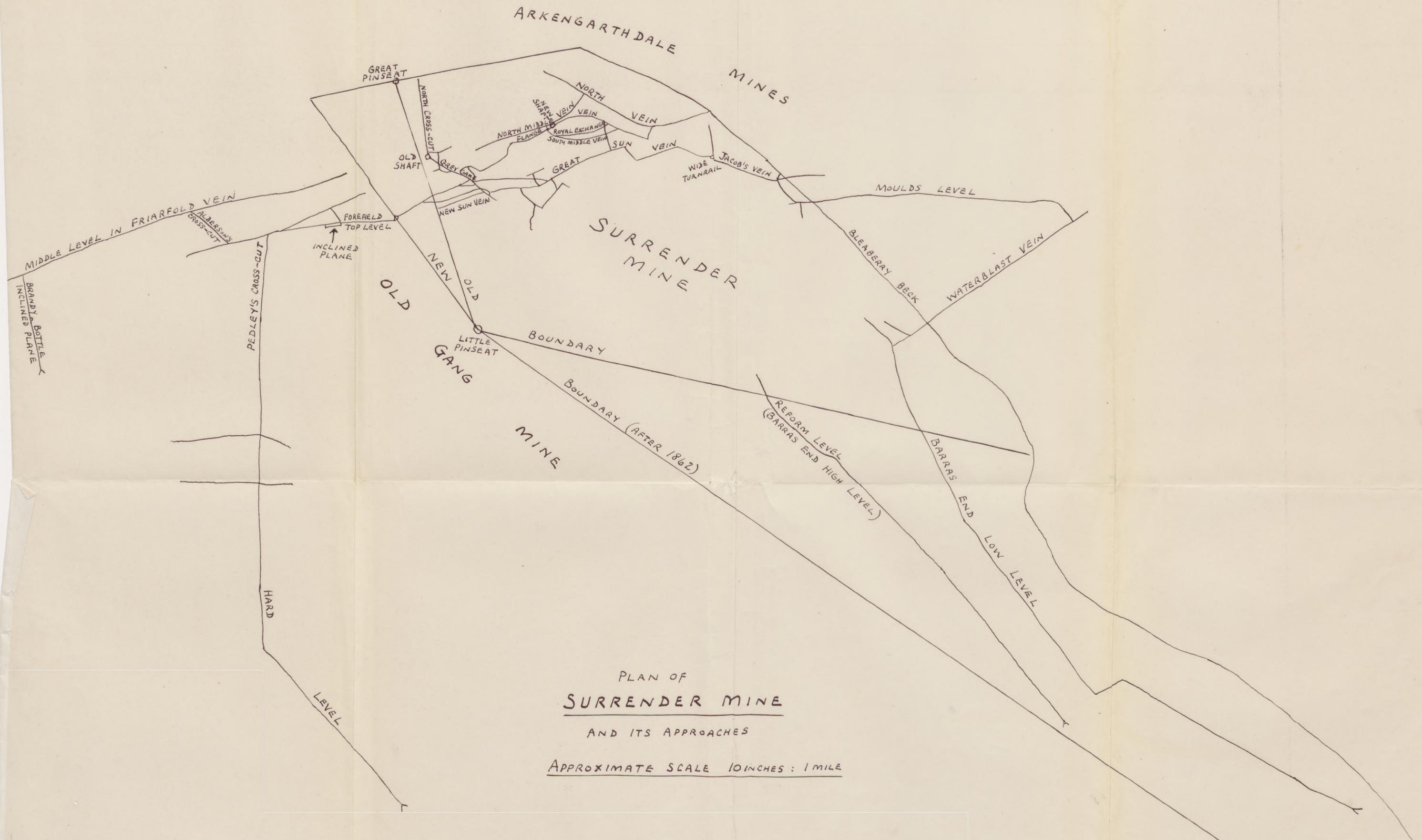
One hundred fathoms was not a long distance to try when so

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1. Vertical section etc., and T.J. Bewick, loc.cit.
 2. Sir G. Denys: "In re Stonesdale Mine" D.H. MSS., SG4/25.
 3. Bewick, loc.cit., and S. Cherry, Notes on Stonesdale Moor Mine, in Agent's Rough Notebook, 1888. D.H. MSS., D8.
 4. Bewick, loc.cit., and Cherry, loc.cit.

rich a prize was at stake. Technical difficulties contributed to the decision to suspend operations in 1861. It was doubtful if the water wheel, which already had 540 fathoms of main level to drain, could keep the mine dry if the level were extended much further. There was also a ventilation problem. A series of air-shafts along the Blakethwaite Vein would have been very expensive because of their depth. A waterblast or similar device could not be used because there was no free outlet for the water, and the scope of the "windy king" was limited.¹

The Blakethwaite Company terminated its lease in December 1866 and the mine was left on the hands of Sir George Denys². Several years later, when he was in the process of forming a company to work the ground west of Gunnerside Gill, Sir George called in a mining engineer, Thomas Bewick, to examine, among other things, the problem of the Blakethwaite Vein. Bewick reported that there were three possible ways of working this vein, by reopening Startingill Shaft and putting in a steam or hydraulic engine and an air compressor, by sinking a shaft directly from the surface which would, because of its depth, need a very powerful engine, or by bringing up a level low enough to drain and work the mine. Both Bewick and Sir George favoured the last approach, primarily because of the high running costs of the other two.³

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1. Bewick, loc.cit., and Sir G.Denys, loc.cit.
 2. R.Place to Sir F.Shuckburgh, Lessors' Agent's Six-weekly Reports, D.H. MSS., SD5.
 3. Bewick, loc.cit., and Sir G.Denys, loc.cit.



PLAN OF
SURRENDER MINE

AND ITS APPROACHES

APPROXIMATE SCALE 10 INCHES : 1 MILE

There were two levels deep enough for the purpose, Parkes Level, in the Beldi Hill mine on the west side of Swinnergill, and Sir Francis Level, in Gunnerside Gill, started in 1864, but each would have to be driven more than two miles to reach the Blakethwaite Vein.

The fundamental difficulty was that the vein might be rich almost to the forehead of the level from Startingill Shaft, or barren almost to the drowned forehead of Blakethwaite Level, over two miles to the east, and there was no inexpensive way of finding out. It was finally decided to wait until a level could be extended gradually to this vein by working productive veins in the intervening ground. To this end, Parkes Level was leased and re-opened in 1873. It was extended for a short distance to the north but very little ore was found and the operations were soon suspended.¹ From this point the prospects of the Blakethwaite Vein, as of several other mines, were bound up with the progress of Sir Francis Level.

Surrender Mine.

The Surrender Mine stood on Reeth High Moor, between the Old Gang and Arkengarthdale fields, and in the heart of the richest ore-bearing ground in Swaledale. It was not, however, easy to exploit. The main bearing beds were on the whole well below the surface, and the evidence of old shafts and waste heaps on the ground suggests that the mine had been little worked before the two whim shafts were sunk in the eighteenth century.

1. Sir G. Denys: Mining Notebook; Sir G. Denys to J. R. Tomlin, 13 May 1874. DH. MSS., N5; A. D. Co. Reports and Accounts, 1873-1883. D. H. MSS., B1.

The strata into which the latter were sunk is heavily faulted, with a considerable "dip" towards the south and east, which limited the area that could be worked economically from the shafts¹. Even when the mine was yielding well the costs of production were high because of the distance that the ore had to be hauled and lifted underground², and as the more accessible ore was exhausted output fell off sharply after 1827.

The obvious need was for a horse level to open up the hitherto inaccessible parts of the mine, and reduce the operating costs of the whole. As the mine stood high on the moor, however, a level low enough for the purpose, and driven entirely within the A.D. royalty, would have to be of considerable length. The first approach to be tried was the Barras End Level³, planned by Peter Denys to work the eastern part of the Old Gang ground, and extend to the Surrender Great Sun Vein, a total distance of about 1250 fathoms. It was started about 1790, from the side of Bleaberry Beck, which formed the boundary with the Arkengarthdale field, and about 740 fathoms south-south-east of the Surrender boundary. By 1811 516 fathoms had been driven, Thereafter it progressed slowly, partly because the veins cut in the driving were generally unproductive, which discouraged the unfortunate Aldersons⁴. Furthermore, the Surrender lessees

1. Surrender Mine Notes and Bargains 1818-28. D.H. MSS., E2.

2. Some ore had to be raised a total of 220 fathoms according to one of the lessees. F.Morley to J.Davies, 11 Nov 1816. D.H.MSS RD13.

3. Later called Barras End Low Level, to distinguish it from Barras End High, or Reform, Level.

4. W.Richards, Memorandum on dispute with Aldersons. DH.MSS., A1.

had little faith in its value, as according to their agents it would be too high to drain and work the main bearing beds of the Sun Vein¹.

The level reached the Surrender boundary in 1827 or 1828², and was driven for some distance beyond by the Surrender Company, but meanwhile attention had been turned to another, and much more effective, method of working the mine, by an extension of the Moulds Level network from Arkengarthdale³. This Approach had a twofold technical advantage. The level was already near the Surrender-Arkengarthdale boundary, and when extended across the latter would be in ore-bearing ground immediately; and it entered the mine at the point where the beds were at their lowest horizon. At the boundary it had the "27 fathoms grit and plate" below the underset limestone on the north, or downthrow side, and the middle of the main limestone on the south side, and the beds rose all the way to the western end of the Surrender ground which meant that most of the ore-bodies could be worked from below⁴.

The use of the Moulds Level depended, however, on a satisfactory wayleave agreement. In 1820 and 1821 the Surrender Company considered the possibility of leasing the whole Arken-garthdale field when the lease of Easterby, Hall and company

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1. Report by James Spensley and Robert Rutter, 11 Mar 1815. D.H. MSS., RD13.
 2. Award of arbitrator in lawsuit Pomfret & Denys v. Aldersons, 27 March 1828. D.H. MSS., L.A.3.
 3. W.Richards to J.Davies, 17 Aug 1820. D.H. MSS., RD.13.
 4. 1852 Surrender Plan, D.H. MSS., P/Sl.

expired in the latter year. Terms were discussed with the Arkengarthdale lessors but without result¹. The lease of Arkengarthdale in 1828 reserved to the lessors the right to grant a wayleave through Moulds Level to the Surrender Company, but no action was taken for some years². In 1839 a new lease of the Surrender ground laid down the necessary conditions for working the mine through the neighbouring royalty³, and the wayleave agreement was finally signed in April 1841. The arrangement was facilitated by the fact that two of the principal Surrender lessees, Robert Jaques and Dr. George Robinson, were also partners in the Arkengarthdale Company. For the use of the level and the right to build a dressing floor of their own near its mouth, with a supply of water from Foregill Beck, the Surrender lessees paid £2100 for a period of twenty-one years⁴.

During the next ten or twelve years the level, which is known in the Surrender ground as Surrender Level, was driven forward in Jacob North and Sun Veins to Wide Turnrail, and then for the whole length of the Great Sun Vein to the Old Gang boundary. Cross-cuts from the level worked a large number of veins and strings between the Great Sun Vein and the Old and New Shafts⁵.

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1. J. Davies to Lady C. Denys, 30 Sept 1821. D.H. MSS., RD13.
 2. Arkengarthdale MSS.9.
 3. D.H. MSS., LC 5.13.
 4. Arkengarthdale MSS.13.
 5. 1852 Plan.

The output, which had fallen to a very low level in 1839-41, rose and remained remarkably steady from 1843 to 1859, with a consistently high output between 1852 and 1858. The Great Sun Vein was systematically cleaned out in all the main bearing beds for the whole of its length and, to quote from an agent's report, "produced immense quantities of ore of the highest percentage"¹. When the deposits in this vein and in the lesser veins and strings had been worked out there was little virgin ground left to exploit, and production inevitably declined. Sir George Denys wrote in 1863, "The old Surrender ground has been very much exhausted; if the trials at present going on do not succeed, it must shut up very soon"². In 1867 the output was only 44 tons of lead, won at a high cost, and in the following year the Surrender Company gave up its lease³.

The Surrender Level still had a potential value as a means of working the adjacent parts of the Arkengarthdale ground to the north and the Old Gang to the west, as it was lower than any level in those areas. A branch of it had already been used to work several veins just north of the Arkengarthdale

1. T.Raw: Report on Surrender Mine, 17 Jan 1873; A.D. Co.Reports, and Accounts 1873-83. D.H. MSS. RB8 and B1.

2. Sir G.Denys to C & H.Bartley, 14 April 1863. D.H. MSS., M1.

3. R.Place: loc.cit.

boundary¹, and Dr. Robinson had proposed a more ambitious plan, the extension of the level in Grey Game Vein, from its junction with the Great Sun Vein, to the north-west boundary of Surrender, through the north-east corner of the Old Gang ground, and into Punchard Gill in Arkengarthdale. Each company was to pay the cost of driving through its own ground, and the right of way was to be common to all². In 1868 the Old Gang Company proposed that it should carry out its share of this project, but the Arkengarthdale lessors refused to grant the necessary wayleave through Moulds Level³.

In 1870 Sir George Denys offered the Surrender ground to the new Arkengarthdale lessees to be used as an approach to the adjacent part of their field. The offer was declined, and three years later the Arkengarthdale lessor, Mr. G. Gilpin Brown, was persuaded by his own agent and by the lessees to withdraw the wayleave, which had been renewed annually since 1862, from Surrender⁴. His stated reason for doing so was that too much water was coming out of Moulds Level in wet weather, but there seems to have been some personal animosity involved as well⁵.

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1. T. Raw to Sir G. Denys, 22 Sept 1868. D.H. MSS., SG4/18.
 2. Sir G. Denys: A Chapter on Mining (undated), p.7.
 3. Newby and Co., lessors' solicitors, to Sir G. Denys, 23 Sept 1868. D.H. MSS., M1.
 4. Sir G. Denys, op.cit., pp.1, 4-5; T. Raw to Sir G. Denys 23 May, 1871 and W. Whitwell to Newby & Co. 22 Feb 1873. D.H. MSS., M1.
 5. Sir G. Denys, op.cit., pp.4-5; and James Blenkiron to Mr. G. Gilpin Brown, 14 Jan 1871. D.H. MSS., M1.

Sir George Denys brought out a pamphlet about the affair, in which he wrote, "It is proposed in this paper to exemplify how a prosperous mine may be stopped in its tracks by the ignorance of agents on the one hand and the credulity of their employers on the other".¹ It was, of course, nonsense to describe the Surrender Mine in 1873 as "a prosperous mine", but the episode illustrates the difficulty of negotiating satisfactory long-term wayleave agreements.

The Surrender Mine was not abandoned immediately. It was included in the ground leased to the A.D. Lead Mining Company in 1873. Two years later the horse level connection from Hard Level was completed by the driving of an incline from Pedley's Cross-cut up into Forefield Top Level.² The top-set beds in Grey Game Vein were worked from the latter, with a little success³. Meanwhile Barras End Level had been resumed. According to the 1839 lease, this level was to be driven forward to meet the extension of Moulds Level in Waterblast Vein, but in 1873 it was still 330 fathoms short of this objective. As Barras End Level was some 15 fathoms higher than Surrender Level an incline was commenced which would work Waterblast North Vein and later go forward to the main Surrender workings⁴. As the

1. Sir G. Denys, op. cit., p. 1.

2. A.D. Co. Report, Sept 1875. D.H. MSS., RA10.

3. T. Raw to Sir G. Denys 9 Dec 1876. D.H. MSS., SG4/36.

4. Sir G. Denys: Plan for working Surrender Mine, undated, D.H. MSS., SG4/42.

latter were already cleaned out, there was little point to the enterprise, and it was carried on half-heartedly. The incline was never finished. The two men working in it had to start a rise to the surface for ventilation, and before this was completed the A.D. Company abandoned the mine¹. For a few more years the lessors kept a small number of men picking over the old workings and re-dressing the waste heaps to extract ore which might have been left by older and less efficient techniques².

The last episode in the story of this mine is instructive. In 1884 the Arkengarthdale Company drove Danby Level in a rich vein up to the Surrender boundary. Sir Francis Denys's agent³ reported that it would be impracticable to try to work the vein from the Surrender side and suggested that this part of the mine should be let to the Arkengarthdale Company⁴. In December 1884, pending the signature of a Take Note, the Arkengarthdale miners drove over the boundary⁵, but, as the managing partner of the Arkengarthdale Company wrote a few months later, "After going a little way... we find that the ground which is represented on the plan as virgin or unworked ground has already been worked to a considerable extent and a level driven to the boundary"⁶. There had been no trickery on

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1. A.D.Co.Report, 22 March 1875. D.H. MSS., RA10; Sir G. Denys to Messrs. Currie, Williams & Williams, 18 July 1879. D.H. MSS.
 2. Sir G. Denys, Mining Notebook.
 3. Sir George had died in 1881.
 4. S. Cherry to Sir F. Denys, November 1884. D.H. MSS. SG4/72-74.
 5. Sir F. Denys to W. Whitwell, 15 Dec 1884. D.H. MSS., T2.
 6. W. Whitwell to Sir F. Denys, 23 Apr 1885. D.H. MSS., T2.

the part of Sir Francis and his agent. Their plans were inaccurate because of the failure of some of their predecessors to keep accurate records of abandoned workings.

West Swaledale Mines.

Three small mines at the western end of Swaledale, Keldside, Littlemoor Foot¹ and Lane End, worked the same complex of east-west veins (here known as the North, Middle and Sun Veins) as at the Old Gang, but in much less favourable physical conditions. Whereas at the latter the drainage has cut through or into the mineralized zone across the line of the principal veins, in West Swaledale the river flows along or parallel to the line of the latter, with the valley floor above the most productive beds. The main limestone is just under the bed of the river at Keldside, and 40 fathoms below at Lane End, because of the cumulative effect of the throws of a series of cross-veins².

In such conditions horse levels were of little or no value, although two were planned and partly driven. To work the base of the main limestone at Keldside, which could be reached directly from the surface by a shaft less than 24 fathoms deep, a level would have to be started more than a mile to the east, and if the same level were continued to Lane End, it would be much too high to work the main bearing beds there. Furthermore the cross veins in this mile of ground shift the main veins laterally³, and the course of the latter

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1. In the ground enclosed in 1738 and therefore the property of the lord of the manor.
 2. Plan of West Swaledale Mines, circa 1860; and Sir G. Denys to G. Clark, 5 Feb. 1865. D.H. MSS., P/K1 and T5.
 3. 1860 Plan.

was imperfectly known even when these mines were finally abandoned. If a long level were to be driven in one of the east-west veins, which would normally be cheaper than cutting through dead rock and offered the prospect of finding some ore, its course might turn out to be very erratic¹.

The mines were therefore worked primarily by shafts and the main technical problem was the provision of enough power for deep working. In 1801 the Lane End Mine was leased by Thomas Butson², who sank Lane End New Engine Shaft, also known as Butson's Shaft, on the north branch of North Vein³. It was between 45 and 50 fathoms deep⁴, and ended at the top of the main chert⁵. A water wheel provided the power for hauling and pumping⁶. Butson and Company were still working Lane End in 1814⁷, but abandoned their shaft shortly afterwards, apparently because the pumps could not keep the mine dry⁸. The older "engine shaft" at Lane End was sunk to a depth of 18 fathoms on the south branch of the North Vein⁹.

At Keldside there were two shafts on the north side of the river, one eighteen fathoms deep, ending in the middle of the main limestone and the other twelve fathoms deep, sunk to the top of the same bed¹⁰. The deeper Keldside shaft was

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1. See below, p.142.
 2. Lease dated 1 October 1801, in the writer's possession.
 3. R.Place: Report on the Lane End and Keldside Mines (no date). D.H. MSS., T4.
 4. 45, 47 & 50 fathoms are the figures given in different reports.
 5. Presumably the main limestone was tried from there by a series of drifts & sumps.
 6. R.Place: Report on the Lane End & Keldside Mines, 1865. D.H. MSS., S.G.4/8.
 7. Lead Weighing Book, D.H. MSS., R.C.5.
 8. Report on Keldside and Lane End Mines, 12-28 Oct 1830, by James Spensley and others. D.H. MSS., S.G.4/4.
 9. Ibid.
 10. R.Place, loc.cit.

working in the eighteen-twenties, when it was used by Hopper and Company to mine some ore under the bed of the river¹. In 1830, all four shafts were idle and flooded².

In 1829 the Lane End and Keldside mines were leased by Jackson and Company, who undertook to install within eighteen months a steam engine "of sufficient power" to drain Lane End, and a second steam engine of not less than thirty horse power at Keldside within three years³. It is doubtful if the latter was ever installed, but a second-hand engine of eighty horse-power was bought for use at Lane End⁴. The remoteness of Lane End was a disadvantage, even though coal was available five or six miles away at Tan Hill⁵. Jackson wrote in May 1829, "Lane End is so difficult to get everything to that we find carriage a very heavy expense. The carriage of our engine and ()⁶ will amount to between two and three hundred pounds".⁷

The trials at Lane End were not very successful, as no lead was smelted until 1835, and the total produce for that year was only a little over twenty-four tons⁸. A few years later

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1. J.Davies to Lady C.Denys. 22 May 1822. D.H. MSS., R.D.13.
 2. Report of James Spensley and others.
 3. Lease of Lane End and Keldside, 1829. D.H. MSS., L.C.2.
 4. H.Jackson to O.Robinson, 31 Dec 1828. D.H. MSS., A.6.
 5. This coal had about two-thirds of the calorific value of ordinary bituminous coal.
 6. This word is doubtful. It may be "cost".
 7. H.Jackson to O.Robinson, 20 May 1829.
 8. Lessors' Account of Duty Lead, 1816-1848. D.H. MSS., S.G.2.

the lessees were apparently allowed to withdraw the steam engine, and as an alternative try Keldside by a long horse level¹. This was Scott's, or Low Level, which began in the "27 fathoms grit and plate" from the south side of the River Swale, about 200 yards above Catrake Force². It had been driven for some distance, and then abandoned, before 1830³, and it could not have been driven far by Jackson and Company as in 1865 it was thought to be about 200 fathoms long⁴. This level would have been a very expensive undertaking unless some good ore were cut in the driving, as it had to go fully one mile to Keldside, and would then be no deeper than the foot of the eighteen-fathoms shaft⁵. In 1825 Sir George Denys⁶ had proposed to Ottiwell Tomlin and his partners, who were considering a lease of these mines, that a level should be driven from below Catrake Force⁷, which would have gained seven or eight fathoms in depth below Scott's Level at the cost of starting about 100 fathoms further east⁸. The mouth of the level would, however, be in the old enclosures⁹, and when Thomas Smith, the lord of the manor, declined Sir George's request for a lease in perpetuity of that part of the level¹⁰, the idea was shelved.

1. Draft lease, 1837 or 1838. D.H.MSS., L.B.5.

2. R.Place, loc.cit. 3. Report of James Spensley and others.

4. R.Place, loc.cit. 5. Ibid.

6. The elder Sir George, who died in 1857.

7. Sir G.Denys to O.Robinson, 22 June 1825, D.H.MSS., A.4.

8. R.Place, loc.cit.

9. That is the land which had been enclosed in 1738 when the Manors of Healaugh & Muker were sold, and in which the minerals belonged to the lord of the manor.

10. T.Smith to Sir G.Denys, 27 Aug, 1825. D.H. MSS., A.4.

In any case Tomlin and his friends rejected the draft lease prepared by the lessors¹.

The output of these mines remained low, and in 1839 and 1840 no lead was smelted². In 1843 they were leased by Cookson and Company, Newcastle lead merchants, who worked them with little success until 1847³. In 1849 or 1850 Lane End and Keldside, together with Littlemoor Mine, were leased by Christopher Lonsdale Bradley, at that time the principal partner in the Blakethwaite Company⁴. At Littlemoor there was a shaft powered by an hydraulic engine for which water was piped from Birkdale Tarn, about half a mile to the north⁵. This shaft was sunk in the North Vein to a depth of 47 fathoms, ending at the top of the plate above the main chert⁶. Two levels, Low and Middle, were driven from the shaft both east and west in the vein to the boundary of the old enclosures⁷. This mine seems to have been the most systematically worked of all the West Swaledale mines, but it was idle in the early eighteen-sixties⁸.

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1. Draft lease; & O. Tomlin to O. Robinson. D.H.MSS., L5 and A4.
 2. Lessors' Account of Duty Lead, 1816-1848.
 3. Ibid., and Lead Weighing Book, D.H. MSS., ADM3.
 4. Draft lease 1849, D.H.MSS., LB5; and Lead Weighing Book, D.H. MSS., ADM3.
 5. 1860 Plan. D.H. MSS., P/K1. The date of the installation of this engine is not known, but the inventory of the Blakethwaite Mine plant in 1861 shows that it was not the same engine which Bradley used until 1850 in the Blakethwaite West Sump. Blakethwaite Inventory 1861. D.H.MSS., R.A.11.
 6. R. Place, loc.cit; and Prospectus of "Lane End, Keldside and Littlemoor Lead Mining Company Ltd.", 1865, D.H.MSS., T.4.
 7. 1860 Plan.
 8. Prospectus of Lane End, Keldside & Littlemoor Lead Mining Company Ltd.

The production figures of Lane End and Keldside show that Bradley was no more successful there than his predecessors¹. When he was asked in 1854 if he could supply coal from the Tan Hill pit for the smelting of ironstone to be mined near Keld, he added this postscript to his reply: "As you are in the way of forming a Company, can you connect the lead mining field I have with it, as I shall be glad to ~~treat~~ liberally so as to get rid of the anxiety and responsibility I have long had to endure²."

Bradley gave up the Lane End and Keldside mines in 1858³, and about five years later the latter was leased by Joseph Holdsworth of London who hoped to float a limited company to work it⁴. He had an eighteen-foot waterwheel, together with pumping and hauling machinery and a crushing mill, erected at Keldside⁵, but ran out of money before his flotation could be accomplished⁶.

In 1864 the Catrake Level was begun, as planned forty years earlier, either by Holdsworth or by Sir George Denys (the second)⁷. It was soon re-named the Sir George Level⁸, and was continued

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1. Lead Weighing Book, D.H. MSS., A.D.M 3.
 2. C.L. Bradley to Mr. Milner, 19 June 1854, D.H. MSS., M1.
 3. Lead Weighing Book ADM 3.
 4. J. Holdsworth to Sir G. Denys, 17 Jan 1865. D.H. MSS., T5.
 5. J.R. Tomlin to Sir G. Denys, 12 Jan 1865. D.H. MSS., T5. and Inventory of 10 Mar 1867 in Kisdon Co. Report, D.H. MSS. T.4.
 6. Sir G. Denys to J. Holdsworth 20 Jan 1865 D.H. MSS., T4; and see below, pp. 174-5VI,
 7. Sir G. Denys, Mining Notebook, D.H. MSS., W2.
 8. Ibid.

by the Kisdon Company, a limited company formed in 1866, with Sir George as managing director, to work the Keldside and Kisdon Mines¹. The level was being driven in what was thought to be Middle Vein, but after it had gone 115 fathoms the bearing of the vein was much more northerly than had been expected and its appearance unpromising. The level was suspended and was never subsequently worked².

The Company then re-opened Richardson's Level³, which was driven in the plate above the main chert southwards from the riverside about halfway between Keldside Smithy and the smelting mill. 76 fathoms were repaired, and rails put in, and a cross-cut was driven 12 fathoms further in search of the Sun Vein. At this point, with no sign of the vein, the level was abandoned in May 1868⁴.

This was the end of mining operations in the West Swaledale tract. The unfavourable topography had imposed a serious hardship on a succession of adventurers but the repeated failure of the enterprises shows that the veins in West Swaledale must have been a good deal poorer than in the mines between Beldi Hill and Hurst. The poverty of the veins (in this case not the main east-west veins) was certainly the cause of the failure of the Kisdon Company's other trials on Kisdon Hill itself. Six levels were driven, and a shaft sunk, principally to work the main limestone, which is here sixteen fathoms thick⁵.

1. Kisdon Company Reports, D.H. MSS., T4.

2. Ibid. 3. It is not known whether this was a horse level or a smaller drift.

4. Ibid.

5. The normal thickness of the main limestone is about 12 fathoms

These trials were carried on systematically and economically. In the words of Sir George Denys, "... nowhere has a greater amount of work been done for the same amount of money"¹. Myton Level was profitable for a time but eventually all the trials proved barren or cut old workings², and the Company suspended all work on 10 January 1870³. In his final report as managing director, Sir George wrote, "I regret extremely that our adventure has not been successful. The uniform barrenness of the veins cut and proved in a rich mineral district like this was and is a mystery of the most baffling kind"⁴.

-III-

The other mines may be described more briefly, either because a detailed analysis would add little to the picture already given, or because there are few surviving records. In the latter category are the Hurst mines, which worked the main east-west veins mainly through a series of shafts. At Hurst the veins traverse a gently sloping plateau at a distance of from one to two miles from the side of the main valley, at Fremington Edge, which belonged to a separate royalty, a double deterrent to the use of levels deep enough to work all the principal bearing beds. The main limestone is, however, near enough to the surface in places to be reached by relatively shallow levels, and two such levels, Queen's and Pries, were working in the nineteenth century⁵. One of the shafts was

1. Ibid.

2. In one of these, Morsgail Level, evidence of rock-burning was found. See above, p.48.

3. Ibid., and Sir G. Denys, Mining Notebook.

4. Kisdon Company Reports.

5. Kinnaird Commission, Minutes of Evidence, Nos. 17407, 17412-5, 17504. The date on the arch of Pries Level is 1859.

worked by a steam engine, and some of the others by water wheels.¹ According to Bewick, some of these workings were carried down into the limestone beds below the undersets², and this mine seems to have been worked successfully through shafts at appreciably greater depths than in the West Swaledale mines³.

Little is known of the development of the Arkengarthdale field during the first three-quarters of the nineteenth century. In particular there are no production figures from 1800 to 1868. From the time of Frederick Hall this field was worked principally by levels, for the use of which the topography is particularly favourable. The driving of the first horse levels has already been described⁴. The earliest, Moulds Level, became the major one of the field, with an extensive network of workings which was connected with Turfmoor and Foregill Levels to the south-west and Damrig and Danby Levels to the north-west⁵. Two branches, in Jacobs Vein and Waterblast Vein, were driven into the Surrender ground. Another important level was Danby, commenced sometime between 1828 and 1848⁶ with a network extending southwards towards the Surrender boundary. Further north was Little Punchard Gill Level, driven under the main limestone to work the ground to the east and north-east of the Blakethwaite Mine. It had reached Cocker Vein by 1828⁷ and was subsequently extended into the Bishops North, Bishops Sun, and Shakes Veins. Later

1. Evidence on the surface.
2. Bewick, loc.cit.
3. The production figures for Hurst from 1853 are given in AppxB.
4. See above, Chapter IV.
5. Report on Arkengarthdale Mines, 1870, Arkengarthdale MSS.14.
6. 1828 lease and 1848 draft lease. Arkengarthdale MSS. 9 and 11.
7. 1828 lease.

in the century its mouth was partially walled up and it was converted into a boat level, the only one in the area.¹

On the north-east side of Arkle Beck were several levels, of which the most important were the Tanner-rake Levels, driven under the hush of the same name,² and Stang and Fagnergill Levels, near the northern boundary of the royalty. The latter mines were developed later than those further south. They were not worked during the last two decades of the eighteenth century,³ although they may, of course, have been worked at an earlier date. The first mention of this part of the field is found in the lease of 1828, which stipulated that a dam was to be made on Stang Side to try Fagnergill Vein with a hush. Stang and Fagnergill Levels were started in 1839 and 1840 respectively. Each had extensive workings, principally in the main limestone, which were connected by a sump six fathoms deep from Fagnergill Level.⁴

The mines of Fremington township formed a small separate royalty known as Fell End. They were worked by hushes and whim shafts in the eighteenth century⁵ and by several levels in the nineteenth. The principal workings, including two levels driven at different horizons,⁶ were in Dolphin Vein, which has

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1. 1870 Report. The Nent Force Level at Alston Moor was used as a boat level. A. Raistrick, Lead Mining and Smelting in West Yorkshire, pp. 87-8.
 2. 1870 Report.
 3. K.L.M.S.S., Pkts 1-15.
 4. Plan of Stang and Fagnergill Mines, in the possession of Mr G.B. Harker, of Arkengarthdale; and information from Mr Harker, formerly secretary of a mining company in Arkengarthdale.
 5. Plan of Fell End Mines, 1787, in the possession of Mrs J. Close, of Low Row.
 6. Compass and Fell End Low Levels. Plans of Fell End Mines, 1881, in the possession of Mr R. Woodward of Fremington.

a break of twenty-seven fathoms, north side up, and is apparently the same vein as Friarfold, Surrender Great Sun, and Booze. Whatever the fortunes of this royalty at an earlier date, it was unproductive in the eighteen-sixties, when only a few men were employed. They were engaged principally on an unsuccessful trial of the 4th limestone in Copperthwaite Vein through the level of the same name¹.

In the Lownathwaite Mines the main east-west veins, here known as North Vein and Sun Vein², were worked in almost ideal physical conditions. Two great hushes have been gouged out of the west side of Gunnerside Gill deep into these veins, and below them levels have been driven straight into the veins from the valley side without any need for cross-cuts³. Because of these advantages the mine was heavily worked before the end of the eighteenth century and was not a major producer after the eighteen-twenties. The principal development of the middle decades of the nineteenth century was the driving of Blind Gill Level, which was begun in 1846⁴ from a point near Blakethwaite

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1. Agent's Notebook, Arkengarthdale, Fell End and Old Gang, 1863-73. D.H. MSS., F8; Kinnaird Commission, Minutes of Evidence, and Sir G. Denys, Mining Notebook.
 2. Thought to be continuations of Old Rake and Friarfold Veins respectively.
 3. The lowest and longest of these levels was Priscilla, which began in the "27 fathoms grit and plate", the bed below the underset limestone, and was driven in the North Vein for about 500 fathoms to the Lownathwaite Great Break Vein, which throws the beds down to the west by 29 fathoms, and then for a further 100 fathoms at the top of the main limestone. Vertical sections of the A.D. Mines and A.D.Co. Report Sept 1875. D.H. MSS., P/AD2 & 3, and RA10.
 4. Date on the arch.

smelting mill and cut the Watersykes Vein 212 fathoms to the west. The vein was followed to the north for 285 fathoms until it was abandoned in the middle of the eighteen-sixties because the dip of the beds to the north put the main limestone too far below the level for profitable working¹. Some years later the ore which had been left was worked through a branch of Priscilla Level driven in Watersykes Vein at an horizon about 22 fathoms below Blind Gill Level². Further to the west the main veins were worked in the Swinnergill Mine by Swinnergill Level and its branches, which formed a network extending eastwards for about 510 fathoms. The level began in the Black Beds, but because of the rise of the beds to the east, its eastern forehead stood in the main limestone³. The workings were not driven further, presumably because the veins were unproductive at this point as they had been found to be to the west of the Lownathwaite Great Break Vein in the Lownathwaite Mine.

West of Swinnergill Beck the same veins were worked in the Beldi Hill Mines by Parkes, Landy and other levels, and by the Old Field Hush, which was the only major hush working in

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1. Vertical Sections, Beurch, loc.cit., Sir G.Denys, Mining Notebook, and Plan of Lownathwaite and Blakethwaite Mines; D.H. MSS., P/L6. Blind Gill Level began in the plate above the underset chert. As this level was worked by the Blakethwaite Company, there are no separate output figures for it.
 2. T.Raw: Report on A.D. Co. Mines, 9 Dec 1876: J.R.Tomlin, Memorandum on resumption of Priscilla Level 8 Mar 1878, DH. MSS. SG4/36 & 39.
 3. Plan of Blakethwaite, Lownathwaite & Swinnergill, 1862, and Vertical Section, D.H. MSS., P/L6 & P/AD2.

Swaledale in the middle years of the 19th century¹. By the eighteen-sixties Beldi Hill was largely worked out.²

To the south of Swinnergill were the Arngill Mines. West Arngill was worked by a level driven under the main limestone in an east-west vein. It was abandoned about 1820, and re-opened in 1868 by Sir George Denys who worked it for a short time with little success³. At East Arngill there were two levels, one in the main limestone and the other under the underset limestone.⁴ The latter raised ore from a flot, a form of deposit comparatively rare on the north side of the Swale⁵. The dip of the beds to the east made drainage difficult; a syphon was used successfully when this mine was re-opened in 1919⁶.

South of the Swale the veins were both fewer and poorer than on the north side of the river. Most of the ore was found in flots associated with the veins. The workings were smaller in scale and more scattered than on the north side of the dale, and most of them were carried on, as the richer mines had been at an earlier date, by partnerships of working miners

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1. Plan of Beldi Hill mine, undated, D.H. MSS., P/M4; and Fawcett MS. p.10.
 2. In 1871 it was completely idle: Return to Rivers Pollution Commission, copy in Agent's Rough Notebook, D.H.MSS., F3.
 3. Sir G. Denys, Mining Notebook.
 4. Vertical Section.
 5. Bewick, loc.cit.
 6. Reports of lessors' agent, 1897-1927. D.H. MSS., V5.

and men with little capital¹.

The most successful mines in this area in the nineteenth century were Muker Side and Grinton Moor. The former was worked by Milner and Company more or less regularly from 1828 to 1861². A plan of this mine dated 1843 shows two levels driven south at different horizons³. Most of the ore was raised from flots in the main Limestone, of which the richest was Modesty Flot⁴. In 1864 Muker Side and some adjacent mines were leased by a limited company called the South Swaledale Company. It raised the output, which had not exceeded twenty tons of lead in a year since 1851, to 215 tons in 1868 and 162 tons in 1869. The ore did not persist, however, and the company gave up its lease in 1872 or 1873⁵. The mine was then abandoned, except for an unsuccessful trial in 1882-83 when a level driven in search of a flot near Modesty holed into some old workings⁶.

Very little is known of the fortunes of the Grinton Moor Mines. There were two principal levels, How Level, driven under the main limestone, and Swinston Level on the west side

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1. See above, p.81.
 2. Lessors' account of duty lead, 1816-1848, D.H. MSS. SG2; and Lead Weighing Books ADM 3 & 4.
 3. D.H. MSS., P/M6.
 4. Sir G. Denys to Julius Roberts 7 Feb 1865. D.H. MSS., T5., (Geological Survey, Special Reports on Mineral Resources, Vol. XXVI, p.30).
 5. T. Raw: Agents Rough Notebook, 1873-4. D.H. MSS. D5.
 6. T. Raw to Sir F. Denys, 15 Feb 1883, with note by Sir F. Denys, 26 Feb 1883, D.H. MSS., S.G4/71.

of Cogden Gill, driven below the underset limestone¹. Other mines south of the Swale were Stockdale, west of Thwaite, Glover or Lover Gill, Spout Gill, Satron Moor, Summerlodge and Whitaside. Most of them were exhausted or poor by the eighteen-fifties.²

-IV-

There was no significant change, as far as is known, in the methods of dressing and smelting used in Swaledale between 1830 and 1870³. The bouse which was brought out of the mine was crushed between rollers and then "jigged" in a hatching-tub to separate the material into layers according to density. The lightest layer was thrown away as dross, the lowest and heaviest taken to be smelted, and the middle layer, called the chatts, was ground to a coarse powder between the rollers of a chatt mill, and jigged again. The "smiddum" or fine ore which fell through the mesh of the hotching sieve, and the finer particles which were carried in suspension and trapped in the slime pits, were treated in various types of buddles.

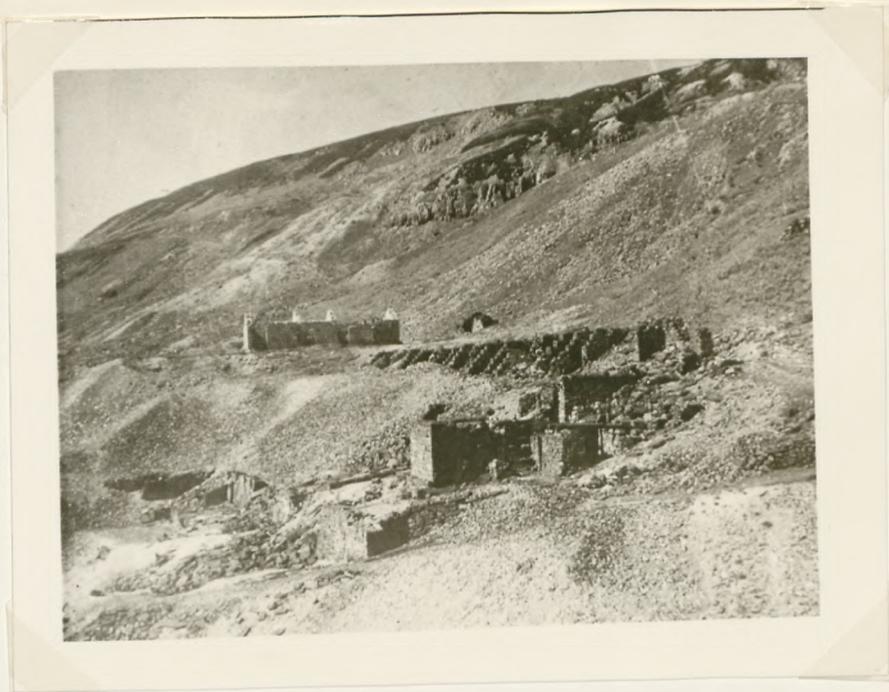
The typical dressing floor of this period had a crushing mill and a chatt mill, both operated by the same water wheel, several hotching tubs and buddles, and two slime pits. The Surrender mine had one dressing floor after 1841, at the mouth of Moulds

1. Geological Survey, Special Reports, Vol. XXVI, p.30.
2. Lead Weighing Books, D.H. MSS., ADM3-4.
3. See above, pp.92-3.

Level in Arkengarthdale through which this mine was then worked¹. The Blakethwaite Company had dressing floors at Blakethwaite, Blind Gill, Sun Hush and Barbara Levels, as well as one at Startingill Shaft in West Stonesdale². At Old Gang there were three main floors, at Hard Level, Bunting Level in Gunnerside Gill, and Kinning Level. At Sir George Level, which is driven into the almost sheer side of Gunnerside Gill about 20 fathoms below Bunting Level, and 50 fathoms away laterally, it was physically impossible to set up a water wheel, and the bouse was crushed by hand. The alternative of using some mechanical device to lift the bouse to the Bunting Level floor does not seem to have been tried.³

There were eight smelting mills in use in Swaledale in the middle of the nineteenth century: Keldside, Beldi Hill, Blakethwaite, Old Gang, Surrender, Arkengarthdale, New Mill, Marrick, and Grinton. The bellows or air-pumps of these mills were all operated by water power, which, in a hilly district with abundant surface drainage, could be applied without serious difficulty in many places. The location of the mills was in general governed by the organisation of the mining leases; the eight mills were operated by eight mining companies. With two exceptions they were built at a convenient central point

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1. Valuation of Surrender plant, 1873; in T. Raw's Rough Notebook, 1873-4. D.H. MSS., B13.
 2. Valuation of plant on sale to A.D. Co., D.H. MSS., SG4/32.
 3. Valuation of Old Gang plant, 1887. Return to Rivers Pollution Commission, Copy in Agents Rough Notebook, 1871. D.H. MSS., SG4/74 and F3.



VI : Bunting Level Dressing Floor, Old Gang Mine



VII : Sir George Level, Old Gang Mine

to serve the mines of each company.

The exceptions were Surrender, where the smelting mill stood by Hard Level Beck, more than two miles from the two Surrender shafts, probably because the latter were sunk on a plateau to which it would have been difficult to bring an adequate water supply, and Marrick Mill which smelted the ore from the Hurst mines, three miles away. A mill built by Washfold Beck at the eastern end of the hamlet of Hurst, close to all the main workings, could have been supplied with a sufficient flow of water, and there is no evidence to explain the location of Marrick Mill. Both Marrick and Surrender Mills were rebuilt on the same sites during the nineteenth century. The use of Moulds Level to work the latter mine made the site of this mill the most convenient one within the A.D. royalty, as it stood at the junction of the road which led from Arkengarthdale, passing the mouth of Moulds Level, to Low Row in Swaledale, with the road to Richmond. The mill, which had been in bad repair for some time, was pulled down and rebuilt at about the same time as the extension of Moulds Level into Surrender¹.

The only changes in the distribution of the smelting mills during the half century after 1815 affected the less

1. Surrender Lease, 1839; Clough, loc.cit., Cave Science, Vol.11 No.9, p.28.

important ones. Keldside Mill was apparently built under the terms of the lease of 1838, the draft of which stipulated that it had to be constructed at the expense of the lessees by May 1839¹. It had only one ore-hearth, and was little used because of the poor fortunes of the West Swaledale mines. It was probably allowed to fall into disrepair, and the Kisdon Company, which worked some of the neighbouring mines from 1866 to 1870, sold its produce in the form of dressed ore².

The Swinnergill mill was abandoned in 1819³, seven years after the lease of this mine had been merged with that of Lownathwaite, and the mill belonging to the latter was abandoned when the mine was joined to Blakethwaite in 1836⁴. The Blakethwaite Mill, built with two ore-hearths on a very confined site at the bottom of the steep-sided Gunnerside Gill, was better placed to handle the ore from the main Lownathwaite Levels than the mill which stood high on the hillside above them, among the whim shafts through which the mine had been worked in the eighteenth century. It was also in the most convenient position to serve Blakethwaite and Blind Gill Levels.

1. D.H. MSS., LB5.

2. Kisdon Co. lease and Pay Accounts, D.H. MSS., LC4 & CB2.

3. Agents Survey Book, Old Gang, Lownathwaite and Swinnergill, 1824-32. D.H. MSS., S.C.7. and A.D. Mills Account, 1805-85, D.H. MSS., SD 3.

4. The last specific reference to the carriage of duty lead from Lownathwaite mill was in 1827, but later references to "High Mills" could have included the latter as well as Blakethwaite, as the rates of carriage from the two were the same. A.D. Mills Account. The mill is shown as disused on the O.S. map of 1847.

Two mills in South Swaledale, Spout Gill and Summerlodge, went out of use early in the nineteenth century, because of the poverty of the local mines, and in the case of the former, because the building of smelting mills elsewhere had taken away most of its casual trade¹.

-V-

During this period, the principal mines were organised in substantially the same way as they had been in the first few decades of the nineteenth century, that is, leased for periods of twenty-one years, usually for a royalty in smelted lead². The rents which had been charged in addition to the royalty during the French Wars were dropped from most of the leases made afterwards, and there was later a slight downward trend in the rates of duty. The Old Gang lessees paid one-fifth until 1849, and one-sixth afterwards³. The Arkengarthdale mines, which had been let at a simple rent of £4200 a year in 1800, yielded one-sixth from 1821 until the early eighteenthies when the duty was reduced to one-ninth because of the depression⁴. The Blakethwaite duty was one-fifth until 1817,

1. Lead Weighing Books, Fawcett MS. p.109.

2. See above, pp.82-5.

3. Ibid.

4. Arkengarthdale leases 1828, 1849, 1870. Arkengarthdale MSS. 9, 12 15; and see below, pp.200.5.

and one-sixth subsequently¹. Swinnergill and Lownathwaite continued to pay the original rate of one-sixth until merged with Blakethwaite in 1836². The Surrender Company paid one-fifth until 1860, and then seven-fortieths for a few years³, and after 1863 one-sixth⁴. Lane End and Keldside, which were never very productive mines, yielded one-seventh until 1866 and one tenth thereafter⁵. The smaller mines were let at an average duty of one-fifth, plus a small rent, before 1815, and an average duty of one-sixth without a rent afterwards.

A useful simplification of the terms of the leases of the major mines was introduced about the middle of the century. In place of the covenants laying down which levels were to be driven, and the number of men to be used in them, the leases provided for the employment by the lessees of a certain minimum number of "dead" workers, twenty-four at the Arkengarthdale and Old Gang mines, of whom half worked under the direction of the lessors' agent, making "lessors trials", which were planned to secure the long-term development of the mines⁷. In Arkengarthdale, by the leases of 1828, 1849 and 1870, 130 "experienced pickmen", i.e. ore-getters, were to be employed in addition to

1. Lead Weighing Book, D.H. MSS. ADML-6.

2. Ibid.

3. Because one of the lessors insisted on one-fifth and the others accepted one-sixth, Sir G.Denys to Dr.Thorpe 2 Aug 1860. D.H. MSS. M1.

4. Lead Weighing Books.

5. Ibid; Kisdon Co.Lease 1866. D.H. MSS. LC4..

6. A.D.Bargain Book 1800-1850. D.H. MSS. SAL.

7. Arkengarthdale lease, 1870 J.L.Tomlin to Sir F.Denys, 18 March 1883. D.H. MSS., P2.

the fathom workers¹; at the Old Gang during the same period 200 miners including fathom workers². When these mines were prosperous, they often employed twice as many workers, or more.

Most of the lessees of this period were local middle-class people, solicitors, doctors, bankers, merchants, land agents, lesser landowners and the like. Six families, the Jaques of Easby, near Richmond, the Tomlins and Bradleys of Richmond, the Robinsons of Richmond and Reeth, the Knowles of Low Row and the Chaytors of Spennithorne, in Wensleydale, held between them the controlling interests in all the mines of any consequence from 1830 to 1870³. These investors were able to achieve a close understanding with the lessors, which smoothed away many of the potential difficulties of the leasing system. Both parties saw that their common interest lay in the systematic development of the mines by companies which could make long-term plans, and, although no legal provision was made for this, the lessees could usually count on having their leases renewed on substantially the same terms. Living near the mines they were able to give close attention to their management. The Old Gang Company, for example, held fortnightly meetings at its office near the smelting mill, and its partners paid frequent visits to the various workings of the mine⁴. In this way

1. Leases of 1828, 1849 and 1870.

2. Old Gang Lease 1839. D.H. MSS. LC5.

3. See below, pp.261-2.

4. Old Gang Agents Notebooks D.H.MSS D1 and F7; Correspondence J.R.Tomlin and Sir George Denys 1878-80. D.H.MSS. N6 and M6; Agents Notebook, Arkendale, Fell End and Old Gang, 1863-73. D.H. MSS. F8.

the lessees, and particularly the six dominant families, accumulated, and passed on to the second and third generations, knowledge of the mines and their management, so that the latter were much more efficiently run than in the days when an absentee proprietor or lessee had left their direction in the hands of an agent working by rule of thumb.

These companies were organised as private partnerships, with the partners holding shares varying from a third or a quarter to one-thirty-second¹. Usually each lessee paid his share of the pay bills and received a corresponding proportion of the smelted lead², but by the eighteen-sixties and-seventies it was becoming the practice for the companies to hold a joint stock, and either distribute net profits or call up further investments as required³. There are few statistics about the level of investment, and the profits and losses made by these partnerships. A major partner in mines like Old Gang and Arkengarthdale must have had at least one or two thousands of pounds to invest. Of course, a few prosperous years would provide the capital for further investment. During the five years from July 1867 to June 1872 the Old Gang Company, working the rich Watersikes Veins, made an average annual profit of £4,716. The next three years saw profits of £5,972, £3,942 and £441. From 1875-76 an annual loss was shown, rising to £2,926 in 1881-2⁴. The six lessees who took equal shares

1. Lead Weighing Books.

2. Ibid; and Old Gang mine: Extracts from pay bills 1829 and 1836. D.H. MSS., R.D.2.

3. Old Gang balance sheets and Income Tax returns 1872-82. D.H. MSS. RA16; Arkengarthdale Company: Deed of copartnership 29 July 1870. Arkengarthdale MSS.16.

4. Old Gang balance sheets.

in the Arkengarthdale mines in 1870 invested £6,700 more than they received during the first three years of working, but by 1887 had made a total net profit of £45,591. In 1877-78, just before the disastrous fall in the price of lead, their profit was £11,390.¹

-VI-

The general application of the techniques of the industrial revolution, particularly the use of horse levels, had led to a marked increase in the output of the Swaledale mines. But with the logic of an extractive industry, it had also brought nearer the day of their exhaustion. By the eighteen-sixties, the output of all the A.D. group of mines was clearly in decline; by 1864 it had fallen to a level lower than in the worst year of the depression of the thirties². In these circumstances the mining entrepreneurs could try to extend the life of the industry in four ways: by re-working "old" veins, by renewed attempts to solve technical problems which had caused productive veins to be abandoned, by extending workings laterally into ground not yet exploited, or by making trials in the limestone beds below the underset limestone.

The re-working of "old" veins might yield a modest output, particularly if a high price for lead allowed the mining

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1. Report on finances of Arkengarthdale mines, 26 May 1891., Arkengarthdale MSS.20.
 2. There was a similar decline in the Wensleydale mines, where the output fell from 1872 tons in 1860 to less than 400 tons in 1868-69. See graph of Wensleydale output, facing p.202.

companies to offer to the mining partnerships a price per bin of ore which would allow them to "make wages" in poor ground that had been by-passed by miners working at a lower rate. Sir George Denys, the principal lessor of the A.D. group, urged the companies to work each stretch of vein three times, once at a price related to the ease of working the bulk of the ore, then at a higher price, and finally at the highest price which would yield a surplus over variable costs, after which the place could be abandoned and the rails pulled out to use elsewhere¹. As a lessor, Sir George's ideal was of course the maximum output rather than the maximum rate of profit for the lessees, but there was a good deal of sense in his policy. However, re-working could do no more than make a useful marginal contribution to total output for a limited period.

The second approach offered little prospect of profit. As far as is known, the Blakethwaite Vein was the only one where a substantial body of ore had been "drowned". The attempt to work this vein from West Stonesdale had only recently (in 1861) been abandoned, and the alternative approaches would be difficult and expensive.

There were fortunately still some stretches of comparatively

1. Sir G. Denys to J. Knowles 16 April 1874, and to J. R. Tomlin 30 Oct 1874; Sir G. Denys to Currie, Williams and Williams, Sept 1877; Sir G. Denys to J. R. Tomlin Jan 1878; Sir G. Denys: Memorandum for insertion into new Old Gang lease, undated. D.H. MSS. SD5, S.G.4/45, S.G.4/44, S.G.4/33.

virgin ground, particularly the Watersykes Veins at the Old Gang, and parts of the Stang and Faggergill and Danby Mines in Arkengarthdale¹. From 1867 to 1874 the former provided most of the output of not only the Old Gang mine, but also the whole A.D. group. In 1873, after the short-lived South Swaledale Company had closed down, 1853 tons of the group's total output of 1897 tons came from the Old Gang, and nearly all of it from the Watersykes Veins²,

After the working out of the latter, the output of the Old Gang mine, and with it that of the whole A.D. group, fell disastrously. There were no important virgin areas left at the horizons hitherto exploited. The future of these mines now depended, as thoughtful lessors and investors had realised fifteen years earlier, on the "virgin ground" that lay at greater depths. If the lower limestone beds proved to be productive, the industry might look forward to a period of renewed prosperity. If not, it was clear, well before the depression of the late eighteen-seventies, that the Swaledale mines, with the exception of some in Arkengarthdale, would have to "shut up very soon."

1. See below, pp.200-201.

2. See above, p.122.

Chapter VI : The Last Phase of the Industry.

The trial of the lower beds was due almost entirely to the initiative of one man, Sir George Denys, the second baronet, who played a very active part in the supervision of the A.D. group of mines from 1857, when he inherited his father's half-share in them, until his death in 1881. Sir George was the very opposite of the absentee proprietors of an earlier period. He lived on the spot, having bought A.D. Hall¹, which he re-named Draycott Hall², in 1851. He was interested in every aspect of mining, and was a keen student of geology³. Always receptive to new ideas, Sir George brought about the first significant improvements in the methods of driving and ventilating levels in Swaledale since the introduction of gunpowder.

The lower beds could be worked in two ways, by a sump from an existing level, powered by a steam or hydraulic engine, or by a deep level. The former method would cost less in initial outlay⁴, but the latter would be more economical in the long run, particularly if an extensive area were opened up. Sir George Denys planned to use both methods, a deep level in Gunnerside Gill where the topography was favourable, and an engine sump at the eastern end of the A.D. royalty, in the Surrender Mine, where a deep level was not a practical possibility⁵.

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1. A.D. Hall was in Fremington. It had previously been used by the Denys family only as a pied a terre.
 2. After Anna Maria Draycott. See above, p.37.
 3. The Draycott Hall MSS contain two lectures or papers on geology and its relation to mining, in Sir George's hand. D.H.MSS.W1.
 4. Not a great deal less. See below, p187 for the costs of the engine sump from Sir Francis Level.
 5. See above, p.128.

Within a few years of his father's death, Sir George became convinced of the need to make an effective trial of the lower beds while profits were still flowing from the exploitation of the more accessible deposits. He wrote "It is absolutely necessary that the lower beds should be looked into at both ends¹ before the upper strata are completely cleaned out"². This was not, however, an enterprise that lessees would undertake lightly. When levels like Hard, Bunting and Priscilla had been driven, some sixty or eighty years earlier, the principal veins which they were to work had been tried by hushes and shafts in the main limestone and in places down to the under-sets and had been found productive. The attack on the lower beds, which had hardly been touched in Swaledale³, was much more speculative. The general local opinion was that "they would never pay"⁴.

The physical difficulties were considerable. The lower limestone beds were thinner, and therefore less likely to be productive⁵, than the main bearing beds, and were separated by greater thicknesses of shale and sandstone. In Gunnerside Gill,

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1. In Gunnerside Gill and at Surrender.
 2. Sir G. Denys. Memorandum for insertion into new Old Gang lease. Undated. D.H. MSS., S.G.4/33.
 3. Some of them had been tried at Hurst and Fell End, apparently without success. Some ore had been raised from the 5th and 6th limestones at Keld Heads in Wensleydale.
 4. Sir G. Denys: Machine versus hand labour in mining, pp.6-7.
 5. See above, pp.13-14.

for example, it would be necessary to go 43 fathoms below the underset limestone to open up the 3rd and 4th limestone, each $2\frac{1}{2}$ fathoms thick, and 31 fathoms further to reach the base of the 5th limestone, 4 fathoms thick. To gain so much depth, a level would have to be started a long way "down bank" from the vein, as nowhere in the Denys royalty was a limestone below the underset exposed along the line of the major veins. Not only would the level itself be expensive to drive because of its length, but it would need at intervals air shafts, the depth of which would increase as the level progressed. Finally the whole work might take from ten to twenty years to complete, and the standard lease of twenty-one years would not allow a company to recover its outlay¹.

Some of these difficulties were resolved by the long connection between the Denys family and the Old Gang Company, which was more or less controlled by the same three families from 1828 to 1887². The latter could count on having the lease renewed on substantially the same terms. In 1863 or 1864 the Company negotiated a new lease in place of the one that was due to expire in 1870, and in doing so agreed to drive a deep level in Gunnerside Gill as a joint trial with the Blakethwaite Company which worked the mines on the west side of the Gill and was no doubt induced to cooperate partly by the hope that the level would ultimately be carried forward to drain and work the Blakethwaite Vein³. The proportion of the cost borne by the

1. The other long cross-cuts, Hard Level and Barras End Level, had been started by the proprietors themselves.
2. See above, p.157. 3. R.Place: Review of prospects of Old Gang Co. 3 Aug 1864. D.H. MSS., R.A.7.

latter is not known¹. On the Old Gang side it was, of course, a "lessors' trial", the work being done by some of the twelve fathom workers who were at the disposal of the lessors' agent.

Sir George named the new venture the Sir Francis Level, after his son who would inherit the baronetcy and the mines from him, because he regarded it essentially as a provision for the next generation. He often spoke of the need to provide "a feast of fat things for generations to come" by opening the lower beds². The level was begun, in July 1864, in the grit and plate between the fourth and fifth limestones, on the west side of Gunnerside Beck about 750 fathoms south of the Friarfold Vein. Sir George expected that the level would cut part of the sixth limestone on the north side of the vein, which is thrown up 28 fathoms, and that a sump 20 fathoms deep would prove the vein to the bottom of the seventh limestone on the high side³. His calculations were sadly wrong, partly because he thought that only 12 fathoms, instead of 27, separated the fourth and fifth limestones. When the vein was cut, the top of the fifth limestone was several fathoms below the level on the upthrow side of the vein⁴.

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1. Sir George later paid one-fifth on behalf of the west side. See below, p.168.
 2. Sir G.Denys. Memorandum on renewal of Old Gang lease 1877. D.H. MSS., S.G.4/46.
 3. Sir G.Denys: Mining Notebook.
 4. Ibid.

At the end of 1866, the Blakethwaite Company terminated its lease, because of the poverty of its mines, and the level was continued by the Old Gang Company alone. By this time 144 fathoms had been driven, at a cost which had risen steadily to £8.5.0 per fathom. In July 1869, after five years work, only 202 fathoms had been completed, and the cost had touched £10 per fathom in the interval, and was currently £8.10.0, exclusive of ventilation¹. The four men employed were driving ten feet a month², at which rate the level would take twenty-five years to complete. Two airshafts had been made already³, and more would be needed, with a greater height to rise. Sir George Denys could require the Old Gang Company to employ eight men in the level, working four six-hour shifts daily, and finish the work in half the time. Even then the whole operation would have taken about eighteen years, and the Old Gang lease would have almost run out. So on March 31st, 1869, Sir George wrote to the Company, suggesting the introduction of a power-driven rock-borer⁴.

"I represented to the Company the desirability of bringing the science of the nineteenth century to the aid of our old jog-trot notions, and urged the adoption of one or other of

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1. Sir G. Denys: Machine versus Hand Labour in Mining, p.7.
 2. Ibid.
 3. Plans of Sir Francis Level 1875 and 1878. D.H. MSS. P/AD4, and John L. Tomlin to Sir G. Denys 13 Nov. 1873. D.H. MSS. M7.
 4. Sir G. Denys to Old Gang Co., 31st March 1869. D.H. MSS. N1.

the many boring machines that have been brought out since the Mont Cenis Tunnel was first started. New habits and customs are, however, not easy to introduce to Swaledale. We are still trailing our produce along the road at two miles per hour, with our broken winded old screws, and rotten old carts, when we might have had a railway up the wāley ten or twelve years ago. As in the case of the Railway, so in this, cold water in plenty was thrown upon the scheme, it was too soon, it was too risky, it would be better to let someone else try it first."¹

Sir George inspected a machine on trial in Cornwall, and another which was being used to make a tunnel for water supply at Greenock, and fixed upon a "Haupts Improved Rock Drill" manufactured by Messrs. J.A.McKean and Co.². Sir George failed to persuade the Old Gang Company to adopt the method, and so contracted to drive the level himself, with a boring machine, at a cost of £8-10-0 per fathom. The Company was to provide all the things usually found by the masters in bargains with ordinary miners, rails, wagons, air pipes etc., and to make

1. Sir G.Denys: Machine versus Hand Labour in Mining. pp.7-8.
2. Ibid. p.8.

the watercourse.¹ Sir George agreed to pay one-fifth of the cost himself on behalf of the west, or Blakethwaite, side.²

"The motive power was water, brought to bear upon a wheel 38 feet in diameter, and 4 feet wide, attached to one of Low's improved double cylinder air compressors of high pressure, with a wrought iron receiver and connections made by E.R. & W. Turner of Ipswich, which worked up to about 60 lbs. pressure on the inch."³.

The first hole was bored on 26th Jan. 1870. The work went badly at first. An engineer, Appleton Clarkson of Ripon⁴, was in charge, and according to Sir George Denys his lack of knowledge of practical mining matters was a fatal drawback. As soon as the men had learned to use the machines, the engineer's contract was terminated, and the work of maintaining the machines was given to John Calvert, a Gunnerside blacksmith.⁵ The first machines used were "far from perfect and constantly getting out of order," though the trouble was eventually put right. The cost gradually rose, until it looked as though Sir George would lose heavily on the contract.

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1. Agreement, Sir G. Denys and others and Old Gang lessees. 5 March 1870. D.H. MSS. N1.
 2. An outlay which he recovered when the A.D. Co. was formed. Sir G. Denys, op.cit. p.8.
 3. Ibid. pp.8-9.
 4. Agreement. Sir G. Denys and others and Old Gang lessees.
 5. Sir G. Denys, op.cit. p.9.

"I began to look very blue, and my agent, now dead, poor fellow, quite lost heart. But I kept up steadily. I had not gone into the thing to make money out of it, and a man must pay for his experience in boring as in anything else.

"It is the opinion of all the men employed, and of the agents, that it would not have been possible for several hundred fathoms to have moved the forehead at a less price than from £12 to £14 a fathom by hand labour. Verily, I had got hold of an uncommon hard bargain. Without rising to the surface for ventilation every 70 or 80 fathoms, the level could not have been carried on. This would have entailed seven or eight rises, costing nearly as much as the level itself, which must have been stopped during the time the rises were being made. This is tantamount to saying it would never have been driven at all. It would have killed half the men, it would have sickened the company completely, and ultimately have been abandoned. From this fate we were saved by the compressor".¹

Sir George stressed the advantages of using machines which blew air in pipes along the level as well as drilling holes in the rock. "No loss of power by friction against the pipes is perceptible at 750 fathoms from the level mouth, and I am told that in the St. Gothard Tunnel the loss is only ten per cent in seven miles. With a good air compressor we could certainly go ten miles without being compelled to make a

1. Ibid. pp.9-10.

single hole for air".¹ "Without doubt, the air compressor is the most valuable invention for mining purposes that exists."² "Wherever extensive mining operations are intended, whether machine drills are used or not, an air compressor put up at the commencement will pay for itself five or six times over".³

Shortly after the boring machine was introduced, gun-cotton was tried experimentally in place of gunpowder. It was found to be efficient but dangerous, and several accidents, none of which were fatal, occurred. Dynamite was then introduced, in March 1873, and the men were quickly convinced of its value "in all situations, wet or dry". "In a hole full of water, for instance, the men have been seen to ram down the cartridges with a stick, until the stuff ran out of the hole at the top looking like pea soup from the bursting of cartridges, but they merely put in as usual the primer and cap, and off it went down to the bottom of the hole. It never misses..... The largest charge we ever put into a hole was into a four foot hole, thirteen two-inch cartridges, or 26 ounces, equal to 5 lbs 4 ozs of gunpowder. It would have been manifestly impossible to have got anything like that quantity of powder into any jumper hole."⁴

On the average each fathom of ground cut required thirty

1. Ibid. p.14.

2. Sir G. Denys: Estimated cost of driving to the Blakethwaite Vein 25 March 1878. D.H. MSS. SG4/59.

3. Sir G. Denys: Machine versus Hand Labour in Mining. p.5.

4. Ibid. pp.10-11. A jumper is a hand-drill.

holes, drilled to a depth of from two to three feet.¹ Each fathom cost 27 shillings in dynamite, caps and fuse, and 22/6d. in repairs to and depreciation of the borers. The latter averaged nearly 100 fathoms each².

In 1878, Sir George Denys offered to the men driving the level a bonus of £20, if they could complete fifty fathoms in four months³. They achieved this, together with a turnrail or siding six fathoms long, in fourteen weeks⁴. Usually only one boring shift was worked each day. Sometimes, as when the bonus was at stake, there were two shifts, but even then there was no night work⁵.

The Friarfold Vein was cut on 18 March 1877⁶. The Old Gang Company rewarded the men who had driven the level with "a dinner and something to drink at one of the Public Houses,"⁷ and Sir George Denys reckoned up the finances of his bargain. The gross price per fathom paid to the men was, on the average, a little under £5-10-0.⁸ This figure included the cost of explosives, and drawing the "deads" out of the level,⁹ items which were normally charged to the men and deducted from the gross price when their wages were paid. Allowing £1 per fathom

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1. Sir G. Denys: Memorandum undated. D.H. MSS. N4.
 2. Sir G. Denys: Machine versus Hand Labour in Mining. p.11.
 3. A.D. Co. Reports 24 March 1876. D.H. MSS. RA 10.
 4. Sir G. Denys, op.cit. pp.12-13.
 5. Ibid. p.12.
 6. Ibid. p.15.
 7. Old Gang Agents Notebook 1876-77. Minutes of Company meeting, 14 March 1877. D.H. MSS. F4.
 8. The highest price was £8; the lowest £3.18.0d. Sir G. Denys: op.cit. p.13.
 9. The drawing alone cost the men ten shillings per fathom. Ibid.

for repairs, walling and arching, and incidentals, and £2 for interest on the capital outlay and depreciation, Sir George estimated that he had "neither won nor lost a five pound note during the seven years, which if not satisfactory from the pecuniary point of view, is certainly rather remarkable".¹

He claimed that he had driven 550 fathoms with the borers in one third of the time and for half of the money that hand labour would have required, if indeed, it could have been completed in that way at all.² He concluded, "I think I may challenge all machine makers, tunnel drivers etc., to show the same amount of work done for the same money.

'Si quid novisti rectius istis, candidus imperti,

Si non, his utere mecum'

which being literally interpreted for those among my mining readers not well up in their Latin, means:

'If you know of any better way of doing these things, kindly tell me how. If not use my tools.'³

However effectively Sir George Denys was able to argue the case of "machine versus hand labour in mining", the justification of the whole endeavour could come only from the product of the veins laid open in the lower beds by Sir Francis Level. The appearance of the Friarfold Vein when cut was very promising. "With two bad or mucky sides of grit and plate, it is nevertheless throughout its entire width of over six feet filled with good large blobs of ore in a strong, very white, mineral

1. Ibid.

2. Ibid. p.5. The total cost of the level was between £6,000 and £7,000.

3. Ibid. pp.14-15.

looking rider,¹ with ribs of good ore on both sides, indicative of a first-class mine in the lime beds both above and below".² Sir George wrote in his mining diary: "Great jubilation.... Thirteen years labour finished triumphantly.... The profit will be in the future, for the men who will find plenty of employment for generations, for the lessees who will get a return for their capital, and for the lessors who will get the royalty."³

II.

While Sir George had been winning his technical battle, through his own will-power aided by "the science of the nineteenth century", he had to wage almost as difficult a struggle on another front, to organise a company to work the ground west of Gunnerside Gill. Two and a half years after the commencement of Sir Francis Level the Blakethwaite Company had given up its lease because of the poverty of its mines. Sir George could not find new lessees amongst the local middle class people who had provided most of the capital for working his family's mines since the eighteen-twenties. They were not attracted by the prospects of exhausted mines where the only hope of profit lay in the untested possibilities of the lower beds in the Friarfold and associated veins, which would not be reached by the Sir Francis Level for a considerable time.

On the other hand, the Limited Liability Act of 1855 and the Companies Act of 1862 had made it easier to attract investment

1. Rider, or veinstone, is composed of other vein-filling minerals, e.g. barytes, calcite. 2. Ibid. pl5.
3. Sir G. Denys; Mining Notebook.

from outside the area, and Sir George had already been initiated into the mysteries of company promotion. His first contacts were with a group of London financiers. One of them, Joseph Holdsworth, leased the West Swaledale mines, and some of those in South Swaledale, in 1863, and subsequently tried to form companies to work them¹. He and his associates planned to take in fully paid up shares, £6,000 out of the £18,000 capital of the projected South Swaledale Company, and a similar sum out of the £30,000 capital of the West Swaledale Company². When Sir George Denys protested that these shares were "excessive and fraudulent",³ he was told that promoters often took one-third or even half of the capital in this way, and that the investing public, grateful for being introduced to opportunities for profitable investment, entirely approved of the practice. He was assured that the financial success of the South Swaledale Company was certain, as it was "more or less connected with the London mining market and... the shares will be worked up to a premium."⁴ As Sir Francis Denys wrote some forty years later, "My father had a good deal of experience of London promotion, and found the city men only looked to profits or flotation and considered the working of the mines as a minor consideration."⁵

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1. J. Holdsworth to Sir G. Denys. 17 Jan 1865. D.H. MSS. T5
 2. G. Clark to Sir G. Denys. 30 Jan 1865. D.H. MSS. T5.
 3. Sir G. Denys to Julius Roberts. 7 Feb 1865. D.H. MSS. T5.
 4. G. Clark to Sir G. Denys. 30 Jan 1865. D.H. MSS. T5.
 5. Sir F. Denys to Sir G. Shuckburgh, 28 Aug 1906. D.H. MSS. V6.

For each of the two fields, an attractive prospectus was produced to entice the investors. Holdsworth wrote to Sir George Denys enclosing the South Swaledale prospectus, "Looking at the printed description of the property, it is hardly possible to imagine anything of a more inviting aspect for investment". He had apparently no sense of irony, for in the same letter he referred to the investing public's "sickening experience" of spurious joint stock companies, especially for mining.¹ Sir George regarded the prospectus as "absurdly erroneous", and his letter² to Julius Roberts, chairman of the financial company which was thinking of backing Holdsworth, seems to have killed the flotation.³ A South Swaledale Company was later formed, but no details of its organisation are known.

Sir George Denys objected rather less violently to the West Swaledale prospectus, deeming it "rather too rosy to endorse it with my name."⁴ Clark offered him £1,000 in paid-up shares if he would withdraw his objections, and become a director of the Company⁵. Sir George declined the offer, but was named as managing director in three subsequent attempts to form a

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1. J.Holdsworth to Sir G.Denys, 17 Jan 1865.
 2. Sir G.Denys to Julius Roberts, 7 Feb 1865.
 3. Sir G.Denys to H.Philips 11 Feb 1865. D.H. MSS.T5.
 4. Sir G.Denys to J.Holdsworth 25 Jan 1865. D.H. MSS. T5.
 5. G.Clark to Sir G.Denys 18 Feb 1865. D.H. MSS. T5.

company to work the West Swaledale mines.

The first projected company was called "The Lane End, Keld Side and Littlemoor Lead Mining Company Ltd.," with a nominal capital of £30,000; the second and third were both called the "Keldside Mining Company Ltd.", with £30,000 and £50,000 capital respectively.¹ The first venture failed to attract enough investors, and so some interesting changes were made in the report attached to the prospectus.

Captain W.H.Rowe, a mining engineer, who had accompanied the Kinnaird Commission on its tour through the northern mining districts, had written a report on the following lines :-

(a) The mines are under water, therefore this report is "of a general character."

(b) The ground is situated in the track of the lodes forming the Old Gang, Lownathwaite and other mines.²

(c) But the configuration is less favourable in West Swaledale, e.g. the bed of the river is above the main limestone.

(d) There are some promising veins worth exploring.

(e) Littlemoor mine should be unwatered and carefully examined before any judgment is passed on it.

(f) A rich deposit of ore was found below the river bed at Keldside.

(g) But the miners working it went too near the bed and flooded the mine.

1. Printed prospectuses, all 1865. D.H. MSS. T4.

2. The prospectus itself said that these veins "have been invariably found productive and have yielded vast quantities of ore." Ibid.

In the version of the report produced a month later for the second company, points (a), (c) and (g) were omitted, and in place of (e) was a recommendation to lease the Littlemoor mine.¹ These changes gave a completely different character to the document, but this project, too, failed for lack of capital.²

Shortly afterwards the Kisdon Company Ltd., a venture at once more modest and more honest, was formed with a capital of £5,000. Sir George Denys was managing director.³

In 1873 Sir George succeeded in forming a company to work the Lownathwaite, Swinnergill, Arngill and Surrender mines. It was known as the A.D. Lead Mining Company Ltd., and had a nominal capital of £25,000⁴. The shareholders, who took up only £18,700 worth of shares between them,⁵ were :-

Sir George Denys			£5,000
Charles Waring	London	Public Works Contractor	£3,000
Benjamin Huntsman	Sheffield		
	and West Retford Hall.	Steel Manufacturer	£2,000
John L. Tomlin	London	Solicitor	£2,000
Joseph Swan	Newcastle	Merchant	£1,000
Thomas Hilliard	Southgate, Herts.	Stockbroker	£1,000
William Benson	Hexham	Colliery Owner	£1,000
Thomas Benson	Hexham	Colliery Viewer	£1,000
James R. Tomlin	Richmond	Solicitor	£ 500
William Brook Smith	Reeth	Gentleman	£ 500
Matthew Shaw	London	Ironmaster	£ 500
Daniel Alderson	Worksop	Maltster and Brewer	£ 500
George Roper	Richmond	Banker	£ 500 ⁶
Henry Priestman	Richmond	Banker	£ 200 ⁶

1. Ibid.

2. Resolution of meeting of provisional directors 16 Aug 1865, D.H. MSS. T4.

3. First annual report of managing director of Kisdon Co. March 1867. D.H. MSS. T4.

4. A.D.Co. Minute Book; John Tomlin to Sir G.Denys 22 Oct 1873, D.H. MSS. SD6 & M7.

5. A.D.Co. Minute Book.

6. Charles Waring was Sir George's son-in-law. A.D.Co. Allotment Book, D.H. MSS., R.D.17.

Sir George's shares were not bought for cash, but were received in part payment for the plant which he sold to the company¹. The investment in cash by local people came to only £3,700, even if we include John Tomlin in this category because of his family connections².

The affairs of the company were managed by an unpaid board of directors, with Sir George Denys acting as managing director as well as principal lessor. This arrangement gave the company the benefit of his considerable knowledge, but caused some difficulties. Under his guidance the company leased not only the ground to be worked west of Gunnerside Gill by Sir Francis Level (the old Lownathwaite mine), but also the Arngill, Swinnergill and Surrender mines. Systematic trials in all of them, and in the main bearing beds at Lownathwaite, did no more than confirm the fact that they were already exhausted.³ It was particularly unwise to try Surrender again, and the Company lost £3,000 on this mine alone.⁴

A second consequence of this dispersion of effort was the purchase of a great deal of plant, in the form of water wheels, dressing machinery, rails, waggons, and other equipment, which according to a subsequent report by a mining engineer,

1. A.D.Co. Reports and Accounts 1873-83. D.H. MSS. B1.

2. See below, pp. 259-262.

3. A.D.Co. Reports 1874-79. D.H. MSS., R.A.10.
Sir G. Denys: Report on Surrender Mine 1877.

4. Sir G. Denys to Currie, Williams & Williams 18 July 1879.
D.H. MSS., SG4/41 and SD5.

T.J. Bewick, loc. cit; and Observations on Value of Plant to be sold to A.D.Co. 2 Dec 1873. D.H. MSS., SG4/32.

Mr. T.J.Bewick, was over-valued in any case¹. The total amount paid in cash and shares to Sir George Denys for plant was over £10,000². It was apparently Bewick's report which led one of the shareholders, William Benson, to withdraw from the company and threaten litigation if Sir George would not give him a price for his shares³. The cumulative effect of the purchase of all this plant, and the expenditure incurred in exploring the old workings, was that the company was in acute financial difficulties before the Friarfold Vein was cut by Sir Francis Level, and before the onset of the depression in the lead trade. In the four years 1874-77 the company raised only 106 tons of lead. In July 1877 the bank debt was £5537-2-8, and the bankers, Roper and Priestman, who were themselves shareholders, refused to meet any more pay bills⁴.

To pay off this overdraft, the directors offered the 630 unsubscribed shares at £7-10-0 each, a discount of 25 per cent, but only 344 were taken up⁵. Two issues of 7 per cent debentures, amounting to £7,500, were made⁶. Both the discounted shares and the debentures were taken up by the

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1. A memorandum in Sir George's hand listed some of the plant sold. The 1861 valuation gave £3070 as the value. Sir George received £4800 for the same equipment in 1873, and noted the current value (circa 1877) as £2,000. D.H. MSS. N2.
 2. A.D.Co. Reports and Accounts. D.H. MSS., B1.
 3. Thomas Benson, Shaw, and Hilliard withdrew shortly afterwards. Sir G.Denys to W.Benson 23 July 1877; and Sir G.Denys' memorandum c.1877. D.H. MSS. N2.
 4. G.Roper to Sir G.Denys 7 July 1877. D.H. MSS. N2.
 5. A.D. Co. Minute Book. 2 July 1877.
 6. Reports and Accounts 1873-83.

existing shareholders. These measures brought only temporary relief, and the company was soon in debt to the bank again.

The dual rôle of Sir George Denys had permitted the insertion into the lease of a clause whereby the duty of one-sixth was not to be paid until the shareholders had received a cumulative dividend of 7 per cent on their investment¹. Sir George eventually disagreed with his fellow-directors about the form of the company's accounts, arguing that all dead work should be charged to the capital account². This would have allowed the profit and loss account to show a profit, and therefore make the duty payable, even though the company was losing money steadily.

Some dissatisfaction over Sir George's position, perhaps because of the deferred royalty clause, was also felt by his fellow lessors. In August 1879 the solicitor to the lessors wrote to Sir George strongly urging him to resign the office of managing director, although remaining a director, and recommending that affairs between the company and the lessors should be dealt with by the latter's solicitor³. Sir George declined the advice and remained managing director until his death in February 1881.

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1. A.D.Co. Reports. D.H. MSS. B1.
 2. Correspondence between Sir G.Denys and W.S.Cooper, Secretary of the A.D.Co. 1879. D.H. MSS. N8.
 3. Currie, Williams and Williams to Sir G.Denys, August 1879. D.H. MSS. N.5.

III.

The Friarfold Vein had been cut by Sir Francis Level about thirty fathoms east of the boundary between the Old Gang and the A.D. Company's mines, and branches of the level were driven in the vein in both directions¹. In driving east the Old Gang Company soon found the vein poor and confused, and in rising to Sir George Level, for ventilation and to prove the vein, found no ore of any importance in the fourth limestone². To the west the ore seen when the vein was cut lasted for only a few fathoms, but at the boundary the ore was again good in the level, and above and below³. Within a few months the forehead of the level, which was being driven in sandstone and shale, was poor again, but the roof was still promising and the ore below the level good⁴. In August 1878 Sir George Denys wrote in his mining notebook, "268 Bings of ore in August. And all going on merrily. At last success seems certain."⁵.

In the meantime, however, the conditions of the English and world lead markets had undergone a fundamental change. There had been no violent fluctuations in the price of lead since the eighteen-thirties. The general downward trend of the eighteen-forties was probably due to the improved efficiency and output of the British mines, and the persistence of

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1. R.Place to F.Shuckburgh. Lessors' agent's six-weekly reports, 2 Aug 1877. D.H. MSS. SD5/R.
 2. Ibid. 17 Dec 1877, Sir G.Denys, Mining Notebook.
 3. Ibid; R.Place, loc.cit. 2 Aug and 15 Sept 1877.
 4. R.Place, loc.cit.
 5. Sir G.Denys, loc.cit.

relatively high prices after the Crimean War boom to the inability of those mines to continue their expansion to match the rising demand for lead and lead products. The output of pig lead from British mines was 64,500 tons in 1850, rose to 73,000 tons in 1855 and 1856, and afterwards fluctuated between 63,000 and 69,000 until it again exceeded 70,000 tons in the years 1868-70.¹

From the middle of the eighteen-sixties an increasing volume of imports caused a steady decline in the price of lead, from £21-12-0 in 1864 to £18-4-0 in 1871. After 1865 Britain was always a net importer of lead. In 1863 Britain had imported 28,666 tons of lead, of which 23,347 tons came from Spain, and 878 tons of ore, and exported over 42,000 of lead. In 1866 imports were 38,000 tons of lead (31,000 from Spain) and 10,155 tons of ore, including 6,625 tons from Sardinia; exports were under 39,000 tons. In the early seventies there was a sharp fall in the output of the British mines, doubtless due to the exhaustion of some of them, despite a substantial increase in the price, which rose to £23-6-0 in 1873, the peak year of the contemporary boom².

In the world-wide depression which followed, the price of lead fell to less than £15 a ton, from which level there was

1. R.Hunt, Mineral Statistics, in Records of the School of Mines, Vol.1, Part IV, 1853-56, and Mineral Statistics, 1857-81.
2. Ibid.

only a partial and temporary recovery, as the long term trend of increasing imports into Britain and declining prices was now resumed. Production was increasing rapidly not only in Spain, but also in Germany, whose output doubled between 1860 and 1870, and in U.S.A., where the building of the trans-continental railways had opened up the rich fields of Nevada, Utah and Colorado¹. During the decade 1863-1872, Britain had exported a total of 92,400 tons of lead to U.S.A.². In 1880 only 253 tons was shipped; in the same year Britain imported almost twice as much lead and ore as was raised at home, and amongst the world's lead producers she was now a poor fourth.³

Sir George Denys' prophecy of success was, however, confounded by the erratic and scanty distribution of the ore rather than by the fall in price. It was soon apparent that the Friarfold Vein was almost completely barren in the fourth limestone. The A.D. Company found some good ore in the third limestone, worked by a drift driven from a rise 26 fathoms above the main level, where in the summary of 1880 ore was being raised at only 10/- a bing⁴. Further west, however, the vein divided

1. Pulsifer: op.cit., pp.62-5, Ch.V.

2. In 1878 there was a tariff of £8-15-0 a ton on lead imported into the United States. Memorandum by F.Denys, 23 April 1879. D.H. MSS. M1.

3. Ibid; R.Hunt, Mineral Statistics, 1863-81.

4. A.D.Co. Report 31 Aug 1880. D.H. MSS. B1.

and the ore petered out¹.

The best ore on both sides of the boundary was found below the level in the fifth limestone, and the two companies sank sumps to work it². To pump the water the A.D. Company used a donkey engine worked by compressed air, and the Old Gang Company put in a small hydraulic engine. The work still had to be lifted by hand in "kibbles", or wooden buckets³. When the sumps had reached a depth of twelve fathoms, this haulage was costing from seven to ten shillings per bing of ore raised, and swallowed the entire profit in a falling market⁴. Later, with the sumps about two fathoms deeper, Sir George Denys wrote that for every two men raising ore, one had to be employed in lifting⁵. At any greater depth there would be a danger of the water overwhelming the A.D. donkey engine⁶. Sir George, as managing director of the A.D. Company, proposed at this stage that the two companies should jointly sink a sump at the boundary, and install an engine powerful enough to do the pumping and haulage for both⁷.

The A.D. Company considered the relative merits of hydraulic and steam engines for this purpose. Earlier in the century

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1. R. Place, loc.cit. 3 Aug 1880.
 2. Sir G. Denys: Memorandum on Old Gang Mine 1881; and Mining Notebook. D.H. MSS. SG4/65. and W2.
 3. R. Place, loc.cit. 5 Nov 1878 and 31 July 1879.
 4. Sir G. Denys: Memorandum on Sir Francis Level engine sump, June 1879; and Memorandum on Old Gang Mine 1880. D.H. MSS., SG4/50 and 63.
 5. Sir G. Denys: Memorandum on Old Gang Mine 1881.
 6. R. Place estimated that it would be adequate to a depth of 16 fathoms. R. Place, loc.cit. 3 May 1879.
 7. Sir G. Denys: loc.cit.

steam engines had been tried for a brief period in some of the Swaledale mines, but the cost of coal, of which the cost of transport accounted for the greater part, was too high for them to compete successfully with water power. On the other hand one of the directors of the company, James Tomlin, argued that steam engines were now much cheaper to buy and more economical in fuel than they had been when first tried in Swaledale, and that an hydraulic engine would be stopped by frost or a severe drought¹. The directors called for a report on the estimated costs of installing and running at Sir Francis a steam engine of the type in use at the Keld Heads mine in Wensleydale. The report showed that the cost of coal would be prohibitive. Coal brought from Richmond station would cost £1-8-4 a ton at the level head, compared with 10-0 at Wensley and Preston Station, close to the Keld Heads mine. Inferior coal could be bought at Tan Hill, in Swaledale, for 8-0 a ton, but the cost of horse transport would raise this to 19-3 at the level head².

The A.D. Company therefore decided in favour of an hydraulic engine. The Old Gang Company, however, declined to join in so expensive an undertaking³, which eventually cost over £4000, so soon after they had paid the lion's share of the cost of driving

1. J.R.Tomlin to Sir G.Denys 9 March 1879. D.H. MSS. N6.

2. Memorandum on comparative costs of steam and hydraulic engines. D.H. MSS. D6.

3. Sir G.Denys, loc.cit.

Sir Francis Level, and particularly as they felt that there was as yet no evidence of enough ore existing to justify the outlay¹. Sir George Denys had no such doubts, and he carried his fellow-directors with him. He wrote to his son Francis to say that he hoped to open the vein to a depth of some 32 fathoms², and when completed "I expect a mine which will astonish the natives and make their mouths water"³. The engine house was completed in September 1880, and Sir George wrote in his diary, "We had a festival at Sir Francis to commemorate the event. Speeches, songs, band of music, thirty gallons of beer and all very happy."⁴

During the dry summer of 1880 the A.D. Company which had effective control over, if not a fair title to, the water supply used by both companies at Sir Francis, cut off the supply to the Old Gang hydraulic engine, to allow the A.D. dressing floor to continue working. The Old Gang Company protested that it had a right to use half the water from Gunnerside Gill, and that the dressing floor could easily work off the accumulated bouse by working double shifts when the weather broke. The A.D. Company, or in practice Sir George Denys, may have taken this step to emphasise the dependence of the Old Gang Company upon its neighbour for working below the level. Sir George expected

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1. J.R.Tomlin to Sir G.Denys 27 Dec. 1879. D.H. MSS. M6.
 2. To the bottom of the 5th limestone on the south or low side.
 3. Sir G.Denys to F.Denys. Undated (1879) D.H. MSS. N5.
 4. Sir G.Denys; Mining Notebook.

that the Old Gang lessees would have to pay handsomely to the A.D. Company for pumping their water and lifting their work¹. "They must therefore agree to our terms, whatever they are, or stick fast."² Sir George resented the other Company's rejection of his proposals, and described its precarious position in what deserves to be regarded as a classic amongst mixed metaphors. "The life of the Old Gang is dangling on a hair with the sword of Damocles hanging over their heads."³

The A.D. engine was bought from Messrs. Hathorn and Davy, of Leeds, and cost, with pumping engine and pipes, £1,200 delivered at Richmond. Carriage to the mine and erection accounted for a further £300. Sinking the sump 20 fathoms deeper cost £500, and the engine house and the shaft down which the water was piped cost £2000. The final cost was over £4000.⁴ The engine could pump 500 gallons of water per minute, from a depth of 60 fathoms, and lift two tons of material every five minutes, or 200 horse wagons in a normal day's shift. The cost of lifting by this method was one-tenth of the cost of hand labour⁵.

While this machinery was being assembled and installed, the A.D. Company lent its donkey engine to the Old Gang Company,

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1. Sir G. Denys: Memoranda on "crisis in affairs of Old Gang Co." 1880. D.H. MSS. SG4/54.
 2. Sir G. Denys: Proposals for forming joint A.D./Old Gang Co. 7 Oct. 1878. D.H. MSS. SG4/40.
 3. Sir G. Denys: Memoranda on crisis in affairs of Old Gang Co.
 4. Sir G. Denys to Francis Denys 14 Sept 1879. D.H. MSS. N5., and Sir G. Denys Mining Notebook.
 5. Sir G. Denys: Memorandum on Old Gang Mines 1881. D.H. MSS. SG4/65

which allowed the latter to continue working below the level¹. When the new hydraulic engine was in position, the donkey engine was withdrawn², and work stopped in the Old Gang sump. The Old Gang Company turned its attention to driving the level eastward in the Friarfold and Old Rake Veins³. Some ore was raised in the latter, in which 220 fathoms had been driven by 1887⁴ but in general the appearance of both was very unpromising⁵.

Sir George Denys died in February 1881, and so was spared the chagrin of finding that the ore in the drifts from the A.D. engine sump did not last. In the summer of 1882 the hydraulic engine stopped, after working for a little over twelve months, and was never subsequently used.⁶

IV.

To deal with the ore from Sir Francis Level the two companies built two large, up-to-date dressing floors, each with substantially the same equipment, on opposite sides of Gunnerside Beck near the mouth of the level. On the A.D. Company's floor the water wheel from West Stonesdale, 28 feet 4 inches in diameter, was set up to provide the power for mechanically-operated hotching tubs⁷. A memorandum by the company agent described the proposed mode of operation. The hotching shaft was to make

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1. Sir G. Denys: Memoranda on crisis in affairs of Old Gang Co. 1880.
 2. Apparently it was used in conjunction with the A.D. hydraulic. Sir G. Denys: Mining Notebook.
 3. Sir G. Denys: Memoranda on crisis in affairs of Old Gang Co.
 4. Old Gang Mine Plan 1887. D.H. MSS. P/OG 9.
 5. Sir Francis Denys; Continuation of Sir George's Mining Notebook.
 6. Ibid.
 7. Costs of new dressing floor at Sir Francis Level, 1876-78, D.H. MSS., S.F.4.

eleven revolutions a minute. "Place a pinion on the said hotching shaft with six teeth, will give the sieve sixty-six bats per minute. If this be thought overfast, five teeth will give fifty-five bats. The latter may be fast enough, as the sieve will be sufficiently hotched in four minutes, 220 bats at the sieve for one hotching. This allows four minutes for the man to clean his other sieve and fill it."¹

The crushing mill and chatt mill, which were driven by two more water wheels, were of an improved design, incorporating some form of classifier which delivered the material graduated according to size.² Another innovation, as far as Swaledale was concerned, was the circular buddle. There were two of these on the first waste dressings, and one on the second waste dressings, where ore was recovered from the "smiddum" and slimes. Two more water wheels drove the mechanism of these buddles³. Each buddle had a floor which sloped downwards gently from the centre to the circumference, with a vertical axle in the centre from which radiated four horizontal arms hung with brushes. The slimes flowed down in suspension in a stream of water into the buddle, the arms of which revolved so that the brushes were kept in gentle contact with the surface of the slimes and the latter

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1. Agents memorandum 30 Aug 1877. D.H. MSS. D6.
 2. As described in W. Forster, Treatise on a Section of the Strata from Newcastle-upon-Tyne to Cross Fell, third edition, p.179. J.R. Tomlin to Sir G. Denys, 13 Jan 1878. D.H. MSS. N6.
 3. Valuation of A.D. Co's plant. 1887. D.H. MSS. B 13.

kept in suspension long enough to effect separation according to density. When the buddle was full, the machinery was stopped and the water drained off. The material was then divided into the usual three parts. At the "head" or centre of the buddle was the ore, which was taken to be roasted and smelted. At the "tail" or outer edge was mud which was thrown away, and the material in between was put aside to be buddled again.

The total cost of the A.D. Company's floor was over £1250, one-fifth of which was spent on the three circular buddles. This outlay was soon recovered, by reducing the cost of dressing and by extracting more ore from the slimes, according to the following account by the company's agent:

"Cost of dressing ore at Sir Francis - new and old appliances, from commencement (5) to Dec 1880.

A.D. Company

<u>New Appliances</u>	<u>Old Appliances</u>
Crop ore (6) 5717 bings dressing at 2/- a bing	dressing at 3/-
£571-14-0	£857-11-0
Waste ore 714 bings dressing at 16/-	476 bings dressing at 22/-
£571-14-0	£523-12-0
(1 bing of waste recovered from 8 bings of crop ore)	(1 waste to 12 ore)
	Loss of waste, 1 in 24, of 5717 bings of crop ore - 238 bings at 64/- a bing
	£761-12-0
	£2142-15-0
<u>£1142-18-0</u>	
Balance : profit on new appliances -	£999-17-0

1. Forster, op.cit., 3rd edition, pp.177-8; J.W.Gough, Mines of Mendip, pp.185-6. 2. D.H.MSS SF4 and N8.
3. "A great saving of time and labour is effected by the modern washing apparatus. The work which formerly required the work of two men and eighteen boys can now be done by two men and four boys." Forster, op.cit., 3rd edition, p.181.
4. D.H.MSS SG4/56.
5. Spring or summer 1878.
6. Ore from the mine.

"Old Gang Company.

<u>Crop ore</u> 2708 bings				
dressing at 2/- a bing	£270-16-0	dressing at 3/-	£406-4-0	
<u>Waste ore</u> 338 bings		225 bings		
dressing at 16/- a bing	£270- 8-0	dressing at 22/-	£247-10-0	
(1 waste to 8 crop ore)		(1 waste to 12		
		crop ore)		
		Loss of waste, 1 in 24,		
		of 2708 bings crop ore =£361-12-0		
		113 bings at 64/-.		
	£541-4-0		£1015-6-0	

Balance : Profit on new appliances £474-2-0."

Frank Huntsman, a director of the A.D. Company, commented, "I am very much interested in your report on the advantages which we derive from the outlay on the dressing floors and circular buddles - the last exceeds my expectations."¹ In the following year, however, the agent, Thomas Raw, wrote that some small slime ore was still being lost in the beck and that more settling pits should be constructed².

The advantages of the new dressing floors were partially offset by the inconvenience of the smelting arrangements. The Old Gang Company had recently been trying to improve the efficiency of its mill in Hard Level Gill. In 1872 and 1873 one of its four ore-hearths was replaced by a reverberatory furnace, and another modified to the pattern of those used in the Cobscar Mill in Wensleydale³. The two new hearths were then run alongside the old ones, but if a record of comparative costs was kept it has been lost. In 1878 the company built a refining furnace

1. Frank Huntsman was the son of Benjamin Huntsman. F.Huntsman to Sir G.Denys, 27 Dec 1880. D.H. MSS. N7.
 2. T.Raw: Report on A.D.Company's Mine 5 May 1881. D.H.MSS. P4.
 3. Agent's Notebook; Arkendale, Fell End and Old Gang 1863-73. D.H. MSS., F8.

to improve the quality of its lead by removing all sulphur and antimony¹. The mill, however, was not well situated to deal with the ore from Sir Francis Level, which had to be carried up Gunnerside Gill to Bunting Level, and taken through the latter and Hard Level to the mill, a distance of over 4 miles, at a cost of 12-0 per ton of lead².

The A.D. Company at first smelted at Blakethwaite mill at the head of Gunnerside Gill, nearly a mile and a half from the level mouth, but the mill was in bad repair and inefficient³. The smelting was therefore transferred to Surrender mill, which was also leased to the company⁴. The carriage of the ore cost 14/- per ton of lead⁵, but the mill was more efficient and the longer flue of Surrender recovered more soot lead than at Blakethwaite.⁶ Too much fume was still escaping, however, and a threat of legal action by the lady of the manor of Healaugh, because of the damage to herbage caused by smoke from the mill⁷, focussed attention on this waste. The directors made enquiries about a number of fume condensers⁸, but soon agreed that there was little point in erecting an expensive condenser at a mill so

1. J.R.Tomlin to Sir G.Denys 3 Nov 1878 and 12 Jan 1880, D.H. MSS., N6 and M6.

2. Sir G.Denys to F.Denys 22 April 1880. D.H. MSS. N9.

3. J.R.Tomlin to Sir G.Denys. 12 May 1878. D.H. MSS. N6.

4. Ibid. 16 May 1878.

5. The cost of the carriage up to Blakethwaite and back down the gill is not known. Agent's Memorandum on selling in lead or ore, 1880. D.H. MSS. SG4/57.

6. J.R.Tomlin to Sir G.Denys 16 May 1878.

7. It is unlikely that such an action would have succeeded, as all rights necessary to mining and smelting were reserved in the sale of the manors in 1738. The A.D. Co., however, promised to make the chimney smoketight. J.R.Tomlin to Sir G.Denys, 23 Apr 1880. D.H. MSS. N9.

8. F.Huntsman to Sir G.Denys, 1 Mar 1880. D.H. MSS. N 7.

inconveniently placed as Surrender was¹. John Tomlin wrote, "Why should not the matter be met boldly and new smelt mills erected above Gunnerside and our lead sent to Askrigg² instead of Richmond. There would surely be a great economy? The Old Gang Co. ought of course to join in such a plan."³

The arguments in favour of a new mill near Gunnerside were reinforced by the proposal, first made in 1878, to amalgamate the two companies. A memorandum about the projected amalgamation by Sir George Denys suggested a mill with four hearths, a roasting furnace, slag hearth, chimney, and condenser, and a tramway from Sir Francis Level to the mill⁴. The companies could not, however, afford the outlay, estimated at between £2500 and £3000⁵, at a time of severe depression.

Until such time as a new mill could be built, the A.D. Company decided that it would be more profitable to sell their produce as ore than to smelt it. The agent calculated that with lead at £15 a ton and dressed ore at £9, the cost of selling lead was 7-11 a ton more than the cost of marketing the equivalent quantity of ore⁶. An important factor in the calculation was the cost

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1. J.R. Tomlin to Sir G. Denys, 23 April 1880. D.H. MSS. N.9.
 2. A branch line from Northallerton had reached Askrigg in 1876. Gunnerside is 7 miles from Askrigg, and 18 from Richmond, but the road to the former climbs a very steep hill.
 3. J.L. Tomlin to Sir G. Denys 29 Oct 1879. D.H. MSS.
 4. Sir G. Denys: Proposal for forming joint A.D.-Old Gang Co., 7 Oct 1878. D.H. MSS. SG4/40.
 5. Ibid; and Sir G. Denys to F. Denys 22 April 1880. D.H. MSS.
 6. Agents memorandum on selling in lead or ore 27 July 1880.

of carriage to Surrender Mill, but some of the ore proved difficult to smelt because of the quantity of "Black jack" (blende) mixed with it, which the dressing appliances were unable to separate because its density was almost the same as that of galena. Sir George Denys wrote: "The consequence is a dead loss as we can frequently get only 16 pigs of clean lead from 4 bings of ore instead of 20 which we ought to get."¹ The agent may, of course, have been wrong in assuming that ore of this quality could be sold for £9 a ton, but the company began to sell all its produce as ore in November 1880². The Old Gang Company, and after the amalgamation in 1889 the new Old Gang Company, continued to smelt lead until 1898, although part of its produce was sold as ore from 1894³.

Neither the Old Gang nor the A.D. Company was extracting silver from the lead during this period, although this was apparently being done in Arkengarthdale and at Hurst. On the average Swaledale lead contained about 2 or 2½ ounces of silver per ton, and at this rate it was not usually profitable to extract the silver as the cost of doing so exceeded the value of the silver. An entry in Sir George Denys' mining notebook, made in or about 1872, reads, "Assay of Old Gang lead: Value of silver 7-6 per ton, cost of extracting 11-6."⁴ Some silver was extracted in

1. Sir G. Denys to J.R. Tomlin, undated (late April 1880) D.H. MSS. N.9

2. Lead Weighing Book. D.H. MSS. ADM6.

3. Ibid.

4. Sir G. Denys: Rough Mining Notebook. D.H. MSS. W3.

Arkengarthdale, presumably from lead containing a greater proportion of it, but the evidence is scanty. In 1854 Richard Jaques, a partner in both the Old Gang and Arkengarthdale Companies, applied unsuccessfully to the North-Eastern Railway Board for permission "to rent or purchase a shed at Richmond Station for the purpose of desilvering lead."¹

In the official mineral statistics, Hunt gives some figures of silver produced from Swaledale lead from 1875, including the following:²

	1875	1876	1877	1878	1879	1880	1881
Arkengarthdale	4148	3528	2223	2950	1825	1830	2938
Old Gang	-	-	1380	1258	1732	1200	500
A.D. Company ³	Nil	-	-	-	-	-	-

The Old Gang agent, however, recorded in his diary on 22 April 1878 that he had just returned the 1877 figures for his mine as:-

"13812 cwt - 1 - 24 of lead, no silver extracted."⁴

Hunt gives the lead produce as 690 tons 12 cwts, with 1380 ounces of silver extracted. This is exactly two ounces per ton of lead, if the odd 12 cwts are ignored, as is the figure for 1878. Hunt apparently supplied the silver production figures himself, though for what reason it is difficult to imagine. The silver production figure for 1879 represents nearly three ounces per ton; the figures for 1880 and 1881 look suspiciously round. There is no reference to silver's being extracted in the very full correspondence and accounts of the Old Gang Company which

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1. Minutes of North-Eastern Railway Company, 1 Dec 1854, quoted in H.W.Parris, Railways in the Northern Pennines to 1880 (1954) p.238.
 2. R.Hunt, Mineral Statistics, 1875-1881.
 3. Here given as "Surrender and Swinnergill".
 4. J.A.Clarkson's Notebook. 1877-78. D.H. MSS. D1.

have survived from this period. The A.D. Company definitely extracted no silver, although the directors considered a number of different processes¹. The Arkengarthdale and Hurst figures may, of course, be perfectly accurate.

V.

After the exhaustion of the ore in the fifth limestone worked from the engine sump, the A.D. Company drove the Sir Francis Level westward in the North Vein, and later to the north in the Watersykes Vein. Both veins were very poor in the lower limestone beds², and the driving of the level was delayed by the financial difficulties of the company. By 1883 the latter was again heavily in debt to the bank and in the following year the mine was seized by the trustee of the debenture holders, Frank Huntsman, to forestall distraint for unpaid poor rates by the local overseers³.

The Old Gang Company, which was still organised as a private partnership, had not incurred such heavy losses as its more adventurous neighbour, but had shown a growing annual loss since 1875-76. There was little prospect either of finding good ore or of a rise in the price of lead, and in 1887 the Jaques, Knowles, and Tomlin families, and their partners, ended a long association with the mines by surrendering their lease⁴.

1. Correspondence, Walker, Parker, Walker and Co. and Sir G. Denys, 1879; and J.L. Tomlin and Sir G. Denys. D.H. MSS. SD5 and M7.
2. Sir F. Denys: Continuation of Sir George's Mining Notebook.
3. A.D. Co. Reports and Accounts 1873-83, and F. Huntsman to Sir F. Denys, 13 April 1884. D.H. MSS. N.10.
4. Notice to determine Old Gang lease on 31 Dec 1887, dated 3 Sept 1886. D.H. MSS. P3. The duty payable by the Old Gang Company had been reduced from one-sixth to one-eighth from 1882. Lessors' correspondence with Old Gang Company 1881-1885. D.H. MSS. P2.

In 1889 a new company was formed to work the combined A.D. Company-Old Gang field. It was known as the Old Gang Lead Mining Company Limited, and had a capital of £20,000¹. Its financial history was similar to that of the A.D. Company. There was a good deal less than £20,000 available to carry on new mining operations. £2,500 was paid in cash for the plant of the two former companies, and £5,500 in shares for the interest of the debenture holders of the A.D. Company, which is presumably the main reason why Frank Huntsman, John Tomlin, Roper and Priestman were shareholders in the new company; £3,600 worth of the shares were not taken up².

The outstanding fact about this company was that it survived for seventeen years. The price of lead had recovered a little from the 1884 figure of £11-6-0 a ton and the annual average price for 1888-1890 varied between £13 and £14 a ton. A new wave of depression in the early eighteen-nineties forced the price down to little more than £9-10-0 a ton, and although it improved before the end of the decade, only a company working very rich deposits could hope to show a profit in these conditions. The Company raised some ore from Old Rake Sun Vein in the former

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1. The chairman of the company was Joseph Cradock of Stockton, who was a nephew of Henry Priestman. He was a partner in the Swaledale and Wensleydale Bank and leased and managed some lead mines in Nidderdale. F.Huntsman to Sir F.Denys, 19 Dec 1887, D.H. MSS. P4.
 2. Old Gang Company Accounts 1890-1906. D.H. MSS. V2. The Company paid a royalty on a sliding scale, ranging from one-ninth when the price of lead was over £18 to one-fourteenth when it was less than £12. Correspondence of Sir Francis Denys, D.H. MSS. N11.

Old Gang ground, and from Watersykes Vein in the underset limestone and chert worked by a northward extension of Priscilla Level, but no discoveries of any great value were made¹.

Sir Francis Level was continued northwards in Watersykes Vein for a twofold purpose, to drain the underset beds in Priscilla Level some 42 fathoms above, in which ore had been left when the northward dip of the beds put the undersets below the level; and also in the hope of reaching and draining the Blakethwaite Vein, which offered the only real prospect of reviving the mines². The rise to Priscilla was plagued by ill-luck. It was started on 13 January 1904, and in March when the rise had gone twelve fathoms an explosion of firedamp occurred, which, to quote the agent, was "unprecedented in the history of lead mining in our neighbourhood."³ No serious injury resulted. To avoid the apparent source of the explosive gas, a drift was driven forward for four fathoms and the rise resumed from there. Some ore was found in the third limestone. Ten fathoms above the drift, the rise cut a feeder of water, and a second drift was driven for 25 fathoms to avoid this. When the rise finally reached Priscilla Level, it had cost

1. Reports of lessors' agent 1897-1927. D.H. MSS. V5.

2. Sir F. Denys, Continuation of Sir G. Denys' Mining Notebook.

3. Reports of lessors' agent, 1897-1927.

£360¹, and only a small quantity of ore was found². According to Sir Francis Denys, this was because the rise should have been made further north³.

For the company this was the last straw. Its capital was exhausted. It had tried to raise more money by issuing £5,000 worth of 6 per cent preference shares, but only £1,000 worth were bought⁴. Later £4,200 worth of 5 per cent debentures were taken up by Roper and Priestman and inherited by Barclays when they absorbed the local bank in 1902⁵. In October 1906 the company went into liquidation. Barclays had to write off the overdraft and unpaid debenture interest amounting in all to over £2000, and sell the debentures, which meant in effect the right to seize and sell the plant, to Sir Francis Denys and one of his co-lessors for £500⁶. A few mines continued working directly under the lessors in the old Old Gang ground until 1914, when the mine was finally abandoned⁷.

VI.

The fortunes of the Arkengarthdale mines after 1870 were strikingly different from those of the A.D. group. The new partnership which took over the former in 1870 began with a few

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1. Sir F. Denys, loc. cit.
 2. Reports of lessors' agent 1897-1927.
 3. Sir F. Denys, loc. cit.
 4. Old Gang Co. Accounts 1890-1906.
 5. Ibid; Lucas, Hutchinson and Meele, solicitors for Barclays, to Currie, Williams and Williams 15 Oct 1906. D.H. MSS. V6.
 6. Correspondence about the liquidation of the Old Gang Co., 1905-06. D.H. MSS. V6.
 7. Reports of lessors' agent 1897-1927.

lean years. The output which had exceeded 1200 tons in 1868 and 1869 fell to an average of little more than 500 tons in the years 1871-1873. The poorest year was 1873, at the height of the boom, with lead prices at their highest level for nearly twenty years. The reason was simply that there was not much good ore in sight¹.

The prosecution of several new trials put the company £6,700 in deficit by the middle of 1873. Then valuable new discoveries were made, first in the Danby Level workings and then in the Stang and Faggergill mines. In 1878 nearly 2000 tons of lead were raised, and the average for the decade 1877-1886 was nearly 1500 tons. By 30 June 1887 the company had made a cumulative net profit of £45,500, despite the low prices of this period. In the year ending 30 June 1878, before the price of lead had fallen seriously, the profit was £11,390. In the year ending 30 June 1887 the profit was £5,343 on a lead output of over 1400 tons². It is difficult to make an accurate assessment of the effect of the low prices on the output of the Arkengarthdale mines as few of the company's records have survived, but it is highly probable that some poorer ore was by-passed because it could not be worked at a profit. The higher profits which would have been made if prices had remained at the "normal"

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1. W. Whitwell to Sir G. Denys, 1 Feb 1873. D.H. MSS. M1.
 2. Report on finances of Arkengarthdale mines, 26 May 1891. Arkengarthdale MSS. 20. The duty had been reduced from one-sixth to one-ninth by 1884. Sir F. Denys to Kays and Jones, 26 Nov 1884. D.H. MSS. T2.

level of from £18 to £22 would also have made more money available for development work.

The working out of some of the richest deposits, particularly in the Danby mine, and no doubt the persistence of a low price, caused a sharp fall in the output from 1582 tons in 1886 to 653 tons in 1888, and a steady decline continued thereafter. It was not until 1902, however, that the mines were closed down, and in 1908 the mines at the northern end of the royalty were leased by a new company, the Stang and Cleasby Mines Ltd. The latter re-opened the Stang and Faggergill mines and drove two new levels into Cleasby Hill. The venture at first promised well, but the ore did not persist, and despite a rise in the price of lead the mines were finally abandoned in 1912.¹

VII.

The fall in the price of lead was not the main cause of the decline and final extinction of the Swaledale lead mining industry. Before the fall began, in 1877-78, the West Swaledale, South Swaledale, Blakethwaite (including Lownathwaite, Swinnergill and Arngill) and Surrender mines had been abandoned or left on the hands of the lessors, and the thousands of pounds spent by the A.D. Company in exploring the latter two merely confirmed the wisdom of the former lessees in giving them up. In the Old Gang mine all the major veins, except the Watersykes Veins, had been more or less cleaned out in the main bearing beds.

1. A. Raistrick, Mines and Miners of Swaledale, pp.74-75; and information from Mr. G.B.Harker, formerly secretary of the company.

TONS

2000

1800

1600

1400

1200

1000

800

600

400

200

1850

1860

1870

1880

1890

1900

PRICE
PER
TON

£25

£20

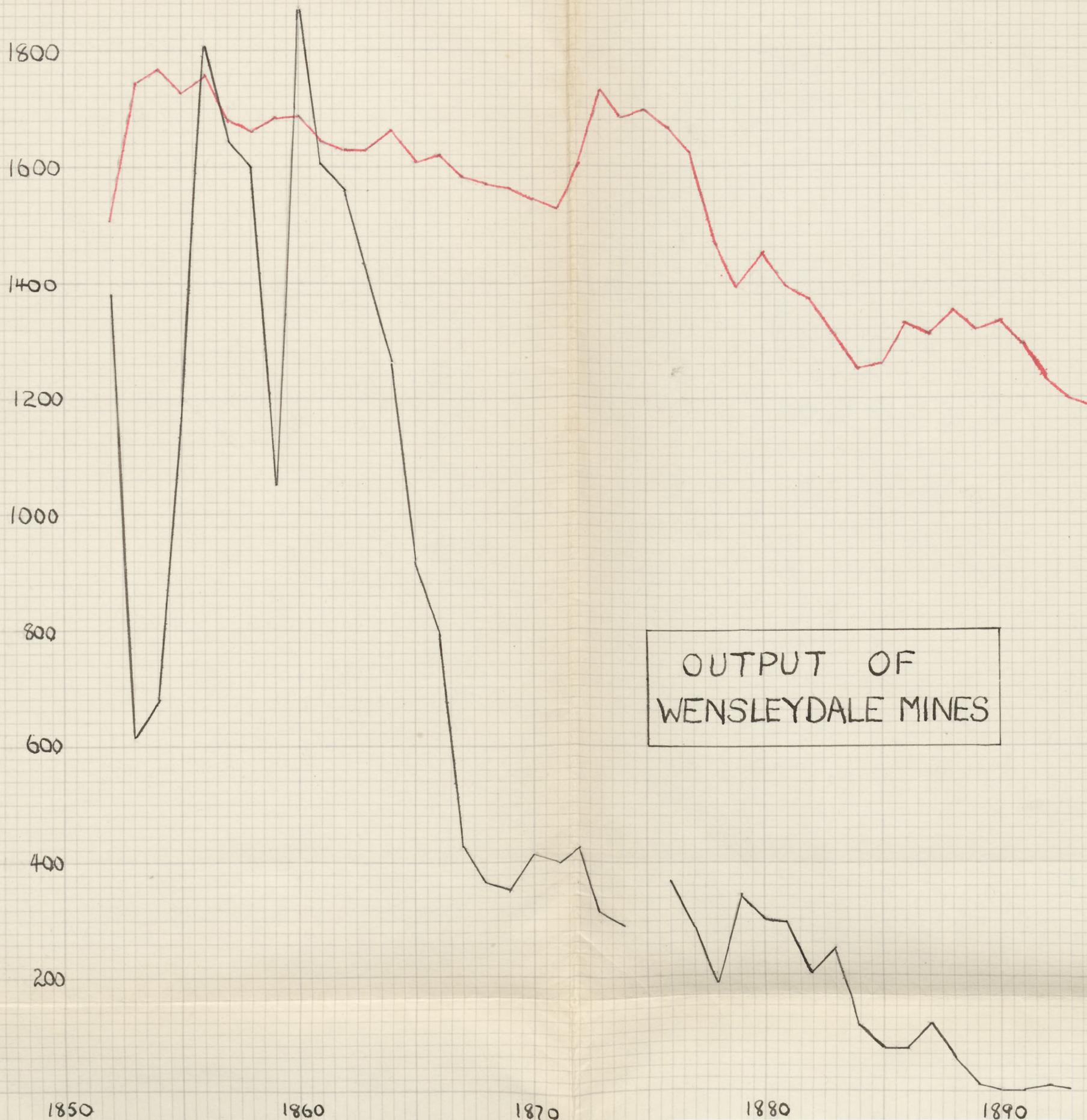
£15

£10

£5

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OUTPUT OF
WENSLEYDALE MINES



These veins, too, gave out while prices were still high, and before the latter began to fall the output of the Old Gang mine, and with it that of the whole A.D. group, had declined to the lowest level hitherto recorded. The last hope of restoring the former prosperity of these mines faded when the lower beds tried through Sir Francis Level turned out to be relatively barren.

Swaledale was not the only lead mining field in Yorkshire which was suffering from progressive exhaustion by the middle of the eighteen-sixties. In the decade 1855-1864 the total output of the county varied between 6000 and 9000 tons. Subsequently it declined steadily, and during the period of high prices in the seventies it ranged from 3700 tons to a little under 3000 tons. The average annual output of the Wensleydale mines during the decade 1855-1864 was 1500 tons. During the next ten years it was only 470 tons, and after 1872 the output never reached 400 tons¹. If the produce of the Watersykes Veins is ignored, the output curve of the A.D. group is very similar to that of Wensleydale.

The fortunes of the Arkengarthdale mines showed in a different way how unrelated movements of price and of output could be. A rich mine could yield a profit at a low price, and a high price would not stimulate a barren mine to produce well. On the other hand, the depression seems to have had a marked effect upon the Hurst mines, where production fell from 300 tons in 1877 to nothing in 1881², but in the absence of any information about

1. R.Hunt, Mineral Statistics, 1855-1881.

2. Ibid.

this mine except for the output figures, any conclusion must be tentative.

Although the fall in price was not the principal cause of the decline of the Swaledale mines, its effect must not be ignored. The depression administered the coup de grace to mines which might otherwise have continued for some years to yield a small output from minor veins and from reworking some of the older workings.

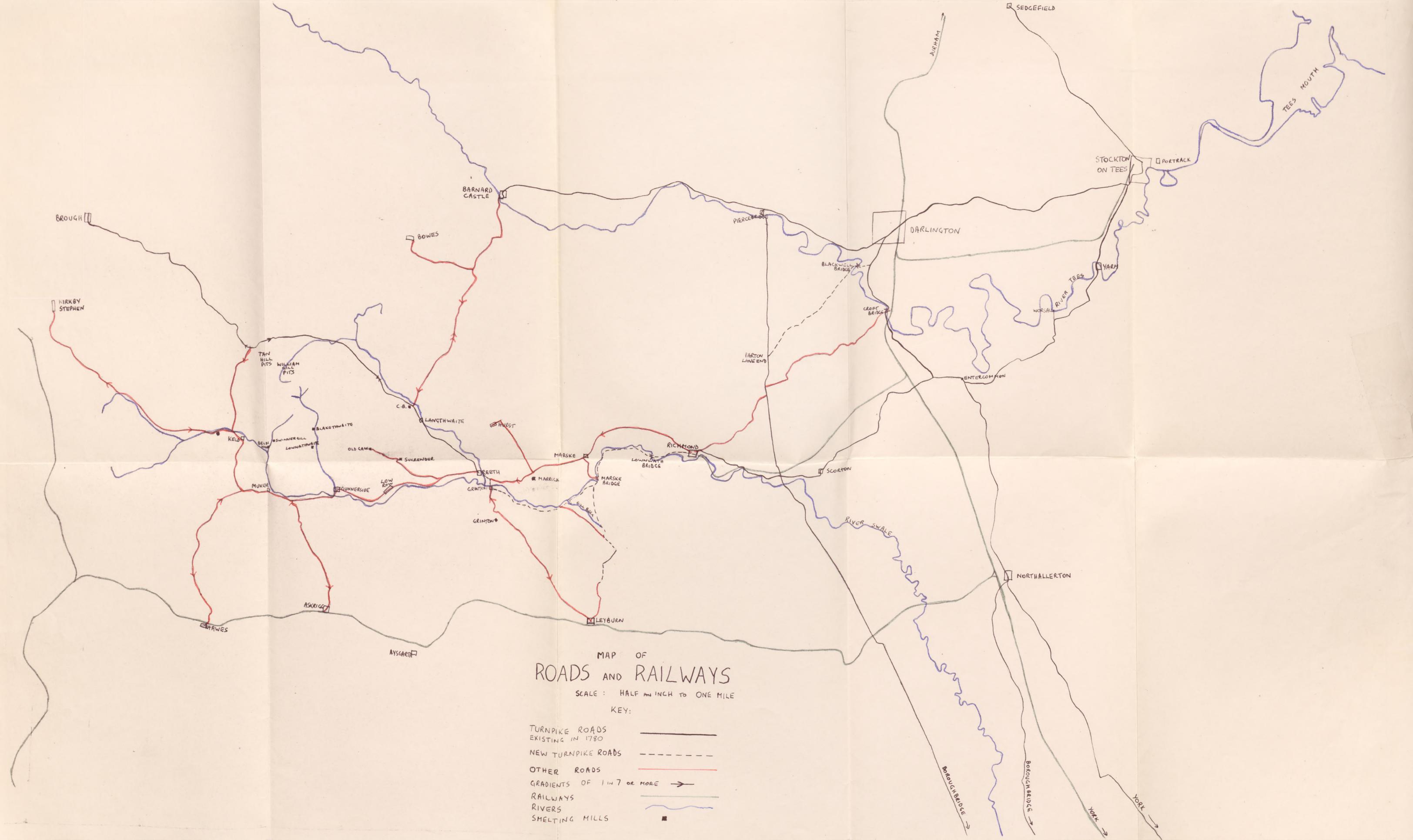
In normal market conditions Sir Francis Level would probably have reached the Blakethwaite Vein, which might have prolonged the productive life of the mines for a number of years. On the other hand, it is important to remember that the major companies working in the area did not give up their mines as soon as they began to lose money. Had this happened, it would have been possible to suggest that a few more years' persistence might have led to the discovery of some new deposit which would have revived the mines. In fact the struggle was not finally abandoned until 1912-1914, a quarter of a century after the onset of the depression in English lead mining.

The results of attempts to reopen the mines confirm these conclusions. In 1918 E.R.Fawcett, the author of the Fawcett MS., and J.R.Pickup, Swaledale men who had prospered in business in Burnley and Nelson respectively, returned to the dale to try some of the smaller mines. They spent nearly £3,000 according to Fawcett, on trials in Oxnop Gill, Satron Moor, Ivelet Side, and Arngills, but raised only about 13 tons of ore, from a flot in

the underset limestone in East Arngill Low Level. The trials were abandoned in January 1921¹.

In 1925 E.C.Vickers, who had raised some 40 tons of barytes from the Old Gang waste heaps in the previous year, formed a company, known as Swaledale Mines Ltd., to work the Old Gang and Surrender mines, and particularly the Watersykes Veins through Victoria Level. The prospectus began, "Solely in consequence of lead falling to the low price of £7 a ton... the mines which the company is acquiring were closed in 1875", although some of the mines had not closed until 1914, and the average price of lead in 1875 was £22-9-4 a ton. Most of the paid-up capital of £10,400 was taken in shares and fees by the promoters, and the rest was spent without any ore being found².

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1. Correspondence, Pickup and Fawcett to Sir F. Denys-Burton, 1918-20. D.H. MSS. RB1; Reports of lessors' agent 1897-1927. D.H. MSS. V5.
 2. Reports of lessors' agent 1897-1927; Prospectus and correspondence concerning Swaledale Mines Ltd., 1925-26. D.H. MSS., V8.



MAP OF
ROADS AND RAILWAYS

SCALE: HALF AN INCH TO ONE MILE

KEY:

- TURNPIKE ROADS EXISTING IN 1780
- NEW TURNPIKE ROADS
- OTHER ROADS
- GRADIENTS OF 1 IN 7 OR MORE
→
- RAILWAYS
- RIVERS
- SHELTERING MILLS

Chapter VII : Problems of Transport.

In the field of transport there were no improvements comparable to those in the methods of mining and smelting, during the seventeenth and early eighteenth centuries. Until the end of the latter century the packhorse, or jagger, which had long been the universal means of transport in Swaledale, was used for the carriage of virtually all the ore, lead, and mining materials on the mining fields, and to and from Richmond. It is probable that jagers were used also to carry lead from Richmond as far as the ports of Yarm, Stockton, and Boroughbridge until these routes were turnpiked in the middle of the eighteenth century.

Some of the routes used before the eighteenth century are recorded in the names of old trackways. One called Orgate led from the Arkengarthdale mines to the smelting mill at Clints, near Marske, which is first mentioned in 1590. Another, Jagger Lane, branches from the old Reeth-Richmond road on the top of the ridge east of Marske, in a straight line towards Darlington, passing near to Whashton smelting mill. Similar trackways run from Reeth to Gayles, and from Arkengarthdale to Newsham, and on from those villages to Darlington and the estuary of the Tees.¹

Packhorses held their place on the mining fields, for the carriage of ore and coal to the mills, until the horse levels were driven. When the mines were worked by a large number of

1. A. Raistrick, Green Roads and Byways, in the Yorkshire Dalesman, Vol. 8, 1947. pp. 233-235, 248, 261.

hushes and shafts it was uneconomical, as well as in some cases physically difficult, to make and maintain adequate cart roads to all of them. A pack animal could take a much more direct route across rough terrain than could wheeled vehicles, which offset the greater carrying capacity of the latter. At about the beginning of the nineteenth century the replacement of a large number of shafts by a few horse levels reduced the mileage of roads necessary and swung the balance of costs in favour of the carts and waggons.

Until this change took place, jagers were used also for the carriage of lead to Richmond, even from the C.B. mill in Arken-
garthdale, which stood by the Reeth-Brough turnpike.¹ The road from Reeth to Marske and Richmond was one of the few roads of North Yorkshire which escaped the censure of Arthur Young when he travelled through the area. He described the surface as good, "owing to the spirited conduct of Charles Turner Esq. when he lived at Clints."² There were, however, two long inclines, with gradients of about 1 in 5 and 1 in 6, to be climbed in each direction, so that waggoners had to split their loads or attach extra horses. There was therefore little to choose between the costs of carriage by packhorses and by waggons, and it was convenient to retain the former as long as they were still used at the mines. The changeover from jagers to waggons,

1. Arkengarthdale mining accounts, 1780-1800. K.L.MSS.

2. The Turners were part-owners of the manor and mines of Arken-
garthdale. A. Young, Six Months Tour through the North of
England, second edition (1771), Vol. IV, p.427.

at the mines and on the Richmond road, took place mainly between 1800 and 1820, when several new roads were made at various mines to link the new horse levels with the public highways.¹

There are some details of the costs of packhorse transport in the accounts of the Arkengarthdale and A.D. mines for the last twenty years of the eighteenth century. Each packhorse carried two pigs of lead, the average weight of an Arkengarthdale pig being 148 lbs. The ore raised in Arkengarthdale during this period was reckoned in fothers and "horses", a "horse" being one-sixteenth of a fother, or 154 lbs. This was presumably the weight of ore carried in each of the panniers slung on the packhorse.² Other jagger loads were : 16 yards of horse rails, 12 horse rail sleepers each 3 feet long, 1 horse-level waggon, 2 washing tubs, 4 whim tubs, 21 yards of buddle boards.³ The weight of a jagger load of coal is not known.

The carriage of ore from the shafts to the mills in Arkengarthdale cost 4d. a jagger load, except for ore from Hallgate Pasture, north-east of Hurst, which cost 8d. Lead was carried from the mills to Richmond at 1-1d and 1-2d. a load, or 6½d and 7d a pig. Expressed as a cost per fother of 22 cwts., these two items came to about twelve shillings. Coal cost 4d a load

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1. M.Wadson, Minutes of Correspondence, 1800-1812; W.Richards to J.Davies, 18 May and 17 Aug 1820. D.H. MSS. C.A.2 and R.D.13.
 2. Arkengarthdale mining accounts, and J.Mowbray, Memorandum, 26 Dec 1795, K.L.MSS. Pkt.15 and Pkt.7(a)/5(a).
 3. A.D. Smelting Mills Accounts 1801-1807. D.H.MSS. R.D.21, Part 1.

at the pits at William Gill or Tan Hill, and carriage to the mills, a distance of about seven or eight miles, cost between 8d and 10d a load. Cinders were sold at the same pits for 6d a sack, with 1-2d or 1-3d for carriage.¹

Between 30th November 1793 and 30th April 1799 the Arkengarthdale mines produced 170 marks² of lead at a total cost of £50,326. Of this £4,061, or a little over eight per cent., was spent on packhorse transport, and a further £2,043 on the carriage of lead in waggons from Richmond to Stockton³. The A.D. Mines Account for the period from 19th January 1786 to 30th November 1792 shows £8,063 as the cost of carriage of ore and lead out of a total bill of £59,388, a little over 13.5%.⁴

During the middle ages Swaledale lead was shipped to the south of England and the continent through the river ports of Yarm on the Tees and Boroughbridge on the Ure⁵. By the end of the seventeenth century Yarm had lost its position to Stockton, further down the river⁶, and at the end of the

1. Arkengarthdale mining accounts, K.L.MSS Pkts.1,7,15.

2. A mark was 400 pigs, so called because each series of 400 pigs was marked with the same letter.

3. Arkengarthdale mining accounts.

4. A.D. Mines Pay Bills 1786-1792. D.H.MSS R.D.7.

5. See above, pp.17-8.

6. J.Brewster, History and Antiquities of Stockton-on-Tees, first edition (1796), pp.64-71.

eighteenth century the latter handled most of the Swaledale lead. Nearly two-thirds of the A.D. lead smelted between 1796 and 1800 was sent to Stockton, the rest going to Hull via Boroughbridge. After 1800 all the A.D. lead went to Stockton¹. All of the Turner family's one-third share of the lead produced in Arken-
garthdale between 1780 and 1800 was sent to Stockton, except for one consignment of three marks sold to a firm of lead merchants at Hull. Sir Charles Turner's steward wrote to the latter, expressing his "desire to keep up and encourage the intercourse with your port", but no more lead was sent to Hull before the mines were leased in 1800.² There was normally no advantage to be gained from so doing, as the prices offered in Hull and Stockton, being governed by those ruling in London, were usually the same, the shipping costs from the two ports to London differed little if at all, and the cost of carriage from Richmond to Hull was about half as much again as to Stockton³.

There were two routes between Richmond and Stockton, one through Scorton, Entercommon, and Yarm, and the other through Darlington. The latter was reached via Croft until the present road via Barton and Blackwell Bridge was constructed in 1832⁴.

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1. Accounts of lead weighed and shipped, 1796-1809, D.H. MSS.ADX.
 2. J. Mowbray to Wright and Bowden 26 May 1797. K.L. MSS.Pkt.7(a)/28; and Arkengarthdale mining accounts, K.L. MSS. Pkts.1,7,15.
 3. M.Wadson, op.cit., and K.L. MSS. Pkts. 1 and 15.
 4. "An Act for making a turnpike road from Angel Inn near Darlington to Barton Lane End... and bridge (between Blackwell and Stapleton)." George IV, 1 and 2, cap.13, 30 July 1831. Previously there was a ferry at Blackwell and a ford at Cleasby, further upstream.

The road from Catterick Bridge to Entercommon, Stockton, Sedgefield and Durham was maintained by a turnpike trust established in 1747¹. The four miles of road between Richmond and the present Great North Road were part of the Richmond-Lancaster turnpike. The route via Darlington joined the Boroughbridge-Northallerton-Durham turnpike², at Croft, and another turnpike at Darlington³.

The tolls charged by the Catterick Bridge-Durham turnpike trust from 1747 were 3/- for a four-horse waggon for the whole distance of 42 miles⁴. By 1810, the charge was 5/7½d, divided between five tollgates⁵, and an Act of that year raised the tolls to 6/- and the number of gates to six⁶. An Act of 1840 maintained the same basic rate, but imposed extra charges for waggons with wheels less than six inches broad, or with nails projecting more than a quarter of an inch from the tyre. In addition, waggons carrying lead, coal and certain other goods had to pay double tolls between 31st October and 1st March⁷.

Not much is known about the condition of these roads.

Arthur Young described the road from Richmond to Scorton as

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1. 20 George II, cap.28.
 2. Established by an Act of 1745.
 3. The Barnard Castle-Stockton Turnpike, established by an Act of 1747.
 4. This amount would be divided between a number of tollgates. 20 George II, Cap.28.
 5. M.Wadson to P.Denys 19 Feb 1810. D.H. MSS. CA2.
 6. 30 George III, Cap.7.
 7. 11 George IV, Cap.26. 8 April 1840.

"pretty good"¹ and from Scorton to Entercommon "middling"². The road from Richmond to Croft Bridge was "very indifferent.. From thence to Darlington is the Great North Road, and execrably broken into holes like an old pavement, sufficient to dislocate ones bones"³. The roads of South Durham were "long famous for their miserable condition."⁴ "Before the Stockton and Darlington Railway was made, the turnpike between the two towns was repaired by throwing trees into the ruts, the trustees having no funds for doing the work better."⁵

The letters of Matthew Wadson, who handled the shipment of A.D. lead from Stockton, written between 1800 and 1812, make no mention of the conditions of the road surfaces, but are full of complaints about the irregularity of lead carriage. The jagers coming from the A.D. mines put the lead down at the Nag's Head Inn in Richmond, which was rented by one of the carriers whose waggons carried the lead to Stockton.⁶ The carriers undertook to deliver each mark of lead to the A.D. Wharf at Stockton within a specified period after its delivery at Richmond, and had the payment for the carriage of the first mark withheld until the end of the contract⁷ as surety for any loss of lead or breach of the

1. Young, op.cit. p.427.

2. Ibid.

3. Ibid. p.428.

4. W.H.Longstaffe: History and Antiquities of the Parish of Darlington (1854), p.359.

5. Ibid. p.360.

6. "Proposals for lead carriage and renting land and New Buildings at Richmond" 16 April 1805; and Agents Cash Account with Lessors 1816-54. D.H. MSS. RD10 and E1.

7. Usually annual.

agreement¹. This provision was of little value, since no agent was employed to keep an account of the deliveries made in Richmond, and it proved impossible to fix the blame for loss or delay on anyone. Wadeson frequently urged Peter Denys to follow the plan of the Arkengarthdale lessees and appoint a Richmond agent², but his advice was not heeded.

"The irregularity of the carriage of which I have so often and so unsuccessfully complained"³ sometimes meant that a chance to sell lead at a good price was lost⁴. Lead was stolen at Richmond,⁵ or when it was left at the roadside through waggons breaking down or horses tiring.⁶ The transport of lead was neglected while the carriers were engaged in haymaking⁷ or harvesting.⁸ As Wadeson wrote, "Carriage is the clog of all our lead business."⁹

In an attempt to resolve these difficulties, lead was carried by barge from Worsall, the limit of tidal action on the Tees.¹⁰ "A Keel brought round from Sunderland has just delivered us a load of lead from Worsall, and is likely to answer very well, for they reckon on her bringing 800 pigs

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1. Proposals for lead carriage etc., and Agreement, G. and T. Cradock and Peter Denys 10 June 1802. D.H. MSS. RD10.
 2. M.Wadeson to P.Denys 9 March 1802 and 21 Oct 1803. D.H.MSS.CA2.
 3. Ibid. 14 Oct 1801.
 4. M.Wadeson to J.Locke 18 Jan 1801.
 5. "Stealing lead at Richmond is carried on to great lengths, Mr. Hall has proof of it". M.Wadeson to P.Denys 14 Jan 1804.
 6. M.Wadeson to J.Davies 28 Feb 1810.
 7. M.Wadeson to J.Locke 5 August 1805.
 8. M.Wadeson to P.Denys 3 Sept 1806.
 9. Ibid. 21 Jan 1801.
 10. Brewster, op.cit., 1st edition (1796), p.54.

at a time, which will make a good thing of it for the undertakers and confirms my idea... indeed so conscious is Mr. Alderson¹ of the advantage, he has leased the wharf there for 12 years."² The keel carried lead from the Old Gang, Surrender, Arkengarthdale and other mines.³

This route was also subject to frequent interruptions, however. The keel was sometimes engaged in delivering other freight on the river and did not always call regularly at Worsall.⁴ The navigation was often hampered by ice. "The river is frequently frozen notwithstanding the tides and rapid current. In 1780, it was frozen eight weeks, and in 1784 when the ice was eight and a half inches in thickness, a sheep was roasted upon the river at Portrack."⁵ This feat was not repeated during the first twelve years of the nineteenth century, but the river was reported to be frozen over at least once in almost every winter during this period.⁶ The ice was often succeeded by floods.⁷ At other times, navigation was hindered by low water and obstructions in the river.⁸

Wadeson suggested the simultaneous use of two routes

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1. A carrier.
 2. M.Wadeson to P.Denys 15 June 1801.
 3. M.Wadeson to J.Davies 20 April 1810.
 4. M.Wadeson to P.Denys 30 Oct 1801 and 28 Nov 1801.
 5. Longstaffe, op.cit. p.20.
 6. M.Wadeson: Correspondence 1800-12 and Brewster, op.cit, 2nd edition (1829), p.278.
 7. Wadeson, loc.cit.
 8. Ibid; and Brewster, op.cit., 2nd edition, p.58.

to improve the regularity of delivery. "If A.¹ was to join Longstaff and take two-fifths or one half of the A.D. lead by Darlington, and the other half with Surrender lead and all duties by Worsall... when the navigation of our river was interrupted we should have carriers independent of water and by keeping two courses of roads there would always be kept up a competition."² This move seems to have caused a slight improvement.³

The rise in the price of grain caused by wartime conditions led to an increase in the cost of carriage. A mark of lead was carried from Richmond to Stockton for £12 in the period 1790-97,⁴ but this had risen to £13-13-0d by 1802,⁵ and to £14-14-0d in 1803.⁶ In 1805 a carrier asked for £17,⁷ and a year later Wadeson feared a further rise. "From the situation of the countries which have usually furnished us with oats etc., we may expect grain very high, that I fear the carriers will make a handle of, to increase the rate of carriage and lengthen the delay."⁸ The cost of carriage from the mines⁹ to Richmond

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1. R.C.Alderson, the carrier.
 2. M.Wadeson to P.Denys 5 Dec 1802.
 3. Ibid; 21 Nov 1808.
 4. K.L. MSS. Pkt. 7(a)/4 and 7(a)/39.
 5. Agreement, Cradocks and Denys.
 6. M.Wadeson to P.Denys 22 June 1803.
 7. And two others for £16-16-0. Proposals for lead carriage etc.
 8. M.Wadeson to P.Denys 13 Dec 1806.
 9. All the mines quoted here are roughly the same distance from Richmond.

rose similarly, from £11-13-4d per mark in 1790¹ to £20 in 1813. John Davies wrote in the same year, "The corn is so dear that none of the carriers can pay their way. I have threatened John Dunn, who hasn't paid his rent, that he will be sold up unless he carries the lead² at 1/- per pig."³

The expense and inefficiency of horse drawn carriage, especially for coal, led to the consideration of cheaper and more efficient means of transportation. Wadeson wrote to Peter Denys in 1812, "I enclose... a report of proceedings for a railway or canal⁴ which from the amazing increase of charge for carriage must be had if possible. I hope you will add your name to this list of subscribers for a survey..."⁵ A route for a canal, to cost £95,000, was surveyed by Rennie, but "some commercial disasters in South Durham rendered the execution of the great engineer's plans hopeless."⁶ Nearly fifty years earlier, Brindley and Whitworth had surveyed a route for a canal from Stockton to Winston, with side cuts to Yarm, Croft and Piercebridge, but no work was carried out.⁷

From Stockton the bulk of the lead was shipped to London and the remainder to Newcastle, Rotterdam and the Baltic ports, particularly Emden and St. Petersburg.⁸ In the first decade

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1. K.L. MSS. Pkt. 15.
 2. Surrender lead, the pigs of which were heavier than those of other mines.
 3. J.Davies to P.Denys 6 June 1813. D.H. MSS. RD13.
 4. Inland from Stockton.
 5. M.Wadeson to P.Denys 30 Jan 1812.
 6. Longstaffe, op.cit. p.368.
 7. Ibid. p.367.
 8. M.Wadeson Correspondence 1800-1812.

of the nineteenth century, the freight charges to London varied between ten and fifteen shillings per ton for "accommodation lead", taken to complete a cargo, and were usually half-a-crown more for "a vessel wholly for lead and sailing at our time." Some of the lead shipped to the Baltic ports, to which Stockton exported little, went as ballast at about seven shillings per ton.¹

Transport difficulties were not left behind when Stockton was reached. The river was frequently frozen below as well as above Stockton, in which event the lead was carted to Portrack, about a mile to the east of the wharves by land but more than two miles further by water because of a great bend in the river.² The navigation of the river was "in a most wretched state" because of sand-banks especially in the bend between Stockton and Portrack.³ The preamble to the Act establishing the Tees Navigation Company in 1808 says that "several vessels are annually lost, either in attempts to enter the river as a place of refuge, or in not daring to make for the harbour."⁴ Shortly afterwards, Matthew Wadeson wrote, "The weather which has prevented shipping has been fatal to many in this quarter, four have been lost in the river's mouth with all their cargoes."⁵

1. Ibid.

2. Ibid; and Brewster, op.cit., 1st edition (1796), pp.54-55.

3. H.Heavisides, Annals of Stockton-upon-Tees (1865), pp.52-3.

4. Brewster, op.cit., 2nd edition (1829), p.175.

5. Wadeson to P.Denys 2 Dec 1809.

These hazards may have caused Stockton to lose some trade to Hull. Brewster wrote in 1796, "Of late years great quantities of lead from the mines in the North Riding of Yorkshire have been sent to Hull, the produce of which mines was formerly brought to this port." The figures given by Brewster show a considerable decline in exports between 1756-58 and 1791-94, but an increase in the quantity of lead shipped to London.¹

Other difficulties described by Matthew Wadeson were caused by the French Wars. In November 1803 two ships were loaded and "might have sailed within the week had not the impress prevented them, but under its unfortunate effects one cannot say when you may look for them. I fear not before Protections are granted."² A year later, "We have just received unfavourable account from the shores on each side of our River, for a privateer passed on Wednesday night or Thursday morning early and has made many captures."³

An artificial channel to cut out the bend of the river between Stockton and Portrack was first proposed in 1769⁴ and planned and surveyed in 1791,⁵ but it was not until 1808 that the Tees Navigation Company was formed for this purpose.⁶ The Company deepened the channel below Portrack and made the new cut at a cost of £9,300.⁷ The cut was apparently about

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1. Brewster, op.cit., 1st edition, pp.73-76. Almost all the lead from Swaledale and Arkengarthdale went to Stockton after 1800.
 2. M.Wadeson to J.Locke 17 Nov 1803. D.H. MSS. CA2.
 3. Ibid. 10 November 1804.
 4. Heavisides, op.cit. p.20.
 5. Brewster, op.cit., 1st edition (1796) pp.55-58.
 6. Heavisides, op.cit. p.183. 7. Ibid. pp.53 and 194; Brewster, op.cit., 2nd edition, p.170.

220 yards long¹ and it reduced the distance from Stockton to the sea by over two miles. The improvements had an immediate effect upon the fortunes of the port. The tonnage cleared in 1804 was 24,534 tons. Two years after the cut was opened, the tonnage had increased to 42,904.²

Under an Act passed in 1828, the Company made a second channel, 725 yards long, at Newport, a mile or two below Portrack, which cut off a second great bend in the river and shortened the distance from Stockton to the sea by a further three miles. The cut was completed in February 1831³. To pay for these improvements, the company levied tolls on shipping on the river⁴, as turnpike trusts did on road traffic.

The first of a series of improvements in land transport along the routes used for the carriage of lead from Swaledale came in 1825 with the opening of the Stockton and Darlington Railway. A branch of this railway from Darlington to Croft, on the north bank of the Tees was opened in October 1829⁵. The extension of this line to Richmond was proposed by a group of influential landowners in 1825⁶, but neither they nor the Stockton and Darlington Railway Company were prepared to build a bridge over the Tees, and the scheme fell through⁷.

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1. This was the distance across the neck of the peninsula. Brewster, *op.cit.*, 1st edition, p.55.
 2. D.J.Owen, Ports of the United Kingdom, (1948), p.144.
 3. H.R.Edwards: Chronology of the Development of the Iron and Steel Industries of Tees-side (1955), pp.36-38.
 4. Brewster, *op.cit.*, 2nd edition, pp.170-172; Longstaffe, *op.cit.* p.374.
 5. Longstaffe, *op.cit.* p.372.
 6. Including the Duke of Leeds, and Lords Tyrconnel and Dundas. Also in the group was Robert Jaques. Parris, *op.cit.* pp.42-3.
 7. *Ibid.*

The plan to build a railway from York to Darlington, put forward in 1835, revived the prospects of a railway to Richmond¹. In 1836 two rival companies appeared, the "Swaledale and Wensleydale Railway"² and the "Richmond and Cleveland Railway."³ The advertisement for the former scheme read, "Several influential gentlemen, interested in promoting the prosperity of the country west of the intended Great North of England Railway, are desirous of forming a railway commencing at or near Croft and extending to Richmond with a depot near Catterick Bridge, which will supply the whole of the country to the west and south-west of the line with coal at a cheap rate, and take down lead and other mineral productions for exportation."⁴ Within two months the two companies amalgamated under the name of the "Citta Dilla and Croft Railway"⁵, the promoters of which gave notice of their intention of making application to Parliament for approval of a railway from the Great North of England line to Broken Brea Pasture⁶, between Easby and Brompton-on-Swale, and about two miles east of Richmond. By terminating the line at Broken Brea, expense would be saved, and perhaps legal difficulties with the owners of land avoided⁷.

The railway bridge across the Tees was not completed until January 1841⁸, by which date the "Citta Dilla and Croft Railway"

1. Parris, op.cit., p.54. 2. Yorkshire Gazette 9 July 1836.

3. Ibid 16 July 1836. 4 Ibid 9 July 1836.

5. Ibid 3 September 1836. "Citta Dilla" is the place where Catterick Bridge Station now stands.

6. Ibid 12 November 1836.

7. Broken Brea Pasture belonged to Robert Jaques who was a member of the Provisional Committee. Ibid 3 Sept and 12 Nov 1836.

8. Parris, op.cit. p.64.

scheme had apparently lapsed. The next move was made by the Great North of England Railway Company which proposed in 1844 to build a branch line to Richmond.¹ An estimate of the volume of goods traffic to be carried by the line included "35,000 tons of coal, 4,500 tons of lead and 200 tons of grove² timber, lime etc".³ The line was opened on 10 September 1846. As well as the nine-and-three-quarter miles⁴ of branch line and four stations, a new bridge across the Swale at Richmond, with a new road into the Market Place, was built.⁵

It is not clear how far the Stockton and Darlington Railway, or its branch to Croft, ~~were~~ used for the carriage of lead from Swaledale before the Richmond branch line was built. The waggoners had used the Darlington, as well as the Entercommon, route before the railway was made, and the saving in cost by using the railway would have amply compensated for the trouble of loading and unloading the lead at the stations. Between 1825 and 1838, carriage by waggon from Richmond to Stockton cost between £14 and £16 a mark of 400 pieces, or approximately 10/- to 11/5d. per ton⁶. At 1½d. per ton mile⁷, the railway

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1. Meeting of G.N.E.R. Co. reported in Yorkshire Gazette, 19 Oct 1844.
 2. Mine.
 3. Yorkshire Gazette 26 October 1844.
 4. The total distance between Richmond and Darlington stations is about 15 miles.
 5. Ibid. 12 Sept 1846.
 6. Agents cash account with lessors 1816-55. D.H. MSS. El.
 7. The cost quoted in an estimate of expected revenue for the Stockton and Darlington Railway. J.S.Jeans, Jubilee Memorial of the Railway System: The Stockton and Darlington Railway (1875) p.292.

company would have charged £2-2-0 per mark, or 1/6 per ton for almost half the journey. The advantage of using the Croft Branch would be slight, especially after the building of Blackwell Bridge in 1832 had provided a shorter road to Darlington. The only record of the carriage of Swaledale lead during this period is an account relating to the share of the lessors' lead belonging to Lady Charlotte Denys, and after her death to Sir Francis Shuckburgh.¹ This lead was carried by waggons to Stockton and continued quite inexplicably to be so carried for several years after the Richmond branch line was opened in 1846. The cost of carriage by this method was £11 a mark between 1848 and 1855², compared with 5/- a ton³, or £7 a mark, charged for the same journey⁴ by rail in 1857. There is little doubt, however, that most of the lead was carried to its destination by rail from Richmond after 1846.

Meanwhile a new road had been constructed from Richmond to Reeth⁵. To avoid the steep gradients of the old road through Marske, it followed the lower slopes of the valley on the south side of the river. A new bridge was built across the Swale at Lownwath or Lownathwaite, and an entirely new road constructed from the boundary of the Borough of Richmond to Stainton Lane End⁶,

1. Agents cash account with lessors 1816-55.

2. Ibid.

3. J. Littlefair's Cash Account 1857-58. D.H. MSS. RB8a.

4. 27 miles by rail.

5. With a branch from Marske Bridge to Bellerby Bank Foot on the road to Leyburn.

6. With the exception of a short stretch between Marske (then called Downholme) Bridge and the present junction of the Richmond-Reeth and Richmond-Leyburn roads.

about four miles from Reeth. From Stainton Lane End the road followed an old occupation road which ran from Grinton to Downholme, with four minor modifications. Crossing the Swale by Grinton Bridge, the new road joined the old one at Fremington, and terminated in Reeth at the Buck Inn, where the Reeth-Brough turnpike began¹. The principal purpose of the road was to reduce the transport costs of the lead mining industry. Most of the trustees were investors in, or otherwise connected with, the mines.

At a meeting of the trustees held on 23rd July 1836, "the building of the bridge over the Swale at Lownwath was contracted for by Mr. Marshall of Northumberland, and the surveyor reported that several portions of the road were let and a considerable number of men actually at work."²

A few days later the trustees gave a dinner at the Buck Inn in Reeth for their surveyor, Thomas Bradley, and solicitor, Ottiwell Tomlin.³ The chairman of the meeting, Captain John Harland, in proposing a toast to Tomlin, said, "I may venture to assert that among the multitude of projects which have been set on foot in this age of speculation, there is not

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1. Plan of intended new turnpike from Richmond to Reeth. North Riding Records.
 2. Yorkshire Gazette 6 August 1836.
 3. Tomlin had been one of the solicitors for the "Swaledale and Wensleydale Railway" in 1836, and Bradley one of the surveyors for the "Richmond and Cleveland Railway."

one to be found which in proportion to its extent will be more beneficial in its general features." He then proposed a toast to Mr. Bradley, "who in laying out our road has erected a monument to his own talents as splendid as I hope it will be permanent. It must not be forgotten, gentlemen, that many attempts have heretofore been made to procure a better road into our romantic and beautiful valley, but no line could be hit upon in which there were not either insuperable difficulties or irreconcilable differences. It has fallen to the lot of Mr. Bradley to discover a line in which all difficulties have been overcome by his talents as a surveyor ... may the completion of the work be as satisfactory to him as its commencement has been auspicious."¹

The completion of the new work was apparently not so satisfactory, for twelve years later the trustees obtained an "Act for more effectually repairing and maintaining the road from Richmond to Reeth", the preamble to which read: "Whereas the Trustees have formed the said Road and built the Bridge in the said Act mentioned, but the said Road hath not yet been finished and completed..."² The sum of £2,500 needed to finish

1. Yorkshire Gazette 6 August 1836.

2. Victoria 11 and 12, cap.cxlvii, 14 August 1848.

the work was to be raised by increasing the tolls on coaches, chaises etc., cattle and sheep, and on carts or waggons with tyres less than six inches wide. Carts and waggons with tyres wider than this, paid at the same rate as before, i.e. sixpence per horse.¹

Posterity has been less than generous to the memory of Thomas Bradley. The road which he cut out of a steep hillside has frequently had to be patched and shored up because of the effects of landslip. His only memorial today is "Bradley's Folly", a hairpin bend which was made to avoid crossing Gill Beck at a point where the hillside slopes very steeply to marshy ground near the confluence of the beck and the Swale.

The "railway mania" of the eighteen-forties produced the first of a series of schemes for building a railway through Swaledale, in this case as a section of a cross-country line. "The Manchester, Liverpool and Great North of England Union Railway proposed to carry their line north ~~from~~ Hawes over the heights into Swaledale and then descend that valley to link up with the Richmond branch. Apparently the only justification for this extra-ordinary scheme was the prospect of securing the lead traffic. Whatever the reason, there were a number of Swaledale men on the Provisional Committee, including Edmund Alderson Knowles, a member of the enterprising Low Row family which had installed steam power in their spinning mill

1. 1836 and 1848 Acts.

ten years earlier."¹

In 1868, James Tomlin and some other mining entrepreneurs formed the Richmond and Reeth Railway Company, and tried to persuade the North Eastern Railway Company to help them to build a line. The most the North-Eastern Company would promise was to "afford them all reasonable facilities for working the line" when the local company had built it.² In the absence of help from the N.E.R. "the amount of local support given to the scheme fell so far short of the expectations of the promoters that it was not deemed prudent to begin the works."³

Another improbable cross-country line was planned in 1881. It was to link Sunderland and Skipton, via Durham, Darlington, Richmond, Downholme, Leyburn and Aysgarth.⁴ A plan dated 1882 shows the Swaledale section of this line.⁵ At the same time, the completion of the railway through Wensleydale⁶ revived the project for a line from Hawes to Richmond via Swaledale. "At a meeting in Reeth in 1882 a proposed extension of the railway from Richmond was discussed. It was to come up Swaledale and connect up with Hawes. A meeting of the Commoners of Muker and Thwaite gave assent to its passing

1. Parris, op.cit. p.87-88.

2. Ibid; pp.238-239.

3. W.W.Tomlinson, North Eastern Railway, its Rise and Development, (1914), p.638.

4. Darlington and Stockton Times 9 July 1881.

5. North Riding Records, ZAZ.

6. The line reached Hawes in 1878.

over the moors to Hawes and Francis Garth was appointed to put a case for its construction before the directors of the railway company at York."¹ Each of these lines involved serious engineering difficulties, which could only have been overcome at great expense, and both plans fell through.

A more modest plan for a light railway from Richmond to Reeth was put forward in 1895², by which date the lead mining industry was moribund. One of the promoters was James William Close³, who had purchased the Fell End Mining royalty and was mining chert on Fremington Edge. A deputation met the directors of the North-Eastern Railway⁴, but failed to secure enough help and the scheme failed.

Mr. Close tried again in 1912, and an order for a "Swaledale Light Railway"⁵ was obtained and the line surveyed.⁶ A provisional agreement was reached with the North Eastern Railway Company for the working of the line⁷ and the Reeth Rural District Council agreed to borrow £10,000 on the security of the rates towards the cost of the railway.⁸

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1. E.Cooper, Some Swaledale Families of the eighteenth and nineteenth centuries. (1956), p.22.
 2. Parris, op.cit. p.254.
 3. S.Cherry to Sir F.Denys 18 March 1896. D.H. MSS. Vll.
 4. Ibid. 17 Oct 1896.
 5. Parris, op.cit. p.255.
 6. Plan in the possession of Mr. R. Woodward of Reeth.
 7. Parris, op.cit. p.255.
 8. E.Cherry to Sir F.Denys-Burton 11 March 1912. D.H. MSS. Vll.

When the finances of the project were finally worked out, however, the Reeth R.D.C. withdrew its support. The Treasury was prepared to lend £25,000 free of interest for five years and then at $3\frac{1}{2}\%$. The North Riding County Council was expected to make a grant as well. The North Eastern Railway Company demanded sixty per cent of the gross receipts, with a minimum of £3,000 a year, or all the gross receipts if less than £3,000, for working the line, and £300 a year for the use of Richmond Station. The members of the Reeth R.D.C. were convinced that the gross receipts would rarely reach £3,000 a year and that therefore the interest on the £10,000 raised by the Council and the £25,000 lent by the Treasury, would become a permanent charge on the rates.¹

It is doubtful if a Swaledale railway could have paid its way, even when the mines were prosperous. Only in an occasional good year did the output of lead exceed 4,000 tons.² This quantity at 2d a ton-mile for twelve miles would have yielded £400, and even at 3d a ton-mile only £600. The carriage of timber and mine stores, the supplies for local farmers and retailers, the ordinary passenger and tourist traffic, and, of course, coal, would have added to the revenue. Cheaper coal might have caused the partial substitution of steam power for water power at the mines, although the coal would still have

1. Meeting of the Reeth R.D.C. 29 May 1914 reported in the Darlington and Stockton Times 6 June 1914.

2. See Appendix B.

to be carted several miles from the railhead. On the whole, however, it is unlikely that the volume of traffic would have justified the building of a line.

It is also possible to exaggerate the benefit which a railway would have brought to the mining industry. At the time of the formation of the Richmond and Reeth Railway Company, the cost of carriage of lead from the Old Gang and Surrender mills to Richmond was about eight shillings a ton.¹ Although the railway would have carried the lead from its terminus in Reeth or Fremington for perhaps two or three shillings a ton, it would still have had to be brought from the smelt mills, a distance of about four or five miles in the case of the mills² accounting for the bulk of the output and the most difficult section of the whole road journey to Richmond. The nett saving per ton of lead carried would probably have been about three shillings or three shillings and sixpence. The mining companies would of course have benefitted from the reduced cost of their requirements such as timber, ropes, steel and machinery.

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1. Fivepence per pig, each pig weighing at this time a little over a hundredweight. A.D. Mills Accounts 1805-85., D.H. MSS., SD3, and Lead Weighing Book, D.H. MSS. ADM4.
 2. Arkengarthdale and Old Gang.

Chapter VIII : The Place of Lead Mining in the Economic
Life of Swaledale.

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In the middle of the seventeenth century, when the "early industrial revolution" began seriously to affect the lead mining industry, Swaledale was still essentially a farming area, mainly devoted to cattle and sheep rearing.¹ The social structure was comparatively simple. There was rarely a resident lord in any of the manors, and there were few people with pretensions to be ranked among the gentry. The latter, who included some small landowners, one or two lawyers, and one family, the Swales of Grinton, who unsuccessfully claimed to be lords of the manor², nearly all lived in the Reeth area.³ In the upper dale the highest social class was that which probably embraced the majority of people in the dale as a whole, the small and middling farmers. Most of their land was copyhold. A few were freeholders, and some farmers held both freehold and copyhold land.

The copyholders claimed to hold their estates by hereditary tenant right, with secure tenure and inheritance, and fixed rents and fines. They rested their claim on their obligation to do military service in defence of Northern England against the Scots⁴, but their privileges may also have derived from

1. In this and subsequent chapters, "Swaledale" means the townships of Marrick, Grinton, Reeth, Arkengarthdale, Melbecks, and Muker.

2. See above, p.30. 3. Grinton Parish Registers.

4. Chancery decree, 1564. Barker MSS.

the relative freedom enjoyed by their ancestors. In the Middle Ages Swaledale fell economically into two distinct parts.¹ In the main valley below Healaugh there was a manorialised economy, with some at least of the arable land laid out in open fields, nucleated villages, and a two-tier peasant class of bondmen and cottars such as was found in most of lowland Yorkshire. Above Healaugh and in Arkengarthdale there were scattered settlements of hamlets and isolated farms, with an economic life based upon sheep rearing, particularly, in the early Middle Ages, in large pastures under the control of monastic and lay landlords; woodcutting and charcoal burning; and lead and coal mining.² The evidence of a small number of inquisitions post mortem suggests that the feudal obligations of those living in the upper dale were slight or non-existent³. As for the lower valley, the stereotyped form of the inquisition obscures subtle differences between one set of customs and another, but as the area was a transitional zone between the fully manorialised economy of the lowlands and the upland regions where society was organised on quite a different basis, it is not unlikely that the peasants there were in a stronger

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1. This was also in origin a racial and linguistic division, the lower part of the valley being settled by Angles, and the upper part by Norsemen. A.H. Smith, Place Names of the North Riding of Yorkshire (1928), pp.270-4, 293-6.
 2. Yorkshire Inquisitions, Vol.1, pp.137-8, 224; Vol.II, p.38. Yorkshire Lay Subsidy, 1301, pp.8,14,22,26,92; Lay Subsidy 1327, in Y.A.S. Vol.74; Miscellanea, Vol.II, pp.125-137; Y.A.S. R.S. Vol.62; Yorkshire Fines, 1218-31, p.64.; Chartulary of Bridlington Priory, pp.249-55; Cartularium Rievallense, pp.304-5.
 3. Yorkshire Inquisitions, op.cit.

position vis a vis their lords than in the lowlands.¹

The dissolution of the monasteries and the sequestrations following the Pilgrimage of Grace brought new owners to three Swaledale manors, Grinton, one of the two manors of Healaugh, and Muker. The lords of Healaugh and Muker manors tried to force their tenants to hold at the will of their lord, and in particular to pay higher rents. The tenants resisted in a series of lawsuits fought between 1564 and 1685, by means of which they secured confirmation of their tenures. By a Chancery judgment of 1617-18, however, the tenants of Healaugh manor had to agree to rent increases, and those of Muker manor to pay a lump sum of £1654 instead.² In Arkengarthdale, which was a crown manor, as part of the Duchy of Lancaster, during the sixteenth century and until it was sold to some citizens of London in 1628, the tenants had a similar struggle, first with a lessee of the manor who threatened their common and mining rights, then with the Crown itself, and finally with Dr. John

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1. Joliffe suggests that the privileges of the Yorkshire copyholders may be rooted in the social structure of pre-Conquest Northumbria. J.A.Joliffe, Northumbrian Institutions, in English Historical Review, Vol.XLI (1926), p.38.
 2. Chancery decrees of 1564, 1617-18, 1676, and 1680, and Court of Common Pleas Judgment 1695, in P.Swale, Barker, Clarkson, and Peacock MSS; and Manors of Healaugh and Muker, Court Book A.

Bathurst, who bought the manor in 1656.¹ Not all the details of these disputes are known, but by the end of the eighteenth century nearly all the land was either freehold or held at the will of the lord.² When Grinton manor was sold by the crown in 1599 all its tenants held land on leases of twenty-one years. These were probably renewable on some customary terms, but no details are known³.

The yeomen who had defended their rights against the attacks of their lords with a considerable measure of success were, however, largely obliterated as a class by the working of impersonal economic forces which transformed a community of farmers, some of whom engaged in lead mining, into a community of miners with smallholdings. These forces were the expansion of the lead mining industry, the natural growth of population, and the operation over much of the area of a system of partible inheritance.

The development of the mining industry from the late seventeenth century has already been described.⁴ The growth of population can be traced from the second half of the sixteenth century. In the manor of Muker there were 56 tenants of Rievaulx Abbey at the dissolution.⁵ By 1617 the number had

1. Y.A.S. R.S. Vol.41. Yorkshire Star Chamber Proceedings, Vol.II. pp.178-180; Cal.S.P.Dom., 1601-03 and Add.1547-54. p.551. V.C.H. Yorkshire North Riding, Vol.II, p.36.
2. See below, pp.242-5.3. Conveyance of Grinton manor to Wiseman and Fitch, Barker MSS.
4. See above, Chapter III.
5. Cartularium Rievallense, pp.328-30.

grown to 111. The first fifty years, 1641-1690, of the Grinton parish registers, covering the townships of Grinton, Reeth, and Melbecks, record 2060 baptisms and 1506 burials, an excess of the former of 554. In the decade 1691-1700 there were 36 more burials than baptisms, but the next ninety years saw decennial increases varying between 23 and 244, and totalling 1242. In 1791-1800 there were 16 more burials than baptisms. Assuming that there was no net immigration or emigration, and that all the local population was baptised and buried by the parson at Grinton¹, the population of these three townships grew from 1200 in 1640 to 1754 in 1690, 2247 in 1750, and 2936 in 1790. The 1801 census figure was 2920, rising to 3629 in 1811 and 3875, the highest level ever recorded, in 1821.²

The true rate of growth may have been rather greater. There was certainly some immigration, particularly during the late seventeenth century and at the end of the eighteenth and the beginning of the nineteenth centuries, which were both periods of relatively rapid development in the mines. A petition about the Wharton bible charity speaks of large numbers of people from other mining areas coming to Melbecks in the former period³, and there are references to this influx in the correspondence between Lord Wharton and his agents in the sixteen-seventies.⁴

1. There were of course adherents of other denominations - Catholics, Congregationalists, Quakers, and later Methodists - some of whom were not buried, and particularly not baptised, at Grinton church. Their presence, however, does not seem to invalidate the general conclusions drawn here.
2. Grinton Parish Registers; Abstracts of the Census Enumeration Returns, 1801-21.
3. Copy of petition by the inhabitants of Melbecks, no date. Peacock MSS. Pkt.1. No.1.
4. See above, p.33.

This movement, by altering the age-structure of the population, may have caused the excess of burials recorded in the Grinton registers for the decade 1691-1700. During the first decade of the nineteenth century the population of the six mining townships of Swaledale increased by 23 per cent, at least a quarter of which must have been the result of immigration. A contemporary writes of "a vast influx of strangers from the mining districts of the western parts of Northumberland, and the neighbouring borders of Durham, Westmoreland, and Cumberland" at the beginning of the nineteenth century, many of them going to Arkengarthdale, the population of which increased by 29 per cent between 1801 and 1811¹. There may also have been some emigration, particularly in the middle of the eighteenth century when lead mining was relatively stagnant, but over the whole period under review it was probably less than immigration.

The third of the forces transforming the economy of Swaledale was the practice of partible inheritance. All the copyhold land in the manors of Healaugh and Muker descended in this way, the holdings being divided between the surviving sons of a deceased tenant, or failing sons between the daughters subject to the widow's right to one-third of the issues from the holding during her lifetime.² How far the system applied to freehold land, or

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1. J. Harland, Glossary of Words Used in Swaledale, (English Dialect Society, Glossaries Series C, No. 1. 1873), pp. 1-2.
 2. Healaugh and Muker Manors, Court Book A.

to land held on different tenures in the manors of Marrick, Grinton, and Arkengarthdale, most of the records of which have been lost, is not clear. A Grinton yeoman divided his tenement between his two sons, subject to his widow's life interest, by a will proved in 1538¹; a systematic examination of unpublished wills would probably provide a fuller answer to this problem.

The court books of the manors of Healaugh and Muker have been preserved from 1686, by which time the breaking up of holdings had already begun. The process continued during the next hundred years. For example, in 1688 John Alderson, who held a tenement in Muker manor of the "ancient customary yearly rent" of forty-two shillings, which in that manor represented a substantial holding, died and was succeeded by five sons. Before the next court meeting one of these sons also died, leaving two male heirs. The farm was therefore divided into six parts, four of them one-fifth of the original, and two of them one-tenth.² Some holdings were divided within the space of three generations into a number of parts ranging from ten to thirty. Very few holdings passed through more than two generations without being

1. Surtees Society, Vol.26, Richmondshire Wills, pp.14-15.
2. Healaugh and Muker Manors, Court Book A.

divided¹. There were, of course, countervailing influences. Inheritance by brothers and nephews caused some re-consolidation. For example, in 1702 five Low Row brothers each inherited one-thirty-fifth of an original tenement from another brother who had died². The same result was achieved in other cases by purchase, as when one brother bought from three others their shares of ten cattle gates in West Stonesdale pasture which they had all jointly inherited from their father³. The latter process was, however, checked by the fines that had to be paid when a holding changed hands⁴. Perhaps more commonly one member of a family would keep a piece of land by paying rent to the other holders. This may have happened at the extreme stage of fragmentation, as when, in 1735, five brothers in Muker manor each inherited, inter alia, a one-ninetieth share in one field⁵. On the whole these practices did no more than slow down the process of fragmentation.

When by this process of division a farm had become too small to maintain a man and his family, they could try one or more of three courses. They could use the land at their disposal more intensively, perhaps by enclosing their share of the common pastures; they could take in land from the moor; or they could take up another occupation in addition to farming. By the

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1. Court Books A-D.
 2. Court Book B.
 3. Court Book D.
 4. In Muker the fine for succession by inheritance was one penny; for succession by grant to an heir ten times the rent; and by purchase twenty times the rent. In Healaugh New Land the fine in all cases was fifteen times the rent, and in Healaugh Old Land twenty times. Court Book A.
 5. Court Book C.

sixteenth century the land in Swaledale was generally divided into three parts, the "ancient enclosures" in the valley bottom and on the lower slopes, used mainly as meadow, the common stinted cow pastures on the middle and upper slopes, and beyond them the unregulated "waste", mainly moorland. During the sixteenth and seventeenth centuries, a number of common cow pastures, including those of Healaugh and Reeth villages, were enclosed piecemeal by the copyholders and freeholders who held stints on them¹. Some land was also taken in from the waste beyond the old stinted pastures and improved. It is impossible to determine how much land was taken in in the seventeenth and eighteenth centuries, as although the names and characteristics of many of the fields on the margin of the moor show that they were created by this process, it cannot usually be dated. It is likely, however, that the work involved in wresting these fields from the moor was done when there was considerable pressure of population on the available farming land.

One form of supplementary employment that could easily be made to fit in with the daily and seasonal routine of farming, and be done by all but the youngest members of the family, was hand-knitting. Hosiers from Richmond and Kendal, the main centres of the trade, and some from Swaledale itself, put out wool to be carded, spun, and knitted into long stockings, gloves and mittens, and seamen's jerseys and caps. In the sixteenth century there were said to be more than a thousand knitters working in the Richmond area².

1. Chancery decrees 1564-1680; Court Books A-D; Depositions of witnesses in Gibson v. Smith and in the Beldi Hill dispute. Barker MSS. 2. M. Hartley and J. Ingilby, Old Hand-knitters of the Dales (1951), pp. 21-32.

Defoe described the trade in the early eighteenth century :

"Here you begin to find a manufacture on foot again, and as before all was clothing, and all the people clothiers, here you see all the people, great and small, a knitting; and at Richmond you have a market for woollen or yarn stockings, which they make very coarse and ordinary...

"The trade extends itself into Westmoreland... it is indeed a very considerable manufacture in itself, and of late mightily increased too, as all the manufactures of England indeed are".¹

The industry was declining because of changes in fashions and the competition of machine knitting in the early nineteenth century². Clarkson wrote of Richmond in 1821, "This town had formerly a large trade in the exportation of knit yarn stockings and seamen's woollen caps to Holland and the Netherlands which through the fluctuations of trade and the vicissitudes of war is now very much on the decline, and indeed is almost entirely banished out of the country"³. On the other hand, Baines' Directory of Yorkshire, published two years later, described hosiery as being an important manufacture in Swaledale⁴. If Baines' information was not out of date, the other centres of the trade must have declined later than Richmond did.

In the last phase of the industry most of the wool was no

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1. D. Defoe, A Tour through England and Wales. (Everyman's Library) (1928), Vol.2, p.222.
 2. Hartley and Ingilby, *op.cit.*
 3. By "country" Clarkson means "district". C. Clarkson: History of Richmond, 2nd edition (1821) p.409. 4. Baines' Directory of Yorkshire (1823) Vol.2 pp.510. 647-9. He gives the value of the output of knitted stockings in Swaledale and Wensleydale as £40,000 a year, but there is no other evidence to verify this figure.

longer carded and spun at home. From about 1835 to about 1870 the Knowles family of Low Row, the leading Swaledale hosiers, spun yarn in a mill powered first by a water wheel and later by a steam engine¹. After their closure a few packmen continued to bring in a little spun yarn from Kendal and Askrigg, but as an industry hand-knitting was dead.²

There is not enough evidence for an accurate assessment of the place of hand-knitting in the economy of Swaledale. In some parts of the Yorkshire dales there were families devoted wholly to the craft, and there may have been some in Swaledale also. It is probable, however, that the main contribution of this industry to the life of the area was twofold, the provision of supplementary earnings for families who were primarily engaged in other occupations, earnings which may not have been large but could be marginally very valuable; and the opportunity afforded to the enterprising to accumulate some capital.

It was, of course, the lead mining industry, expanding at a time when the growth of population was causing the fragmentation of holdings, which provided the main alternative occupation to farming. It is highly probable that the latter process helped to stimulate the development of the mines, as farmers or farmers'

1. See below, p.258.

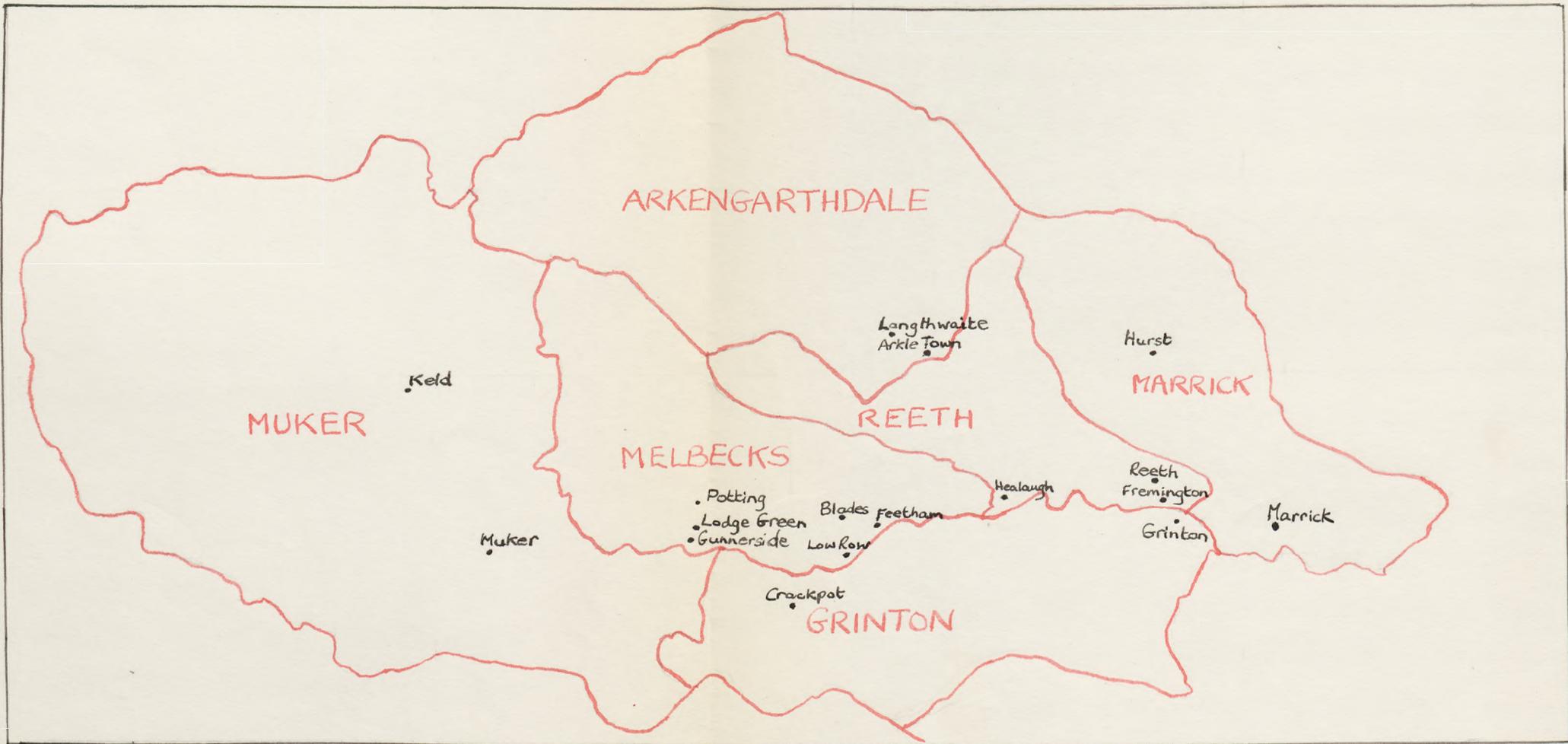
2. Hartley and Ingilby, op.cit.

sons with time to spare and in need of money went out to prospect for veins on the moors. It was easy to combine the two occupations, as the independent miner could work at times of his own choosing. Even in the nineteenth century, in mines worked by large capitalist companies, it was usually possible for a partnership of miners to decide its own working hours.¹ In the middle of the seventeenth century farmers began increasingly to engage in part-time mining. By the end of the eighteenth century their descendants were in the main miners who engaged in part-time farming.

-ii-

It is impossible to say at what point between 1650 and 1780 mining supplanted farming as the leading economic activity of Swaledale. Between 1780 and 1880, however, lead mining was not simply the occupation of the majority of men in the area. It dominated the life of the dale, and dictated the whole pattern of the local economy. In the first place, most people in the dale drew all or part of their livelihood directly or indirectly from mining. In the 1831 census, 908 adult male workers were returned as employed in lead and coal mining, compared with 354 engaged in agriculture. The preponderance of miners

1. See below, pp.265-6.



THE TOWNSHIPS OF SWALEDALE

SCALE: HALF AN INCH TO ONE MILE

of miners was greatest in Melbecks and Arkengarthdale, as the following table, relating to males over twenty years of age, shows.

	Grin ton.	Reeth.	Mel- becks.	Muker.	Arken dale.	Marrick.
Farmers employing labour	3	3	1	13	0	15
Farmers not employ- ing labour	61	47	17	21	8	53
Agricultural labourers	16	10	1	68	0	17
Manufacture	0	0	1	0	0	0
Retail trade and handicraft	21	132	53	42	30	6
Capitalists and professional	2	19	7	5	0	3
Labour not agric- ultural (lead and coal miners)	48	184	223	118	285	50
Male servants	5	6	2	0	0	7
Others	0	5	31	46	8	0 ¹

It must have been difficult for the census enumerators to decide into which category to put a man who divided his time fairly equally between mining and farming. 1831 was a year of acute depression in lead mining, making such people more dependent than usual upon their real income from farming. The predominance of mining is therefore not likely to have been overstated. A few of the 908 miners were coal miners.²

1. Abstract of the Census Enumeration Returns, 1831. The earlier censuses are not sufficiently reliable and uniform to be of much value, and the later ones give occupational analyses only by counties. 2. The notes accompanying the abstract say that all of the 285 miners in Arkengarthdale were lead miners, and all of the 48 men in Grinton coal miners. Neither statement is correct, as a few men in Arkengarthdale worked at the coal pits of Punchard Gill, William Gill, and Tan Hill, and the lead mines of Grinton township employed many more men than did the small pits working a thin coal seam on Grinton Moor. Abstract of Census Enumeration Returns, 1831, pp.769 & 776.

The category "others" may have included some unemployed miners. Some of the men returned under the heading retail trade and handicraft were craftsmen - stonemasons, blacksmiths, joiners, carpenters, and coopers - employed wholly or partly by the mining companies. The retail tradesmen supplied the needs not only of the miners but also of the mining companies. For example, the candles which were consumed in large quantities in the mines were made mainly by local tradesmen. Even the farmers who did not work as miners sometimes raised horses to sell to carriers, or went into the transport business themselves. Arthur Young wrote of the Swaledale farmers, "Their stock is chiefly cows and horses to carry lead."¹

The returns of deaths of males over ten years of age for the same area for the years 1859-61 include 92 miners, smelters, agents, and sons of miners, fifteen farmers and eight farm labourers, twelve craftsmen and their sons, five landed proprietors and ten others.²

When the mining industry was at its height, a substantial part of the agricultural land of Swaledale, particularly in Melbecks and Arkengarthdale, was held by the miners as small-holdings. A list of the tenants of the manor of Arkengarthdale in 1798 is worth reproducing in full. It includes only one occupier, John Marr, who was a true farmer. There were, of course, other occupiers who owned their own land, or rented it from lesser landowners, who are therefore not included in this list.

1. Young, *op.cit.*, Vol.2, p.189.

2. Kinnaird Commission Report, Appendix B, pp.406-7.

Manor of Arkengarthdale. 19th April 1798.

List of tenants, with the new rents fixed by a survey of 1797¹.

Tenant.	Occupation and Situation.	Quantity Ac. r. p.	Old Rent. £. s. d.	Improved Rent. £. s. d.
Alderson, Chris (Pullen)	Miner, Hillside	14 3 36	7-10- 0	9 - 4-0
Alderson, David	Miner, Hillside	3 0 24	4- 4- 0	5 -10-0
Atkinson, Ann	Widow, near Arkletown	6 0 8	6-15- 0	6 -15-0
Alderson, Chris (Screamer)	?	33 0 21	7- 5-0	8 - 0-0
Alderson, Ralph	Miner, Tottergill	7 0 34	4- 1- 0	5 -10-0
,, Geo. Junr.	Agent, Scarhouse	4 1 38	1- 1- 0	1 -10-0
Barningham, John	Miner, Schoolhouse	17 0 25	11- 6- 0	12 -17-0
Chalder, Nathan	Miner, Holly Intake	4 2 34	8 -0- 0	9 - 0-0
Coates, George	Miner, Arkletown	9 0 12	10-10-0	13 -10-0
,, John	,, Booze	1 3 16	4-15- 0	4 -15-0
,, Vincent	,, ,,	13 3 17	10- 5-0	10 -11-0
Coulton, Edward	Blacksmith Bankhouse	6 1 21	5-10- 0	6 -17-0
Croft, James	Miner, Booze	2 2 26	4-10- 0	4 -10- 0
Chalder, Ruth	Widow, High Green.	9 0 20	5- 0- 0	6 - 6- 0
Douglas, John	Miner, Booze.	1 2 21	2-10-0	2 -10- 0
,, Margery	Widow, Booze	2 1 26	4- 4- 0	4 - 4- 0
Gill, Thomas	Miner, Arkletown.	5 3 9	6-10- 0	8 - 0 0
Garbutt, Robert	,, Booze	11 3 15	8- 0- 0	8 -19 -0
Hilton, Braithwaite	Miner, Arkletown	2 0 10	6- 6- 0	6 -15 -0
Harker, John	Agent under Fowlett & Co	18 0 9	8-10- 0	11 - 0 -0

1. K.L. MSS., Pkt.7(b)/3.

Tenant.	Occupation and Situation.	Quantity Ac. r. p.	Old Rent. £. s. d.	Improved Rent. £. s. d.
Hird, Wm & John	Miners, Booze.	4 1 27	6 -0 -0	6 -6 -0
Harker, Robert	Innkeeper, Booze.	12 1 22	10 -0 -0	11 -6 -0
,, Ralph (Jug)	Miner, Hillside	8 0 39	9 -9 -0	10-10 -0
,, Simon	,, ,,	28 1 6	15- 0 -0	18-0 - 0
Hillary, William	Miner, nr Tottergill	11 1 16	5-10- 0	5 10 -0
Hall, James	,, ,,	18 2 16	10- 0- 0	10-14 -0
Harker, John	Miner,Booze	11 1 23	9-10- 0	10- 6 -0
Hall, Nathan	Miner, nr Tottergill	20 2 16	8- 0- 0	8- 0 -0
Harker, James	Underground Agent	3 3 29	5-14-0	6- 0 -0
Hutchinson Wm	Schoolmaster, Schoolhouse	1 2 26	3- 0-0	3- 0 -0
Longstaff, Wm	Miner, Hillside	7 3 22	4-10-0	4-10 -0
Louthin Thomas	Smelter,Gill nr Arkle- town.	7 1 23	7-10- 0	7-10 -0
Liddell, Ralph	Miner, nr Arkletown	5 3 36	5- 0- 0	5-16- 0
<u>Marr, John</u>	<u>Bouldershaw Farm</u>	131 3 8	52- 0- 0	60- 0- 0
Mudd, James	Miner	3 1 30	5- 4- 0	6- 9- 0
Pratt, Joseph	Joiner, nr Scarhouse	6 0 5	8-15- 0	10- 5- 0
Peacock, Joseph	Miner, Lang- thwaite	5 2 18	7- 0 -0	7-10-0
,, William	Carpenter at mines	4 3 5	4- 0- 0	4-15-0
,, Thomas	Miner, nr Arkletown	6 3 20	7- 0- 0	7-16-0

Tenant.	Occupation and Situation.	Quantity.			Old Rent.			Improved Rent.		
		Ac.	r.	p.	£.	s.	d.	£.	s.	d.
Raine, Joseph	Stonemason, Arkletown	6	3	2	6-	0-	0	6-	16-	0
Robinson, Mary	Widow ,,	5	0	15	9-	0-	0	10-	0-	0
Sleach, Thomas	Miner, nr Arkletown	4	1	25	7-	0-	0	7-	18-	0
Stubbs, Robert	Miner, nr Booze	4	2	28	6-	10-	0	7-	0-	0
Stones, Edward	Miner, Eskelith	2	3	30	3-	15-	0	3-	15-	0
Whitehead, Matthew	Blacksmith Arkletown	28	0	8	23-	0-	0	26-	7-	0
Walker, William	Miner, Booze	2	3	30	4-	4-	0	4-	4-	0
		531	0	27	369-	3-	0	416-	6-	0

The most accurate analysis of the extent of smallholding in the main valley of Swaledale can be made by relating the census figures of 1831 to the tithe returns of Grinton parish (including Muker Chapelry) for the year 1832. (The 1831 return has been lost).

Township	Population	1831 Census		1832 Tithe	
		Inhabited dwellings	Families	Occupiers paying tithe on agricultural produce	Occupiers with one or more milking cows.
Grinton	696	120	127	62	59
Reeth	1456	307	314	123	111
Melbecks	1455	283	290	145	140
Muker	1247	266	268	166	157

For comparative purposes the 1821 census returns can be related to the 1823 tithe records, the earliest surviving ones.

Township	1821 Census			1823 Tithe	
	Population	Inhabited dwellings	Families	Occupiers paying tithe on agricultural produce.	Occupiers with one or more milking cows or heifers.
Grinton	696	129	129	80	68
Reeth	1460	264	321	162	103
Melbecks	1726	330	351	176	155
Muker	1425	277	285	171	134

In 1821-23 460 out of 1086 families in these four townships had at least one cow; in 1831-32 467 out of 999. In each case a few more people paid tithe on such things as geese and garden produce. Pigs, which were probably kept by a large number of people, appear to have been generally exempt from tithe¹.

A more detailed analysis of Melbecks, the township with the greatest proportion of miners, shows the following picture:

1. A few large tithe-payers paid a composition of which no details are given. Some of them were corn-millers, a few apparently large farmers. The latter probably increase slightly the true number of people with cows. Grinton Parish Tithe Collection Books 1823-38. Peacock MSS. B 1-5.

	No. of families. 1831.	Occupiers, 1832		Tithe Paid, 1832.			
		paying tithe	with one or more milking cows.	not exceeding 2/-	2/0 $\frac{1}{2}$ - 7/6	7/6 $\frac{1}{2}$ - 15/-	More than 15/-
Kearton		14	14	6	6	0	2
Feetham		25	24	15	8	1	1
Blades		15	15	3	9	2	1
Low Row		19	19	10	5	3	1
Smarber		11	11	2	8	0	1
Lodge Green		33	30	21	6	2	2
Pott Ing		6	6	1	2	1	2
Gunnerside		22	21	11	4	1	6
Melbecks	290	145	140	69	48	10	16

The figure of 16 occupiers paying more than 15/- in tithe agrees well enough with the 18 farmers of the 1831 census.

117 of the 145 occupiers paying tithe paid no more than 7/6d.¹

The full details of one hamlet are given below:

1. The tithe payments include an "offering" of 2d. per adult.

Kearton	Cows	Heifers	Calves	Lambs	Fleeces	Geese	Agistment of Pasture	Acres of Ploughing	Hay Modus	Offerings	Total Tithe.		
											s. d.	£.	s.	d.
John Bell (Betty)	2								2	2			9
John Bell (Conny)	3								8½	4		1	9
Solomon Harker	3	4					3		10½	2		4	11
Chris Heslop Snr	2					½			½	3		2	0½
,, Jnr	1		1						1½	2		2	7
William Martin	3	6		3	3		21	21½	1.10	4	10	10	4½
John Metcalfe	3								5¼	2		1	1¾
James Newton	3						1		3	3		2	1½
William Pratt	3								5½	2		1	2
Thomas Pedley	2								¼	2			7¼
Francis Raw	4	2		1	1/10				8	4	1	17	0
Mary Spence	1								3	2			8½
Henry White	4								5½	2		5	3½
Chris White	1		1						1½	1		2	5

These figures are not quite typical of Melbecks as a whole. In Kearton six of the people with cows or heifers had one or two, and eight had three or more. The respective figures for

the whole of Melbecks were 92 and 50.

Allowing for the fact that some of the smallholdings would be held by craftsmen, farm labourers, and widows, it is reasonable to conclude from the above evidence that rather more than one-third of the miners had some sort of agricultural holding, usually with one or two cows.

Two local diaries allow us to put some flesh on these statistical bones. The first is the diary of James Clarkson, of Smithyholme near Keld, who would probably have been classed as a farmer in the census returns. Here are some consecutive entries for 1840 :

- August 21 Finished hay
- 31 Selled geese to J.Dinsdale
- Sept 3 (illegible)
- 8 Bargain day at Lane End and Keld Side mines
- 15 Put mugs into fog (1)
- 16 It was snow this day
- 21 John Alderson and myself started dressing at Keldside
- 22 Selled yearling stag (2) to George Metcalfe
- 23 Fetched my gimmers out of Black Allotment into Kisdon Allotment (3)
- 26 Livered yearling stag to George Metcalfe
- 30 Finished working at Keldside - 2 bings 7 cwts
- Oct 3 Partner and myself started in bottom (4)
- 21 T.Robinson blacksmith graved our gear
- 23 Fetched gimmers out of Kisdon Allotment.

In common with most of the miner-farmers, Clarkson left the mines completely for about a month at hay-time. For the rest of the year he divided his time between mining and farming, frequently spending part of the day in each activity.

The relationship between farming and mining could hardly be expressed more succinctly than by the following entry in the notebook of John Barker of Healaugh, for March 25th, 1825 :

-
- 1. Put sheep into a meadow in which the grass has grown again after hay-time.
 - 2. Horse
 - 3. Gimmers are young female sheep.
 - 4. In the mine.
 - 5. J.A.Clarkson's Diary, Peacock MSS B18.

"Lent James Pedley, Healey, £1-10-0, which he promises to pay me at the second Old Gang pay from this time if he don't sell his sheep before."¹

Cattle-shows in the dale included such classes as :-

"For the working miner who has brought up the largest family without parochial assistance.
First prize £3, second prize £2, third prize £1."²

"For the cart which with the least draught and wear and tear is calculated to carry the greatest number of pigs of lead from the neighbouring smelting mills to Richmond, £5."³

"For the best milch cow, property of a miner, smelter or day labourer, where only one is kept. £1.

"For the best fat pig, property of a miner, smelter or day labourer. £1."⁴

and in the Arkengarthdale Show of 1857, one for the best pair of miner's clogs. The prizes at this show were "chiefly given by the gentlemen forming the mining companies... endeavouring to encourage the men employed by them to keep superior animals for domestic use...."⁵

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1. John Barker's Diary and Account Book, 1823-1855, Peacock MSS B13.
 2. Reeth Cattle Show, 1841. Darlington and Stockton Times, 3 Oct, 1936.
 3. Classes to be included in the Reeth Cattle Show of 1845, Yorkshire Gazette, 9 Nov, 1844.
 4. Wensleydale Advertiser, 21 Nov 1848.
 5. Ripon and Richmond Chronicle, 12 Sept 1857.

Some of the miner-smallholders were copyholders, who enjoyed security of tenure, with rents that were in the nineteenth century little more than nominal¹. The remainder rented their land from the lord of the manor, from owners of freehold land, and in some cases from copyholders². With the exception of the Arkengarthdale rental, there is no statistical evidence about the level of rents. Sir George Denys wrote in the eighteen-seventies, "It is a good policy on the part of mining proprietors to let the miners have their bits of land and houses at an easy rent; it makes them stick to their homes and to their work and they work for less wages..."³ But the rents do not seem to have been easy. Only a minority of the miners who were not copyholders could find smallholdings, and competition between them tended to keep up the rents.⁴ A significant comment is provided by John Davies, writing to Lady Charlotte Denys in December 1821. "The farmers in this country are no better than those in the south. The land is much reduced in rents, all. But your Ladyships land here is chiefly let to the miners, and as long as the tenants can earn wages they will pay the rents as they now are on the rental."⁵

1. They had, of course, to pay fines on entry.

2. Valuation for tithe commutation, Grinton parish, 1844. Peacock MSS. B6-10.

3. Sir G. Denys; A Chapter on Mining, p.6. He was referring particularly to Arkengarthdale, where the lord of the manor also owned the minerals.

4. Fawcett MS., p.208.

5. D.H. MSS. RD13.

The miner-smallholder system has left a lasting mark on the landscape of Swaledale. At the beginning of the sixteenth century nearly every village or hamlet in the dale had its common stinted cow pasture. Some of these, including Reeth, Healaugh, and those in Arkengarthdale, were enclosed by private agreement during the sixteenth and seventeenth centuries. Others, including Fremington, Crackpot, Satron, and Muker, were enclosed by Act of Parliament in the late eighteenth and early nineteenth centuries¹. A few, however, were never enclosed: Kearton, Feetham, Little Rowleth, (the pasture of Low Row), Great Rowleth (Lodge Green Pasture), and Gunnerside².

The reason for this is not hard to find. Throughout the period of parliamentary enclosure the majority of the stints on these pastures were held by small men, who would lose more than they would gain from the division of the pastures into a large number of small fields. They seem to have reacted like Arthur Young's poor man, except that they could say, "All I know is that I have a cow, and I am not going to have it taken from me". There is, however, the other side of the medal. These common pastures, which provide most or all of the summer pasture for the cattle of the present-day farmers, are in a much poorer condition than the fields of other villages which have been enclosed.

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1. Enclosure Awards in North Riding Record Office and North Riding Registry of Deeds; Cooper, Muker, pp.55-7.
 2. A few closes have been carved out of Kearton and Great Rowleth pastures.

Chapter IX : The Fortunes of Capital.

Until the seventeenth century the initiative in searching for and winning lead ore rested with partnerships of independent miners, many of them combining mining with some other occupation, who worked with simple tools and equipment. Their chief investment, and their chief risk, was their own labour. The mineral owners or lessees normally played a passive role, receiving a proportion of the output of the miners without themselves bearing any risks. From the second half of the seventeenth century the industry became increasingly capitalistic, as first the major mines like Old Gang, Lownathwaite, Hurst, and Arkengarthdale, and later most of the lesser mines, were exploited on a larger scale and by techniques which could not be commanded by the small man.

The earliest active capitalists about whom anything is known were the mineral owners themselves, particularly Philip Lord Wharton and his brother Sir Thomas, their own agents and stewards, like Philip Swale and Adam Barker, and local men like Robert Barker and Edward Thompson, both apparently engaged in trade in Richmond. For a time during the eighteenth century much of the capital came from outside the area. The Hurst mines were leased first by four men from Flintshire and London and then by the London Lead Company, the Grinton and Swinnergill mines by the same company, and the South and West Swaledale mines by the Company of Mine Adventurers. From the withdrawal of these companies the proprietors themselves assumed the

leading role as entrepreneurs until the Napoleonic Wars, when a new group of capitalists appeared, several of them lead merchants. The major mines in their heyday, from about 1830 to 1870, were leased by local middle class people, and finally, in the last phase of the industry, limited liability helped to bring in some outside capital once more.

The contribution of each of these groups to the development of the mining industry has already been considered. We can now turn our attention from the organisation of the industry to the people themselves, and consider the place of lead mining in the lives and economic activities of some of the local people who invested capital and directed mining operations.

The longest, although not the most intimate, connection with mining is that of the Barkers, Robert Barker, a Richmond shoemaker, was a partner with Philip Swale in leases of several mines in the sixteen-seventies. When he died his shares passed to some of his relatives, including his brother Adam, who had been living and working in the Wirksworth lead mining field in Derbyshire. He settled in Swaledale, managing the Old Gang and Lownathwaite mines, and also sharing in an enterprise in some of the Wharfedale mines.¹ He and his wife and children bought land in Swaledale, particularly a house and land in Healaugh which is still in the possession of the family.²

1. P.Swale MSS. Vol.I, Nos.143,192,195; Vol.II. Nos.42,49,51,110.
2. Healaugh Manor Court Books A and B; Barker Family Accounts, 1697-1765, Peacock MSS. B11.

For several generations the Barkers preserved roughly the same social position as Adam, engaging cautiously in a variety of economic activities. The family land was sometimes farmed, sometimes let off for rent. Samuel Barker (1746-1823), grandson of the first Adam, lent money on mortgage and short-term loan, and left several hundred pounds worth of such debts to his nephew John, who carried on the practice, lending money particularly to miners and mining investors. The same John invested in Whitaside lead mine in 1835 in a characteristically cautious way, taking a one-eighth share in a modest venture. His cousin Adam (1807-1871) invested in a number of mines in South Swaledale, and was also, like his great-grandfather, a practical miner and mining agent.¹

In contrast to the socially static Barkers, the families of Parke and Knowles rose from humble origins to a position of substance and rank through profitable dealings in lead mining and the hosiery trade. Both industries offered this sort of opportunity to a small man who was enterprising and thrifty. It was possible for a miner to begin by taking, with one or more partners, an independent bargain, and if successful to re-invest his gains in a larger enterprise. A hosier could start a part-time business by putting out small quantities of wool to be carded, spun, and knitted, and gradually expand his business by re-investing his profits. In either case an agricultural

1. Barker Family Accounts, 1697-1765 and 1788-1837; and John Barker's Account Book 1823-1855, Peacock MSS.B.11-13; Kinnaird Commission, Minutes of Evidence, Nos.17033-17105.

holding provided a valuable economic base from which to develop these operations. These opportunities tended to dry up in the early nineteenth century, when the hand-knitting industry was in decline, and nearly all the mining field was either exhausted in the beds accessible to simple techniques, or was in the hands of capitalist concerns.

The first members of the Parke family of whom we have any record are John Parke of Gunnerside and Thomas Parke of Low Row, who were described respectively as miner and hosier when, in 1742, they leased the Beldi Hill mine, in partnership with Leonard Hartley, a Richmond solicitor. They also worked mines at Fryer's Intake, near Low Row, on Harkerside and Ellerton Moor, and at Beezy, near Askrigg in Wensleydale. Their interests in these mines passed to John and Ralph Parke, sons of Thomas, each variously described as hosier and gentleman¹. Another Thomas moved to Liverpool, and in 1758 went into partnership with John, who stayed in Low Row to manage his hosiery business and the mines, and two Liverpool men, as linen merchants.² The Beldi Hill mine remained in the hands of the family until 1808, after which the Parkes do not seem to have played any part in the economic life of Swaledale.³

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1. Deposition of witnesses in Beldi Hill dispute, Barker MSS, and D.H. MSS. RB16; Parke MSS. in Fawcett MS.
 2. Deed of partnership, Messrs. Crosbie and Trafford and Thomas and John Parke, Barker MSS. A son or grandson of this Thomas Parke became a high court judge and was created Baron Wensleydale. Dictionary of National Biography.
 3. Correspondence between Thomas Smith and Thomas Butson, Clarkson MSS.

The rise of the Knowles family was achieved in one generation. Edmund Alderson Knowles, a miner-farmer from Thwaite near Muker, is first mentioned in 1796 as one of two tributing miners looking for ore on Whitaside Moor.¹ In 1801 he was one of ten partners, most of them miners, in a larger enterprise, Thomas Butson's lease of the Lane End Mine.² He also engaged in the hosiery trade. In 1799 the lord of Healaugh and Muker manors, Thomas Smith, referred in correspondence to the probability that Edmund Knowles would "succeed to the mill". This may have been the fulling mill on Haverdale Beck which was in his possession at a later date.³

By the eighteen-twenties the Knowles family had arrived. In a directory of 1823 Edmund Knowles appears as a hosiery manufacturer, and John Knowles as the head of a company of worsted spinners and hosiery manufacturers.⁴ In 1821 Edmund Knowles became a partner in the new company formed to work the Arken-garthdale mines, and in 1828 he joined with some of the same partners in a lease of the Old Gang mine.⁵ He also bought and farmed land in Low Row⁶. After his death in 1835 his sons

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1. Articles of Agreement for trial, 3 Dec 1796. Clarkson MSS.
 2. Lease of the Lane End Mine, 1801, in the writer's possession.
 3. Correspondence between Thomas Smith and Thomas Butson.
 4. Baines, op.cit. Vol.2, p.649.
 5. See below, p.261.
 6. Grinton Parish Tithe Collection Books, and Valuation of Melbecks 1844. Peacock MSS. B1-5, 9.

Edmund, James, and John, now accepted into the ranks of the "county" families, maintained the family interest in the Arkengarthdale mines until 1870, and the Old Gang mine until 1887. They also leased for a time the Beldi Hill mine and the Tan Hill coal mine.¹

Meanwhile, to meet the growing competition of machinery in the knitting industry, they built a new mill on Haverdale Beck, powered first by a water wheel and later by a steam engine, where they spun yarn to put out to their home-workers, and for a time made carpets.² The mill was unfavourably placed, however, for both the supply of cheap coal³ and access to markets, which led the Knowles family to take an active part in various efforts to bring a railway line into Swaledale⁴. The mill closed shortly after the failure of the Richmond-Reeth railway project in 1868⁵.

Partners with the Knowles family in leases of the major Swaledale mines were the families of Jaques and Tomlin. Robert Jaques, who became the largest mining investor, owned an estate at Easby near Richmond⁶. Ottiwell Tomlin was a Richmond

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1. Kinnaird Commission, Minutes of Evidence, No.17703; Extracts Old Gang Pay Bill 1829 and 1836, and Agents Accounts, Arken-garthdale and Old Gang, 1864-83. D.H. MSS. RD2 and F7.
 2. Hartley and Ingilby, op.cit., pp.21-32.
 3. The coal for the mill was brought by horse and cart from Tan Hill.
 4. See above, p.224.
 5. Hartley and Ingilby, op.cit.
 6. According to David Brooks, late town clerk of Richmond and a local historian, the Jaques family first made its money in the East India Company.

solicitor who was for a time town clerk. His sons James and John, who practiced as solicitors in Richmond and London respectively, and the son and grandson of Robert Jaques, maintained and added to their families' interests in the mines. Both families bought estates near the mines, where they could stay when visiting their enterprises.¹

The only wealthy hereditary landowners to become substantial mining investors were the Chaytors of Spennithorne, Croft, and Witton Castle, who owned extensive estates, particularly in the North Riding. William Chaytor, of Spennithorne, who had been a barrister and a Member of Parliament, was wealthy enough to settle £10,000 on each of his three daughters, as well as leaving large estates to other relatives on his death in 1818². He and his son, Sir William, were for some time the principal lessees of the Surrender mine, and the family also invested in lead mines in Wensleydale. Smaller landowners were the Morleys, lords of the manor of Marrick, and proprietors of the Hurst mines, who at various times held shares in the Surrender, Grinton Moor, Summerlodge and Whitaside mines³, Matthew Whitelock of Cogden Hall, Grinton, and William Metcalfe of Hipswell Lodge, near Richmond.

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1. The Jaques at Eskeleth in Arkengarthdale, and the Tomlins near Healaugh.
 2. Copy of W.Chaytor's will, D.H. MSS. A3.
 3. Surrender leases and correspondence, D.H. MSS. A3 and LC5; Ripon and Richmond Chronicle, 3 Jan 1857.

There were several land agents and surveyors, who seem to have been able to put their specialist knowledge to profitable use, particularly Robert Clarke of Stockton, John Breare of Middleham, and Thomas and Christopher Bradley of Richmond. Both Breare and Clarke were consulted about the management of the Arkengarthdale mines in the seventeen-nineties¹, and Christopher Bradley wrote a book entitled, "An Enquiry into the Deposition of Lead Ore in the Mineral Veins of Swaledale."

Other professional people included three Richmond bankers who had a long association with the mines, Roper S.Roper, his son George Roper, and Henry Priestman, and another solicitor, George Allison of Richmond and Darlington. A Kirkby Stephen group which leased the Lane End and Keldside mines in 1829 included a solicitor, two bankers, a brewer, a chemist, and a doctor². Another doctor, George Robinson, became one of the leading Swaledale capitalists. He came to Reeth as a medical practitioner about 1820, and, to quote Sir George Denys, "had not been long there before he discovered that the chronic epidemic of the district, mental and physical, was 'mining'. Naturally enough he took up the study of the prevailing disease and, being a shrewd man, soon discovered that mining was likely to pay

1. See above, pp.74-6.

2. Lease of Lane End and Keldside to Jackson and Company, 1829.
D.H. MSS. LC2.

better than physic, if seasoned with judgment, and hence became an investor.... He died affluent and respected at a good old age¹. His son, G.A.Robinson, was later the principal lessee of the Grinton Moor mines².

This predominantly middle class group, all of them resident in or near Swaledale³, dominated the economic life of the dale from the eighteen-twenties until the eighteen-seventies. They worked nearly all the lead mines during this period. The Arkengarthdale lessees from 1821 to 1848 included Robert Jaques, Ottiwell Tomlin, Edmund Alderson Knowles, and Matthew Whitelock, together with John Birkbeck of Low Row, a small landowner, Richard McCollah, a Reeth merchant, and two Richmond men. By 1828 Dr. Robinson had joined the partnership, and a few years later other members of the Knowles family came in. From 1848 to 1870 the lessees included two Jaques, two Tomlins, three Knowles, and a Roper.⁴

The Old Gang Company had a remarkably consistent membership from 1828 to 1887, with the Jaques, Tomlin and Knowles families represented all the time. Other partners were Dr. Robinson, Matthew Whitelock, and William Metcalfe.⁵ James and John Tomlin, Priestman and George Roper were shareholders in the

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1. Sir G.Denys, A Chapter on Mining, pp.1-2.
 2. Kinnaird Commission, Minutes of Evidence, No.17829.
 3. Except for John Tomlin, who worked in London, but kept in close touch with affairs in Richmond and Swaledale.
 4. Arkengarthdale leases, Arkengarthdale MSS 9 and 11.
 5. Old Gang leases, D.H.MSS. A5, LB4, P3, and lead weighing books, D.H. MSS. ADM 1-6.

A.D. Company formed in 1873¹. The Surrender partnership was first the Chaytors and Breare, soon joined by Josias Morley; and later Dr. Robinson, who became the principal partner, Chaytor, Jaques, Allison, and the Rev. John Gilpin, a member of the family which owned the manor and mines of Arkengarthdale². The Blakethwaite mine was worked from 1806 to 1836 by Robert Clarke and other members of his family, John Breare, and another partner, and was then taken, together with the Lownathwaite and Swinnergill mines, by the Bradleys and Tomlins, with Timothy Hutton of Clifton Castle holding a small share³. The Bradleys also leased the West Swaledale and Hurst mines, and the Tan Hill coal mine, and for a time they mined a little ironstone near Keld.⁴ Matthew Whitelock leased the William Gill coal mine in Arkengarthdale.⁵

The economic interests of this group extended to other fields. Thomas Bradley was one of the managing trustees of a gas company established in Richmond in 1821⁶. Robert Jaques

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1. See above, p.177.
 2. Surrender leases and correspondence, D.H. NSS. A3 and LC5.
 3. Blakethwaite leases and proposals for leases, D.H. MSS, LB3, A7, and LC3; and C.L. Bradley to T.Hutton 23 March 1837., North Riding Records, ZAZ. Mining.
 4. West Swaledale draft lease, 1849; lead weighing book; C.L. Bradley to unnamed addressee, 19 June 1854; D.H.MSS. LB5, ADM3, and M1; Returns of lessees in R.Hunt, Mineral Statistics 1860-1866; Miscellaneous memoranda, D.H. MSS. MX. There were several unsuccessful attempts to launch an iron-founding industry on the basis of these ironstone deposits, in 1817, 1836-38, 1846, 1854 and 1867. Some of these schemes were associated with plans for railways in the area. D.H.MSS. A8, RD4, SG4/5, and SG4/7.
 5. Extracts from pay bills, Old Gang, 1829 and 1836. D.H.MSS. RD2.
 6. Clarkson, op.cit., pp.433-34.

was a director of the Swaledale and Wensleydale Bank.¹ He was also a promoter of two schemes for building a railway from Darlington to Richmond, in 1825 and 1836.² The two companies which put forward rival schemes in the latter year had respectively Ottiwell Tomlin as solicitor, and Thomas Bradley as surveyor³. Edmund Alderson Knowles (the second) was a member of the provisional committee of the Manchester, Liverpool and Great North of England Union Railway, which proposed in 1845 to carry its line through Swaledale⁴. In 1868 James Tomlin, Sir George Denys, and Mr. Gilpin Brown, lord of the manor of Arken-garthdale, formed the abortive Richmond and Reeth Railway Company⁵. Meanwhile a turnpike road had been built between Richmond and Reeth. The solicitor of the turnpike trust was Ottiwell Tomlin, the surveyor Thomas Bradley, and the list of trustees included the names of Jaques, Tomlin, Knowles, Chaytor, Robinson, Bradley, Metcalfe, Birkbeck, Whitelock, and McCollah.⁶

1. Parris. op.cit. pp.29-37.

2. See above, pp.218-9.

3. Yorkshire Gazette, 9th and 16th July 1836.

4. See above, p.224.

5. Parris, op.cit. pp.238-9.

6. An Act for making a Turnpike Road from Richmond to Reeth.
6 and 7 William IV, cap.XVII, 22 April 1836.

The members of this group of local middle class people were not just passive investors drawing interest on their capital. They took a very active part in the management of all their interests, especially the lead mines, which were probably run more efficiently during the period of their control than at any other time. They were willing to try any form of enterprise which offered a good prospect of profit, and on the whole they enjoyed the success which their energy and ability, and their contribution to the economic well-being of the area, had earned. The wide spread of their activities makes it as difficult to decide into which occupational category they ought to be put as in the case of the farmer-miner-knitters at a lower social level. The category of the 1831 census returns, "Capitalists, Bankers, Professional, and Other Educated Men" would comfortably embrace most of them. But nineteenth century local society had a neater description for them, whether their grandfathers had been working miners or wealthy landowners. They were "gentlemen".

Chapter X : The Conditions of Labour.

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The growth from the late seventeenth century in the scale of mining operations meant also the growth of a class of employed miners. The transition from independent producer to employee in the lead mining industry was, however, much less disturbing both for the individual and for the society of which he formed a part than was the case in, for example, the textile industry. The miners who worked for the mineral owners or companies in the eighteenth and nineteenth centuries still retained much of the organisation and outlook of the independent tributing miners of an earlier period. Instead of searching for ore-bearing veins and, if successful, working a stretch of one by paying a customary or agreed proportion of their output to the lord of the minerals, the miners bargained with their employers to work in a certain part of a mine and raise either a stipulated number of bings of ore, or as much as they could during a particular period, at a price per bing¹ that was fixed in relation to the expected difficulty of the place. In some cases the agents offered lists of bargains for the miners to choose from, and in others the head of a partnership² sent in a proposal to the agents. The pickmen, as the miners raising ore were usually called, could decide their own hours of work and the arrangement of

1. A bing was eight cwts.

2. A partnership usually consisted of from four to six men.

shifts within the partnership. They also decided their own methods of working, and their income depended quite as much upon their own judgment, and, of course, their luck, as upon the bing-tale rate agreed with the agent. These miners felt, and were, much more independent than their contemporaries who worked on farms, in factories, or in coal mines.

The miners driving levels or sinking shafts, who also worked in partnerships on what was called "fathom-tale", were paid a price per fathom which was initially fixed, and periodically adjusted, according to the hardness of the rock. The smelters and dressers were paid a rate per ton of lead smelted and ore dressed, the latter rate varying according to the quality of the bouse. Some craftsmen, e.g. coopers making tubs and masons building chimneys or walls, were paid by the piece. The other craftsmen and the labourers on roads, dams, peat stacks, etc., were paid by the day or week.

These categories were not entirely exclusive. Fathom-tale workers sometimes raised some ore in driving their levels, and bing-tale men were occasionally paid for making a drift. Both groups did occasional daytale work. Smelters often did other work, by day or piece work, during slack times in the mill.

There is a good deal of evidence about the earnings of labourers, craftsmen, and smelters, but much less about the more numerous and more important groups, the pickmen and the fathom workers. It will be convenient to deal first with the

former, and then with the latter.

-ii-

The only figures of daily wage rates before 1780¹ are given in an account relating to three Swaledale mines² in 1705. Three men who were full-time daytale workers received 1/3, 1/2, and 1/- a day respectively, and a number of males working from four to seven days each, out of a period of forty-two working days, received 5d, 6d, 7d, 8d, and 1/- with 8d as the most common. One man was paid 1/- per day for five days for repairing hearths.³ The median rates for labourers on bridges and roads, and craftsmen, given in the North Riding Quarter Sessions Records in 1702, were 8d and 1/6 respectively⁴, which suggests that the 1/3 and 1/2 rates at the mines applied to craftsmen.

In 1783 most labourers in Arkengarthdale were paid 1/- a day with a small number receiving 1/4. The two rates probably relate to different jobs, e.g. general labouring and repair work. Females were paid 10d. and 8d. During the next few years the proportion of men receiving 1/4 increased until in 1789 it was the most common rate. Wage rates rose generally in the nineties and by 1800, 2/- was the common rate for labourers.⁵

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1. Except for some general figures given by Arthur Young: "The men earn at an average about 1/3 a day, the women 1/-, and boys and girls from 4d to 9d."; Young, op.cit., Vol.2, p.189.
 2. Old Gang, Lownathwaite, and Swinnergill.
 3. Lead Account, Swaledale, 31 Oct to 19 Dec 1705. D.H. MSS. RD18.
 4. E.Gilboy, Wages in Eighteenth Century England (1934), Appx.II, Tables X and XI.
 5. K.L. MSS. Pkts. 1, 14 and 15.

It seems to have remained so during the next half century, with occasional examples of rates of 1/10 and 1/8. However nearly all the figures for this period come from one account and relate to a small number of men, and the picture they give may not be fully representative.¹

There was a similar increase in the rates paid to craftsmen. The daily wage of a stonemason rose from 2/- in the eighties and nineties to 2/6 in 1805 and 3/6 in 1810-11, falling back after the war to 3/-, which remained the normal rate during the eighteen-twenties. A joiner's pay rose from 1/4 in 1783 to 3/- in 1811-12, and remained at that level, or a little higher, after the war. The normal rate for blacksmiths seems to have been 2/- before the war and 3/- afterwards².

Smelters were paid at different times as follows:

Arkengarthdale	1783-1790	5/- for 23 cwts of lead ³
Blakethwaite	1799-1800	6/10 for a fother (22 cwts). ⁴
Old Gang	1805-1811	6/8 for 24 cwts. ⁵
Old Gang	1836	6/- for a fother. ⁶

In Arkengarthdale, for three consecutive half-yearly periods in 1784-86, the average earnings of four partnerships of smelters

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1. A.D. Mills Account 1805-85. D.H. MSS. SD3.
 2. Further details are given in Appx.C, table 1.
 3. K.L. MSS. Pkt.15.
 4. Blakethwaite and Puchat Account 1799-1800. D.H. MSS. RD9.
 5. A.D. Mills Account 1805-85. D.H. MSS. SD3.
 6. Old Gang Mine, Extracts from Pay Bills, 1829 and 1836, D.H. MSS. RD2.

each of two men, were £30-7-6, £27-10-0, and £25-10-0.¹ A partnership of Old Gang smelters in the period 1805-08, when wage-rates were appreciably higher than twenty years earlier, earned an average wage per man of about 13/6, excluding their earnings during the peat harvest². Smelters seem to have earned roughly the same average wages as craftsmen, although their earnings were, of course, more variable.

There is little evidence about the wages of labourers, craftsmen, and smelters between 1830 and the eighteen-sixties.³ At the latter period labourers were paid 2/6 a day for repair work and 2/- for general work, masons 3/6, joiners 3/-, and blacksmiths 2/6 and 2/8. In general, the rates were no higher than in the eighteen-twenties. The boom of the early seventies led to a general rise in wages⁴. The immediate causes of the increase in Swaledale were the competition for labour of the iron and coal districts of Cleveland, Tees-side and South Durham, and the rise in the price of lead from £18-4-0 in 1871 to £23-6-0 in 1873⁵. The prosperity of the Old Gang mine at this time also made that company more disposed to grant increases.

1. K.L. MSS. Pkt.15.

2. The full details are given in Appx.C, table 2.

3. A table of rates for the period 1855-1881 is given in Appx.C, table 3.

4. Rostow gives 1873 as the peak year of the book. W.W.Rostow, British Economy of the Nineteenth Century (1948), p.33.

5. Both figures are annual average prices of London pig lead. R.Hunt, Mineral Statistics, 1871 and 1873.

In February 1873, William Whitwell, the managing partner of the Arkengarthdale Company, wrote to Sir George Denys:

"The present price of lead is very satisfactory and I am prepared to admit that so far we have not suffered much from the advance in wages. But if the present advance in price is caused by diminished production arising from the scarcity of miners, we shall before long feel the effects in Swaledale and Arkendale.

"An advance of 15 to 20 per cent has taken place in Weardale and Teesdale, and also in Patterdale... Of wages in Swaledale I know nothing but in Arkendale it is 10 to 12 per cent. In Patterdale until two years ago our average was 17/-, now it is 20/-. At the increased rate of wages, less work is done. A man at 3/6 a day does less work than he used to do at 3/- and 2/6. The men are drifting off to the iron and coal districts... At present we have little ore in Arkendale but if we had some good mines where are the miners to come from except by tempting those back who are gone away, at a considerable advance?"¹

In November 1873 John Tomlin wrote, "I don't think we can say no to the application for more wages to the smiths etc. at the Old Gang."² Their rate went up, in common with those of the other craftsmen, to 3/6 a day. Smelters and woodmen had already been granted increases, and labourers also gained 6d. a day³.

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1. W. Whitwell to Sir G. Denys, 2 Feb 1873. D.H. MSS. M1.
 2. J.L. Tomlin to Sir G. Denys, 13 Nov 1873. D.H. MSS. M7.
 3. Agent's Notebook, Arkendale, Fell End, and Old Gang, 1863-73, D.H. MSS. F8.

The fall in the price of lead from £20-11-3 a ton in 1877 to £14-16-0 in 1879, and in the case of the Old Gang Company the decline in output which had begun in 1874, caused a corresponding series of wage cuts which brought wages down to, and below, the level of 1872. In addition the numbers of craftsmen and labourers employed were drastically reduced.¹ The smelters fared better than the other groups as far as rates were concerned. The Old Gang smelters had been paid 7/- a ton between 1873 and 1878, and in May 1878 the Company "ordered that the smelters be reduced to 6/- a ton equal to 18/- a week."² Two months later, however, a deputation of smelters persuaded the company to pay 6/8, perhaps on the grounds that the currently poor output of the mine made it impossible for them to earn 18/- a week at the lower rate.³ The smelters at Surrender mill had their rate reduced from 7/6 to 6/8 at the same time⁴, and the Blakethwaite smelters, who had been paid as much as 8/- and 9/- during the boom, seem to have had a rate of at least 7/- in 1878⁵. Both these mills were, however, much less efficient than the Old Gang, and these higher rates would not mean higher earnings.⁶

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1. J.R.Tomlin to Sir G.Denys, 6 Nov 1878, and Surrender Mine Accounts 1878-81, D.H. MSS. N6 and CB2.
 2. Company Minutes, in J.A.Clarkson's Notebook, 1878.D.H. MSS.D1.
 3. Ibid.
 4. Surrender Mine Accounts, 1878-81.
 5. Blakethwaite Mine Accounts 1872-73, and A.D.Co.Accounts 1873-8. D.H. MSS., CB2 and CB1.
 6. See above, p.192.

The work of dressing the bouse was done at a rate per bing of dressed ore, which was usually paid either to partnerships or to contractors known as "washings-masters", who in turn employed other workers, mainly women and children, by the day. The rates paid at a number of Swaledale mines¹ between 1860 and 1880 varied from 2/- to 6/- a bing, according to the difficulty of dressing. Waste dressers were paid either by the bing of ore, or by the ton of lead smelted from the waste ore. The rates varied from 22/-² per bing of ore to £6 per ton of lead for the waste recovered on the washing floor, and up to £14 per ton of lead for ore recovered from becks or waste hillocks. These rates, too, rose in 1873 and fell in 1878 and later years.³

At the Old Gang and A.D. Company's mines, washings-masters had to make a return to the company of the wages paid to dressing-floor workers, and the balance left to themselves. A return to the A.D. Company in 1875 reads, "J.Miliner, waste workers 2/8, 2/6, 2/-, 1/6, 1/3 per day. J.Miliner 3/4 per day"⁴. In 1872, William Lowe, washings-master of the first waste floor at the Hard Level, Old Gang, received £341-12-3 for dressing the waste ore, and paid his workers £208-7-11, leaving "for Mr. Lowe, Boy and Uncle", £133-4-4. This was apparently thought to be

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1. Old Gang, Surrender and A.D. Co. (Lownathwaite).
 2. The rate at the Sir Francis Level floor was 16/- (after 1878) See above, pp.190-1.
 3. A.D. Co. Blakethwaite and Surrender Pay Accounts; J.A.Clarkson's Notebook 1878; and Old Gang; Applications for bargains, 1860-73. D.H. MSS. CB1, CB2, DL, S.G.1.
 4. T.Raw's Rough Notebook, 1873-76. D.H. MSS. D4.

too high a return to the contractor, for the rate per ton of lead was reduced from £5 to £4 in February 1873¹.

The work of drawing bouse and dead rock out of the levels was paid for in a similar way. The rate per waggon varied, according to the distance, from 2d to 8d, the latter rate being paid for the long haul from the Surrender mine through Old Gang to the Hard Level mouth, after 1875.² This work was done by both partnerships and contractors,³ and these rates, too, shared in the general movements of the eighteen-seventies.⁴

-iii-

There are three kinds of evidence about the earnings of pickmen and fathom workers, calculations from pay accounts, figures of actual earnings given by agents, and qualitative evidence about the general level of miners' wages. The bing-tale rates are of only limited significance, as a partnership might earn more at 7/- a bing in a rich vein than at 60/- in a poor place; the same applies to fathom-tale rates. If the net earnings of each partnership are not given in the accounts, they can be calculated only if all the necessary details are known: the gross earnings, or alternatively the amount of ore raised or distance cut and the rate per bing or fathom; the deductions

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1. J.A.Clarkson's Memo.Book, Arkendale, Fell End and Old Gang, D.H. MSS.F6.
 2. Surrender Mine Pay Accounts 1873-78. D.H.MSS. CBL.
 3. Old Gang, Applications for bargains 1860-73.
 4. Nearly all the rates were reduced by $\frac{1}{2}$ d in 1878. The 8d rate for Surrender became 7d. J.A.Clarkson's Notebook, 1878, and Surrender Mine Accounts, 1878-81.

made for candles, explosives, drawing, tools, and, in the case of ore bargains, dressing; and the number of men in each partnership. It is possible in the case of fathom workers, although not in the case of pickmen, to make a very rough estimate of the deductions,¹ but if the number of men in each partnership is not known, as in the case of the otherwise adequate Arkengarthdale pay accounts of 1783-91, no reliable calculation can be made. There are no adequate quantitative records for either group of workers before 1850.

The ore-bargain system at the Old Gang mine in the eighties and seventies worked as follows. The leader of a partnership sent in writing to the agents a proposal to work a certain stretch of vein and raise (say) 100 bings of ore at 48/- a bing. The agents noted their recommendation on the application, which was then considered at the fortnightly meeting of the company. The bargain might be granted for a smaller number of bings, or at a lower rate, than had been asked for. When the rich Watersykes Vein was being worked from 1866, bargains were usually let on a monthly basis.

Examples of these two kinds of bargains at the Old Gang mine are:

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1. In fathom work the deductions tended to be proportionate to gross earnings as both the rate paid, and the quantity of materials used, would vary with the hardness of the rock. There was no such relationship in ore-raising, as the pickmen might use a large amount of gunpowder in making a drift, and find no ore at all; or raise a lot of ore in a soft vein without any blasting at all.

17 July 1860	4 partners	Old Rake Vein	100 Bings at 48/-
9 Aug. 1860	4 partners	Freemans Vein	200 Bings at 48/-, 200 at 40/-.
20 Sept 1860	1 man & 1 boy	Barras End old workings.	20 Bings at 48/-, 20 at 40/-.
31 Oct. 1860	4 partners	Hard Level, Jas.Pratt's ground.	50 Bings at 48/- ¹ , 150 at 40/-.

Oct-Nov.1866 - Watersykes Vein.

7 partners	5th length, soles,	any quantity for 1 month @ 10/- a Bing.
2	,, 2nd ,, ,, ,, ,, ,, ,,	,, @ 40/- ,,
6	,, 14th ,, roof ,, ,, ,, ,,	,, @ 10/- ,,
8	,, level forehead ,, ,, ,, ,,	,, @ 12/- ,,
6	,, 13th length ,, ,, ,, ,,	,, @ 10/- ,, ²

Forty shillings was the usual price in Arkengarthdale in 1864³. The maximum rate at the Surrender mine in the eighteen-seventies, was 60/- a bing⁴. Sir George Denys frequently urged lessees to pay a rate as high as this so that the poorer parts of a mine could be cleaned out⁵.

Fathom-tale bargains were made on the initiative of the agents. The rates varied more than bing-tale rates, being based upon the hardness of the rock to be cut. The fathom rates in Arkengarthdale in the seventeen-eighties varied from

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1. Old Gang Applications for bargains 1860-73. D.H.MSS.SG1.
 2. Agents rough notebook 1865-73. D.H. MSS.E6.
 3. W.Spensley to Sir G.Denys 16 May 1864. D.H. MSS. SG4/13.
 4. A.D.Co. Pay Accounts 1873-78. D.H. MSS. CB1.
 5. Sir G.Denys: Memorandum for insertion into new Old Gang lease, undated; Notes on draft Old Gang lease 1877; and to J.R. Tomlin Jan 1878. D.H. MSS. SG4/33, 45 and 47.

5/- to £6¹, and in two Old Gang accounts of the eighteenth-fifties², and sixties³ from £1 to £10-10-0 and £1 to £8 respectively. The rates in the latter accounts were adjusted monthly.

The earnings of fathom workers calculated from these two Old Gang accounts are set out in Tables 1 and 2. The accounts give the distance cut, the rate per fathom and the number in the partnership, but not the deductions. The latter have been estimated on the basis of the only accounts giving the necessary information before gunpowder was replaced by other explosives⁴, at 20 per cent of the gross earnings. A few of the partnerships included boys, and they have been reckoned as equal to half an adult. They may have earned on the average more than this, as youths of sixteen and seventeen were

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1. K.L. MSS. Pkt.15.
 2. Old Gang Dead Work Book 1854-55. D.H. MSS. SC6.
 3. F.Taylor's Fathom Work Book, 1865-67, in the possession of Mr. C.F.Taylor of Gateshead.
 4. Extracts from Old Gang Pay Bills 1829 and 1836. D.G. MSS.RD2.

TABLE I. MONTHLY EARNINGS OF FATHOM-WORKERS, OLD GANG, 1854-55 p 27

	Number in Partnership		MONTH ENDING							
	Initially MEN	BOYS	20 MAY 1854	20 JULY	20 SEPT	20 OCT	20 NOV	20 FEB 1855	20 MARCH	20 APRIL
ROBERT PEDLEY	4		f2-18-6	f2-18-6	f3-3-0	f2-18-6	f3-3-0	f3-0-8	f3-0-8	f3-5-0
THOMAS SUNTER	4		2-16-0	2-1-0	?	1-16-0	1-10-8	?	2-4-0	2-9-9
GEORGE WATTERS	4		2-8-0	2-6-10 $\frac{1}{2}$	?	2-9-0	2-11-4			
GEORGE WHITE	4		2-13-8	2-18-0	2-13-2	2-5-10 $\frac{1}{2}$	2-15-0	2-10-0	2-10-0	
CHRIS. WHITE	6		1-13-0	2-2-1 $\frac{1}{2}$						
JOSEPH SPENCE	4		2-4-4	1-4-3	1-8-5 $\frac{1}{2}$	1-19-8	2-4-4	2-9-1	2-8-0	2-8-0
GEORGE BRUNSKILL	4		2-10-0	2-10-5	1-9-5 $\frac{1}{2}$	?	?	2-7-3	2-7-3	2-11-0
RALPH DUNN	1	2	2-4-9 $\frac{1}{2}$	1-11-2 $\frac{1}{2}$						
JOSEPH SIMPSON	4		2-9-0	1-17-4	2-14-10 $\frac{1}{2}$	?	?	2-18-8	2-12-11	3-1-10 $\frac{1}{2}$
ANTHONY SIMPSON	4		<u>3-13-4</u>	<u>3-10-0</u>	<u>3-13-4</u>	<u>3-6-0</u>	<u>3-6-6</u>	<u>3-6-6</u>	<u>3-6-6</u>	<u>3-12-10</u>
NATHAN SIMPSON	4		2-12-0	2-4-0	17-4	2-6-10 $\frac{1}{2}$	2-6-8	?	?	2-9-0
RICHARD PEACOCK	6		1-0-0	2-5-9	1-15-5	2-0-0	1-11-4	2-2-0	2-2-0	2-2-8
CHRIS. HESLOP	6		2-6-7	2-3-5						
METCALFE HIRD	6		?	2-2-0	2-6-0	1-17-5				
ROBERT CHAPHAN	4		2-12-0	2-12-0	2-10-1 $\frac{1}{2}$	2-12-0	2-12-0	2-12-0	2-12-0	2-12-0
JOHN METCALFE	6		?	2-4-5	<u>3-5-0</u>	2-19-5	2-8-0			
JAMES PRATT	1	3	1-14-8 $\frac{1}{2}$	1-4-0	9-7	1-15-2 $\frac{1}{2}$	1-12-9 $\frac{1}{2}$			12-9 $\frac{1}{2}$
WILLIAM NEWTON	2	2		10-8	<u>3-6-10$\frac{1}{2}$</u>	1-7-3	2-10-3	2-8-0	2-8-0	2-7-1
JOHN RUTTER	2	3		1-6-10 $\frac{1}{2}$	<u>2-15-4</u>	1-7-8				
ROBERT NEWTON	2				2-7-5 $\frac{1}{2}$	2-7-7	2-2-8	2-6-11	2-6-0	2-4-9 $\frac{1}{2}$
JAMES BELL	2	2			2-11-2 $\frac{1}{2}$	?	1-1-4	1-16-1 $\frac{1}{2}$	1-18-5	1-18-5
CARTER DEMAIN	2							<u>2-18-8</u>	2-7-8	2-10-0
THOMAS WAGGETT	4							2-5-0	2-5-6	2-4-5
CHRIS. MILNER	3	1						2-6-9	2-10-3	
JAMES HUGILL	3							1-12-0	2-2-8	
ROPER CLARKSON	2								2-9-1	2-1-5

RED = 12/- PER WEEK OR MORE PER MAN
 RED UNDERLINED = 15/- PER WEEK OR MORE PER MAN

TABLE 2. MONTHLY EARNINGS OF FATHOM-WORKERS, OLD GANG, 1865-66

	No. in Partner ship Initially	AUGUST 1865	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY
ISAIAH RAW	4	[1-14-10½]	[3-0-0]	[2-18-5½]	[2-15-0]	[3-7-2½]							
JOHN PRATT	6	1-1-4	2-10-0	2-8-9½	1-13-0	1-16-0	1-6-7	2-7-5½	2-14-10½	3-0-0			
JOSEPH PRATT	3	2-9-4	3-8-3			2-16-0	2-17-7	2-17-7	2-15-5½	2-15-5½			
LEONARD METCALFE	4	2-15-0	3-1-2½	3-4-0	3-3-0	2-18-6½	3-0-0	3-3-0	3-0-0	2-9-0	?	9-4	
JOHN ROBINSON	4	3-3-0	3-3-0	3-3-0	2-19-1½	<u>3-5-4</u>	3-1-8	2-13-0	3-2-5½	<u>3-6-1½</u>	3-4-8	2-10-8	3-4-5½
RALPH WAGGETT	2	2-13-4	2-13-4				2-12-0	2-16-0	2-18-0	2-18-0	<u>3-7-8</u>	<u>3-8-4</u>	<u>3-8-4</u>
JOHN PEACOCK	4	3-1-1	2-16-0	2-16-0	<u>3-7-5½</u>	<u>3-7-5½</u>		2-16-0	2-18-5½	3-0-0	2-15-9½	2-9-9½	2-17-1½
JAMES RAW	2	<u>4-0-0</u>	2-16-10½	<u>3-8-3</u>	<u>3-7-2½</u>	2-16-0	<u>3-10-2½</u>						
GEORGE WATERS	2	2-12-0	2-2-3	<u>3-14-8</u>	2-13-4	3-0-0	2-14-8	3-0-0	1-16-0	1-15-4	1-12-8	1-13-4	1-13-7
ROBERT PEACOCK	2	<u>3-16-0</u>	<u>3-9-8</u>	2-17-0	2-17-0	<u>3-16-0</u>	3-1-4	<u>3-16-0</u>	2-17-0	3-1-4	<u>4-1-8</u>		
CARTER DEMAIN	2	2-16-0	3-0-8	2-12-0	<u>3-6-2½</u>	2-12-0	2-16-0	2-16-0	2-14-8	2-16-0	3-0-0	2-10-0	3-1-4

RED = 12/- PER WEEK OR MORE PER MAN.

RED UNDERLINED = 15/- PER WEEK OR MORE PER MAN.

probably more common in fathom and bing-tale partnerships than boys of eleven and twelve years. The value of the tables is reduced by these two rather arbitrary estimates, but they still serve to show the approximate level of earnings, the degree of variation in the latter, and the movement of earnings between the periods of the two accounts.

A question mark in the tables indicates that some of the necessary information, e.g. the number of men in the partnership, is wanting, and four months, for which most of the items are doubtful, have been omitted from the first table. The average weekly earnings of the two highest paid partnerships in each account were 16/- and 14/- in 1854-55 and 15/6 and 15/4 in 1865-6.

There are only two representative¹ accounts from which the earnings of ore-men might be similarly tabulated. One relates to the Old Gang mine between 1860 and 1867², and the other to the A.D. Company's mine during the first five months of working Friarfold Vein from Sir Francis Level³. The pay sheet of the latter is set out in Table 3. The average wage per man for the whole account was £3-5-9 a month, or 15/2 a week.

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1. There are a few other accounts for the eighteen-seventies, but they relate to mines that were very poor, e.g. Surrender, or to the unsuccessful exploration on Kisdon Hill.
 2. Old Gang Mine Bargain Book Ledger, 1860-67; in the possession of Mr. C.F. Taylor of Gateshead.
 3. A.D. Company's Pay Accounts 1874-78. D.H. MSS. CBl.

TABLE 3. A.D. COMPANY, SIR FRANCIS LEVEL, BOUSE SHEET, 1878

		No. of Partners	Rate in		Gross Wages	Deductions				Net Earnings	Net earnings per man	
			Shillings	Cuts		Candles	Dynamite	Drawing	Washing			Tools
APRIL 1878	R. RUTTER.	8	40	30	£60-0-0	£1-17-4	£9-16-0	£5-4-2	£4-0-0	5-0	£38-17-6	£4-17-2
	T. KILBURN.	8	30	30	£45-0-0		3-13-0	4-3-4	3-0-0		34-3-8	4-5-5 ¹ / ₂
	M. HUTCHINSON	?	6	24	7-4-0			1-10-0	12-0		5-2-8	-
MAY 1878	R. RUTTER.	8	29-4	32	47-4-0		5-9-0	2-19-2	2-19-0		35-16-0	4-9-6
	G. WHITFIELD.	8	23-3	24	28-1-0		5-3-0	2-13-4	2-6-9		17-17-11	2-4-9
	J. HARKER.	?	37-2	10	18-12-6		3-9-0		3-14-6		11-9-0	-
	M. HUTCHINSON.	8	24-4	24	29-8-0		6-0-0	2-1-8	2-9-0		18-17-4	2-7-3
	G. CLARK.	4	8-3	36	15-1-6	7-0	1-0-0	1-6-8	16-9		11-11-1	2-17-4
	T. HARKER.	4	6-0	36	10-16-0	14-0	1-7-0	16-8	12-0		7-6-4	1-16-7
JUNE	C. SUNTER.	8	30-6	30	46-2-6		1-2-0	4-3-4	3-1-6		37-15-8	4-14-5 ¹ / ₂
	T. HARKER.	4	7	36	12-12-0	14-0	10-0	2-1-8	14-0		8-12-4	2-3-1
	M. HUTCHINSON	8	23-6	30	35-12-6	1-17-4	4-2-0	2-16-8	2-7-6		24-9-0	3-1-1 ¹ / ₂
	G. WHITFIELD.	8	21-1	28	29-15-0	1-17-4	3-13-0	2-11-3	2-2-6		19-10-11	2-8-7 ¹ / ₂
	R. RUTTER.	8	19	32	30-8-0	1-17-4	6-0-0	2-12-1	1-18-0		18-0-7	2-5-1
JULY	C. SUNTER.	8	22	32	35-4-0	1-8-0	2-0-0	2-15-5	2-4-0	5-0	26-11-7	3-6-5 ¹ / ₂
	J. BRUNSKILL.	8	18-1	32	29-0-0	1-8-0	3-12-0	3-9-7	1-16-3	5-0	18-9-2	2-6-1 ¹ / ₂
	T. HARKER.	4	9	36	16-4-0	7-0	1-6-0	2-1-8	18-0	5-0	11-6-4	2-16-7
	G. WHITFIELD.	8	15	32	24-0-0	1-8-0	1-10-0	1-13-4	1-10-0	5-0	17-13-8	2-4-2 ¹ / ₂
	M. COOPER.	6	8	36	14-8-0	7-0	1-0-0	1-0-10	16-0	2-6	11-1-8	1-16-11 ¹ / ₂
AUGUST	T. HARKER.	4	15	36	27-0-0	17-6	1-8-0	2-18-4	1-10-0	4-0	20-2-8	5-0-6 ¹ / ₂
	C. SUNTER.	8	35	32	56-0-0	1-17-4	8-3-0	5-4-2	3-10-0	10-0	36-15-6	4-11-11
	G. WHITFIELD.	8	32	32	51-4-0	1-17-4	6-19-0	4-7-6	3-4-0	8-0	34-8-2	4-6-0
	M. COOPER.	4	12	36	21-12-0	1-1-0	2-19-0	2-1-8	1-4-0	5-0	14-1-4	3-10-4
	J. BRUNSKILL.	8	20	34	34-0-0	1-17-4	4-16-0	5-0-0	2-0-0	8-0	19-18-8	2-9-10
	J. TIPLADY.	?	35	20	35-0-0	1-15-0		4-3-4	3-10-0	5-0	25-6-8	-

A similar calculation from the Old Gang pay account proved impracticable. There is frequently some doubt as to whether the agent has recorded all the changes in the numbers of men and boys in the partnerships. The latter have occasional months with no earnings, which may be due to the men not having worked during that period, or to their having raised no ore. In any case the earnings are highly variable, more so than in the A.D. account, and averages would have only a very limited significance. To illustrate both these difficulties and the variability, the longest run of earnings in the account - those of George Alton and partners - is set out below, expressed as net monthly earnings per man. The partnership included boys who have been reckoned as equal to half an adult.

<u>1860.</u>	<u>£.</u>	<u>s.</u>	<u>d.</u>	<u>1862.</u>	<u>£.</u>	<u>s.</u>	<u>d.</u>	<u>1863.</u>	<u>£.</u>	<u>s.</u>	<u>d.</u>
Sept	3	8	5	Jan	1	12	3	May	3	19	4
Oct	1	15	7	Feb		13	9	June	2	13	3
Nov	4	19	5	Mar			1	July	5	18	10
Dec	3	15	6	Apr	5	2	8	Aug	4	12	8
				May	3	10	11	Sept	4	0	5
<u>1861.</u>				June	1	17	1	Oct	4	16	2
Jan	2	8	7	July	4	4	2	Nov	4	11	10
Feb	4	19	5	Aug	1	11	11	Dec	4	6	3
Mar		nil		Sept	1	0	3				
April	6	0	9	Oct		nil		<u>1864.</u>			
May	1	19	2	Nov		15	8	Jan	3	12	8
June	1	18	4	Dec	2	13	11	Feb	3	3	7
July	4	3	5					Mar	2	12	2
Aug	4	6	5	<u>1863.</u>				Apr	4	0	4
Sept	2	3	6	Jan	7	11	10	May	3	7	11
Oct	4	18	8	Feb	5	4	2	June	3	3	6
Nov	1	3	8	Mar	2	4	2	July	2	12	10
Dec	1	9	6	Apr	1	11	4	Aug	2	1	8

Continued.

TABLE 4.

Bing and Fathom-tale Earnings.

Old Gang 1872-73 and 1877.

	<u>Ore-Man.</u>				<u>Dead Man.</u>			
	Highest		Lowest		Average	Average	Lowest	Highest
<u>1872.</u>								
June	34/6	33/5	7/6	6/7	17/3	15/4	12/8	24/11
July	38/-	28/-	6/-	5/8	16/-	15/4	13/9	18/8
Aug	20/4	18/5	5/8	2/3	11/10	14/-	9/3	15/9
Sept	26/4	24/4	9/11	8/-	16/4	10/2	5/7	15/-
Oct	29/6	25/4	10/9	6/8	18/-	15/8	12/-	18/7
Nov	103/2	36/11	9/2	6/3	21/2	15/10	11/11	20/7
Dec	30/8	26/6	9/10	9/3	18/3	16/7	15/-	21/1
<u>1873</u>								
Jan	27/-	25/-	10/9	6/1	16/2	15/10	13/1	18/3
Feb	31/1	24/4	6/8	6/6	15/-	15/6	9/5	29/11
Mar	27/1	26/-	6/3	5/9	15/5	15/10	11/8	26/6
April	86/11	39/6	6/2	2/-	18/-	17/-	12/-	27/-
May	57/9	51/2	6/-	3/-	18/9	16/8	10/-	26/6
June	44/6	33/6	8/-	6/9	21/4	16/6	12/-	19/11
<u>1877</u>								
Jan					20/5	16/8		
Feb					17/6	16/6		

Watersykes Sun Veins, and the first two months of 1877 fell within the period when wage rates reached their highest point of the century. The figures therefore show a level of earnings, for the ore-men at least, higher than the average for the period 1850-1880. An overall average for each category of workers cannot be given, as the number of men in each partnership is not mentioned in the agent's returns. The medians of the averages returned for each month are 17/6 for the ore men and 15/10 for the dead men. If the numbers of miners were constant throughout, the overall averages would be 17/5 and 15/6 $\frac{1}{2}$.

m It will be seen that whereas the fathom workers earned a lower average wage than the pickmen, the earnings of the latter were much more variable, both between one partnership and another, and for each partnership from month to month. Humanly speaking, this variability is a more important feature of the wages system than the actual level of earnings. One might say that forty men, half of whom had £1 a week, and the other half 8/- a week each, earned on the average 14/-. "But the twenty men earning each 8/- a week, however, have only their 8/- each and can barely get the most common necessaries to preserve life; and if the twenty men earning £1 each can procure comforts with their wages, the poor twenty are none the better off for that. Instead of saying then that the forty men spoken of were in comfortable circumstances, an accurate observer would say that one-half of these men were in extreme misery and the other half were well paid for men in their station."¹

When miners, drawers or dressers had a "hard bargain" and
1. Dr. Mitchell, Sub-Commissioner, in Appendix to First Report of the Childrens Employment Commission, Mines, Part 11, p.745.

were making poor wages, they often applied to the company for a variation of the terms of their bargain, or for some other form of relief. Some examples, from the Old Gang mine, are given in Appendix C, Table 4.¹

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Most of the qualitative evidence about the wages of the miners relates, like the statistical evidence, to the period after 1860. We owe the earliest reference to Frederick Hall. "...for several years past, for 8/- to 12/- per week, frequently for much less; alas! for 2/6 to 3/- per week."² William Spensley wrote in 1864, "Having kept the accounts and made up the pay bills for the lessees of Old Gang for about 30 years, I should be disposed to guess the profit of the mine about £100,000 for that length of time, and notwithstanding the plentiful remuneration, there have been many cases where the poor miners did not earn more than 1/2 a day"³. One must allow for bias in qualitative evidence. Hall was using the poverty of the miners to support the case for a cartel of lead producers, and Spensley was urging that a higher rate per bing should be paid in Arkengarthdale. They may have tended, therefore, to understate the level of wages. On the other hand, one would expect lessees and their agents to be biased, if at all, in the other direction.

1. Old Gang, Applications for bargains 1860-73. A similar practice was followed in Arkengarthdale, according to Mr.G.B.Harker, and no doubt at other mines as well.

2. Hall, op.cit. p.7.

3. W.Spensley to Sir G.Denys, 16 May 1864.D.H. MSS.SG4/13. Spensley had recently secured an agent's post in Arkengarthdale.

Two witnesses before the Kinnaird Commission gave figures of earnings. According to Adam Barker, miners at Surrender thirty years earlier, i.e. about 1833, earned 7/-, 8/- and 9/- per week.¹ Current wages, quoted by G.A.Robinson, averaged 10/- a week in one mine and 15/- to 18/- in others².

The references to wages during the years 1873-78 agree with the statistical evidence that 18/- a week was a reasonable average wage, and a man with 20/- was well off. In 1873, men earning 20/- were said to be amongst the most highly paid miners³. In 1874, the A.D.Company's agent recorded fathom-tale bargains let to three partnerships with "a promise that the next bargain be let to make them up to 20/- a week."⁴ At a meeting of the Old Gang Company in June 1877, "Mr. Tomlin asked T.Raw what wages the ... ore-getters were making on the Blakethwaite side - good men about 18/- per week and less. Mr. Tomlin complained of the wages made by the ore-men. They are quite willing to give 18/- per week for six days a week, and if they only work five days a week to have only 15/-."⁵

In 1879 the A.D.Company's miners raising ore in the Boundary Sump below Sir Francis Level, at 20/- a bing, complained about their wages. James Tomlin commented, "If the men have made on to 18/- a week at the bing tale... they have no ground of

1. Kinnaird Commission, Minutes of Evidence, No.17046.

2. Ibid. No.17809.

3. J.R.Tomlin to Sir C.Denys 5 April 1873. D.H. MSS. M5.

4. T.Raw's Rough Notebook. 1873-76. D.H. MSS. D4.

5. Minutes of meeting, 20 June 1877, in Old Gang Agent's Notebook, 1876-77. D.H. MSS.F4.

complaint."¹ The men may have felt themselves entitled to higher wages, as they were working in a lot of water.

The highest consistent wages during this period, about 25/- per week², were earned by the men driving Sir Francis Level with the boring machine between 1870 and 1877. This figure included bonuses paid for fast driving, and was in part a reward for the skill needed to work the borers. New men joining the partnership had "to allow of their wages 2/- per week for lessons with the machine, this to continue for three months."³

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From 1878 onwards, and especially after 1881, the poverty of the mines and successive reductions in rates combined to force wages below subsistence level. In Arkengarthdale alone the veins currently worked were rich enough to offset the low level of lead prices. "The workings throughout Arkengarthdale are said to be fairly prosperous and the mining population are earning average wages."⁴

In 1877 the Old Gang Company had reduced the maximum bing-tale rate to 44/-, and in the following year it was cut to 40/-. Thomas Raw commented, "This is much felt by the miners, who cannot make bread in many instances."⁵ Shortly afterwards the rate was cut to 36/-, and fathom rates reduced by ten per cent. Bargains were to

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1. J.R.Tomlin to Sir G.Denys 28 Oct 1879. D.H. MSS. M6.
 2. Sir G.Denys, Machine versus Hand Labour in Mining, p.13; and Agents Rough Notebook 1865-73, D.H. MSS. E6.
 3. Agents Rough Notebook 1865-73.
 4. Darlington and Stockton Times, 19 Nov 1881.
 5. T.Raw to Sir F.Shuckburgh 28 Jan 1878. D.H. MSS. SD5.

be let "for the men to work 40 hours a week and to earn 15/- per week."¹

The A.D. Company was still paying up to 44/- a bing in 1881², when the failure of the ore in Friarfold Vein, below Sir Francis Level, removed its last prospect of success. In 1882 the Company introduced a sliding scale which was later adopted by the Old Gang Company. The maximum price per bing was to be 40/- when lead was £12 a ton, 49/- when it was £15 a ton, rising to 60/- when lead reached £20 a ton³.

Most of the fathom workers were dismissed and had to choose between taking bing bargains at very low wages or leaving the dale. Most of the miners chose the latter course, but some remained. "Through the depression the poor men are taking ore contracts in various places in the old ground."⁴ In 1885, Leonard Jaques, a partner in the Old Gang Company, wrote, "Some of the miners are making miserable wages, in fact the average of the ore-getters has been less than 9/- a week for the past two months."⁵ By 1887, both companies had reverted to a maximum of 36/- a bing⁶, and the men were "at starvation point and leaving fast."⁷ Later some of the dwindling number of miners left at

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1. At 36/- or even 40/- a bing in poor places, a miner would earn much less than this. Minutes of Old Gang meetings 20 March and 1 May 1878 in J.A.Clarkson's Notebook, 1878. D.H.MSS. D1.
 2. This company had earlier paid up to 60/- a bing in poor places.
 3. T.Raw to Sir F.Denys 14 Oct 1882 and Sir F.Denys to J.L.Tomlin 24 Oct 1882. D.H. MSS. SG4/69 and 68.
 4. I.e., in places previously worked. T.Raw to Sir F.Shuckburgh, 31 Dec 1881. D.H. MSS. SD5.
 5. L.Jaques to Currie, Williams and Williams, 12 Feb 1885. D.H. MSS. P2.
 6. S.Cherry to Sir F.Denys, 7 Feb 1888, and Sir F.Denys to F.Huntsman, 1 Oct 1888. D.H. MSS. P4.
 7. Sir F.Denys to F.Huntsman 10 Oct 1888. Ibid.

the Old Gang, worked in the mines only when no other work was available. In the summers of 1898 and 1904, the lessors' agent reported that the produce of the mine had fallen off, "due to the men having outside employment."¹ When the Old Gang Company was liquidated in 1906, it had only eight underground miners in its employ.²

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If we attempt a comparison between the lot of the Swaledale lead miner³ and that of workers in other occupations, the following picture emerges. The miner had a lower average wage than most other workers, and earned little if anything more than a North Riding farm labourer. His wages were more variable, and were paid less frequently, than those of industrial workers. He worked shorter hours, much shorter than factory workers did during the first half of the nineteenth century, and he felt, and was, much more independent. His health and expectation of life were relatively poor, although his calling was less dangerous than coal mining. On the other hand, the lead mining industry did not, at least in the nineteenth century, exploit female and child labour as the early textile factories and the coal mines did.

A rough comparison between the wages of Swaledale miners and those of other occupations and categories is set out in Table 5. The Swaledale figures are very tentative, and averages mean less

1. Reports of lessors agents 1897-1927. D.H. MSS. V5.

2. Sir F. Denys, continuation of Sir G. Denys' Mining Notebook, D.H. MSS. W2.

3. I.e., ore and fathom workers.

TABLE 5 : Comparative Table of Average Earnings

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	1795	1804	1824	1828	1851	1860	1864	1871	1874	1881
SWALEDALE LEAD MINERS	ORE-MEN FATHOM WORKERS CRAFTSMEN ² AND SMELTERS LABOURERS ³					14.0	14.6 ¹	14.6	14.6	12.0
						12.0	13.6	15.6	16.0	13.6
		11.0	15.0	18.0	18.0		18.0	18.0	21.0	18.0
		9.0	12.0	12.0	12.0	12.0	12.0	{ 15.0	15.0	{ 18.0 16.0 }	12.0
ALL MINERS EMPLOYED BY LONDON LEAD CO. IN ALSTON MOOR, TEES- DALE, WEARDALE AND WESTMORLAND ⁴			15.1	13.5	13.9 ¹ / ₄	14.5 ³ / ₄	15.10	14.2	22.5	
BOWLEY'S TENTATIVE TABLE OF AVERAGE WEEKLY WAGES ⁵	PROVINCIAL ARTISAN TOWN LABOURER AGRICULTURAL LABOURER	14.0	22.0	24.0			24.0			
		12.0	14.0	16.0			20.0			
		9.0	13.0	9.6			14.0			
NORTH RIDING AGRICULTURAL LABOURER ⁶	NOMINAL WAGES EARNINGS	10.0		10.3		11.0	13.8	14.0	13.6	16.6
							14.6			
DURHAM COALMINERS ⁷						(1861) 25.5	(1866) 28.9	24.4		(1879-1883) ⁸ 21.10 ¹ / ₂

1. This figure is increased by the higher wages earned in the Watersykes Vein, which at this time provided most of the output of the whole A.D. group.

2. The figures for craftsmen and labourers are six times the daily rate, and do not allow for underemployment.

3. The rates for repair work and general labouring are given separately for 1867-74.

4. I am indebted for these figures to Dr A. Raistrick.

5. A.L. Bowley: Wages in the United Kingdom in the Nineteenth Century, p.70.

6. Compiled from different authorities by Bowley, op. cit., Table at end of book.

7. Given as five times the daily rate, as coalminers did not usually work a full six day week. These figures make no allowance for deductions or perquisites. Ibid p.108.

8. This is the average of the 1879 and 1883 figures.

in lead mining than in most industries, but the relationship shown by the figures should be approximately correct. The figures are supported by statements in the report of Sub-Commissioner Mitchell, of the Children's Employment Commission, referring to the lead mining fields of Alson Moor, Weardale and Allendale, where the average wages were at least as high as Swaledale. "By moving only twenty miles lower down into the coal country¹ a young man might nearly double his income and have the prospect of adding many years of health and strength to his life...."² and: "In general the miners consider that they do not gain more money than the agricultural labourer, but they have a great deal more spare time and are less under restraint."³

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The latter advantages were enjoyed in Swaledale at least as much as in the mining fields further north. In the latter, the miners worked eight-hour shifts for **five** days a week⁴. In Swaledale a six-day week was regarded as normal, but the usual shift was six hours. With one exception⁵, six-hour shifts were stipulated for the driving of covenanted levels in the leases between 1811 and 1870⁶. The Sir Francis Level was driven by

1. From Weardale.

2. Appendix to First Report of Children's Employment Commission 1842-43, Mines, Part 11, p.722.

3. Ibid. p.745.

4. Ibid. p.725.

5. The Blakethwaite lease of 1812. D.H. MSS. LB3.

6. The leases were: Old Gang 1811, Lane End and Keldside 1825 (draft, not executed), and Arkengarthdale 1828, 1848 (draft) and 1870.

men working six-hour shifts¹, and at the same period a woodman repairing levels contracted to work for not less than six hours a day².

Evidence about the hours of ore-men was given to the Kinnaird Commission. According to Thomas Coates, Arkengarthdale and, until shortly before, Old Gang agent, the hours worked were, "Some three, some five, some eight, just as it happens."³ Two other agents⁴, and Sir George Denys said that the normal underground shift was six hours.⁵ Many partnerships worked two day-shifts, but did not usually work at nights⁶. Ore-men could, however, work as long as they chose⁷, and one partnership claimed to have worked eighteen hours a day in a poor place⁸. Ore-men who made a rich strike on a quantity-bargain⁹ could chose between a higher income and more leisure.

The hours worked by dressers, smelters, craftsmen and day labourers are not known, except that labourers at the Old Gang mine worked an eight-hour day in 1878.¹⁰ In the mining areas to the north, the dressers and smelters normally worked ten-hour shifts, the former for six days a week, the latter for four or five shifts per week¹¹.

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1. Memorandum about Sir Francis Level, undated, D.H.MSS.N4.
 2. Agents Rough Notebook 1865-73. D.H. MSS. E6.
 3. Kinnaird Commission, Minutes of Evidence, No.17293.
 4. Adam Barker (Whitaside and Summerlodge) and Thomas Raw (Surrender).
 5. Ibid. Nos.17101-2, 17366, 17686.
 6. T.Raw, Ibid, No.17687. No night shifts were worked in driving Sir Francis Level. Sir G.Denys, Machine versus Hand Labour in Mining. p.12.
 7. Sir G.Denys, Kinnaird Commission, Minutes of Evidence No.17382.
 8. See Appendix C, table 4. 9. I.e. a bargain of a fixed number of bings. 10. Minutes of Old Gang Meeting, J.A.Clarkson's Notebook 1878. D.H. MSS. D1.
 11. Appendix to First Report of Children's Employment Commission pp.725 and 735.

The hours worked in Swaledale in the late eighteenth and early nineteenth centuries were not longer than those of the Victorian age, but shorter. Arthur Young wrote of the Swaledale miners, "The day's work finishes by twelve or one o'clock, after which no bribes are sufficient to tempt them into the farmers service, in the busiest times, not even for one hour."¹ John Tuke wrote of wages in the "Western Moorlands" of the North Riding in the seventeen-nineties, "The miners have 1/- per day of three hours."² These statements might be rejected as the product of too superficial an enquiry, but there is some corroborative testimony. Adam Barker told the Kinnaird Commission that in his younger days³ the miners "did not work more than about three or four hours; if they stayed six or seven hours it was considered two days' work or shifts in a general way when I was young."⁴ The lease of the Blakethwaite Mine in 1812 stipulated that four or five hour shifts should be worked in driving the Blakethwaite Level, although six hour shifts were fixed in the Old Gang lease of the previous year.

The shortness of the hours worked underground was almost certainly due to the fact that lead mining was originally a part-time occupation, and that even in the nineteenth century between

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1. A.Young, op.cit. Vol.11. p.189.
 2. J.Tuke, General View of the Agriculture of the North Riding of Yorkshire (1800) p.286.
 3. He was born in 1808.
 4. Kinnaird Commission, Minutes of Evidence, No.17103.

a third and a quarter of the miners had some sort of agricultural holding. Another contributory factor may have been the difficulty of working long shifts in mines that were badly ventilated.¹

The miners did not have any organised system of annual holidays, but they often left the mines at haytime to work on their own or their neighbour's smallholdings. The Old Gang Company ruled in 1878, "Men who go to hire a month for haytime, their places not to be kept for them but fresh men to be put in their places."² The annual walks of the local friendly societies, cattle shows and the major fairs drew many men away from the mines for the day, and "feasts" were sometimes held by the mining companies themselves. When the Watersykes Vein improved the output and prospects of the Old Gang mine, the company held a festival, with brass bands and refreshments.³ The A.D. Company celebrated the completion of the Sir Francis Level Engine House, in September 1880, in a similar manner⁴.

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In Arkengarthdale, in the years 1783-99, the miners were paid twice yearly⁵. The Old Gang mine must have had a long interval between the pays during the Aldersons' lease⁶, for Sir George Denys⁷ wrote in 1825 that his agent "considers that Messrs. Aldersons have ruined their field by the length of tick they require."⁸ He continued, "The Arkengarthdale plan is to pay

1. See below, pp.312-3.

2. Minutes of Old Gang Meeting 17 July 1878, in J.A.Clarkson's Notebook, 1878.

3. A framed copy of the handbill advertising the occasion, in Sept 1866, is in the Draycott Hall Estate Office.

4. Sir G.Denys, Mining Notebook. 5.K.L.MSS., Pkts.1, 14 and 15.

6. 1811 to 1828. 7. The elder.

8. Tradesmen as well as employees were paid on the pay days.

the miners twelve times in the year, the miners working six weeks at the beginning and to be paid for a month, which leaves a fortnight for the employers to make out the accounts..."¹ This system, which Robert Jaques introduced into Arkengarthdale in 1821 and the Old Gang in 1828² was still in operation in the later years of the century³. The Surrender Company paid monthly in 1818⁴, and the A.D. Company, which included Surrender, did the same in the eighteen-seventies.⁵ The Kisdon Company (1866-70) paid only six times a year⁶, and some of the other small concerns may have done likewise.

Some form of subsistence advances, in money or kind, was in operation at some mines when there was a long interval between pays⁷. An account of 1798, headed "Debtors to Proprietors of A.D. Lead Mines (Fremington Subsist)" records debits in respect of "wheat, cheeses and shop goods" for 231 people, including Peter Denys and a clergyman. The amounts, for a period of nearly seven months, range from a few shillings to £8-10-0 for shop goods and to £19 for wheat and cheeses⁸. There is another reference to "Fremington Subsist" in the Blakethwaite mine account of 1799-1800⁹ and mention of a "Lent Money Book" in 1810 or thereabouts.¹⁰

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1. Sir G. Denys to O. Robinson 28 Aug 1825. D.H. MSS. A4.
 2. Old Gang Mine, Extracts from Pay Bills 1829 and 1836. D.H. MSS, RD2.
 3. Old Gang Bargain Book Ledger 1860-67; various agents notebooks 1863-78; and information about Arkengarthdale from Mr. G. B. Harker.
 4. J. Davies to Lady C. Denys, 14 Nov 1818. D.H. MSS. RD13.
 5. A.D. Co. Pay Accounts 1873-78. D.H. MSS. CB1
 6. Kisdon Co. Pay Accounts 1866-70. D.H. MSS. CB2.
 7. See also above, pp. 33-4.
 8. D.H. MSS. RB19.
 9. D.H. MSS. RD9.
 10. J. Littlefair's diary, D.H. MSS. RD21, part 2.

The Arkengarthdale and Darwent Lead Mining Company, which worked the Arkengarthdale mines from 1800 to 1821, and seems to have paid quarterly, and the neighbouring Fell End Company, advanced provisions against miners' earnings.¹ There is no evidence in any of these cases as to whether the miners were forced by any other compulsion than their need for credit to trade at the "company shop".

In the early part of the nineteenth century the Old Gang lessees had to rent the A.D. Inn in Fremington, and a draft lease of this mine in 1828 laid down that all pays were to be made there². The motive of the lessors in making this stipulation is not known. Partnerships of miners commonly divided their earnings in a public house, where the publican provided the necessary change and promoted his own prosperity at the same time. G.A. Robinson, a prominent temperance reformer³, told the Kinnaird Commission that he always had enough change sent to his mines to allow partnerships to divide their earnings on the spot. He also said that no pays were then made in public houses⁴.

The variability of miners' earnings, and the relatively long intervals between the pays, gave the miners' families periods of feast and famine and made it difficult for them to keep out of debt. Even a month is a long time for poor people to manage on a variable income, and thrift in good times is a virtue more

1. Minutes of Arkengarthdale Select Vestry, 1819-1826.

2. Draft lease (not executed) to Raisbeck and Company, 19 May, 1828. D.H. MSS. A5.

3. Log Book, Gunnerside Wesleyan School, 25 April 1867.

4. Kinnaird Commission, Minutes of Evidence, Nos. 17826-7.

easily praised than practiced. G.A. Robinson said, "Supposing a man gets what we call a hit, if he makes an extra amount, he lives like a fighting cock as long as it lasts, particularly in rich cakes and all that sort of thing."¹ On the other hand, John Knowles described the men as good savers². If the men had to depend upon credit, this would effectively reduce their standard of living. As a mining agent told the miners of a neighbouring field, "I do not consider that goods can safely be furnished on the precarious credit which the miners now possess for less than thirty to thirty-five per cent profit, hence eightpence or ninepence in hand will buy as much as could be had for a shilling on credit."³ Monthly pays were, however, a great improvement upon the less frequent pays which were once common. To quote Robinson again, "I believe that one of the great advantages which we have had here has been in making our pays monthly, formerly they used to be quarterly. When they were made once a quarter the men were over head and ears in debt, and on the pay days they would meet and they would drink for a week or a fortnight before they ever struck another bat."⁴

of earnings, combined. -ix-

The variability of earnings, combined with the long interval between pays that was general before about 1820, created a serious

1. Kinnaird Commission, Minutes of Evidence, No.17815.

2. Ibid. No.17742.

3. T.Sopwith; "Observations addressed to the miners and other workmen employed in Mr. Beaumont's lead mines in East and West Allendale and Weardale." 2 Feb 1846.

4. Kinnaird Commission, Minutes of Evidence, No.17825.

social problem. Outright unemployment amongst miners was rare, except in periods of acute depression like the late eighteenth and early thirties, as it was usually possible for them to find some sort of bargain, if only re-dressing the wasteheaps. But even in prosperous times a miner might draw for full-time work a wage which was quite inadequate to maintain him and his family. A man with a smallholding had some other means of sustenance, however limited, to fall back upon. But half the miners at least had no such advantage, and they in particular might be forced to seek poor relief to supplement their earnings. A "Speenhamland System" was a much more natural growth in a lead mining community than in the agricultural counties of the south with which it is chiefly associated.

The best example of the operation of the system comes from Arkengarthdale, which had the greatest proportion of miners in its population of any Swaledale township, in the period after Waterloo, when the local mines were going through a lean period. The total expenditure of the township on poor relief in the year 1744-45 had been £32-3-10 $\frac{1}{2}$, part of which was spent on wool to be knitted into stockings by the inmates of the township workhouse.¹ In the year 1817-18, by which time, of course, the population had considerably increased, £1446-3-6 was spent on relief in cash and kind, against which £84-17-1 was received from the earnings of paupers at the mines.²

1. Arkengarthdale Township Poor Law Accounts, 1744-47.
2. Arkengarthdale Poor Law Accounts, 1817-18.

Some of the men who applied for relief were given allowances of food and money, and had their earnings kept by the township. Others received a small pension in addition to what they could earn. For example, in November 1819, Edmond Colling, who had a wife and two children, was granted 8/- a week by the Select Vestry, the parish to have his earnings. James Alderson, who had a wife and four children, was granted 10/- a week, the parish to have his earnings, but not those of his wife and children. He was also given a pair of blankets and a quilt.

In December 1819 George Woodhall was granted 12/- a week in bread from Joseph Alderson, a contractor who supplied food for the Vestry, the township to have both his and his daughter's earnings. At the same meeting, "Absolam Alderson applied for some addition to his bread, he having 16/6 a week. It is thought there is no advance in the price of provisions. Ordered that he have no more." A miner at this period would have done well to earn a regular wage of 16/6 a week, or even the 13/- or 14/- which several other families received from the Vestry.

In February 1820 George Woodhall "applied to have his daughter's earnings at the C.B. shop"¹, by which he meant permission to draw provisions from the truck shop of the mining company against his daughter's earnings, which had been earmarked by the township. He was given "3/- per week in bread at the C.B. shop, and 7/- from Joseph Alderson", and was recommended for admission to Leeds General Infirmary, to which the Vestry paid an annual subscription, because of "a misfortune in his eye!"

1. The Arkengarthdale mines were known as the C.B. mines, after Charles Bathurst.

Later in the same year two men applied to have their wives' earnings which the parish was claiming. The Vestry agreed on condition that the women worked for the Arkengarthdale and Darwent Mining Company. This stipulation was frequently made; it appears that the company was short of female labour for its dressing floors. The company and the vestry worked very closely together. One of the agents was a very active member of the vestry.

In March 1821 three men tried to contract out of the system whereby they drew their provisions from the C.B. shop, which is unlikely to have supplied them at keenly competitive prices, up to the limit allowed by the parish, and had their earnings kept back until the debt was cleared. They wanted the vestry to write off what they owed and let them make a clean start. Their application was referred to a magistrate. In the same month, however, eleven men signed an agreement "for the contractor to stop their wages at the mines' pay to the amount they have had advanced them in money and bread provided they have so much earned!"

The vestry had found that without such an undertaking it might be difficult to recover what it had advanced. For example it was reported at a vestry meeting on 20 December 1819, "Ann Alderson drew £6-2-0 at the pay table the 18th instant after all deductions and she refuses to pay anything back to the township for what she has got before. Ordered that her pension be stopped for the future on that account." Other people had to be reminded that, although the parish had in effect guaranteed them a minimum wage, they still had an obligation to work regular hours, and in

November 1820 the vestry began to reduce the pensions and allowances of the persistent absentees. For example James Hird's pension was reduced by 3/- a week, "he only having been at work two days last week." In the following June it was resolved that "John Alderson's pension be stopped until he gets his ore dressed up." Shortly afterwards it was "ordered that George Alderson have 1/- a week taken from his pension till such time as his wife looses and stops the dam¹ according to contract, and fills the water tubs regular."

The system obviously cried out to be abused, and the most accomplished wastrels were William Marcus and his family. In November 1819 one of his daughters was given shoes to go to Barnard Castle hirings, with a promise of an outfit of clothes if she found work, and the vestry agreed to find clothes and work for a second daughter. In January 1820 a shift and a pair of clogs were provided for another member of the family, but when later the same month one of the Marcus girls applied for a bed-gown and petticoat for her mother, the application was refused, "on account of her going to sell a pair of her father's kersey-mere smallclothes the day before."

Two months later, William Marcus appealed to the magistrates for an increase in his relief, and the vestry indignantly recorded the following minute: "The Vestry having taken into consideration respecting William Marcus family and the complaint that has been made to the magistrates, they have had 10/- a week paid to them for a considerable time and all they could make to it, which is more than any family has had in the parish this year, without

1. This was probably a dam controlling the flow of water to a dressing floor.

working or making some endeavour to pay a part of it back out of their earning. Their eldest daughter was clothed for the purpose of going to work but she refuses to work, and the Vestry thinks it a hard thing that out of seven in family there is not one of them that will work. Besides, it is setting a bad example to others. They therefore hope that the magistrates will see the propriety in not countenancing such idle and disorderly persons who make a practice of going about the country instead of working the same as other people to gain their livelihood, without being so burthensome to a parish which is unusually oppressed with the maintenance of its poor, and laying totally upon them for support.

"Ordered that they have no more pension and the overseer to appear against the summons tomorrow."

The vestry resumed payment of the pension, although they resisted further demands. In April 1820 one of Marcus's daughters applied for increased relief, but it was "ordered that her father and her go to work tomorrow morning or else have no more pension!" In the following month the vestry repelled a two-pronged attack. "William Marcus's wife applied for a bedgown and petticoat; not agreed except her husband will work. William Marcus's daughter applied for clothes to go to service in; refused as formerly she got new clothes to go to work in but after would not go." Shortly afterwards, perhaps disheartened by this treatment, the family left the district.

In 1821 Jaques, Tomlin, Knowles, and Company took over the lease of the Arkengarthdale mines from the Arkengarthdale and Darwent Mining Company. They instituted a system of monthly

pays instead of the half-yearly or quarterly pays which had hitherto been normal. The change allowed the vestry to tighten up the administration of poor relief; grants in aid of wages fell sharply, although they did not entirely cease. The development work of the new company seems also to have provided increased opportunities for profitable employment, and this also helped to reduce the burden of relief. For example, in October 1821 Robert Hodgson's pension was stopped, "his wife having her wages paid once a month, and himself being paid once a month or two months." A later application from the same man was refused, as he and his wife had made 18/- a week between them for the previous eight weeks, and he was told that if he did not repay 3/- advanced during that period, he would be taken before a magistrate.¹

By the period 1834-36 the average expenditure on poor relief in Arkengarthdale had fallen to £741, which was, in proportion to its population, normal for Swaledale, although much higher than in Richmond and neighbouring agricultural villages.²

The Muker Select Vestry also made grants and loans, in money and kind, to supplement earnings. The following examples could be multiplied many times:

1. Minutes of Arkengarthdale Select Vestry, 1819-1826.
2. The figures were: Arkengarthdale: 1831 population 1446, expenditure £741. Reeth: 1456 and £795. Grinton 696 and £332. Marrick: 659 and £404. For comparison: Richmond: 3900 and £829. Skeeby 183 and £35. Scorton 492 and £97. Poor Law Commissioners, Third Annual Report, 1837, p.286.

18 October 1821: "Jas Waggett to be advanced 8/- per week towards bread to be repaid by the masters as per note given by them for that purpose at his pay."

5 May 1825: "Michael Hutchinson to have a peck of meal per week until his earnings improve."

18 August 1830: "Jam Jack to have 4/- per week until an improvement in their earnings."

Entries of a weekly payment, principally to lead miners, "till earnings improve" or "till a change takes place" are particularly common. In addition grants of from 12/6 to £1-10-0 were frequently made towards the payment of rents, and as the depression developed in the late twenties, grants were made to help people find work "in the manufacturing districts." The practice of paying monthly does not seem to have been common in the mines of Muker township at this time.¹

The Poor Law Amendment Act, which was fully applied in Swaledale from the formation of Reeth Union in 1840², bore hardly upon the local poor. The Reeth Board of Guardians urged the Poor Law Commissioners to allow a relaxation of the prohibition on outdoor relief for the able-bodied, because there were in the area "many individuals who although able-bodied and no part of their families labouring under bodily or mental infirmity are yet unable without parochial assistance to maintain themselves

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1. Minutes of Muker Select Vestry, 1819-1837. See also below, p. 309.
 2. Arkengarthdale, Grinton, Reeth, and Marrick, but not Melbecks or Muker, were included in Richmond Union from 1837 to 1840. Minutes of Richmond Union, Vol. I.

and their families... if such persons were refused outdoor relief they would immediately come into the house, and the Poor Rates of several of the parishes, already very heavy, would be increased to an alarming extent."¹ The Commissioners, however, were unwilling to relax their rules. As they wrote to each Board of Guardians on its formation, "Their (the Commissioners') orders will shield you from undue responsibility, from the personal spite of the ignorant, or of those who have an interest in the abuses by which the labouring class has been so extensively pauperised; and will conduce to that uniformity which is so important to the efficient working of all unions."² The Reeth request was apparently refused, for a year later the Guardians applied to the Commissioners for approval of a grant to help three able-bodied men and their families "to leave the workhouse and go into the manufacturing districts where they hope to find work."³

The proprietors and lessees of the mines also helped the miners in difficult times. The following examples are taken from the accounts of the lessors of the A.D. group of mines:⁴

28 Oct 1818. "Paid Surrender miners by order of Sir G. Denys as Charity for loss of time"⁵. £100."

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1. Minutes of Reeth Union, 17 September 1841.
 2. Poor Law Commissioners, Third Annual Report, p.75.
 3. Minutes of Reeth Union, 7 October 1842.
 4. Agent's Cash Account with Lessors, D.H. MSS. E1.
 5. The reason for the "loss of time" is not known.

- 19 Nov 1830. "Paid Mrs. Robinson as Charity to the Poor Washer Women at the Old Gang Field, £2."
18 May 1832. "Paid E.A.Knowles, one of the Committee¹, a donation to the Poor of Melbecks £20."

A charity fund, maintained by deductions from miners' wages, or by contributions from the employers, or both, existed at various times and places. In an account relating to three Swaledale mines in 1705², the following payments are recorded:

		s	d
	(Geo Story for 7 weeks charity at 12d per week	7	0
	(John Gibson ,, ,, ,, ,, ,, 2/- ,, ,,	14	0
"Pention	(Ann Freeman ,, ,, ,, ,, ,, 15d ,, ,,	8	9
	(Margaret Miller ,, ,, ,, ,, ,, 15d ,, ,,	8	9
	(Ann Stepp ,, ,, ,, ,, ,, 12d ,, ,,	7	0
	(To Ant.Hird being lame and it being supposed that he got his lameness on my Lord's field.	10	0
Charity	(To Mic.Metcalf being very poor and having had several hard bargains upon the field.	4	0

A charity fund was in operation at the A.D. mines in 1799-1800³, and some twenty years later, when the following items appear :

- 1 April 1818: "Paid Jas. Brown out of the Charity Fund having his arm broke at the Spout Gill mine, £4".
 31 March 1820: "Paid Thompson Blenkiron as Charity from the Miners' Fund £2-2-0."⁴

1. This may have been a committee set up to relieve distress during the depression. E.A.Knowles was one of the leading citizens of Melbecks.
 2. D.H. MSS. RD18.
 3. Blakethwaite and Puchat Account 1799-1800. D.H. MSS. RD9.
 4. Agent's cash account with lessors, D.H. MSS. El.

In the A.D. Mills smelting and carriage accounts for the years 1830 to 1838 one penny in the pound, after the first pound of a man's quarterly earnings, was deducted for the charity fund¹. A similar system operated in Arkengarthdale in the seventeen-eighties². There is no evidence about the existence of a charity fund after 1838, perhaps because of the development of friendly societies.

It is not unlikely that the inflexibility of the new poor law stimulated the development of these societies. Two of them, the "Banks of Swale" Court of Ancient Foresters at Low Row, and the "Miners' Desire" Lodge of Ancient Shepherds at Gunnerside, were established in 1838 and 1844 respectively³. There were at least three other similar bodies in the area, the Oddfellows in the Muker district⁴, a society known as the "Reeth Club", the full name of which is not known⁵ and the "Loyal Swaledale and Arkengarthdale Independent Friendly Society"⁶, popularly known as the Swaledale Club⁷. The latter had seventy-two members in 1840, and only one more in 1864. Between 1864 and 1879, however, the membership rose from 73 to 125⁸, falling subsequently with the decline of the mines until the society was wound up in 1896. The benefits enjoyed by members were free medical

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1. A.D.Mills Lead and Carriage Pay Bills, 1830-61.D.H. MSS. SF1.
 2. Pay account for half-year ending 31 May 1784. K.L. MSS. Pkt.15
 3. Wensleydale Advertiser, 16 July 1844 and 7 July 1846.
 4. Ibid. 2 July 1844. 5. Log Book of Reeth School, 1863-89; The School had a holiday for the walks of the local friendly societies.
 6. Ledgers of the Society, in the possession of Mr C. Croft.
 7. Log Book of Reeth School. 8. A period during which the general level of wages rose. Friendly Societies usually lost members when real wages fell. E.J.Hobsbawm: Economic Fluctuations and Social Movements since 1800. Economic History Review 2nd series.Vol.V, No.1, 1952, p.10.

attention, for which the doctor was paid an annual capitation fee of 2/6 in 1840 and 3/- in 1879, sick pay at rates varying from 5/6 to 10/- per week, and funeral grants for members and their wives of £3 and £2 respectively. Subscriptions were 1/4 per calendar month¹.

The advantages conferred by such a society upon the rate-payers as well as its members is shown by the following minute of the Muker Select Vestry:

"11 March 1835 £1 be allowed to Simon Carter to reinstate him in the club and his family to make up the remainder."

The Arkengarthdale Select Vestry similarly helped a friendly society member to pay off his arrears.

There is no record of the existence of any trade unions amongst the lead miners, who normally combined for the purpose of collective bargaining only on a small scale, as when smelters, woodmen, carriers or similar groups sent in a joint claim for higher pay. The miners had a strong sense of community, arising out of the nature of their calling, as in the case of coal miners, but there was an essential individualism involved in the work of raising ore. There was always the prospect, however remote in reality, of making a lucky strike, and the rate paid by the employers was only one of the factors determining the miner's income. The bargain system was flexible,

1. Ledgers of the Society.

and on the whole relations between master and man seems to have been reasonably good.

Neither of the two strikes which are known to have occurred during the nineteenth century was caused by a dispute about wage-rates. The first "stick", as the men involved called it, at the Lane End and Keldside Mines in 1841, is described in James Clarkson's diary :

"Wednesday, July 7th. Bargain day at Lane End and Keldside Mines. Intended to be but all the men stood out for their pay at the usual time.... John Craig the agent came out and told us that the men that chose to go in and take bargains was to take pay when it came, but the men that would not was to quit and they would pay them. So we all went to Cathole¹ and got some ale, we spent 1/- per man. Partner John Alderson was spokesman, the agreement as follows; 'We, the undersigned miners and workmen of the Keldside and Lane End lead mines have come to the following resolutions:

- 1st. To have all wages due to us paid up in full on or before Friday, July 16th.
- 2nd. Any of the undersigned miners or workmen not complying with the first resolution to forfeit his or their whole pay.
- 3rd. Any of the above said miners or workmen taking new coming miners or workmen by way of lodgers or boarders to forfeit the sum of £1 for every man so taken in.
- 4th. All miners or workmen belonging to the said mines not attending at the Bridge End on Friday 9th July at 10 o'clock in the forenoon to forfeit the sum of five shillings individually, unless a sufficient reason can be given for such absence.
- 5th. None of the miners to begin work at the Keldside nor Littlemoor² until they all be satisfied and all give their consent so to do.' "

1. An inn at Keld.

2. A neighbouring mine worked by the same company.

The agreement was signed by forty-seven men. Two others at least refused to sign. Some of the men, including Clarkson and his partner John Alderson, found work at the nearby Beldi Hill mine. The rest drifted back to work at Keldside early in August, and were finally paid on the 16th of that month. Two men were not allowed to return. "It is likely they were supposed to be the beginners of this stick."¹

The second recorded strike was caused by an attempt by the new Arkengarthdale lessees in 1870-71 to discipline their workers. On December 15th, 1870, Whitwell and Company announced that miners who were not at work by 7 a.m. would be fined one shilling for each occasion. It is not clear from the newspaper reports whether this regulation applied only to fathom workers, or to ore-men as well, but all the men struck, and the mines were idle for about eight weeks. The miners agreed that they should work six hours a day for a six day week, as the company demanded, but they resented the fines which struck at their cherished independence. Eventually, after about fifty men had left to find jobs elsewhere, principally in the West Riding, the remainder was forced by poverty to return to work, and several men were fined for being late at the next pay.²

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The worst feature of lead mining as an occupation was its effect upon the health of the men working underground. A Commission appointed to enquire into the health and working

1. J.A.Clarkson's Diary, Peacock MSS B18.

2. Darlington and Stockton Times, 21 Jan, 4 and 25 Feb, and 25 March, 1871.

conditions of metalliferous miners reported :

"It may be affirmed as a general proposition that the health of copper, tin and lead miners as a class is greatly inferior to that of labourers engaged in agricultural and other open air employments, an assertion which is corroborated by the periodical returns made to the Registrar-General. At a comparatively early age the miners almost invariably exhibit in their features and persons the unmistakable signs of debilitated constitutions. Their faces are sallow, they have an anxious expression of countenance and their bodies are thin. At the border of middle age or soon afterwards their health begins to fail, the maturity and confirmed strength of that time of life seems to be denied to them, they rapidly acquire the feebleness of declining years and become unfit for laborious work at the time when their experience and skill would otherwise have made them valuable workmen."¹

The ill-health and high mortality rates of the miners were caused principally by diseases of the lungs. The characteristic miner's disease was often referred to as "miners' consumption"², and was sometimes wrongly identified with pulmonary tuberculosis. "Though some miners and especially those whose families are pre-disposed to the affection do die of consumption, by far the largest amount of mortality is due to other forms of lung disease of a bronchitic or asthmatic character."³ Dr. G. Arnison,

1. Kinnaird Commission Report, 1864, p.VIII.

2. In Swaledale it was usually called "the miners' complaint" or "miners' asthma".

3. Ibid. p.IX.

employed by the London Lead Company, described the disease some twenty years earlier as "a chronic inflammation of the bronchiae and lining membrane of the lung, presenting the usual characters of habitual asthma... Commonly the disease merges into pulmonary consumption." The miners were also liable to chronic dyspepsia, "frequently the result of inflammation of the mucous membrane of the stomach and bowels..."¹

There was "a striking uniformity in the causes to which the miners attribute the impairment of their health; these are bad air², powder reek and stour".³ Of twenty-four samples of air taken in the Swaledale mines by the officers of the Kinnaird Commission, for which the oxygen content was given, 2 were "normal", i.e., oxygen content 20.9% or more, 4 were "impure", i.e., oxygen content between 20.6% and 20.9%, 18 were "exceedingly bad"⁴, i.e., oxygen content less than 20.6%. The worst sample, from the Stang mine in Arkengarthdale, contained 18.77% oxygen. The worst sample in the whole of England and Wales contained 18.2%⁵.

The doctor who recorded these figures commented, "I need only observe that if 0.1 or 0.2 deficiency of oxygen indicate bad ventilation in houses, the state of these mines must exceed

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1. Appendix to First Report of Children's Employment Commission, Mines, Part II, p.755.
 2. I.e., deficiency of oxygen.
 3. "Stour" is rock dust. Kinnaird Commission Report, p.XXVIII.
 4. These words are used in the Report, p.XVI.
 5. Kinnaird Commission Report, Appendix B, pp.202-218.

all that we who live above ground can comprehend. We enter gradually and cannot well judge; if we leapt from the pure air into a close end in an instant we should recoil with horror."¹

Even when the ventilation was reasonably good, the miners still breathed in minute particles of rock dust², particularly when working in shale³. For a time after blasting, the air was filled with powder fumes as well⁴. Carbonic acid gas, or choke damp, was sometimes encountered in badly ventilated workings⁵. On the whole, the Swaledale witnesses before the Kinnaird Commission believed that foul air itself was the principal cause of the bad health of the mines⁶.

Dr. McCollah testified that another contributory factor was the "succession of colds to which... miners... are more liable than other men."⁷ The miners usually had to walk from one to four miles to work, and would not infrequently get wet on the way; they might also work in a wet place underground. They did not usually change their clothes before and after working

1. Ibid. p.222.

2. Kinnaird Commission, Minutes of Evidence Nos.17067-8, 17222, 17534.

3. Ibid. Nos.17151, 17225, 17466.

4. Ibid. Nos.17545-6.

5. Ibid, Nos.17451-6.

6. Ibid. Nos.17190, 17484-5. Haldane and Thomas, on the basis of investigations made nearly forty years later in Cornwall, when mechanical rock-drills were widely used, doubted the ill-effects of bad air and powder fumes. "To come finally to stone dust the evidence seems to us extremely strong that this, and this alone, is the cause of the lung disease which is so common among Cornish and other metalliferous miners."

J.S.Haldane and R.A.Thomas, Causes and Prevention of Miners' Phthisis. Trans.Institution of Mining and Metallurgy, Vol.13, 1903-04, pp.379-438.

7. Ibid. No.17150.

although facilities were provided at some mines for this purpose¹.

Some deaths were caused through accidents, by falling down shafts² or by falls of rock in the mine, but explosions of gases were almost unknown and accidental explosions in blasting, according to the agents, comparatively rare.³ Lead mining was not regarded as a particularly dangerous occupation.

Smelters were liable to suffer from miners asthma⁴, and also from a form of lead poisoning which began as acute colic and ended in the worst cases in paralysis⁵. Dr. McCollah believed, however, that smelters were on the whole healthier than miners. "The construction of the smelting mills is now very much improved and the ventilation quite superior to what it was 30 years ago; consequently you rarely see the disease amongst young men working in the smelting mills, whilst amongst the older men it is a common complaint."⁶

In Swaledale, a miner was thought to be an old man at the age of 50 or 55⁷. Only a small proportion of the men survived the latter age, and few could work after 50⁸. With one exception⁹ however, the Swaledale witnesses thought that miners lived longer than they had done earlier, largely because of the improved ventilation of the mines¹⁰.

1. Ibid. Nos.17591, 17681-2.

2. Ibid. Nos.17080-1, 17635-6.

3. Ibid. Nos.17676-8.

4. Ibid. No.17170.

5. J.Percy, Metallurgy of Lead., pp.524-5.

6. Kinnaird Commission, Minutes of Evidence, No.17167.

7. Ibid. No.17244.

8. Ibid. Nos.17245, 17121.

9. Robert Daykins, agent at the Hurst mines. Ibid. No.17494.

10. Ibid. Nos.17071-2, 17130, 17240-2.

The health of the miners was favourably affected by the relatively short working day, the smallholdings which provided many of them with a healthy spare-time occupation, and the practice followed by some of them, of leaving the mines for a few weeks' outdoor work at haytime.

The following tables give the comparative death rates of metal miners and other workers in the lead mining districts of the six most northerly counties of England¹.

Average annual number of deaths per 1,000 miners and per 1,000 males exclusive of miners, for 1860-62 inclusive, from all causes:

Years.	(a) Metal Miners,	(b) Other males.	(a) as a percentage of (b)
15-25	9.53	7.57	126
25-35	12.38	9.19	135
35-45	17.64	10.13	174
45-55	33.11	16.18	205
55-65	78.34	29.38	267
65-75	127.52	66.10	193

Ditto from pulmonary diseases:

Years.			
15-25	3.40 ²	3.97	88
25-35	6.40	5.15	124
35-45	11.76	3.52	334
45-55	23.18	5.21	445
55-65	41.47	7.22	574
65-75	53.69	17.44	308

1. Kinnaird Commission, Report pp.XXX, XXXI.
2. The lower mortality of this group was attributed to "the very probable fact that youths with a known tendency to diseases of the lungs are not usually put to labour in the mines." Ibid. p.XXXI.

The returns of deaths in Swaledale for the years 1859-61 show a similar picture. Taking males over 15 years, the average age at death of lead miners, including agents and smelters, was 46.67 and the average age of men in all other occupations was 60.79. Of the eighty-five men in the first group, fifty-five died from chest diseases. The figure for the second group was seventeen out of fifty-one.¹

Women and boys provided most of the labour for the dressing floors, a form of work of which the worst feature was exposure to the weather. Not every dressing floor had shades over the tubs, partly because they cut off the light in the morning and evening in winter.² The number of women employed in this work declined during the middle years of the nineteenth century³. Earlier in the century, and in the eighteenth century, women had worked the waste heaps for ore⁴, but in 1842, there was "no instance in the whole kingdom of any girl or women being employed in underground work in (metal) mines."⁵

The lowest age at which children went to the dressing floors is not known, but it may have been nine. "Children under nine are seldom so strong as to be of any use whatever which is the best security against their being employed."⁶ Boys usually went underground at the age of eleven or twelve, but a man was often

1. Returns of deaths of males over ten years of age.

Ibid. Appendix B. pp.406-7.

2. Kinnaird Commission, Minutes of Evidence, Nos.17255-6,17612-4.

3. Ibid. Nos.17254, 17611.

4. K.L. MSS. Pkt.15 and J.Davies to Lady C.Denys, 1 March, 1821. D.H. MSS. RDL3.

5. Children's Employment Commission, First Report, Mines, p.260.

6. Ibid. Appendix, p.725.

allowed to take his son, if he was a strong boy, at the age of ten.¹ The principal jobs of the younger boys underground were blowing the windy king and pulling durk-tubs along rails in the drifts. No record of any system of apprenticeship has been found, although one may have been operated by the craftsmen.

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There is little written evidence about the housing conditions of the mining community. John Tuke describes the cottages of the agricultural labourers of the North Riding at the end of the eighteenth century, as follows: "The cottages of the labourers are generally small and low, consisting only of one room and very rarely of two, both of which are level with the ground and sometimes a step within it. This situation renders them damp and frequently very unwholesome and contributes with the smallness of the apartments to injure the health of both parents and children, for in such contracted hovels, numerous families are often compelled to reside."²

The cottages of the Swaledale miners at the same period may have been a little better than those described by Tuke. The dale had an adequate supply of building stone and more skilled labour than the typical farming areas of the Riding. Writing of the mining areas of Durham and Northumberland in 1846, Thomas Sopwith, admittedly a spokesman for the employers and therefore

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1. Kinnaird Commission, Minutes of Evidence, Nos. 17074-8., 17258-9, 17326-8, 17511-3, 17604-8.
 2. Tuke, op.cit. p.41.

disposed to take a favourable view of the living conditions of the workers, described the miners' cottages as "exceeding in comfort the usual dwellings of the labouring classes."¹ The Swaledale cottages of the present day seem to be more soundly constructed and more comfortable than the cottages occupied by farmworkers in villages like Gilling West and Piercebridge, an impression which is shared by many local people.

There were, however, considerable numbers of one and two roomed dwellings in Swaledale in the first half of the nineteenth century. Enough examples of the former have been found to show that they were not rare, and an exhaustive survey might bring to light many more. Some were single-storey buildings, some were built one above the other with an outside staircase to the upper storey, and others were built over stables with a similar mode of access.² Not all "livings"³ of the last two types had only one room, some having two, and occasionally three rooms. The typical cottage of the middle of the century was probably the "up n'a down", or two-roomed cottage on two floors, although there may have been a substantial number of larger dwellings by this time.

In 1863, Dr. McCollah spoke of a considerable improvement in the standard of housing, which had had its beneficial effects upon health⁴. Improvements at Hurst had helped to check

1. T.Sopwith, op.cit.

2. These rooms seem to have been, on the average, about fourteen feet square.

3. The Swaledale term for separate dwelling.

4. Kinnaird Commission, Minutes of Evidence, Nos.17134, 17137.

typhus, which had previously been endemic for several years¹. The improvements included the replacement of thatched roofs by slates², and the construction of upper stories on existing one-storey dwellings, as well as the building of new cottages.

However, the only written description of the miners' cottages in the later years of the nineteenth century is far from flattering: "... Looking at the dwellings of the humbler classes suggested to us the thought that their mode of construction belonged to the dark ages when health was but a secondary consideration in the arrangements of the architect, if indeed it entered into his mind at all. The great want is proper ventilation. The rooms are too low and the windows too small consistently with the laws of health....

"But probably the most unsightly and certainly one of the most unhealthy appendages of the humble domicile of the Swaledale miner are the mounds of ash and dung which are distributed in close proximity to the doors. Their peaked summits which are constantly emitting a smoky vapour remind one of a burning mountain, and from which there often emanates a foul stench, which poisons the blood and renders the neighbourhood very unhealthy."³.

Routh's stricture may indicate changing ideas about housing,

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1. Ibid Nos.17198-201. The mining agent at Hurst described the cottages there as "pretty good but small".Ibid. No,17499.
 2. Letter to Ripon and Richmond Chronicle, 23 Feb 1856.
 3. J.Routh, Rambles in Swaledale, 2nd edition, (1897), pp.84-5. The first edition was published about 1880, and this description may date from that time.

rather than that the cottages in Swaledale were particularly bad by local nineteenth century standards. Opinion amongst older Swaledale people is divided as to whether the picture is overdrawn.

The census returns of 1801 show that there were 5.52 inhabitants per dwelling¹ in Arkengarthdale, and 5.26 in Melbecks, which were the two townships with the highest proportion of miners. During the next ten years, the population of Arkengarthdale increased by nearly 29 per cent, and in 1811 there were 6.8 people per house, with 308 families returned as living in 225 houses. Grinton in 1801 had three families for every two houses and 6.47 people per house.² As the people would not be distributed equally among the houses, and as many of the latter would have only one or two rooms, the figures for Arkengarthdale and Grinton represent serious overcrowding. Hall wrote in 1818 of families sleeping "five or seven in a bed."³

The number of people per house in Arkengarthdale and Melbecks declined from 5.32 and 5.23 respectively in 1821 to 4.09 and 4.42 in 1881. During the next twenty years, the number of inhabited houses fell by half in Melbecks and by more than half in Arkengarthdale, but as the population declined at an even greater rate there were fewer than four people per house in each township in 1901.⁴ The increase in the amount of housing

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1. All these figures refer to inhabited houses. The definitions of "a separate dwelling" by the enumerators may not have been wholly accurate and consistent.
 2. Abstracts of Census Enumeration Returns 1801-21.
 3. Hall, op.cit. p.7.
 4. Abstracts of Census Enumeration Returns, 1821-1901.

space per person was, of course, greater than these figures alone would suggest, as the average size of the houses increased during the century, and smaller dwellings were merged to form larger ones as the population declined, particularly after 1881.

In the living rooms of many of the cottages were beds which folded up into cupboards during the day.¹ These would be almost a necessity in the one-roomed dwellings, and increased the sleeping accommodation in the larger cottages. These beds are referred to by the contributor of a footnote to Tuke's account of the cottages of the North Riding as "close wainscotted beds."² They were known in Swaledale as "chiffoniers" and in Durham as "press-beds."

The rents of the cottages ranged from £1 to £3 a year³. "In some instances the single rooms over stables in which they lived were let as low as 10/- per year."⁴

Miners who worked too far away from their homes to walk the distance each day would lodge during the week at cottages near the mines, paying a small sum for a bed and cooking facilities. If this form of accommodation was not available, lodging shops might be built at the more remote mines by the companies. The dirty and unpleasant conditions of such shops in Weardale are described in the report of the Children's Employment Commission

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1. I am indebted for this information to Mr. Tom Peacock of Reeth, an auctioneer.
 2. Tuke, op.cit. p.41.
 3. Muker Select Vestry Minutes, and Fawcett MS., p.209.
 4. Fawcett MS. p.209.

of 1842-43¹. They were apparently not common in Swaledale, where the existence of only two has been definitely established. One was at Punchard in Arkengarthdale², and the other near Bunting Level in Gunnerside Gill.

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There is little detailed information about the most important aspect of the material welfare of the miners and their families, the food which they ate. Their basic foodstuffs were bread, bacon, potatoes and vegetables, skimmed-milk cheese³, suet dumplings and puddings, and particularly oatmeal, which was made into "crowdy", a sort of porridge⁴, and oatcakes.⁵ The variability of miners' earnings meant that they sometimes lived "like a fighting cock", and sometimes had nothing but crowdy and potatoes. Presumably the men with smallholdings fared a little better than the others. As fewer women went out to work in Swaledale than in the factory towns, the standard of cooking was probably better than in the latter. On the other hand, G.A. Robinson told the Kinnaird Commission that although the miners' families consumed "a fair proportion" of animal food,

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1. Appendix to First Report, Part II, pp.740-741.
 2. Agent's report on Arkengarthdale mines, 1870. Arkengarthdale MSS.14.
 3. According to Fawcett, whole-milk cheese was made for sale outside the dale, and was eaten at home only on special occasions, like Christmas. The cheese made from skimmed milk was reputed to be so hard that it could be kicked all the way to work without being seriously damaged.
 4. Crowdy is made by pouring boiling water over oatmeal, and leaving it to swell.
 5. This account is based upon Fawcett MS. pp.206-7, the minutes of Arkengarthdale and Muker Select Vestries, and discussions with older Swaledale people.

"they do not use it in the best way, they do not understand cookery."¹.

It may be relevant to quote the diet sheet of a local workhouse, that at Richmond.² The breakfast each day consisted of 8 oz of bread and a pint and a half of oatmeal porridge, supper of the same quantity of bread and a pint and a half of broth on two days, and for the rest of the week 7 oz of bread and a pint of "good rice milk". There was more variety at dinner time, 8 oz of meat and $\frac{3}{4}$ lb of potatoes and vegetables on two days, 8 oz of bread and a pint and a half of broth on two days, and on the other three 8 oz of bread with 5 oz of bacon, 8 oz of bread with 3 oz of cheese, and 16 oz of suet pudding with butter.³ If the paupers were in fact fed according to this scale, and if the food was wholesome and well-cooked, both of which are rather large assumptions⁴, they probably fared at least as well as the poorer classes outside. As an assistant poor law commissioner lamented, it was "almost impossible, in many districts, to prescribe a diet less abundant, and of inferior quality, than that of the majority of the labouring classes, and at the same time sufficient to keep the inmates of the workhouse, belonging to the same classes, in health and strength."⁵

1. Kinnaird Commission, Minutes of Evidence, No. 17814.

2. No diet sheets from Reeth workhouse have been recorded.

3. Minutes of Richmond Union, 24 June 1837. At this time, and until 1840, most of Swaledale came within Richmond Union. The foodstuffs bought on half-yearly contracts by Reeth workhouse from 1840 to 1880 were wheaten meal and flour, oatmeal, beef, suet and tea. The relative quantities consumed are not given. Minutes of Reeth Union. 4. An earlier workhouse master at Richmond had fed the paupers with a sheep that had been found dead on the moors. Minutes of Richmond Vestry, 28 July 1795.

5. Poor Law Commissioners, Sixth Annual Report, p. 399.

Chapter XI The Social Effects of the Decline of the Industry

- i -

The domination of the economy of Swaledale by the lead mining industry meant that any significant change in the fortunes of the industry had far-reaching social effects. There is a very close correlation between variations in output and the growth and decline of population, both in the general movements of the whole area and the experiences of different parts of it.

The population of the whole lead mining area, as is shown in the table below, reached its peak in 1821. The

	Grinton	Reeth	Melbecks	Muker	Marrick	Arkendale	TOTAL
1801	518	1128	1274	1119	474	1186	5699
1811	649	1394	1586	1339	499	1529	6996
1821	689	1460	1726	1425	621	1512	7433
1831	696	1456	1455	1247	659	1446	6959
1841	594	1343	1633	1241	648	1243	6702
1851	598	1344	1661	1321	555	1283	6762
1861	611	1299	1622	1005	462	1147	6146
1871	469	1077	1437	913	412	1018	5326
1881	377	988	1165	837	307	999	4673
1891	280	667	600	615	246	761	3169
1901	262	570	497	549	178	427	2483
1911	269	628	411	519	161	363	2351

depression of 1829-34 caused a slight decline, and the high output of the eighteen-forties did no more than stabilise the population, as improved techniques of mining, dressing, and smelting made it possible for the mines to produce a given output with a smaller labour force. Between 1851 and the middle of the seventies the population declined steadily, as the yield of a number of mines dwindled and most of the total production came from a small number of rich veins.¹ After about 1878 the movement of people swelled into a mass emigration as the closure or increasing poverty of the mines forced the miners and their families to leave the dale in search of work.

There were, however, marked local variations from this general picture. Muker suffered its greatest loss in the decade 1851-1861, because of the poverty of the West Swaledale, South Swaledale, Beldi Hill, and Swinnergill mines. The population of Melbecks remained steady during this period because of the prosperity of the Old Gang Mine which employed most of the miners of the township as well as some from neighbouring townships. When both the Old Gang and A.D. Companies failed, Melbecks suffered the worst decline of all. Between 1881 and 1891 it lost 565 people, nearly half of the population at the beginning of the decade, and if figures were available for the years 1877 and 1883 they would show an even more dramatic change. In Arkengarthdale, on the other hand, there was a net loss of only 19 in the decade 1871-1881, when

1. Particularly the Kinning and Watersikes Veins at the Old Gang.

the mines there were experiencing a last wave of prosperity. The rapid depopulation of this township began about 1886, and the census figures show a loss of forty-five per cent of the population between 1891 and 1901.

The actual emigration from Swaledale was, of course, greater than the net loss of population shown by the census figures. If the rate of natural increase in Swaledale was comparable to that of England and Wales, the population of which increased by more than three and a half times during the nineteenth century, the net emigration from Swaledale between 1821 and 1901 was probably of the order of 10,000 people. The first marked movement was caused by the depression of 1829-34. The price of lead was very low, some mines were given up by their lessees, and some people thought that the industry was finished. A Swaledale yeoman wrote in his diary in October, 1830, "Now the mines are exhausted, the price of lead is low, and miners are forced to obtain a living in other countries which they cannot get here!"¹ Several hundreds of people left the dale during this depression, most of them from Melbecks and Muker.

Some of them went to the United States, which may have seemed doubly attractive because of the distress and unrest prevailing in England. One pauper family had its passage

1. E. Cooper, Some Swaledale Families of the Eighteenth and Nineteenth Centuries, pp.42-43, quoting the diary of Edward Broderick.

money paid by the Muker Select Vestry: "£20 to be paid to John Founder to forward him and his family to America, to be paid when he enters on board a ship at Liverpool."¹ Edward Broderick noted in his diary on September 3rd, 1830,

"Emigration to America was the theme of the conversation, all apparently are for going but few go."² Two men migrated in 1828 and found employment as lead smelters at Galena, Illinois.³ Four other men, one or two of whom had families, sailed in May, 1830, and one of them found work in the Pennsylvania coalfield.⁴

Intermittent emigration to U.S.A. continued during the next two or three decades. In June, 1844, and April, 1845, the Wensleydale Advertiser reported that a substantial number of people from Swaledale had passed through Hawes on their way to Liverpool to embark for the United States.⁵ In 1876 another member of the Broderick family visited some of the Swaledale settlers in the United States. He found the largest group of them living in or near the lead mining centres of Galena, Dubuque (Iowa), and Mineral Point (Wisconsin).⁶

Most of the migrants, however, found new homes in Britain, some of them perhaps returning to the places which they or their fathers had left to go to Swaledale during the period when the mines were expanding rapidly. The poor law records suggest that most people went, as one would have expected, to

1. Minutes of Muker Select Vestry, 24 Feb 1830.

2. Cooper, op.cit., p.38.

3. Ibid., p.40.

4. Ibid., p.39.

5. Wensleydale Advertiser, 18 June 1844 and 1 April 1845.

6. Cooper, op.cit., pp.103-106.

the textile districts of East Lancashire and the West Riding, and to the coalfield of South Durham.¹ People with a settlement in Swaledale who applied for poor relief elsewhere in the period 1820-1840 were living mainly in the Manchester and Bradford areas, in South Durham, in Pateley Bridge, another lead mining centre, and particularly in the area between Burnley and Skipton.² Some of the migrants may, of course, have returned home, especially when periods of depression in textiles or coal mining coincided with good years in the Swaledale mines, as, for example, in the early eighteen-forties.

A picture of the last great wave of emigration is given by the log books of some local schools. Gunnerside Wesleyan School lost twenty-three children during the year ending October, 1878, when the movement was only just beginning.³ Reeth School lost eighty-one children, a little over half the number on the register, during the year ending October, 1882.⁴ Entries like the following are common: "Owing to the scarcity of work in the neighbourhood, several large families of the miner class are about to leave the neighbourhood."⁵ Of the twelve families whose destinations are given, seven went to Lancashire, and five to the Keighley district.⁶

1. During the Durham coal miners strike of 1832 lead miners from North Yorkshire were brought in to work in the pits. A. Redford, Labour Migration in England, (1926), p.50.

2. Minutes of Arkengarthdale & Muker Select Vestries & Reeth Union.

3. Gunnerside Wesleyan School Log Book, 4 Oct 1878.

4. Reeth School Log Book, 29 Sept 1882.

5. Ibid., 17 Feb 1882.

6. Ibid.

The miners and their families naturally tended to go to towns where they had friends and relatives to help them find work and accommodation, and whose presence would lessen the wrench of leaving their old home. Some quite large colonies of Swaledale exiles grew up in this way, and annual reunions were still held in Burnley and Nelson in the nineteen thirties.¹ Burnley attracted a large number of Swaledale people, as it was a coal mining as well as textile town, and the men could find work to their liking while the cotton industry provided opportunities for the women.

The failure of the mines and the migration of the miners had a calamitous effect upon the dale as a whole. Local shopkeepers who had supplied the miners' families, and in some cases the mining companies, lost most of their customers and were left with bad debts on their hands. A Reeth shopkeeper wrote to a young relative just before Christmas, 1890, "Nothing but poverty; getting worse and worse and worse. Mines still poor. Trade horribly bad. I offer many things at below cost price."² Many shopkeepers went out of business and joined the migration. The number of public houses declined. Even the schoolmasters' salaries went down, because this was the era of "payment by results."³

1. E. Pontefract and M. Hartley, Swaledale (1934), p.97.

2. Jabez Raisbeck to Sarah Lambert. 23 Dec 1890. Letters in the possession of Mr C. Croft of Reeth.

3. Log books of Gunnerside Wesleyan and Reeth Schools.

Some of the miners who had smallholdings did not leave, but tried to rent enough land to become full-time farmers. Many of the present farms of the area are amalgamations of former smallholdings. As a consequence of this some of the farms are small even by the standards of Swaledale, where most of them are family concerns employing no farm labourers. Secondly, one-third of all the farms in the five townships of Grinton, Reeth, Arkengarthdale, Melbecks, and Muker consist of more than one holding. Six consist of four holdings and one of five,¹ and there were more examples of this kind a generation ago. In many cases the separate holdings are not contiguous. Long and Davies give two examples of this fragmentation.

"Farm Y consists of nine lowland meadows in five distinct parcels totalling 28 acres, with a 52 acre parcel of grazing on a hillside. Thus the six parcels . . . cover only 80 acres, although the distance between the furthest corners of the most distant fields is one and a quarter miles.

"The degree of fragmentation on Farm X is even more marked. The greatest distance between the fields is one and a half miles, though this farm totals only 30 acres of meadow land and 37 acres of rough grazing in eleven fields."²

1. W.H. Long & G.M. Davies, Farm Life in a Yorkshire Dale (1948) p.93.

2. Ibid., p.61.

An extractive industry leaves not only social but physical scars when it dies. Abandoned dwellings form one of its legacies. In Melbecks, for example, the number of inhabited houses was halved between 1881 and 1901,¹ and most of the other mining areas had a comparable experience. In some such cases two or three cottages were put together to make one larger house. Other cottages have been converted into barns or storehouses, pulled down, or simply left to decay. There has been a marked improvement in the appearance of some of the villages on the main roads of the dale since the first world war with the development of the tourist trade and weekend cottages, the immigration of a new class of people coming to the dale to retire, and more recently the increase in the number of people living in the dale but working outside it, in places like Richmond and Catterick Camp.

Some of the villages and hamlets too far from the main road to attract these new occupants have, however, continued to decay. Hamlets like Kearton, now no more than a name covering a few scattered farms, and Blades, both near the Old Gang Mine, Ravenseat and West Stonesdale, near Keld, and particularly Hurst, once a large mining village, almost qualify for the description "lost villages". The atmosphere of decay is particularly strong at Hurst, where the few houses still inhabited stand among the sites of some demolished cottages and the ruins of others and look out over the

1. Abstracts of Census Enumeration Returns, 1881-1901.



VIII : Gunnerside Gill

Looking south; in the left middle-ground is Bunting Level lodging shop, and opposite to it on the west side of the Gill are the waste heaps of Sun Hush and Priscilla Levels, Lownathwaite Mine.



IX : Large waste heap, Surrender New Shaft

crumbling buildings and barren waste heaps of the mine. Arkle Town, once the principal village of Arkengarthdale,¹ with a population of two or three hundreds, has dwindled to a few cottages. But here the change is less apparent, as nearly all the abandoned dwellings have been pulled down.

The ruins and spoil heaps of the mines themselves can be regarded at choice as a dreary and negative landscape, or as a fascinating palimpsest recording many centuries of human activity. The remains of the smelting mills and dressing floors, which have survived best in places too inaccessible for them to be used as cheap quarries, are valuable records for the historian, although they are unlikely to be generally regarded as worth preserving in the foreseeable future. The waste heaps themselves are full of interest for anyone who will read them intelligently. Some of them trail in a line across the moors for several miles, making it unnecessary to use a geological map to follow the course of the major veins. Here a necklace of small waste heaps close together shows that the vein has been worked by a series of shallow pits. There a large waste heap standing alone marks the site of a shaft a few hundred feet deep. A mountain of spoil by the mouth of a level shows that it was a major adit, through which a large part of the mine was worked. Where the fragments of waste are sorted according to size and density was once a dressing floor.

1. The parish church stood there until it was pulled down and replaced by a new building at Langthwaite in 1818.



X : Line of waste heaps along Friarfold Vein, looking westward across the head of Hard Level Gill, Old Gang Mine



XI : Surrender Smelting Mill

The great hushes which have been gouged out of the valley sides in some places form an unusual and dramatic feature of the landscape.

Most of the ruins and the waste cover poor moorland soil, and are not visible from the roads in the most frequented parts of the dale, so they cause little damage to the two main industries of present-day Swaledale, farming and tourism. Against this background of barren moor they stand as a reminder of the days when the mines found work for far more people than the soil of Swaledale could support. As Xenophon says,

"There is land of such a nature that if you sow, it does not yield crops, but if you dig it nourishes many more than if it had borne fruit."¹

1. Essay on the Revenues of Athens, I, 5, quoted in G. Agricola, De Re Metallica, p.6.

Appendix A : Geological Sections

I : Average section between Low Row and Keld, from the main limestone downwards.(1)

II : Section at Lownathwaite Great Break Vein and 2 Lownathwaite Coal Shaft.

	<u>Fms</u>	<u>Ft</u>	<u>Ins</u>		<u>Fms</u>	<u>Ft</u>	<u>Ins</u>
Main limestone	10	-	-	Millstone grit	8	-	-
Sandstone and shale with one coal bed	8	2	8	Thick plate	22	-	-
Underset chert: 0 to 3	2	-	-	Flinty chert	2	-	-
Underset lime:3-2-0 to 6-4-0				Plate	1	3	-
Sandstone and shale	20	-	-	Crow chert	2	3	-
3rd limestone	1	4	-	Crow limestone	2	3	-
Sandstone and shale	12	3	-	Ten Fathoms Grit	10	-	-
4th limestone	3	2	-	Plate and iron beds	10	-	-
Flagstones and shale	18	2	-	Red Beds	3	-	-
5th limestone	7	3	-	Plate	1	3	-
Sandstone and shale with one coal bed	9	1	6	Black Beds	4	-	-
Limestone	-	2	-	Plate	-	-	9
Sandstone and Shale	10	-	-	Limestone	-	4	-
6th (Simonstone) limestone	4	1	-	Plate	-	2	-
Sandstone and shale with several thin limestones	10	-	-	Main chert	3	-	-
7th (Hardraw Scar) limestone	6	2	-	Shales	1	-	-
Sandstone and shale	25	-	-	Main limestone	12	-	-
Limestone	4	1	-	Grit	4	3	-
Shale, base not seen	-	5	-	Plate	4	3	-
				Underset chert	3	3	-
				Underset limestone	4	-	-
				Marl	-	4	-

1. Geological Survey, Mallerstang, p.110

2. D.H.MSS P/AD3.

3. Shale.

4. Sandstone

III : Section on the west side of Gunnerside Gill. (1)

IV : Section at Surrender Mine. (2)

	<u>Fms</u>	<u>Ft</u>	<u>Ins</u>		<u>Fms</u>	<u>Ft</u>	<u>Ins</u>
Millstone grit	8	-	-	Millstone grit	8	-	-
Plate	10	-	-	Plate and one			
Flint	-	2	-	flint bed	12	4	6
Crow chert	2	3	-	Flinty chert	2	3	-
Crow limestone	2	3	-	Plate	1	3	-
Ten Fathoms Grit	10	-	-	Crow chert and			
Ten Fathoms Plate	10	-	-	plate	1	4	-
Red Beds	3	-	-	Crow limestone	2	4	-
Plate	1	3	-	Grit	-	5	-
Black Beds	4	-	-	Plate and coal	-	1	8
Plate	-	-	9	Grit	1	2	-
Limestone	-	4	-	Plate	1	3	-
Plate	-	2	-	Soapy grit	3	2	-
Main chert	4	3	-	Plate	-	4	-
Main limestone	12	-	-	White grit	7	2	-
Grit	4	3	-	Plate	2	-	-
Plate	4	3	-	Iron beds	2	-	-
Underset chert	3	3	-	Plate	1	3	-
Underset limestone	4	-	-	Red Beds	3	-	-
Marl	-	4	-	Plate	1	3	-
Grit and plate	27	-	-	Girdle bed	2	-	-
Snake Chert	-	2	-	Black Beds	3	-	-
3rd limestone	2	3	-	Lime and plate	1	2	-
Grit	10	-	-	Main chert	2	3	-
4th limestone	2	3	-	Main limestone	12	-	-
Grit and plate	27	-	-	Grit	1	4	-
5th limestone	4	-	-	Plate	-	2	-
				Grit	3	3	-
				Plate	2	1	-
				Limestone	1	2	-
				Underset chert	3	3	-
				Underset limestone	4	-	-
				Marl bed	-	4	-
				Grit	6	2	-

1. D.H.MSS P/AD2
2. D.H.MSS P/S1

V : Typical section in
Arkengarthdale.(1)

VI : Section at Fourth Whim
Shaft, Wetshaw,
Arkengarthdale.(2)

	<u>Fms</u>	<u>Ft</u>	<u>Ins</u>		<u>Fms</u>	<u>Ft</u>	<u>Ins</u>
Millstone grit	14	-	-	Coal	-	2	6
Coal	-	1	-	Millstone grit	14	2	6
Plate	5	-	-	Shale and mudstone	14	2	-
Limestone	-	2	-	Flinty chert	2	3	-
Plate	3	-	-	Shale	-	3	-
Limestone	-	3	-	Crow chert	1	2	-
Plate	1	-	-	Shale	1	3	6
Limestone	-	3	-	Second crow chert	2	1	-
Plate	4	-	-	Crow limestone	2	-	-
Flinty chert	2	4	-	Soapy grit	1	-	-
Plate	1	-	-	Coal	-	2	-
First crow chert	1	-	-	Soapy grit	1	-	-
Plate	1	-	-	Shale	1	3	-
Second crow chert	2	3	-	Ten Fathoms Grit	10	4	-
Crow limestone	2	-	-	Shale	2	5	-
Grit and one coal bed	3	3	-	Girdle beds	2	-	6
Grit and two plate beds	9	5	-	Chert or iron bed	2	-	-
Plate	2	4	-	Red Beds	2	1	-
Iron beds	2	-	-	Shale	1	1	-
Plate	1	-	-	Black Beds	2	2	-
Red Beds	6	-	-	Shale and mudstone	1	4	-
Plate	1	3	-	Main chert	3	-	-
Black Beds	2	3	-	Main limestone	12	-	-
Plate	-	2	-	Sandstone	6	4	6
Limestone	1	-	-	Shale	2	3	-
Plate	-	4	-	Underset chert	6	-	-
Main chert	3	-	-	Underset limestone	3	1	6
Shale	-	1	-	Sandstone and girdle beds	20	4	-
Main limestone	12	-	-	Shale	6	-	-
Grits	2	4	2	3rd limestone	4	-	-
Plate and one grit bed	6	-	10				
Underset chert	4	-	-				
Plate	-	1	-				
Underset limestone	3	-	-				
Grit and one coal bed	22	1	-				
Plate	5	-	-				
3rd limestone	2	-	-				

1. Forster, op. cit., second edition, p.67.
2. Memoirs of the Geological Survey, Mallerstang, p.116.

APPENDIX B : Production Figures

Table 1 below has been compiled from the Draycott Hall and Kirkleatham MSS, table 2 from the official mineral statistics. The value of the latter is limited, as they begin only in 1845, and do not give separate figures for all the mines until 1868. Furthermore, the earlier figures given for Swaledale as a whole may not be completely accurate, as the returns were not made compulsory until 1872, and Hunt sometimes included in his Swaledale list mines in other areas, e.g. the Beezy mine in Wensleydale. The Draycott Hall papers, on the other hand, give a long run of production figures for the A.D. group. For the period 1817-1914 complete records have been preserved. The figures for the years 1786-1811 are only approximately accurate.

The output of the period 1786-1794 is taken from a summary account, which may not include all the smaller independent concerns. The A.D., including Surrender, figures for 1796-1811 come from Matthew Wadson's accounts of lead shipments from Stockton. Some marks of lead which were sent to Hull in the

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1. Memoirs of the Geological Survey, Vol II, Part 2, 1848; Records of the School of Mines, Vol I, Part IV, 1853-6; R.Hunt, Mineral Statistics, 1857-1881; Home Office, Mineral Statistics, 1882-1915.
 2. Hunt, op.cit., 1862-8.
 3. Lead weighing books, 1816-1898, D.H.MSS ADM1-6, OGI-45, S1-11, BB1-9, RC1-9; Reports of Lessors' Agent, 1897-1914, D.H.MSS V5.
 4. A.D. Mines Pay Bills, 1786-1792. D.H.MSS RD7.
 5. A.D. Lead Weighed and Shipped, 1796-1809, and Accounts of Lead Sold, 1800-1812. D.H.MSS ADX and CA2.

years 1796-98, and therefore do not appear in Wadeson's accounts, have been included at the current average weight for marks.¹ One month has been allowed for the carriage of lead from the mills to Richmond, and two months from the former to Stockton. Therefore lead weighed in Richmond in January, or delivered at the wharf at Stockton in February, is assumed to have been smelted in December. There is a possible source of error in the figures based on Wadeson's accounts. The quantity of duty lead from the smaller concerns, e.g. Lane End, has been multiplied by the rate of duty, but in some cases these concerns may have sold all their lead to the lessors and the latter shipped it through Wadeson. The quantities involved are small.

The Arkengarthdale figures for the years 1783-1791 are taken from pay accounts,² and do not include slag lead. The output for the period 1794-1799 is taken from some calculations of production costs.³ Some of the Arkengarthdale figures are given for periods of more or less than one year; these have been converted into annual totals, and are shown in Table 1 in brackets.

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1. A mark consists of 400 pigs of lead.
 2. K.L.MSS Pkt 15.
 3. K.L.MSS Pkt 7(d)/1.

Ore, when sold as such, has been converted into lead, on the assumption that its smelting produce was 95 per cent of the assay. Except in the latter case, the output of the A.D. mines for each year is the quantity of lead smelted between January 1st and December 31st, not the ore raised between these dates, whenever smelted, as in the official statistics. All figures have been calculated in tons, hundredweights, and pounds, but are given in the tables to the nearest ton. There is therefore an occasional discrepancy between the sum of the figures for the separate mines, and the total given.

The London prices given relate to common pig lead. The figures for 1783-1821 are the average prices in January of each year per London fother of $19\frac{1}{2}$ cwts, as given by Tooke. The figures for 1822-1854 are the average of the prices given by Tooke and Newmarch for four separate weeks in January, March-April, July, and November of each year. They relate to London fothers until 1839, and tons thereafter. The prices for 1854-1915 are annual average prices per ton, taken from the official statistics. Some prices at which lead was sold at ¹Stockton between 1783 and 1811 are given also. An arrow ²indicates that there were several intermediate prices, all rising or falling progressively.

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1. T. Tooke, History of Prices, Vols I - IV, 1838-49; T. Tooke and W. Newmarch, History of Prices, Vols V and VI, 1857.
 2. K.L.MSS Pkt 7(a), (c), and (d); and M. Wadeson, Accounts of Lead Sold and Minutes of Correspondence, 1800-1812. D.H.MSS CA2.

Table 1 : Output of A.D. Mines, 1786-1915, and Arkengarthdale

Mines 1783-1789

Year	A.D. Group less Surrender	Surrender	Total A.D. Group	Arken- garthdale	London price (per fother of 19½ cwts)	Prices paid at Stockton (per fother of 22 cwts)
1783				388	£20-5	£20
4				(732)	£16	£17-10
5				709	£18-5	£16-15
6			632	493	£17-10	
7			689	503	£18-10	
8			469	566	£22-10	
9			544	487	£22-10	
1790			706	505	£19-5	
1			839	(551)	£18-15	
2			1183		£20-15	
3			1100		£20-15	
4			915	878	£20-15	
5				1218	£17-5	£18, £19-10
6			1306	1218	£21-10	£20
7			1407	(601)	£19-10	£16-10
8			1136	687	£19-10	
9			1079	(559)	£20-10	
1800	800	543	1343		£22-10	
1	2233	1020	3252		£25	£23, £24
2	1878	441	2320		£28	£28, £28-10, £30
3	968	425	1393		£33-10	£31
4	893	703	1596		£33	
5	980	776	1756		£40	
6	1139	538	1677		£41	£38
7	1083	1315	2398		£38	£36, £37
8	751	1348	2099		£28	£25-10, £26-10, £24-10 → £40
9	1354	1096	2450		£43	£37, £39-10, £34, £28 → £33
1811	618	864	1482		£38	£34-10, £33, £33-10 → £29
2					£30	
3					£29	
4					£33	
5					£28	
6					£18	

(continued)

	Old Gang	Surr- ender	Blake- thwaite	Lowna- thwaite	South Swale -dale	Lane & Keld Side	End Mines	Total A.D. Mines	London Price
1817	930	520	12	58	11	-	1532	£18	
8	841	1011	8	20	3	1	1883	£26	
9	746	984	27	61	11	-	1829	£23	
1820	886	488	631	56	5	-	2067	£23	
1	726	336	497	152	20	-	1731	£23	
2	395	243	519	91	5	-	1254	£22-17-6	
3	478	342	452	67	14	7	1359	£23	
4	435	314	635	120	14	6	1524	£23-7-6	
5	615	257	509	155	16	2	1554	£27-5-0	
6	1858	227	470	130	7	-	2692	£22-15-0	
7	636	304	321	156	3	-	1420	£20-11-3	
8	489	337	188	231	13	-	1259	£18-18-9	
9	547	346	151	198	7	-	1259	£17-2-6	
1830	648	454	122	92	9	-	1327	£14-3-9	
1	675	242	127	27	4	-	1075	£14-12-6	
2	1021	190	56	11	-	-	1278	£13-10-0	
3	1028	146	47	11	-	-	1232	£14-1-3	
4	1024	135	37	21	17	-	1234	£17-10-0	
5	1210	126	9	37	25	24	1432	£18-15-0	
6	1321	213	34	26	19	98	1710	£25-0-0	
7	1403	295	38		68	44	1847	£21-5-0	
8	1268	224	28		10	33	1562	£20-6-3	
9	1959	60	268		10	-	2298	£18-16-3	
1840	2376	103	575		9	-	3063	£18-1-10	
1	1782	54	582		5	16	2439	£20-3-9	
2	1968	154	599		13	63	2792	£18-8-9	
3	2151	303	581		41	24	3100	£16-15-0	
4	1549	473	1060		19	33	3134	£16-17-6	
5	1049	350	537		5	17	1957	£17-17-6	
6	752	340	702		1	17	1811	£19-2-6	
7	954	342	282		15	8	1602	£18-11-3	
8	798	354	225		-	-	1377	£16-17-6	
9	1113	338	227		21	-	1698	£15-9-4	
1850	1129	436	159		15	-	1741	£17-8-9	
1	1037	371	174		43	14	1639	£17-5-7	
2	878	649	217	West	9	26	1779	£17-13-9	
3	894	425	160	Stonesdale	3	17	1499	£23-11-3	
4	1001	462	113		6	9	1591	£24-1-3	
5	1033	425	177	19	9	9	1673	£23-3-0	
6	2056	402	75	475	7	-	3016	£24	
7	2097	481	65	183	11	-	2838	£22	
8	1963	493	141	16	2	4	2619	£21-11-6	
9	1276	386	140	8	-	-	1811	£22-6-0	
1860	1222	292	132	15	-	-	1660	£22-6-3	
1	1196	174	56	-	3	-	1430	£21-0-4	
2	969	326	52	+	-	-	1348	£20-16-3	

(continued)

	Old Gang	Surr-ender	Blake-thwaite	South Swaledale	Kisdon Co.	Total A.D. Mines	London Price
1863	686	354	107	2	-	1149	£20-16-0
4	717	183	132	-	-	1031	£21-12-0
5	736	122	196	-	-	1054	£20-2-0
6	1163	89	73	12	) (1)	1338	£20-10-0
7	2071	44	56	33	) 16	2205	£19-11-6
8	1403	62	156	215	)	1837	£19-6-6
9	2178	51	115	162	-	2506	£19-1-6
1870	1977	57	83	92	-	2210	£18-13-0
1	1568	76	49	28		1721	£18-4-0
2	1767	63	21	19		1870	£20
3	1853	44	<u>A.D.Co.</u>	-		1897	£23-6-0
4	1476	24	7	-		1508	£22-2-0
5	1031	25	16			1072	£22-9-4
6	591	85	52			728	£21-13-10
7	636	54	31			721	£20-11-3
8	758	10	379			1147	£16-14-0
9	623	28	484	1		1135	£14-16-6
1880	518	41	640	-		1199	£16-7-6
1	265	74	471			810	£14-19-3
2	481	28	192			701	£14-7-3
3	311	5	98			414	£12-18-0
4	224	13	68			305	£11-6-0
5	357	9	133			499	£11-10-0
6	237	-	65			302	£13-4-9
7	78	-	3			81	£12-17-0
8	16		21			37	£13-18-3
9	54		-			54	£13-0-10

	Old Gang Co. (including A.D. ground)	London Price		Old Gang	London Price
11890	101	£13-7-10	1904	12	£12-1-6
1	100	£12-8-10		5	£13-17-5
2	70	£10-15-1		6	£17-11-5
3	73	£ 9-16-11		7	£19-12-3
4	22	£ 9-11-9		8	£13-14-5
5	58	£10-12-11		9	£13-6-2
6	23	£11-7-9	1910	3	£13-3-2
7	25	£12-10-5		1	£14-2-8
8	44	£13-2-8		2	£18-5-0
9	90	£15-1-10		3	£18-17-3
1900	59	£17-3-11		4	£19-3-11
1	29	£12-14-2		5	£22-17-8
2	12	£11-14-8			
3	10	£11-15-4			

1. This output for the years 1866-8 is not included in the total of the A.D. group.

Table 2 : Output of Hurst, Arkengarthdale (including Fell
End) and Wensleydale Mines

	Hurst	Arkengarthdale	Wensleydale	London Price
1852	264		1386	£17-13-9
3	170		615	£23-11-3
4	168		682	£24-1-3
5	97		1200	£23-3-0
6	87		1806	£24
7	130		1643	£22
8	102		1600	£21-11-6
9	33		1047	£22-6-0
1860	39		1872	£22-6-3
1	41		1605	£21-0-4
2	221		1560	£20-16-3
3	176		1413	£20-16-0
4	176		1265	£21-12-0
5	96		925	£20-2-0
6	197		789	£20-10-0
7	750		424	£19-11-6
8	529	1257	364	£19-6-6
9	502	1230	355	£19-1-6
1870	565	705	414	£18-13-0
1	290	636	396	£18-4-0
2	268	458	423	£20
3	357	453	318	£23-6-0
4	397	791	293	£22-2-0
5	264	1037	?	£22-9-4
6	247	883	365	£21-13-10
7	307	1482	296	£20-11-3
8	180	1967	192	£16-14-0
9	150	1219	343	£14-16-0
1880	43	1247	302	£16-7-6
1	-	1472	296	£14-19-3
2	-	1751	205	£14-7-3
3	-	1409	257	£12-18-0
4	140	1257	106	£11-6-0
5	568	1401	72	£11-10-0
6	702	1582	75	£13-4-9
7	647	1094	112	£12-17-0
8	274	653	54	£13-18-3
9	105	674	12	£13-0-10
1890	-	480	4	£13-7-10
1	-	467	-	£12-8-10
2	-	346	9	£10-15-1
3	-	307	-	£ 9-16-11

(continued)

Arkengarthdale London Price

1894	251	£ 9-11-9
5	217	£10-12-11
6	190	£11-7-9
7	233	£12-10-5
8	160	£13-2-8
9	106	£15-1-10
1900	84	£17-3-11
1	57	£12-14-2
2	51	£11-14-8
3	-	£11-15-4
4	-	£12-1-6
5	-	£13-17-5
6	-	£17-11-5
7	3	£19-12-3
8	66	£13-14-5
9	117	£13-6-2
1910	129	£13-3-2
1	59	£14-2-8
2	14	£18-5-0
3	-	£18-17-3
4	-	£19-3-11

APPENDIX C: Wages

Table 1 : Daily and Weekly Wage Rates 1783-1830

	Mason	Smith	Joiner/Carpenter	Calsining
1783	2/-			
4			1/4	
5				
6				
7		2@12/- p.w. 1@ 8/6 p.w.		
8				
9		ditto	1/4	9/- p.w. & son 8/-
1790				
1				
2				
3	2/-, labourer 1/4			
4	2/- master, 1/9 journeyman	ditto	2/- day, 3/10 for 2 days, 5/6 3 days, 9/- p.w.	
5				
6				
7	2/- master, 1/6 labourer			
8				
9	2/-		2/-	
1800				
1				
2				
3				
4				
5	2/6		2/6	1/6
6			2/6 & apprentice 2/-	1/6, 1/10, 2/-, 2/6
7				2/-, 2/3, 2/6
8	3/-			1/6, 2/- 2/-, 2/6
9				
1810	3/6		5/6 man & son, 2/6	
1	3/6		3/-	
2			3/-	
3				
4				
5				
6				
7	2/6, 2/- labourer	3/-	3/-, 3/6	
8			3/-	
9				
1820			3/6, 3/-	

(continued)

	Mason	Smith	Joiner/Carpenter	Calsining
1821	3/-		3/6	
2			3/6, 3/-; assistant	2/6
3				
4				
5	3/-		3/6, 3/-	
6	3/-		3/6, 3/-	
7				
8	3/-		3/6, 3/-	
9				
1830				(1)

Table 2: Earnings of Jonathan Pratt and partners, Old Gang smelters, 1806-1808

Period	Paid for smelting			For other work			Total			Description of other work
	£	s	d	£	s	d	£	s	d	
4 Jan 1806	14.	8.	2	3.	4.	0	17.	12.	2	Repairing hearth, 32 days at 2/-
- 15 Feb										
15 Feb	16.	12.	2	4.	10.	0	21.	2.	2	Removing black slags to rollers, repairing hearths, etc. 45 days at 2/-
- 29 Mar										
29 Mar	19.	6.	1	4.	0.	0	23.	6.	1	Repairing peat roads, 40 days at 2/-
- 10 May										
10 May	15.	2.	7	4.	4.	0	19.	6.	7	Repairing peat house, etc. 42 days at 2/-
- 21 June										
21 June	11.	10.	4	3.	0.	0.	14.	10.	4	Thatching, opening gutters, etc. 30 days at 2/-
- 2 Aug										
2 Aug										Thatching by bargain
- 13 Sept	11.	3.	1	4.	0.	0.	15.	3.	1	
13 Sept										Thatching peat stacks 30 days at 2/-
- 25 Oct	15.	9.	9	3.	0.	0	18.	9.	9	
25 Oct	11.	6.	2	2.	0.	0	13.	6.	2	Smelting waste
- 6 Dec										" "
6 Dec 06	13.	10.	10	3.	0.	0	16.	10.	10	" "
- 17 Jan 07										
17 Jan	4.	19.	6	3.	00.	0	7.	19.	6	Cutting peat house floor
- 28 Feb										

(continued)

1. K.L.MSS Pkts 1, 14, 15; A.D. Mills Account, 1805-1885, D.H.MSS SD3

Period	Paid for smelting			For other work			Total	Description of other work		
	£	s	d	£	s	d			£	s	d
28 Feb -11 April	12.	6.	2	7.	10.	0	19.	16.	2	Repairing roads, cutting a bank, etc.
11 April -23 May	17.	5.	8	5.	0.	0	22.	5.	8	Building a fold for slags, 50 days @ 2/-
23 May -4 July	14.	16.	8	3.	0.	0	17.	16.	8	Cutting new race, Raygill Spring
4 July -15 Aug	13.	7.	10	1.	12.	0	14.	19.	10	Repairing peat roads
15 Aug -26 Sept	8.	4.	0	6.	6.	0	14.	10.	0	Cutting ground for calsiner at new mill
26 Sept -7 Nov	18.	0.	8	4.	0.	0	22.	0.	8	Cale to hold up road
7 Nov -19 Dec	1.	15.	0	8.	10.	0	10.	5.	0	Chopping wood and shovelling snow.
19 Dec 07 -30 Jan 08	14.	17.	10	2.	0.	0	16.	17.	10	Sundry employment, 20 days at 2/- (1)

1.A.D.Mills Account, 1805-1885

TABLE 3 : DAILY AND WEEKLY WAGE RATES 1855 - 1885

	LABOURERS	BOYS	DRESSING BY THE DAY	ROASTING OR SMELTING BY THE DAY	STONE-MASON	BLACKSMITH	JOINER / CARPENTER
1855	2/- R	8 ^d					
6							
7	2/- R; 2/- P	1/- + 10 ^d FP	1/6 + 1/- P			2/4; ASST 1/6	
8	2/-						
9							
1860							
1							
2							
3		8 ^d					
4							
5							
6	2/6 R	1/-			3/6; LAB 1/6	2/6 SON AGED 12, 4/- p.w.	3/- J 3/- C
7	2/6 R 2/6 W				3/6; LAB 1/6	" " 14, 6/- p.w.	
8	2/6 R					" " 15, 9/- p.w.	
9	2/6 R					2/8 " " 16, 12/- p.w.	
1870							
1				4/ S			
2	2/6 R	1/2; 1/1	3/-	3/ Ro.	3/6	2/8	3/- C
3	3/- R; 2/8 W → 16/- p.w.	1/2 → 1/3		2/11 p.w.	3/6	3/- → 3/6	C. 3/- → 3/6
4	3/4 R; 3/- R; 2/8; 2/6	1/6; 1/4 ASST R 1/4 → 2/-	3/-	3/6; 3/- Ro.			
5		1/5; 1/4; 1/3; 1/-	Boys 6 ^d	4/ S; 3/- Ro.		4/-; 3/6	
6		1/6; 1/3					
7		1/4					2/11 p.w. J
8	2/8 → 2/6 → 2/-; 2/8 → 2/6 W					3/6 → 3/2; 3/6 → 3/-	4/- J, ASST 2/-; J 4/- → 3/6; 3/- J
9	2/6 R; 2/-					3/-; 15/- p.w.	
1880	2/6 R; 2/-					3/-	
1	2/- R; 2/- 2/6 W						
2							
3							
4							
5							

ABBREVIATIONS USED :

- R = REPAIR WORK
- P = PEAT
- F = FEMALE
- W = WOODMAN
- ASST = ASSISTANT
- S = SMELTING
- Ro. = ROASTING
- J = JOINER
- C = CARPENTER
- LAB = BLACKSMITH'S LABOURER
- p.w. = PER WEEK

THE SMELTERS FIGURE OF 20/11 PER WEEK IN 1843 IS THE AVERAGE EARNINGS FOR THE MONTH OF MAY AT THE OLD GANG MINE.

Table 4: Applications for variation of bargains, Old Gang Mine.

1860-73

<u>Kind of work</u>	<u>Request</u>	<u>Answer</u>
Bing tale	Have worked two months, driven 25 fathoms in a drift, not much ore but 193 waggons of deads. Will you take the waggons? (1)	Granted
"	Have worked a long time here and ore good. Now fallen off and we can't make wages. Can we have 46/- a bing?	Granted
"	No ore, ground hard and bad, have been working 18 hours a day. Can we have 50/- a fathom? (2)	Granted
"	Mine poor, can we have £3 a month, plus what we make? (3)	Granted
"	Poor ore, will you take the charge? ⁴	Granted
"	Last month's income £9-16-2, expenses £9-14-0, "in consequence of the poverty of the mines." Can we have a grant?	£1 a month during the company's pleasure.
Drawing	Some difficulty in keeping my men. Can I have ½d a waggon more for all Victoria Level work?	Granted ½d more for all except New Sun Vein.
"	High price of corn and increased length at Bunting Level. Can we have 6d a waggon for the new end, and 4d for the old?	Refused at present.
Dressing	"The mines being poor and difficult to wash, we propose to have 5/- a bing for the whole of the work at Bunting."	Refused. (5)

1. Pay the cost of drawing.
2. For the distance their level or drift was driven.
3. The number of men in the partnership is not given.
4. Allow the men the cost of candles and gunpowder.
5. D.H.MSS SGL.

Bibliography

Introductory Note

There are few published works on lead mining in Yorkshire. The most useful are the Memoirs of the Geological Survey and a number of articles by Dr A. Raistrick, particularly his "Ore-hearth lead smelting in the seventeenth and eighteenth centuries". The latter's "Mines and Miners of Swaledale" is a short, popular account, which is based in part upon an unpublished history of the mines written by the late E.R. Fawcett of Muker. Fawcett's MS is a confused and erratic work which requires the most critical use, and a few of its errors, of which a typical one is the confusion of the Arkengarthdale and Darwent Mining Company which worked the Arkengarthdale mines from 1800 to 1821, with the A.D. Lead Mining Company which was formed in 1873, have found their way into Dr Raistrick's book.

Mr R.T. Clough, an architect, has written a series of illustrated articles on the lead smelting mills of Yorkshire. The historical and technical details relating to the Swaledale mills are unreliable, but the reconstruction drawings are very useful. Some of the illustrations are reproduced here by courtesy of Mr Clough.

The principal source for this study has been the Draycott Hall MSS, the records of the Pomfret-Denys (A.D.) mining royalty from 1780 to 1914. They include a large number of plans, leases, and lead weighing books; some bargain books and pay accounts; agents' reports, accounts, and notebooks; and correspondence and memoranda which are particularly full for the

periods 1800-1830 and 1860-1890. The records of the manors of Healaugh and Muker have been scattered. Some are preserved in the North Riding Record Office, others have found their way into two small collections in private hands, the Barker and Clarkson MSS. A similar collection, the Peacock MSS, contains tithe records and some useful accounts and diaries.

The Kirkleatham MSS include the records of the Arkengarthdale mines for the period 1780-1800, and there are a few nineteenth century leases and accounts for the same field in the manorial records, here referred to as the Arkengarthdale MSS. The Backhouse MSS are a collection of scrap books containing various records, notes, and letters about the Yorkshire mines. They contain little of value for Swaledale, and in general need to be used very critically.

I would like to record my appreciation for help received from the following libraries : Newcastle, King's College Newcastle, Stockton, Darlington, North Riding, Leeds, University of Leeds, Manchester, the Bodleian, University of London, the Friends' Reference Library, and the British Museum.

I am grateful to the following for information and for the loan of, or permission to consult, various records : The North Riding County Archivist, Mr C.K.Croft Andrew, and his staff, Sir Thomas Sopwith and Mr J.B.Harper, Earl Peel and Mr D.Scott, Mr W.Calvert, Mrs I.Chapman, Mr G.Clarkson, Mrs J.W.Close, Messrs. E.Cooper, C.Croft, G.O.Hall, G.B.Harker, R.Hird, Mrs A.Nathan, Miss W.Packman, Mr R.Place, Mrs A.Plant, Messrs.

W.S.Raw, C.Shevels, C.F.Taylor, J.C.Woodward, and R.Woodward.

I am particularly indebted to Mrs M.S.Radcliffe of Draycott Hall, Mr T.Peacock, and Mr.L.Barker for access to, and the loan of, their documents; to Mr H.G.Alderson and my wife for assistance in preparing the production figures, graphs, maps, and plans; to Dr A.Raistrick, who has been unstinting with help and advice; and to Professor A.Briggs, who has supervised the preparation of this thesis.

The photographs have been taken by Mr L.Bolam and myself. Mrs A.Hill has typed the thesis.

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Kirkleatham MSS

in North Riding Record Office.

Arkengarthdale MSS

in Leyburn Estate Office.

Peacock MSS

in the possession of Mr T.Peacock, of Reeth.

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