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MINES OF THE WEST PENNINES

by

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INTRODUCTION

Lead mining on the West Pennine escarpment has been documented since mediaeval times, although widespread, lead production has been generally lower than in areas further east in Upper Teesdale or on Alston Moor. Nevertheless, there have been some areas of considerable activity and because of their remoteness, many of the sites have escaped destruction and vandalism. This has not been an easy area to research in that it has involved strenuous walking and parts of it can only be reached on certain days because of safety restrictions imposed by the army firing ranges at Warcop. These are shown on the O.S. maps as 'Danger Areas' and are marked by red flags when in use. Access beyond the few rights of way is not normally possible and any queries should be directed to: Warcop Training Camp, Warcop, Appleby in Westmorland, tel. 0800 7835181 or on www.mod.uk.

Throughout this monograph, the pre-1974 county boundaries have been used; this is still the basis of classification at most county record offices. The area is mainly in the county of Westmorland and includes parts of Cumberland in the north and Yorkshire in the south. Most of the parishes have their centres of population below the steep west face of the Pennines and tend to be long narrow strips, running east-west across the Pennine watershed into Teesdale, where they are bounded by the River Tees. For this reason, some of the mines described here are also covered briefly in Ray Fairbairn's 'Mines of Teesdale' monograph.[1] Much of the countryside is inhospitable with poorly defined natural boundaries, a situation which presented few issues from an agricultural point of view but became important when income from mining rights was at stake. In the eighteenth and nineteenth centuries there were a number of boundary disputes and old maps show several 'disputed areas' where territorial ownership and county boundaries were unclear.

The mines covered here are almost all lead mines, together with some very small copper mines. Some coal pits have been referenced where they occur in lead mining areas but no attempt has been made to cover these in detail. Some iron mining has also been carried out in the north of the area but this has generally been poorly documented. Iron smelting and refining sites occur in the area and have been researched by Marshall and Davies-Shiel.[2] Many of the lead mines were worked for barytes either by mining or by working the spoil heaps and this has been covered, although in lesser detail. At the foot of the escarpment, there are several gypsum mines. These are again outside the scope of this monograph and have been described by Ian Tyler.[3]

Other than the mines covered in Fairbairn's monograph, there has been little historical research reported on this group. Kingsley Dunham's book on the economic geology of the area has been referred to throughout this monograph.[4] The main primary documents are to be found in the Cumberland County Record Offices at Kendal and Carlisle, which house the archives of the Earls of Thanet, the Lowthers, the Senhouse Flemings and others. Most of the old maps referred to may be found at the Kendal Office. The Cumbria County Record Office at Whitehaven has several plans of abandoned mines, previously held by the Health & Safety Executive. The North of England Institute of Mining and

Mechanical Engineers, Newcastle holds the records of the London Lead Company and some mine plans and other collections previously held by the Northumberland County Record Office at Newcastle. The Strathmore and Bowes Museum archives in the County Durham Record Office at Durham hold information on mines within the Teesdale basin (even though they were in Westmorland and Yorkshire) together with surveys and plans in the Dunham Collection. The North Yorkshire County Record Office at Northallerton has some references to mining in Mallerstang and occasional references to the Hilton smelt mill. Much of the local history has been gathered from sources at these record offices or at the Local Studies section of Kendal Library. A significant amount of information has also been provided from the NMRS records by courtesy of Mike Gill. Ian Tyler's 'Lakes and Cumbria Mines Guide' has been a recent and useful gazetteer, field guide and general catch-all which has prompted even more site visits.[5]

From an editorial point of view, the Northern Pennines provides more than the normal share of frustrations and dilemmas. The spelling of geographic names can be confusing and the authors have standardised, for example, on 'gill' rather than 'ghyll' and 'sike' rather than 'syke'. There is a local tendency, particularly with historical sources, to create compound names - so that Dunfell Hush is to be found on the south-eastern slopes of Great Dun Fell, Stakebeck Mine is to be found on Stake Beck and so on. There are plenty of other confusions, there are two 'Silverband Mines' (one in Yorkshire and now in Co. Durham; the other in Westmorland and now in Cumbria), at least two 'Swindales' with lead mines and two 'King's Pots'. We have done our best!

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HISTORY

THE COUNTY OF CARLISLE

The earliest surviving document dealing with Cumberland is a 13th century transcription of Gospatrick's Writ which was issued at the time of Edward the Confessor. It deals with the land bounded by the Rivers Derwent, Eamont, the Central Pennines and the Solway, which it terms 'the lands that were Cumbrian'. During the 10th century it was under some degree of Anglian influence but became part of the kingdom of Strathclyde. In 945 AD King Dunmail of Strathclyde was defeated in battle by King Edmund of Northumbria, who then gave it to Malcolm I of Scotland as part of an alliance. It remained part of Scotland until 1032 when Canute exchanged it for Lothian but by 1068 it had returned to Scottish rule when it was seized by King Malcolm III. For this reason, almost the whole of Cumberland and much of Westmorland are excluded from the Domesday Book of 1086.

William II took Carlisle in 1092 and established the Solway as his northern boundary. He is said to have colonised the land by garrisoning the castle and by bringing in peasant families from elsewhere to occupy and cultivate the land. During the reign of King Stephen, Cumbria was occupied by King David of Scotland, who supported the claims of his niece Matilda to the English throne. Henry II won Carlisle back in 1157 and apart from brief occupations of the castle by Alexander II in 1216 and Charles Edward Stuart in 1745, the city has remained as part of England.

From 1072, the area had become part of the Honour of Carlisle under Ranulph de Meschines, who also held the lower Eden valley and the Barony of Appleby. He increased his holding when he married the daughter of Ivo de Taillebois and acquired the Barony of Kendal. Ranulph held the enlarged Honour of Carlisle until 1120 when he succeeded to the Earldom of Chester and relinquished the northern lands to the crown. The lands were then allocated into smaller baronies, with the crown retaining Carlisle and its surrounding area together with the Forest of Inglewood.

The old administrative area of the County of Carlisle was abandoned in the Pipe Rolls after 1175 and the new designation County of Cumberland used first in 1177. About the same time, the Barony of Appleby was severed from the Honour of Carlisle and with the Barony of Kendal was formed into the new County of Westmorland. The new fiscal area first appeared in the Pipe Rolls of Yorkshire in 1176 under the name 'Westmarieland' and remained as a subdivision of Yorkshire until [1]Richard I in 1189.[1]

THE COUNTY AND BARONY OF WESTMORLAND

The County of Westmorland appears to have been created as a separate earldom by Richard II who conferred the title on Ralph Neville of Raby in the County of Durham. During the Wars of the Roses, the elder branch of the Nevilles retained Westmorland while the junior branch went on to greater things as Earls of Warwick and Salisbury.[3] The County of Westmorland was divided into four wards (East, West, Kendal and Lonsdale). The Barony of Westmorland consisted of the East and West Wards and thus there arose, somewhat confusingly, both a county and a barony of Westmorland.

Although much of the land and mineral rights within the Barony of Westmorland were held by the Cliffords and Thanets, many of the manors and their mineral rights had been granted or sold to others. Most of these were later bought up by powerful landowners such as James Lowther, Earl of Lonsdale with the result that documentary records are held in various repositories throughout the North of England and ownership and inheritance issues appear complex. The histories of the various manors are described in the sections dealing with the mines.[4]

The Barony of Westmorland was given by Ranulph the Earl of Chester, son of Ranulph de Meschines, to his sister and it passed through normal lines of inheritance to Hugh de Morville. Hugh was one of the knights who murdered Thomas á Becket, Archbishop of Canterbury during the reign of Henry II and the barony was forfeited to the crown as a result. The land remained as crown property until 1203 when it was granted by King John to Robert de Veteripont (or Vipont) whose son John sold off some of the lands. His son Robert was killed in the Barons' War fighting on the side of Simon de Montfort and the barony was eventually restored to his two young daughters Isabella and Idonea who were placed in the wardship of Roger de Clifford, Earl of Hereford and Roger de Leybourne, Earl of Kent. The daughters married the sons of their guardians and the Barony of Westmorland in 1274 became the holding of Roger de Clifford through marriage. The Cliffords held the barony together with other lands in the North of England, with some interruptions, until the death of George Clifford the 3rd Earl of Cumberland in 1605. He left Westmorland and the northern estates to his brother Francis, despite the strong and vociferous claims of his daughter Anne (1590-1676). She married Richard Sackville, who became Earl of Dorset and then after his death, Philip Herbert, Earl of Pembroke and Montgomery, who died in 1649 when Anne returned north. In the meantime, both Francis Clifford and his son died without issue and in 1643 the northern estates passed to Anne according to the terms of her father's will. She set about rebuilding the six castles, which had been slighted during the Civil War, without opposition from Cromwell or Charles II and died at the age of eighty six. Anne's claim to the lands and title was strong in that, although her father's Earldom of Cumberland was restricted to male heirs, the Baronies of Westmorland, Vesci, Clifford and the High Sheriffwick of Westmorland were not.[2]

History repeated itself, in that when Anne died in March 1676, she left the Westmorland estates to her elder daughter, Margaret Tufton (nee Sackville) the dowager Lady Thanet and her Craven estates in Yorkshire to Lady Alathea Compton, who was the child of her younger, deceased daughter Lady Northampton. However, her eldest grandson, Nicholas Tufton, 3rd Earl of Thanet stepped in and claimed everything. The estates went to him but not for long; he died in 1679, followed by his brothers John and Richard the 4th and 5th Earls who died in 1680 and 1684 respectively. The title finally passed to Thomas Tufton the youngest of the brothers and 6th Earl of Thanet. When he died in 1721 he had five daughters and the estate passed to the grandson of Margaret Tufton, Sir Sackville Tufton who became the 8th Earl. The succession continued into the 20th century until Henry Sackville Thanet Tufton, the 3rd Lord Hothfield, died in August 1961 leaving the estate to Marquis Hill.

BOUNDARIES

There were several parts of individual manors where the boundaries were not settled and because of their remote, inhospitable moorland location did not become an issue until lead mining or some obligations such as the mending of roads became significant. The eastern county boundary between Westmorland and Durham was the River Tees. The eastern boundary with Yorkshire was less well-defined. At the time of the 1st Ordnance Survey in 1856 and the county re-organisation of 1974, the boundary with Yorkshire ran along Maize Beck westwards to the Pennine watershed. This is also the case with the maps of Cary 1811, Greenwood 1824 and Hodgson 1828 but with differences in the boundary along the watershed. All show the main boundary runing through the centre of Mickle Fell but with a second boundary cutting through the west end of Mickle Fell. Jeffrey's 1776 map of Yorkshire shows only the latter boundary. Moll's map of Westmorland of 1724 shows a completely erroneous course of the eastern Lune extending northwards to Dun Fell and Blencarn Beck. All of the ground to the east is shown as being within Lune Forest and Yorkshire. Bowen's maps of 1760, 1763, 1767 and that of Ells in 1767, avoid naming the Tees completely, although it is shown correctly by Cary

Figure 1. Part of Moll's map of 1724 of the eastern boundary of Westmorland, showing an erroneous course of the eastern Lune and boundary with Yorkshire.

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GEOLOGY

STRUCTURE

The western edge of the Pennine escarpment is defined by the major NNW-SSE Pennine Faults in the north and the NNE-SSW Dent and Argill Faults in the south. The northern boundary is determined by the E-W Stublick Fault and the southern boundary by the WNW-ESE Craven Faults. Between these, the area is crossed by major E-W faults which divide it into blocks. The Alston Block in the north lies between the Stublick and Lunedale Faults. The Askrigg Block is bounded by the Stockdale disturbance in the north and the Craven Faults in the south. Both blocks have intrusive granite cores, established during Silurian and early Devonian times and which have since been important factors influencing subsequent development and response to tectonic influences. Between these blocks lies the Stainmore Trough, which has been subjected to much less W-E uplifting and has, therefore, been an important communications route between the two upland areas.

The major E-W faults which divide the area were initiated during the early Carboniferous period and were followed in the late Carboniferous by the Hercynian Orogeny which created a system of NNW-SSE and subsidiary ENE-WSW joints, together with broad folds on E-W axes such as the Cotherstone Syncline. The joints were created by northwards directed shearing forces.

The Whin Sill intrusion took place in the early-Permian and was followed by gentle doming of the Alston Block and creation of ENE-WSW, E-W and NNW-SSE vein fractures caused by the presence of the low-density granite. Mineralising fluids percolated these fissures and may have aided their propagation.

The major uplift of the Pennines occurred as a result of the Cimmerian earth movement during the late Jurassic period the and finally by the Alpine Orogeny during the Tertiary. This formed a tilted block with an escarpment at its western edge and formed along the existing fault lines initiated during Devonian times.

The Permo-Triassic sediments which covered the area were stripped, or not laid down during the period of movement, exposing earlier Carboniferous strata which form the host rocks of the ore deposits at the crest of the Pennine escarpment. The later sediments are to be found in the low-lying Vale of Eden to the W and the eastern parts of the Alston Block.

Further movements, in part caused by variations in ice pressure during the Pleistocene, resulted in postmineralisation shifts and the slickensides along vein faces, which are apparent in some mines.

CLASSIFICATION

The strata of the Carboniferous period have been classified into the Dinantian (Lower Carboniferous – Carboniferous Limestone) and Silesian (Upper Carboniferous - Millstone

Grit and Coal Measures) sub-systems. In this area the most common exposures are in the Dinantian, which is further divided into the Tournasian and Visean series. The Tournasian series has a single stage and the Visean series is divided into five stages: Chadian, Arundian, Holkerian, Asbian and Brigantian. The Namurian series lies above the Visean and is divided into seven stages. The limestones are further divided into zones which are based on fossil occurrences and have names such as D_1 S_2, C_2S_2 etc.

The Visean rocks consist of cyclical depositions of limestones, separated by shales, sandstones, seatearths or ganister and thin bands of coal. The resulting cyclothems are referred to by the name of the lower limestone and are rarely complete and often die out or merge laterally

Several systems of classification were in use during the first half of the last century and to add further complication, miners and historians have used the traditional local names for the various rocks and strata. For example, old mining documents often refer to the intermediate rocks between the limestones: 'hazle' is sandstone, harder than freestone but softer than girdle bed; 'tuft' varies from a fine-grained brown micaceous sandstone to a coarse grit; 'plate' is shale; 'sill' is a flat bed usually sandstone and not necessarily igneous; 'Whin Sill' is a hard igneous intrusive bed. Some of the more common or useful beds have unique names, others are named after the limestone associated with them.

STRATIGRAPHY

The rocks of the crest of the escarpment are Carboniferous sediments lying unconformably on older Palaeozoic rocks, the Skiddaw Slates. The underlying rocks are exposed at the Cross Fell Inlier which is a narrow strip between the Carboniferous escarpment and the Outer Pennine Fault. The base of the Carboniferous rises from 290 m O.D. in Scordale to 381 m O.D. in Kirkland Beck and peaks at 411 m O.D. in Crowdundle Beck (between Cross Fell and Dun Fell).

The earliest Carboniferous rocks are conglomerates, sandstones and shales with some thin limestones and coals which filled up undulations in the Pre-Carboniferous floor. There is little evidence of lower Visean strata which include the Ravenstonedale Limestones (Chadian), Hillbeck Limestone (Holkerian) and its northward continuation, the Dun Limestone (Scordale and Dufton Fell).

The Melmerby Scar Limestone (MSL - Asbian) is the thickest Carboniferous limestone and consists of massive grey or pale grey posts, separated by marl beds of a few inches in thickness. This forms the dominant scar faces to be seen in Scordale (30 m thick), High Cup Gill, Dufton Fell (50 m thick) and Knock Ore Gill. South of Stainmore the MSL correlates with the Great Scar Limestone.

Above the MSL, the Robinson Limestone (Asbian) is separated by a series of shales and sandstones and is 4-6 m in thickness, although in Augill Beck, Stainmore, it reaches 25 m.

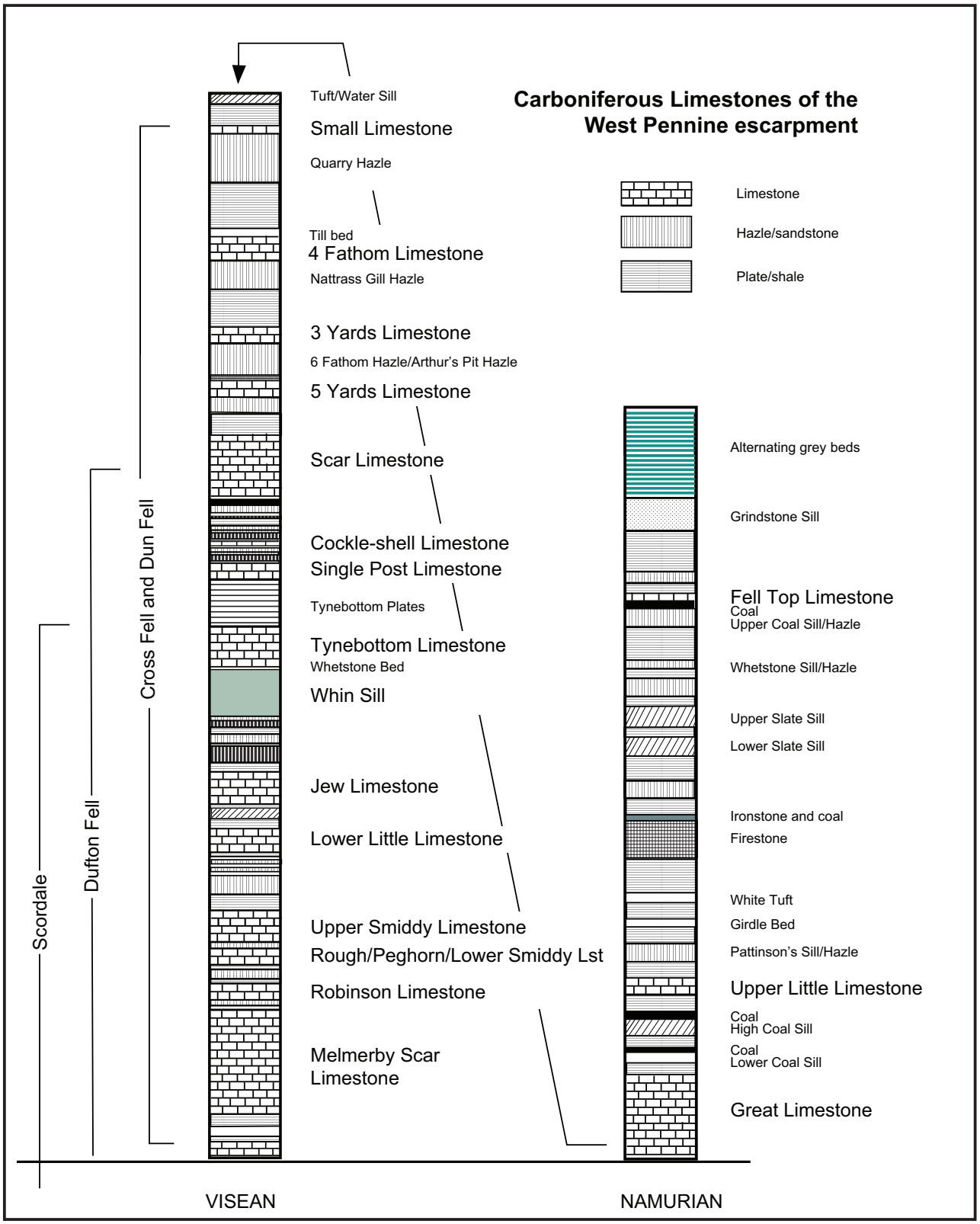

Figure 2. Carboniferous succession of the West Pennine escarpment from Scordale to Cross Fell. In Scordale, the Whin Sill occurs above the Melmerby Scar Limestone and as shown here at Cross Fell.[5]

The Brigantian Limestones of Scordale and Dufton Fell comprise: the Rough/Peghorn/ Lower Smiddy, the Smiddy/Upper Smiddy (4-10 m thick), Lower Little, Jew and Tynebottom (8 m thick with associated 'Alternating Beds' of thin sandstone, sandy shale and shale, repeated many times).

In Scordale, the Whin Sill (ca. 5 m thick) overlies the MSL and Robinson Limestones. At Cross Fell, the Whin Sill (ca. 40 m thick) lies underneath the Tynebottom Limestone and is succeeded by Brigantian strata: Scar Limestone with Slaty or Low Brig Hazle, Five Yard Limestone with Six Fathom or Low Brig Hazle, Three Yard Limestone with Nattrass Gill Hazle, Four Fathom Limestone with Quarry Hazle. The Iron Post/Hewitson's Limestone with Tuft is not present on Cross Fell but is about 0.3 m thick on Dunfell where there is a thin coal seam in the Tuft.

Namurian strata overlie the Brigantian rocks on Cross Fell and Dun Fell: Great Limestone, Upper Little Limestone, Crag Limestone, Lower Felltop Limestone and Upper Felltop Limestone (UFT). There are 25 m thick beds of Dun Fell Sandstone below the thin UFT.

MINERALISATION

The orebodies are principally of two forms: vein deposits created by mineralisation along fissures and seldom more than 20^{o} from the vertical and metasomatic flats where mineralising fluids have percolated between limestone beds and have replaced the limestone (metasomatism). Replacement of limestone adjacent to vein oreshoots to some degree is usually found with both types of deposit.

Lead is found principally as galena containing ca. 6 troy oz of silver/ton of lead metal. Silver is invariably present as a solid solution in the galena. Niccolite (NiAs), annabergite $Ni_3(AsO_4)_2.8H_2O$ and gersdorffite (NiAsS) were found at Dowscar Level, Hilton in 1978. Barytes ($BaSO_4$) and fluorspar (CaF_2) were common gangue minerals and barytes was worked in the late nineteeth to late twentieth century throughout the area. Witherite ($BaCO_3$) has been found in the Murton Fell North Vein in an area known as the 'Carbonate Shake'. Iron in the form of limonite or 'brown haematite' ($Fe_2O_3.xH_2O$) has been extracted or tried at several locations, principally at Ardale Head (Ousby), Gamblesby Fell, Dun Fell and Hartley. Copper occurs in trace amounts throughout the area and there were copper trials at Renwick and Long Fell near Hilton of which no details have been found.

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TINDALE FELLS, GELTSDALE, CROGLIN AND RENWICK

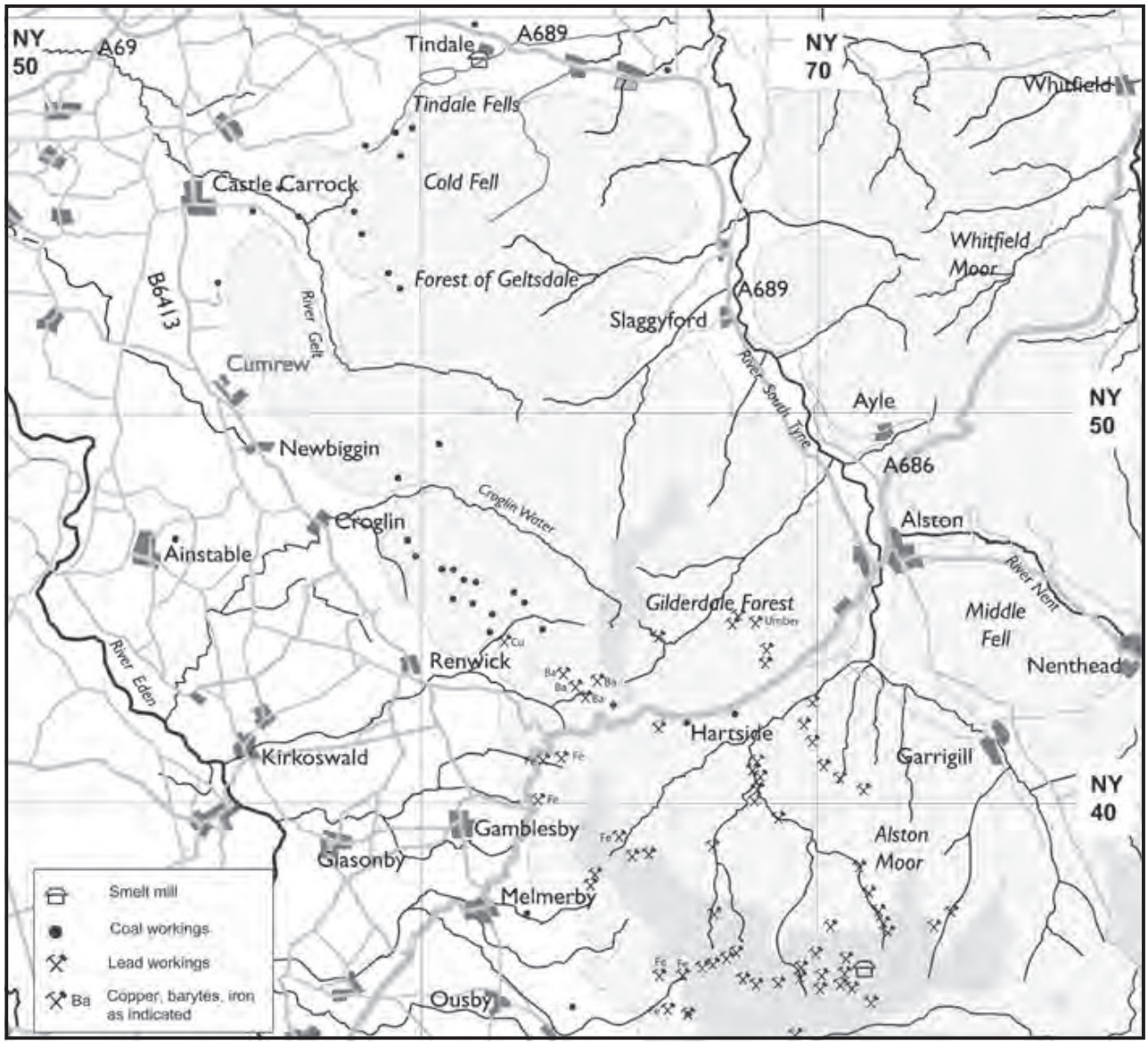

Figure 3 Mines of the northern part of the West Pennine escarpment. Workings outside the area of interest (eg Alston Moor) are not shown.

This area comprises the northernmost extremity of the Pennines; coal is abundant in the northern parishes, particularly in the manor of Croglin, where there were mines in the fells on either side of Croglin Water. Thomas Robinson in 1709 wrote:

> *'Croglan Fell. Lordship and Royalty in Possession of Lord Wharton. No Tryals made. The last and lowest depression is Coal Fell, so called from the colliery. The Mannor and Royalty are in the Possession of the Earl of Carlisle, the present lessee is the Ingenious Mr Mowberry. Here the coal class is in full strength and perfection, the seams being at their height and growth. All the solid strata upon these mountains have their horizontal depressions, which the miners call dibbing and rising, and they dib most commonly to the north. This is a very ancient colliery - supplies Carlisle and the countryside near it'.*[1]

In contrast to Robinson's description, Mannix and Whellan stated that although coal was plentiful, it was of an inferior quality.[2]

Figure 4. Site of the Tindale Fell zinc smelting works, showing the coal bunker for the fuming plant near the skyline. The bases for the Waelz kiln are to the right and the railway line is just beyond. The massive slag blocks in the foreground are an agglomerate of slag and other debris such as broken retorts. [Photograph R. Smith].

TINDALE FELL ZINC SMELTING WORKS

The site of the Tindale Fell zinc smelting works (NY 618 592) can be found in Tindale village, just off the A689 Brampton-Alston road. The site is surrounded by a new wire fence, apparently to restrict access to what is a polluted area.

The history of the works and its various companies has been reported by Almond.[3] The site was acquired in 1845 by James Henry Attwood who negotiated a 50-year lease from the Earl of Carlisle for an annual rent of £20. In 1863, the earliest recorded production was 750-800 tons of zinc, although there would have been some output before then. There were complaints of fumes from 1857 and the effects were *'worse each year and... they were much injured by it'*. Zinc ores from the North Pennines, Isle of Man, Ireland, Germany and Sweden were treated at the works. When Attwood died in 1865 the Tindale Spelter Company continued operations. The company was led by John Cameron Swan and family, who also took over many of the London Lead Company properties in the North Pennines, when that company ceased working there in 1882.

Zinc ores were crushed to fine powder in water-powered mills then roasted to remove sulphur in reverberatory furnaces. The calcined ores were then mixed with non-

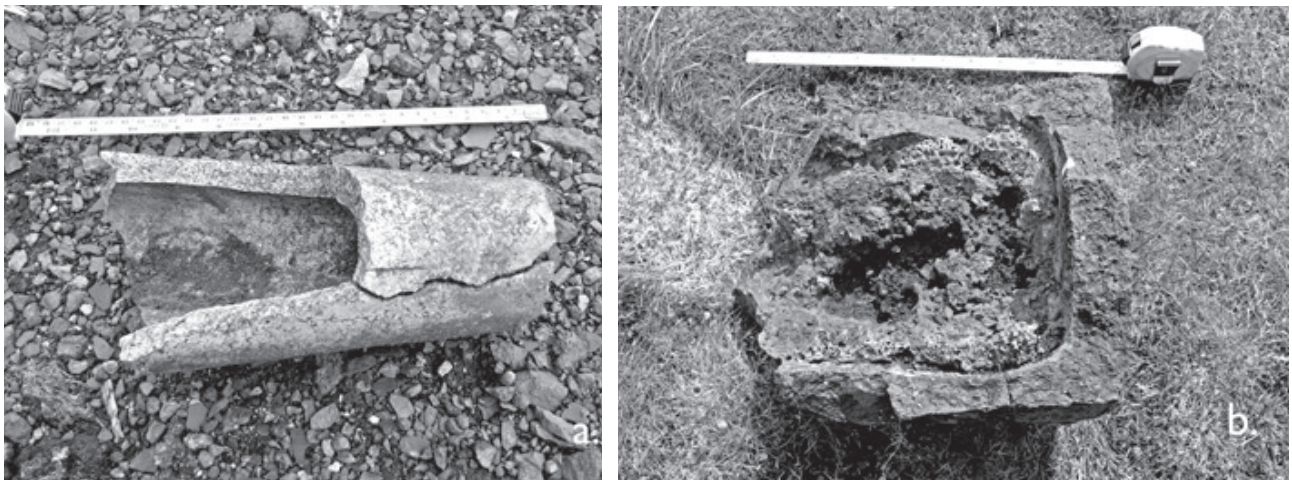

Figure 5. Zinc condenser, (a) front end and (b) rear end of a hexagonal retort with residue at Tindale Fell, shown against a 12 inch scale. [Photograph R. Smith].

bituminous coal fines and charged into fireclay retorts and heated strongly to reduce the oxide to zinc metal. This sublimed and was captured in 'prolongs' or condensers which were luted on to the retorts and which protruded from the furnace. Escaping zinc vapour from the condensers was ignited and bunt to a white fume which was allowed to escape into the atmosphere. By the 1880s there were 14 furnaces and a total of 912 retorts at work. Liquid metal from the condensers (ca. 4-5 kg/day from each) was run off into moulds.

The Swans consolidated their activites and in October 1882 formed the Nenthead and Tynedale Lead and Zinc Company Ltd. and paid £18,000 for the assets of the Tindale Spelter Company. Smelting at Tindale ceased at a time of economic difficulties in 1895 when nthe 50-year lease for the site expired. The Carlisle family laid down very stringent environmental requirements for a renewal of the lease and clearly did not want operations to continue.

During the 1920s there were various enquiries from companies wishing to treat the heaps of waste on the site. Tindale Zinc Extraction Ltd., registered in August 1928, erected a 30 m long by 2.5 m diameter rotary Waelz kiln supplied by Krupps. It had a throughput of 100 tons/day of residues. These were mixed with coal fines and the kiln was heated by an oil burner at the discharge end. The offtake gases were cooled through a long metal zig-zag flue from 700°C to about 100°C and zinc oxide fume was caught in woollen bag-filters. The process would have a much lower environmental impact than the primary treatment of sulphide ores conducted by the earlier companies and would reduce the amount of zinc and cadmium present on site. Problems arose because the white zinc oxide fume, sold as a paint pigment, was contaminated with coal and was sold to the National Smelting Company's zinc reduction works at Avonmouth. This company had invested in the Tindale works, which ceased operations when a receiver was appointed in November 1931.

The National Smelting Company took over the site in 1933 when it was used to process cadmium-rich zinc sinter plant residues from their Avonmouth and Swansea works by mixing the residues with coal and then fuming the mixture in the kiln at a somewhat

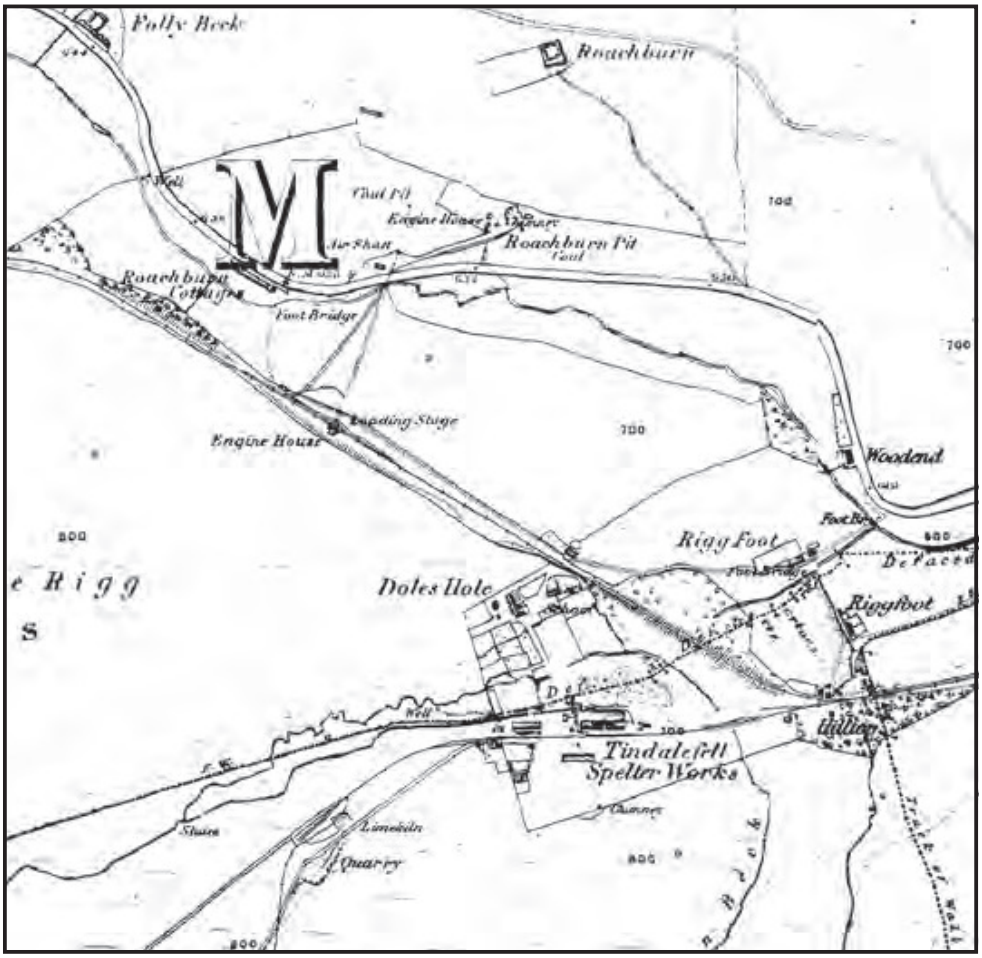

Figure 6. Map of Tindale Fell zinc smelting works and Roachburn coal mine. [1st edn. O.S. map].

lower temperature to preferentially concentrate cadmium. The fume was then transported to Orr's Ltd. of Widnes for further wet-chemical treatment. This process lasted for 87 days during which severe accretions were a constant problem and finally the kiln lining catastrophically failed.

Nevertheless, 3,400 tons of Tindale residues having 5.7% Zn and 1.7% Pb, in addition to those from Avonmouth and Swansea, were treated; 46 tons of cadmium were eventually extracted. The various items of equipment were transferred to other sites in the UK.

The main features of the site today are the line of the Brampton-Hartleyburn railway track which runs along the south side and the concrete plinths which supported the rotary kiln. To their west can be found the foundations of a terrace of workmens' cottages, known as Spelter Works Row and the white cottage which remains. One wall of the coal bunker for the kiln still stands at the east end of the kiln position. The stream bed has been recently consolidated and a lined channel built. Fragments of retorts and condenser ends (some oval and some circular in section) can be found throughout the site and show adhering residues of zinc fume and processed ore as well as extensive glazing caused by exposure to heat. Residues abound throughout the site and include rather spectacular lumps of slag, about 2-3 m in height.

BRAMPTON COAL FIELD

Operations in this area were large industrial concerns, interconnected by railways, with several under the direction of the Earl of Carlisle. Roachburn Mine (NY 6170 5980) lies immediately north of the A689 road and has a rail connection with the zinc works. On 28 January 1908 there was a massive inrush of peat and water and a memorial to this event stands at Coalfell (NY596 599).[4] Another coal mine was on the Brampton and Hartleyburn