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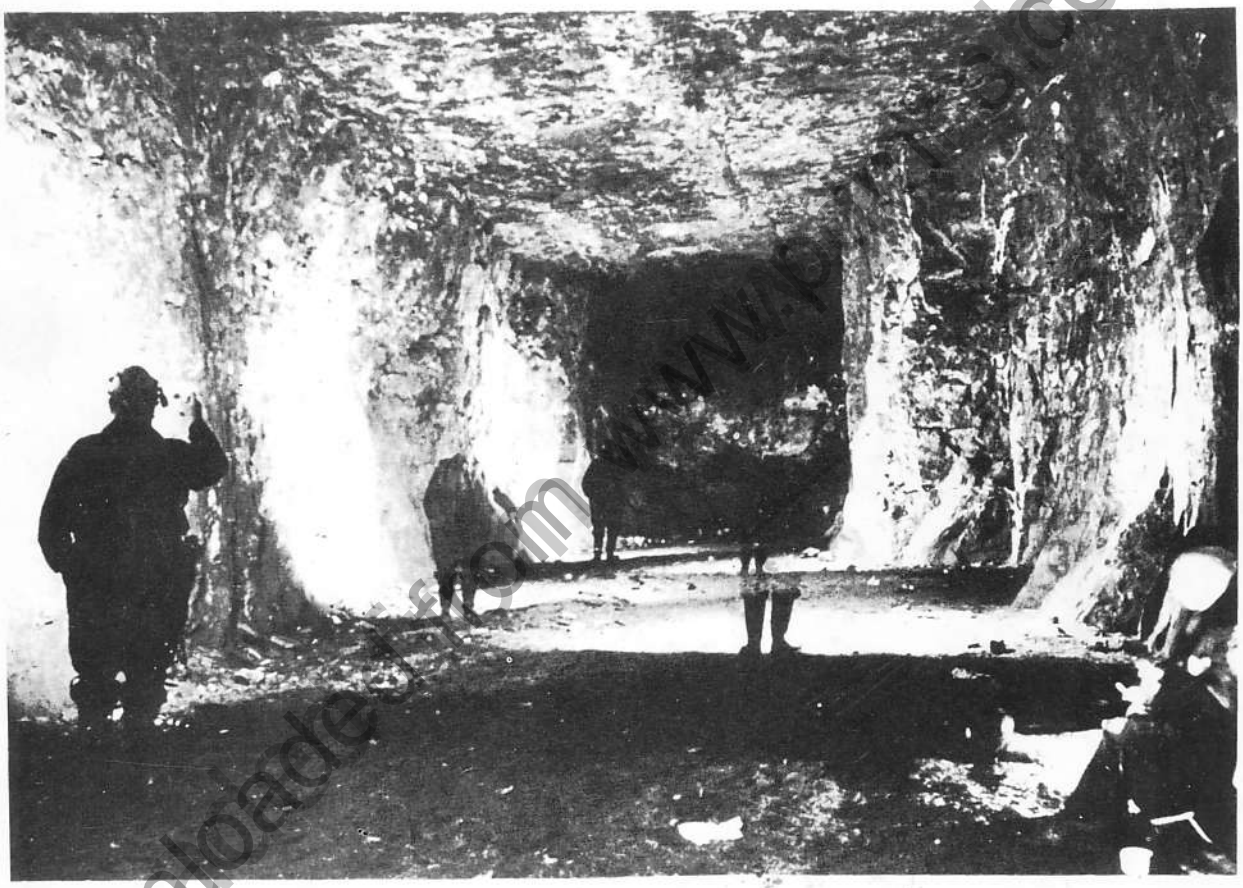

Ballroom Flat, Smallcleugh Mine, Nenthead

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# The History and Workings of the Nenthead Mines, Cumbria

**by Martin F. Critchley**

Cover photo: The Ballroom Flat in Smallcleugh Mine by Harry Parker

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# The History and Workings of the Nenthead Mines, Cumbria

by Martin F. Critchley

ABSTRACT

Around Nenthead there is a compact and rich mining area within the northern Pennine orefield. This area was first explored in the Middle Ages, but it was not until the early eighteenth century that the great expansion in mining took place. This expansion was mainly due to the Greenwich Hospital who owned the mineral rights and the efficiency of the London Lead Company who held up to 50% of the leases. Throughout the eighteenth and nineteenth centuries the London Lead Company unified their underground workings at Nenthead in to one large system. At the end of the nineteenth century the London Lead Company withdrew from the area, although they were making profits up to the end. The mines were then taken over by the unsuccessful Nenthead and Tynedale Lead and Zinc Company in 1882 and in turn by the Belgian Vieille Montagne Zinc Company in 1896. This latter company led to a successful revival of mining in the early twentieth century. During the Second World War the old waste dumps at Nenthead were re-treated for the Ministry of Supply. After the war the mines were investigated by Anglo Austral Mines, but little production took place. Today the mines are idle, but they display a wealth of mining remains both underground and on the surface.

## 1. INTRODUCTION

The village of Nenthead was built in the early nineteenth century by the London Lead Company, both as an administrative centre for its' mines in the area and to provide housing for its workers. By the time that the village was built the London Lead Company and many other smaller companies had developed the mineralisation around Nenthead to form the most important lead mining centre in northern England.

The importance of the Nenthead area can be judged from the excellent publications of Arthur Raistrick and the splendid series of mine plans preserved in the North of England Institute of Mining and Mechanical Engineers in Newcastle. Several articles have been written on the modern exploration of many of the old workings around Nenthead, but there has been no comprehensive description of the history and workings of the Nenthead Mines. This article can only begin to outline the story of the Nenthead Mines and I hope that it will help others to publish more detailed accounts and surveys of the individual mines.

## 2. GEOLOGY OF THE NENTHEAD REGION

### 2.1 STRATIGRAPHY

The Nenthead mining region occupies the north-western part of the northern Pennine orefield, which lies in an upland area known geologically as the Alston Block. The basement of the Alston Block consists of deformed Lower Palaeozoic sediments, intruded by the Devonian Weardale Granite. During Carboniferous times the Alston Block was a region of shallow water sedimentation, with the northern and southern margins acting as contemporary hinge lines. Sediment deposition on the block was accompanied by gentle and rhythmic subsidence; each period of subsidence being followed by sediment infill and a shallowing of water depths. This subsidence resulted in the deposition of a cyclic succession of Carboniferous sediments in repetitive units termed cyclothems (Dunham, 1948) and each cyclothem represents one cycle of subsidence and sediment build-up (Ramsbottom, 1973). A complete cyclothem consists of limestone at the base,

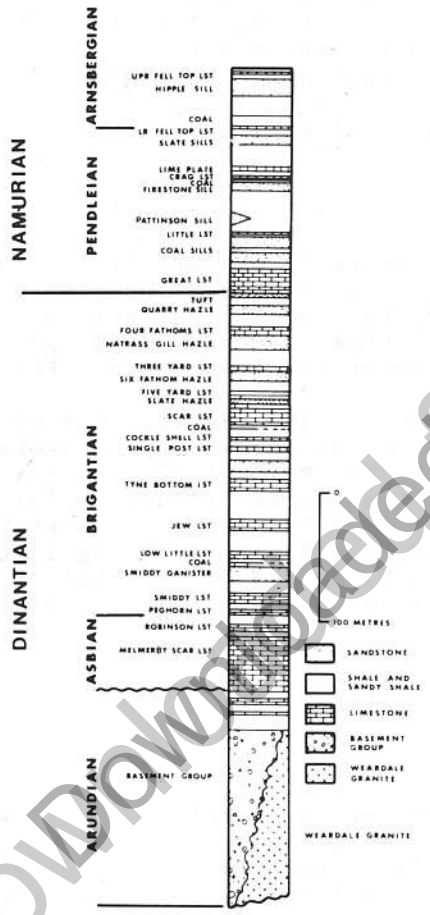
followed by mudstone, siltstone, sandstone, seat earth and coal. Often the top-most units of a cyclothem are absent due to erosion by the base of the overlying cyclothem. In addition the basal Carboniferous is predominantly calcareous, whilst the proportion of sandstones and mudstones increases up into the Namurian and Westphalian (Fig. 1). Coal seams, up to 0.7m thick, are present in the Namurian succession and these have been extensively mined in the past at outcrop and in shallow pits. Today, there are two operating coal mines near Alston.

The base of the Namurian is marked by the Great Limestone, which is the thickest limestone in the area and is the main host for flat-type mineralisation.

Intruding the sediments of the Alston Block is the Late Carboniferous (Stephanian) quartz-dolerite Whin Sill. The sill is generally intruded parallel to the sedimentary strata and over much of the block it is intruded beneath the Tynebottom Limestone. It is not exposed either at outcrop, or underground in the Nenthead region.

## 2.2 VEIN MINERALISATION

There are three sets of veins in the northern Pennine orefield and examples of all sets are present in the Nenthead region (Fig.2). These three sets are: (i) ENE striking 'productive' veins; (ii) NNW striking 'cross' veins; (iii) ESE to east-west striking 'quarter-point' veins.



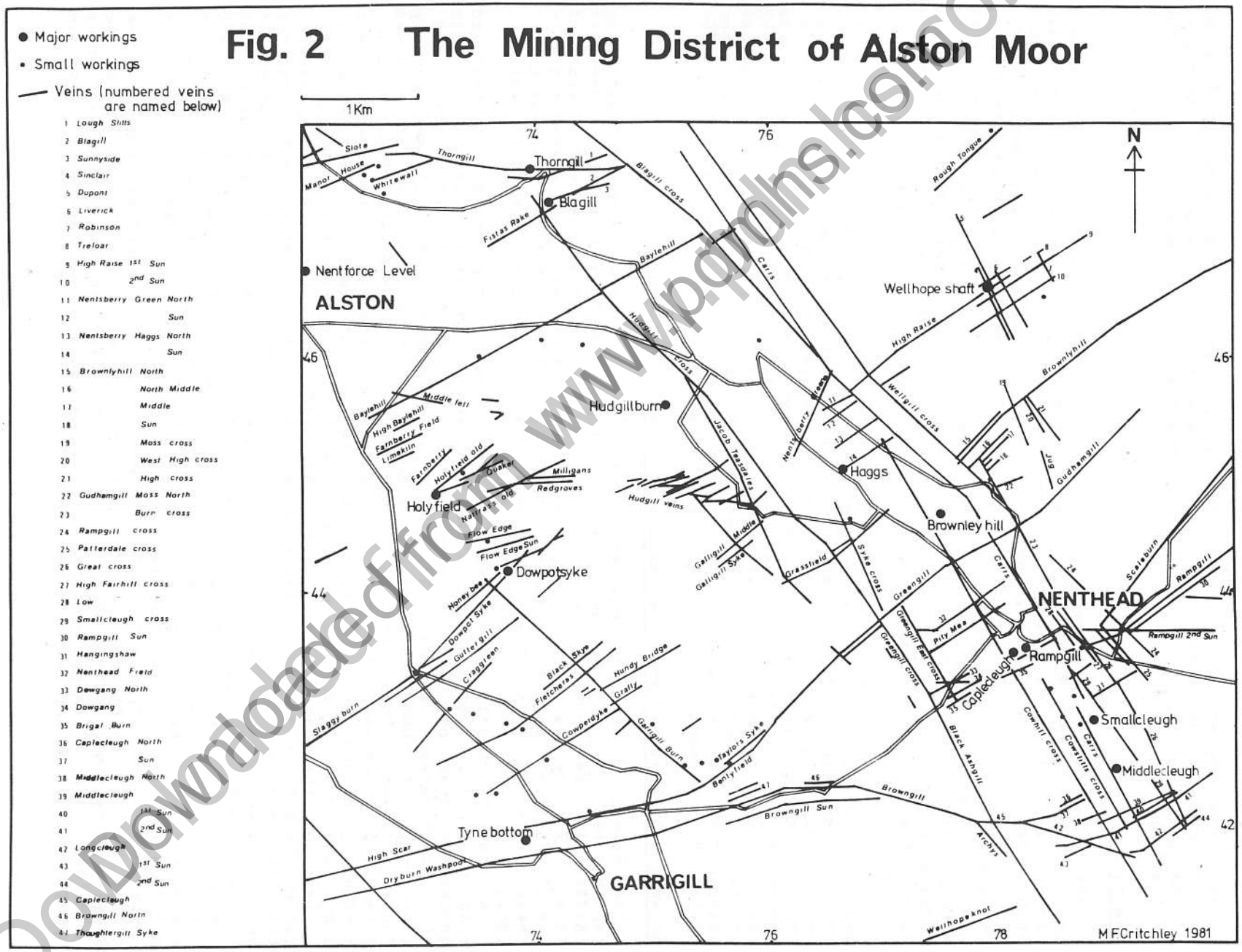

ig.1. Generalized stratigraphic column for the Nenthead area (after Smith, 1974)

### ENE Veins

At Nenthead, the greatest proportion of ore has been won from the ENE veins. The ENE veins appear to fill normal faults, with small vertical throws of up to 4m. In the harder beds, such as the limestones and sandstones, the ENE vein-fractures are nearly vertical, but in the softer beds, such as the shales, the vein dip decreases and the opening across the vein also decreases (Forster, 1809). Thus, the main oreshoots are confined to the steeper parts of the veins, in the competent beds (Leithart, 1838)and form ribbon-like bodies.

Horizontal slickensides are present along many of the vein cheeks and these may be covered by either undisturbed crystal growths or by a veneer of sheared and fractured minerals. The period of horizontal movements along the ENE veins must post-date their formation by normal faulting or the horizontal slickensides would not have been preserved. The association of slickensides with undisturbed and crushed minerals suggests that the strike-slip movement occurred prior to mineralisation on some veins, but on others it took place during or after mineralisation. An example is seen on the Longcleugh Vein in the Middlecleugh Level, where slickensides on the vein walls pitch 15°W and are partly covered by cubes of green fluorite. A thin gouge fills the centre of the vein and this contains vertical slickensides and probably represents the late stage stress relaxation.

# Fig. 2 The Mining District of Alston Moor



Horizontal movement along the ENE veins can also be inferred from the displacement of NNW veins. The plans of the workings in the Wellhope Shaft area of Nentsberry Haggs Mine (NY779467), show that the ENE veins displace the NNW dextrally by up to 17m (Smith, 1980).

NNW Veins

NNW cross veins are well developed in the Nenthead region. The principal cross veins are: Hudgillburn-Greengill-Black Ashgill, Cowhill, Cowslitts, Carr's, Wellgill, Smallcleugh and Great cross veins. The throws on the cross veins are variable, but they generally have large normal displacements; Carr's Vein, for example, has a throw of 77m to the NE in Loveladyshield Level (NY760462). Cross veins having large throws are rarely mineralised and Dunham (1948) suggested that they may have been choked by dragged-in shale prior to mineralisation. The oreshoots on the cross veins with small displacements are comparable in size to those on the ENE veins (Dunham, 1948). Parallel to the larger NNW veins are many subsidiary fractures, which have little or no displacement.

Evidence of strike-slip movement is also present along the NNW veins and again horizontal slickensides on the vein cheeks are covered by later minerals. In the Smallcleugh Mine, the Smallcleugh Cross Vein, between the Middlecleugh 2nd Sun and Longcleugh veins, displaces several ENE veins dextrally by about 3m. The Smallcleugh Vein and the ENE veins are vertical in this level and the horizontal displacements of the ENE veins cannot be explained by apparent shifting due to vertical downthrow on a hading vein, but only by actual strike-slip movement along the Smallcleugh Vein. Forster (1821) gave other examples of the sideways shift of ENE veins by NNW veins, including a 45m dextral displacement of the Rampgill Vein by the Patterdale Vein.

Browngill Vein system and other east-west veins

The Browngill Vein is regarded as the principal channel of mineralisation in the Nenthead region (Dunham, 1948). To the west and north of Garrigill (NY744415), the vein strikes at 079° and it is known as the Dryburn Washpool Vein. To the NW of Garrigill, the Tynebottom Mine (NY738419) worked flats in the Tynebottom Limestone adjacent to the Browngill Vein, but the grade of ore in these flats was less than comparable flats in the Great Limestone (Wallace, 1861).

A line of shafts and surface workings alongside the Garrigill to Nenthead road marks the position of the Browngill Vein to the east of Garrigill. This ground was developed from the Wikesike Level (NY756426). In the neighbourhood of Longholehead Whimsey (NY770423), the Browngill Vein strikes roughly east-west, but 500m east of the whimsey the vein turnson to an ESE trend and Dunham (1948) stated that the vein curves into the NNW Archy's Vein. Observations underground in the Caplecleugh Mine suggest that the Browngill Vein continues through Archy's and Black Ashgill cross veins on the ESE trend as Longcleugh Vein. Evidence given by Wallace (1856) supports this assertion.

East of the Carr's Cross Vein (NY793418), the Longcleugh Vein appears to curve sharply on to a NE striking trend. In addition, Dunham (1948) suggested that the Middlecleugh veins also curve off on the north side of the Browngill Vein. However, in the sub-levels between the Smallcleugh and Caplecleugh levels, the Middlecleugh 2nd Sun Vein is cut through by the Browngill Vein and continues on the SW side of the latter. This suggests that the Middlecleugh 2nd Sun Vein is a normal ENE vein and is cut by the later Browngill Vein. A similar explanation may be invoked to account for the NE portion of the Longcleugh Vein and the main Browngill fracture may continue to the ESE.

Several other important east-west veins occur in the Nenthead area. To the north, the Slote-Thorngill Vein was worked for lead and baryto-calcite at the Blagill Mine (NY740476). Redgrooves Vein (NY740449) and the Hudgillburn veins (NY752448) are arranged en-echelon along a ESE line and the Rampgill 2nd Sun Vein (NY790439) is another east-west vein.

## 2.3 FLAT MINERALISATION

Large quantities of lead and zinc ore were extracted from 'flats' in the Great Limestone around Nenthead (Wallace, 1890). Three forms of flat mineralisation have been observed in the Nenthead mines. The first type was the most economically important and consists of void linings of sphalerite, galena, ankerite and quartz. The limestone surrounding the voids is usually ankeritised and often disaggregated. The second type of flat mineralisation comprises veining associated with sharp brecciation of the limestone; galena and sphalerite occur with quartz as the cement between the breccia fragments. Actual replacement of the limestone by sulphides is rarer and constitutes the third type of flat mineralisation. Generally, the sulphides replace fossil fragments in the limestone. Apparent replacement of the limestone by large amounts of galena is probably the result of the total infilling of cavities within the limestone. Dunham (1948) recorded three beds within the Great Limestone, known as the High, Middle and Low flats, which preferentially contain flat-type mineralisation. The Smallcleugh Flats are developed in the Low Flat, whilst those at Rampgill, Scaleburn and Gudhamgill are found in the High Flat.

## 2.4 MINERAL DISTRIBUTION

Moore (1982) suggested that mineralisation in the Nenthead region can be related to the operation of a convective cell about 5km across. He outlined the cell based on the occurrence of workable zinc deposits. During a recent investigation (Critchley, 1981) samples of mineralised material were collected from in-situ in the old underground workings and these samples were used to investigate the mineral distribution around Nenthead. The sphalerite was collected in the hope that it could be used to obtain a picture of the temperature distribution over the area during mineralisation. Unfortunately, the fluid inclusions in the sphalerite proved to be too small or were totally fluid filled and therefore could not be used to find homogenisation temperatures. The Pb and Zn sulphides show an even spatial distribution over the area sampled. Fluorite and chalcopyrite, however, are restricted to the vicinity of the Browngill Vein. Secondary nickel and colbalt minerals occur at the Tynebottom Mine on the Browngill Vein and early primary Ni-Co-As-bearing sulphides have also been discovered in this mine (Vaughan and Ixer, 1980). Elsewhere in the orefield these minerals have been found in the centres of mineralisation and the evidence supports Dunham's notion that the Browngill Vein was the main feeder for mineralisation in the Nenthead-Garrigill area.

In the Wellhope Shaft section of Nentsberry Haggs Mine (NY779467), the intersections between ENE and NNW veins appear to have acted as feeders for the mineralisation. In the vicinity of these intersections, all veins carry coarse galena, with sphalerite and pyrite and a quartz-ankerite-barite-witherite gangue (Dunham, 1948). Away from the intersections the Zn/Pb ratio increased, due to the decrease in galena; barite and witherite also increased in quantity.

Textural studies on the Nenthead mineralisation by Vaughan and Ixer (1980) showed the following paragensis for sulphide assemblages: framboidal pyrite - pyrite - marcasite - gersdorffite - ullmanite - chalcopyrite - bournonite - galena - sphalerite. Little modern work has been undertaken on the textures of the gangue minerals.

# 3. DEVELOPMENT OF MINING AT NENTHEAD

## 3.1 EARLY PERIOD: ROMAN TO MIDDLE AGES

Although the Romans were active in Derbyshire and elsewhere, there is no direct evidence for their involvement in the northern Pennine orefield. However, Raistrick and Jennings (1965) suggested that the Romans may have worked silver-rich galena-bearing gravels at Chesters on the north bank of the River South Tyne, 4km upstream from Garrigill. Until the Middle Ages, most of the inland areas of northern England were desolate and uninhabitated. There was little or no incentive to explore for minerals and no infrastructure to support mining. In the twelfth century there was an upsurge in the demand for lead, mainly for the roofing and plumbing of monasteries and castles, particulary under the rule of Henry II.

The first detailed notice of mining in the Alston area was in 1133, when according to Walton (1945) a certain Robert de Monte recorded:

> "...at this time [1133] veins of silver ore were discovered at Carlisle and the miners who dug for it in the bowels of the Earth paid five thousand pounds yearly to King Henry."

The mine mentioned was probably active before 1133, for in 1130 the Burgesses of Carlisle accounted to the Exchequer 100/- for the rent of a silver mine (Raistrick and Jennings, 1965). Wallace (1890) suggested that a mine near Nenthead may have already been in operation by this date, he wrote:-

> "Joseph Winskill found coins and tools in Old drift on Browngill Vein, believed to date from [King] William Rufus (1087-1100)."

During the early twelfth century, the Manor of Alston was held by the King of Scotland, although complete jurisdiction was retained by the King of England. The 'Mine of Carlisle' was worked intermittently for lead during the twelfth century, but in 1219 Robert de Vieuxpoint complained that the Lord of Teesdale, Hugh de Balliol, had prevented miners from working (Walton, 1945). King Henry III issued several Royal Mandates, ordering that the miners of Alston be allowed to dig and mine. Between 1226 and 1272 an annual rent of £2,154 was paid for the 'Mine of Carlisle' (Nall, 1886). Nall (1902) recorded that some time prior to 1359 the Carlisle leases had passed to a German called Tilman, who worked the mines along with his fellow countrymen.

The Manor of Alston was held by the Vieuxpoint family until 1414, when William Stapleton was granted the manor and mines for a rent of 10 marks per annum. It appears that the Stapletons had worked the mines prior to 1414, but the workings had become profitless (Walton, 1945). In 1475, King Edward IV granted the Flectheras Mine on Alston Moor to the Dukes of Gloucester and Northumberland, and others, for 15 years at one eighth duty to the King, one-ninth to the Lord of the Manor, and one-tenth to the Church (Sopwith, 1864).

## 3.2 SEVENTEENTH CENTURY

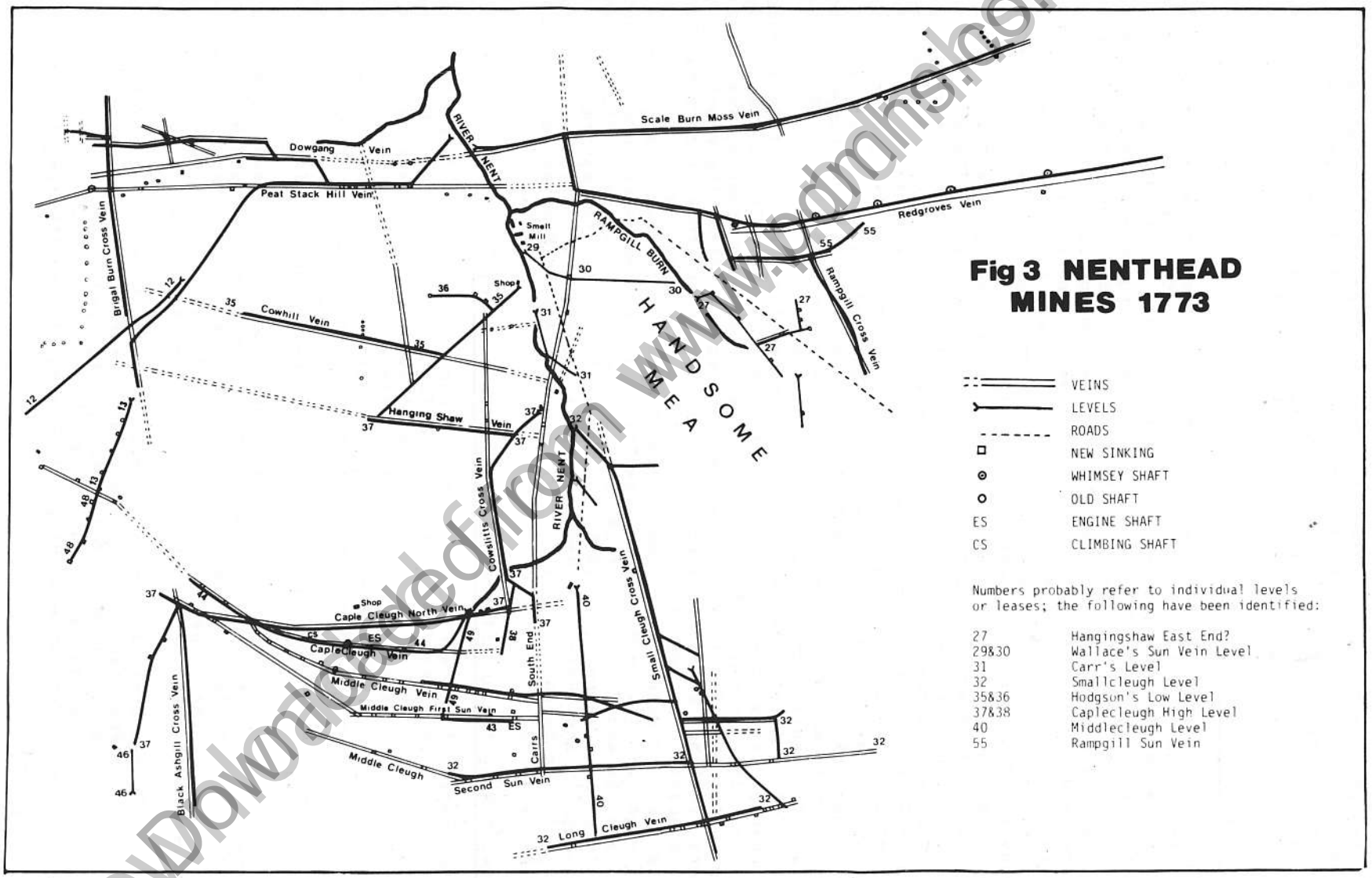
There are no records of the mines on Alston Moor between 1475 and the early seventeenth century. In 1611 a large part of the Manor of Alston Moor had become the property of the Hyltons (Raistrick and Jennings, 1965). The Hyltons granted the mines on 999 year leases for an annual rent of £64. Subsequently, in 1629, the mines were reported to be exhausted, and the whole manor, including the Lord's rent and mineral rights were sold to Sir Edward Radcliffe for £2,500 (Hunt, 1887). The Manor remained in the Radcliffe family (who later became the Earls of Derwentwater) until 1731.

In 1664, Sir Francis Radcliffe leased to George Bacon of Broadwood Hall, Allendale:

> "...all the lead ore in the Manor of Aldstone Moor for 3 years, at the sum of 37/- for every bing load of lead ore that is, or shall be gotten within the said liberties, during the said term, being fifths or otherwise to the said Francis." (Dickinson, 1901).

## 3.3 EIGHTEENTH CENTURY

Lead mining prior to 1700 was probably limited to surface workings and small underground pits. The real expansion in exploration and mining took place during the second half of the eighteenth century, and was concentrated on the mineral veins at the head of the Nent Valley (Fig. 3). Initially, mining took place along ENE veins, until the discovery of the rich lead flats in the Great Limestone. The first vein to be exploited to any extent was the Rampgill Vein, commencing in 1690. Greengill Mine was also opened up at about that time. There were other workings at Blaygill and Fletcheras mines prior to 1700 (Raistrick and Jennings, 1965).




# Fig 3 NENTHEAD MINES 1773

| | |
|---|---|
| | VEINS |
| | LEVELS |
| | ROADS |
| □ | NEW SINKING |
| ⊙ | WHIMSEY SHAFT |
| ○ | OLD SHAFT |
| ES | ENGINE SHAFT |
| CS | CLIMBING SHAFT |

Numbers probably refer to individual levels or leases; the following have been identified:

| | |
|---|---|
| 27 | Hangingshaw East End? |
| 29&30 | Wallace's Sun Vein Level |
| 31 | Carr's Level |
| 32 | Smallcleugh Level |
| 35&36 | Hodgson's Low Level |
| 37&38 | Caplecleugh High Level |
| 40 | Middlecleugh Level |
| 55 | Rampgill Sun Vein |

Three important factors led to the development of the mining district at Nenthead during the eighteenth century. The first factor was the formation of the London Lead Company in 1692. The second arose from political events associated with the 1715 Jacobite rebellion. Advance in mining technology, particulary smelting was the third factor.

## London Lead Company

The London Lead Company was the largest mining operator on the Alston Moor throughout the eighteenth and nineteenth centuries. The history of the company has been extensively researched by Raistrick (1935 and 1977), but a short resumé is necessary here, in order to understand the mining developments in the area.

The company was founded in 1692 as the 'Governor and Company for smelting down lead with pitt coal and sea coal'. The company was initiated to smelt lead by the new reverberatory method, and a smelting works was purchased in Bristol for £9,000 in 1692 (LLcM, 1692). Lead ore was purchased from Wales, but the smelting process was unsatisfactory and the works were resold in 1695; the company was then dormant between 1695 and 1704.

At sometime between 1692 and 1696, a company known as the "Ryton Company" was established at Newcastle-upon-Tyne by a group of Quakers. The Ryton Company was initially concerned with the purchasing of lead ore from the mines on Alston Moor, the Derwent Valley and Cumberland, for its smelting works at Ryton-on-Tyne. The Ryton Company bought a share in the Blaygill Mine from T.Errington for £1,600 (Wallace, 1890). The company also bought the mines of Tyne Green, Windy Brae and Clargill at Tynehead (Raistrick, 1977). The Ryton Company was closely connected with the Company of Royal Mines Copper (generally known as the Welsh Company), which was founded in about 1692. This company was involved in lead smelting at Gladlis in Flintshire.

In 1704, the Ryton and Welsh companies acted together to obtain a transfer of the charter from the dormant London Lead Company. This was accomplished by recalling the Court of Assistants of the London Lead Company, and electing new members to the Court from the Welsh Company. After the elections, the old members of the Court retired. By 1705 the whole stock of both the Ryton and Welsh companies had been transferred to the London Lead Company.

The revived London Lead Company almost immediately started acquiring mines of their own on Alston Moor and elsewhere. By 1706 they were working Thortergill Syke and Browngill veins from a level on the Garrigill side of Nenthead (Raistrick and Jennings, 1965). Lead ore from the North was initially smelted at Blaygill and Ryton. New mills were opened at Whitefield (1706) and Acton (1710) in the Derwent Valley to treat ore from Alston Moor and the Derwent Mines (Atkinson, 1974).

## Greenwich Hospital and Eighteenth Century Developments

The Earl of Derwentwater lent his support to the 1715 Jacobite rebellion; much to his misfortune. After the defeat of the rebellion, his estates were confiscated by the Crown in 1716, but they were passed back to his son, John, soon after. On the death of John Radcliffe in 1731 the estates again came into the possession of the Crown; the next rightful heir was under sentence of death and outside the Kingdom. In 1735 the House of Commons resolved that the money in the Exchequer received from the estates (over £7,000) and all future rents and profits should be applied to the Greenwich Hospital for Seamen (Greenwich Hospital, 1860).

The hospitals' interests in the area were supervised by two "Receivers" and a "Moormaster". Before 1735, many of the main veins around Nenthead had been discovered, but only a few had been developed. These veins were worked by a large group of small operators. Wallace (1890) gave a list of companies working before the settlement of the Estates to the Greenwich Hospital:-

Thomas Errington, Esq., of Beaufort; Lough Vein, Guddamgill, Peatstack Hill, Briggle Burn, Thorngill and Goangill, Browngill Moss and Dodberry Dyke head.
Enoch Hudson, do. do. do. do.
The Quaker Company, Blaygill, Browngill, and Thortergill.

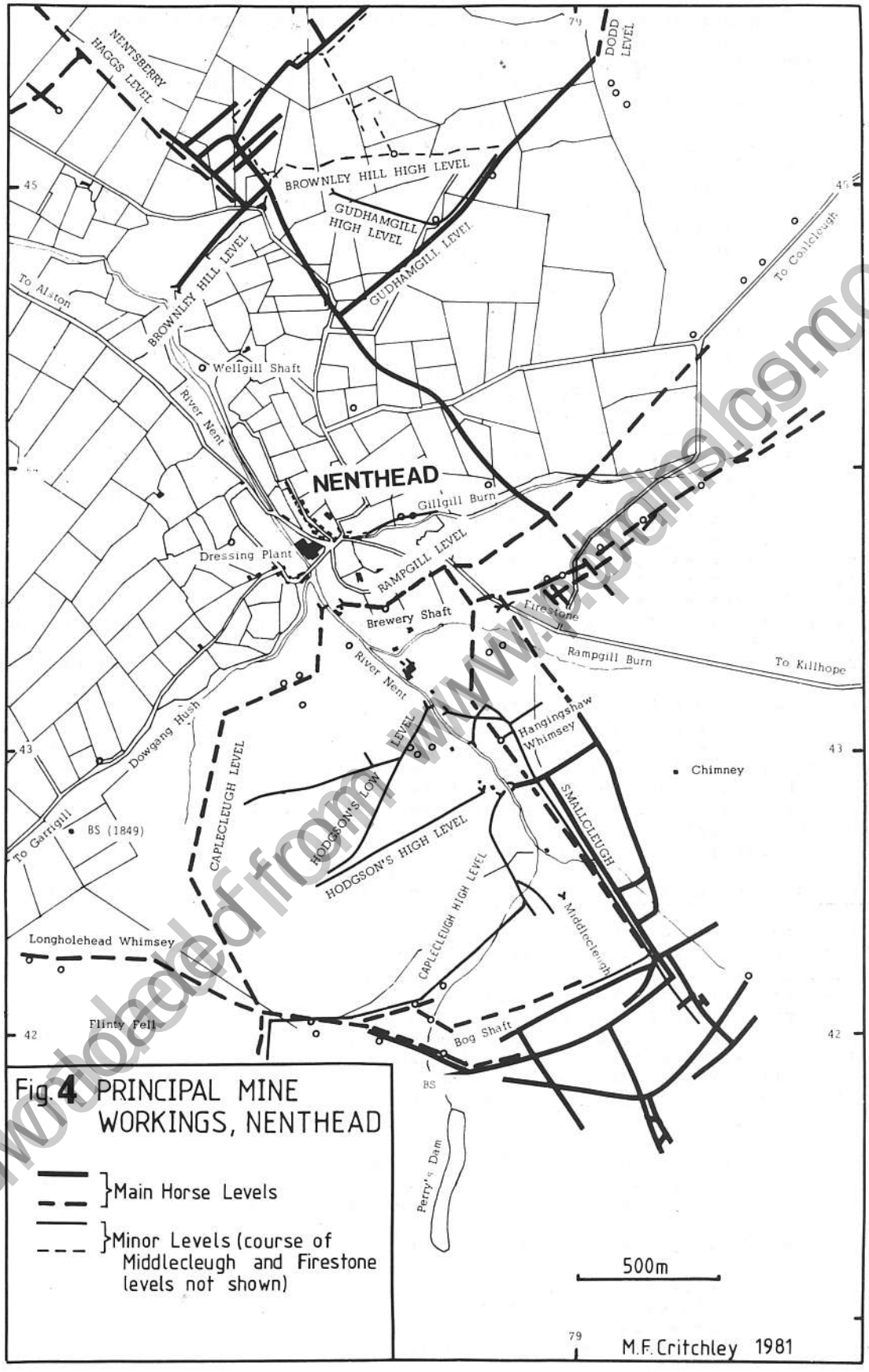



**Fig. 4** PRINCIPAL MINE WORKINGS, NENTHEAD

Main Horse Levels

Minor Levels (course of Middlecleugh and Firestone levels not shown)

Mr Alderman Ridley, Nentsberry Middle vein, Middle Skye, Brownley Hill and Haggs.
Mr Bacon, Greengill, Browngill.
John Jackson, Farenbury, Park Grove and Slate Mea.
Thomas Atch (Atkinson), Redgroves Nattrass.
Mr Stephenson of Cross Lands; Dowpott syke.
Sam White, Fletcheras and Scar Ends.
Mr Rodgers of Newcastle; Thortergill, and Redgroves (Rampgill).
Mr John Aindey, Hill Close and Goodamgill Moss.
William Lee, Rock Hill.
William Hewetson, Horse Edge.
Jno. Graham, and Jno. Richardson, Gill House Burn.
Thomas Burne, Birchy Bank.
Henry Featherstone, High Birchy Bank.
Sir John Myers, Howburn Moss, Carr's, Long Cleugh, and Fletcheras and Cowslitts.
Thomas Brown,Cash Burn, Birchy Bank.
Mr Mowbray, Corn Riggs.
George Errington, Crossgill Head.
John Watson, Green Crag.
Jno. Forster, Gate Castle. Some copper ore found.
Jno. Carrick, Dryburn.
Mr Ainesly, Longholehead, Thortergill, Haggs, Brownly Hill and Redgroves (Rampgill).
Mr Ainesly, Dr Hutchinson, and Watson, do., etc.
Mr Tinzwood, Fairhill, Nenthead.

After acquiring the mineral rights, the Greenwich Hospital decided to offer thirty-one mines for lease, for which the following bids were received in 1736 (Wallace, 1890):-

| | Washers | Miners |
|---|---|---|
| Peat Stack Hill - G Liddle,Mr Mulcaster, Thomas Yeats, each 1/4th, Wm. Empson, 2/9th, Mr Haley and Barnfather .. .. .. .. .. .. .. | 4 | 20 |
| Brighill Burn - G Liddle and Barnfather .. .. .. | 0 | 4 |
| Greengill - G Liddle and Barnfather .. .. .. .. | 2 | 8 |
| Thorngill - G Liddle, Thomas Yeats, 1/4th, Wm. Smitn and Co. .. .. .. .. .. .. .. .. | 2 | 10 |
| Lough Vein - G Liddle .. .. .. .. .. .. .. | 0 | 6 |
| Redgrooves or Rampgill - G Liddle, Quakers, J Aysley and Dr Hutchinson, of Carlisle .. | 4 | 20 |
| Thortergill - G Liddle, Quakers .. .. .. .. .. .. | 0 | 6 |
| Browngill - G Liddle, Quakers, G Mowbray .. .. .. | 0 | 6 |
| Longholehead - G Liddle, Wm. Todd, Wm. Haley, Mr. Mowbray, Ridley, Cooper and Thornbury .. | 3 | 12 |
| Clargill Cleugh - G Liddle .. .. .. .. .. .. .. | 0 | 0 |
| Blaygill or Fistas Rake - G Liddle, Quakers, Bowman Smith and Muncaster (now employed) .. .. .. | 4 | 20 |
| Redgroves Nattras - G Liddle, Wm. Todd and Yeats | 0 | 6 |
| Benty Field - G Liddle .. .. .. .. .. .. .. .. | 0 | 6 |
| Fairhill - G Liddle and Mr Hales.. .. .. .. .. .. | 0 | 6 |
| Brigghill Burn Cross Vein - G Liddle and Mr Thornbury.. .. .. .. .. .. .. .. .. .. .. | 0 | 6 |
| Fletcheras - G Liddle, Thomas Haley, Esq., Samuel White.. .. .. .. .. .. .. .. .. .. .. | 0 | 6 |
| Guttergill - Wm. Todd, 1/6th, Dan. Wren, 1/6th .. .. | 0 | 4 |
| High Craig - Wm. Todd, 1/5th .. .. .. .. .. .. .. .. | 0 | 4 |
| Nunnery Top Vein - Samuel White, 1/5th.. .. .. .. .. | 0 | 4 |
| Haggs - J Aynesley, 1/5th .. .. .. .. .. .. .. .. .. | 0 | 4 |
| Paddock Vein - Joshua Archer, 1/5th.. .. .. .. .. .. | 0 | 4 |
| Carrs and Cowslitts - Hodgson, Hall, Whitefield and Haley.. .. .. .. .. .. .. .. .. .. .. .. | | |
| Wellgill Syke - Moor and Gilpin .. .. .. .. .. .. | | |

Cornriggs- Mowbray .. .. .. .. .. .. .. .. .. ..
Longcleugh - Emerson and Hall .. .. .. .. .. ..
Nentsberry Haggs - Harrison .. .. .. .. .. .. ..
High Nentsberry Haggs - Wm. Todd.. .. .. .. .. ..
Cash Burn - Thomas Brown .. .. .. .. .. .. .. ..
Black Stone - Dr Hutchinson and Watson.. .. .. ..
Clargill Cleugh - G. Liddle .. .. .. .. .. .. ..
Windy Brow - Quakers .. .. .. .. .. .. .. .. ..

In October 1736 the London Lead Company proposed to lease the whole of Alston Moor for 21 years at one-seventh duty (LLcM, 18th October 1736). This application was amended in November of that year (LLcM, 16th November 1736), to work Alston Moor for one-sixth duty, and with an expenditure of £3,000 on dead work (driving of development and exploration levels etc.) They also placed a bid to work Blaygill:-

> "...at one-fifth duty, and oblige themselves to expend the sum of £400 in dead work and to employ 30 hand, eight months in the year." (LLcM, 7th December 1736).

At the same meeting of the company on 7th December 1736, it was also decided to propose a lease of Redgrooves (Rampgill) for 21 years at one-eighth duty, spending £1,000 on dead work, and also employing 30 men for 8 months. Unfortunately, for the company, it was reported that the Commissioners of Greenwich Hospital had decided to grant the lease for most of Alston Moor to Col G Liddell (LLcM, 26th December 1736). Liddell's lease covered all the mines on Alston Moor except the Carr's Mine, which was leased to a Mr. Thomas Hayley, and the Rampgill Mine, which was retained by the Commissioners for their own use. The duty paid by Liddell on the Peatstack Hill lease was one-third and at all the remaining mines this was one-fifth of the ore raised (Monkhouse, 1940a). The London Lead Company wrote to the Commissioners complaining that their company had already worked Blaygill and Redgrooves for 10 years previously. Liddell soon sub-leased Blaygill to the London Lead Company (LLcM, 17th May 1737). In 1737 Liddell produced a prospectus stating that a profit of £104,544 could be made at his mines over the 21 year period of his lease. He formed a company by issuing 96 shares and immediately commenced building a smelt mill near to the Rampgill Mine at a cost of £900. This mill contained 4 ore hearths and 4 refining furnaces, and could treat 24 fothers of ore a week. Meanwhile, the Commissioners of Greenwich Hospital started a level at the Rampgill Mine and they, together with Mr. Hayley, sold their ore to Liddell's smelt Mill. However, the Rampgill trials proved unsuccessful and in 1739 Liddell took over the Rampgill lease (Monkhouse, 1940a). In the first 18 months to Michaelmas 1738, Liddell's company produced 865 bings of ore worth about £1,200, at a cost of over £6,333. Following this initial loss, there is no evidence that the operation became anymore successful and in 1745 the London Lead Company purchased the smelt mill and obtained a transfer of Liddell's mining leases. The Nenthead smelting mill was redesigned by the London Lead Company and began smelting lead ore again in August 1746 (Raistrick, 1977).

Not long after acquiring the transfer of leases from Liddell, the London Lead Company commenced obtaining its own leases from the Commissioners of Greenwich Hospital. During 1751 the company negotiated the following leases (LLcM, 19th September 1751 and 10th January 1753):-

| | |
|---|---|
| Longholehead East End | 4th May 1751 for 17 years |
| Dowpotsike | 14th April 1751 for 18 years |
| Longcleugh | 5th April 1751 for 17 years |
| Shawfoot Sun Vein | 7th May 1751 for 17 years |
| Middlecleugh | 6th May 1751 for 18 years |
| Goodhamgill Moss or Goodhamgill North Vein | 12th May 1751 for 20 years |
| Goodhamgill South Vein | 13th May 1751 for 20 years |
| Newberry or Newberry Side Vein | 14th May 1751 for 20 years |
| Fairhill Flow Edge Vein | 14th Jan 1751 for 19 years |

During the next few years more leases were added or renewed (LLcM, 23rd Decemeber 1761):-

| | |
|---|---|
| Garrygill Burn Old Grooves | 26th Oct 1754 for 21 years |
| Fletcheras | 20th Sept 1753 for 21 years |
| Longholehead Sun Vein | 30th Sept 1752 for 21 years |
| Longholehead West End | |
| Rampgill | |
| Redgrooves | 24th Feb 1755 for 21 years |
| Fairhill East Sun Vein | (Renewal of Liddell's |
| Fairhill East North Vein | original leases) |
| Browngill | |
| Shawfoot West of Nent | |
| Thortergill | |
| Rampgill Sun | |
| Middlecleugh East End | 14th April 1758 |
| A south vein cut in the upper level west of Middlecleugh | |
| Middlecleugh 1st Vein,extending to the deep level, or to the south of the north vein | 17th Oct 1759 |
| Middlecleugh 2nd Vein | |
| Middlecleugh 3rd Vein | 17th Oct 1760 |
| A vein west of Carrs Vein | |
| Carrs Vein from south end of W Lorrans lease | 15th Sept 1759 |
| Vein cut in flank level of Garrigill Burn Old Groove | 1st May 1760 |
| Hundy Bridge Syke | 12th May 1760 |

Several mines, including the Black Ashgill Mine (not to be confused with the Ashgill Head Mine in Teesdale), were leased to the London Lead Company in the Manor of Priorsdale to the SW of Nenthead. The Priorsdale Estate was purchased by the company in 1824 for £7,300 (Raistrick, 1977). On Alston Moor as a whole, during the eighteenth and nineteenth centuries, the London Lead Company never held more than 50% of the mining leases. However, in the Nenthead part of Alston Moor, the company was the dominant force. Some of the smaller companies operating around Nenthead up to 1900 are described in section 5.

During the 1780's the mines at Nenthead under the London Lead Company were making consistent profits, as the Court minute for 1790 recorded:-

Profits on Mines for 9 years to 1790

| | |
|---|---|
| Scaleburn Moss | £2051-12-3 |
| Smallcleugh | £ 794-11-7 |
| Browngill Sun Vein | £3250-12-0 |
| Rampgill | £ 492- 8-3 |
| Middlecleugh | £1524- 3-0 |
| Shawfoot | £ 129- 7-0 |

Losses on Mines for 9 years to 1790

| | |
|---|---|
| Gudhamgill Moss | £ 291-10-3 |
| Browngill | £1335-15-3 |

Duty Ore

Mines were leased from the Greenwich Hospital during the eighteenth century for a duty of one-fifth or one-sixth of the ore actually produced. At first the duty ore given to the Greenwich Hospital was resold by them to a mining company. Frequently, the London Lead Company brought the duty ore from their own mines. Prices paid for the duty ore was recorded in the London Lead Company minutes:- in 1758 duty ore was purchased at 47/- a bing (8 cwts) for bouse and 42/- a bing for cuttings (LLcM, 29th June 1758). In 1761 the prices paid were 57/- a bing

for bouse and 52/- a bing for cuttings (LLcM, 21st May 1761). Another major buyer of duty ore in the mid-eighteenth century was the Earl of Carlisle (LLcM, 11th July 1754). Carlisle was himself involved in mining and in the 1750's leased the Peakstackhill and Greengill mines from the Greenwich Hospital (LLcM, 8th July 1757).

In 1767 the Commissioners of Greenwich Hospital decided to smelt their own duty ore. They built the Langley Smelt Mill for this purpose on the northern margin of the orefield, close to coal supplies (Monkhouse, 1940b).

## 4. MODERNISATION AND CONSOLIDATION OF MINING AT NENTHEAD

The middle part of the eighteenth century saw the development of the Nenthead mines and by 1780 most of the major mines were in operation. From 1780 onwards the mines under the control of the London Lead Company were modernised and a unified system of exploration, development and mining evolved.

### 4.1 CHANGES IN MINING LEASES

Several new vein leases were added to the London Lead Company holdings and old leases were renewed, at first on 21 year terms at one-fifth or one-sixth duty and later for 31 years. Originally, all these leases were for 1200 yard (1096m) vein lengths, with 40 yards (37m) either side. Each lease had to be worked for at least 9 months a year, by four or more men. As elsewhere in Britain, the method of vein leasing presented problems when veins joined or crossed. Berwick (1869) recorded that litigation between the Hudgillburn and Gillgill Syke companies over vein ownership lasted 20 years until 1844. The vein lease system at Nenthead was also cumbersome to administer, and probably inhibited exploration. In the 1820's the London Lead Company succeeded in consolidating their Nenthead leases into one large leasehold. A condition of this lease was that they should employ at least 100 pickmen (Raistrick and Jennings, 1965).

Short leases were also given by the Commissioners of Greenwich Hospital. Sopwith (1833) noted that grants of leases for trials were generally for a period of six months and: -

> "The parties making the trial are bound to observe the following conditions:- To commence the trial within a month from the date of the grant; the trial to be regularly continued till the end of the term, and at least two pickmen daily employed or an equivalent labour,one-fifth of any ore raised to be paid as duty ...."

The depression of the early 1830's caused a fall in lead prices and a reduction in the duty paid to the Greenwich Hospital. Duties of one-fifth were reduced to one-sixth and existing duties of one-sixth reduced to one-seventh (Raistrick and Jennings, 1965). With increasing geological knowledge in the nineteenth century, attempts were made to define the controls of mineralisation and to use these controls in exploration. Wallace (1856) used his geological observations to compile a report on the future prospects of the Nenthead region for the London Lead Company. Many other such reports were probably written concerning the planning of mine development, but only Wallace's report survives.

Attempts were made to encourage deeper mining in the Nenthead region by reducing the duty on ore won from the workings at depth. In the second half of the nineteenth century the Commissioners of Greenwich Hospital applied a basic rate of one-seventh duty to all leases, which was reduced to one-eighth if...

> "...the leasor employed one-eighth of men below the existing free drainage level, one-ninth of a quarter and one tenth of a third of the men were so employed."
> (Raistrick and Jennings, 1965).

After 1863, the general duty was reduced to one-ninth (Nall, 1902).

## 4.2 EMPLOYMENT AND DEVELOPMENT

Important factors in the advance of mining at Nenthead were the improvements in techniques for dressing and smelting documented by Raistrick and Jennings (1965), and Raistrick (1977). Contemporary accounts of the ore-washing and smelting can be found in Mulcaster (1806), Pattinson (1838), Mitchell (1842) and Sopwith (1869). Development during the early nineteenth century was also encouraged by the construction of the Nentforce Level by the Commissioners of Greenwich Hospital (see section 4.3). The extensive use of cross-cutting also helped in the exploration for new ore bodies. Cross-cutting rarely took place in the unmineralised ground but usually followed a weakly mineralised fracture known as a 'leader'. Cross-cutting eastwards from the Smallcleugh Cross Vein in the Smallcleugh Mine led to the discovery of the Smallcleugh(Handsome Mea)Flats in 1796. These flats were discovered at the southern end of the mine and worked back towards the entrance. By 1819 the flats were reported to have been worked out (LLcL, 1819), and Wallace (1861) estimated that the Smallcleugh Flats covered an area of over 8 acres (3.25 hectares).

During the 1820's it was estimated that the London Lead Company had nearly 20 miles (32km) of levels at Nenthead, and were spending £6,000 - £7,000 on new trials (Raistrick and Jennings, 1965). Extensive cross-cutting had the added advantage of producing a unified network of underground haulageways: the principal of these were Rampgill, Caplecleugh Low (Dowgang) and Smallcleugh horse levels (Fig.4). The Rampgill Level served the workings on Rampgill and Scaleburn veins, as well as some of the workings at the eastern ends of the Middlecleugh veins. The Caplecleugh Low Level drew ore from the Dowgang Vein and also from the Browngill - Caplecleugh - Middlecleugh vein system at the head of the Nent Valley. Output from the Smallcleugh Level was mainly confined to the production from the Smallcleugh Flats. Ore from the Rampgill and Caplecleugh levels was treated at the extensive Rampgill High dressing floor adjacent to the Rampgill Level mouth, and from 1818 at the Rampgill Low dressing floor in Nenthead. A smaller dressing plant served the Smallcleugh Level. The upper strata on the Rampgill Vein were exploited from the Rampgill Firestone Level, which was commenced in 1830 (LLcP). The Middlecleugh Level served the upper portions of the Longcleugh and Middlecleugh veins.

## 4.3 NENTFORCE LEVEL

The Receivers for Greenwich Hospital on Alston Moor in the 1770's were Richard Walton and John Smeaton. In 1775 Walton and Smeaton prepared a report for the Commissioners of Greenwich Hospital, proposing the driving of a drainage level from Alston to Nenthead. The purpose of this level was to explore for deeper extensions to the veins and to dewater the existing mines. The original plan was to drive a straight line on the horizontal from Alston (NY720467) to Lovelady Shield (NY759462), and then from Lovelady Shield to a point below Middlecleugh Burn (NY790425). Instead the route adopted followed the line of the River Nent presumably in order to reduce the depth of the ventilation shafts (Wilson, 1963). Work on the level commenced on the 1st July 1776 (Colpoys et al, 1805), driving at a width of 3ft 6ins (1m). In June 1777 it was decided to increase the size of the level to 9ft square(2.75m); this was done so that it could be used as a canal to carry out the waste rock (Wilson, 1963). In the nineteenth century, the canal part of the level proved to be a tourist attraction (Plate 1).

A report published in 1805 stated that the level had been driven a total length of 2 miles and 304 yards (3,497m), over a period of 28 years at an expense of £26,000 (Colpoys et al, 1805). It was estimated that the remaining 4,976 yards (4,550m) to be completed would take a further 36 years to drive, at an additional expense of £30,000. A plan accompanying the report and dated 1809 (the report must have been written in 1805, but not published until after 1809) shows that the level had nearly reached Lovelady Shield Bridge. During the course of driving the level up to 1805, only one vein of any worth had been discovered. This is the Hudgill Cross Vein, which yielded £4,261-10/- of duty ore for the Greenwich Hospital. The company exploiting the vein sunk two shafts down to the Nentforce Level at their expense (Sheffield, 1805).

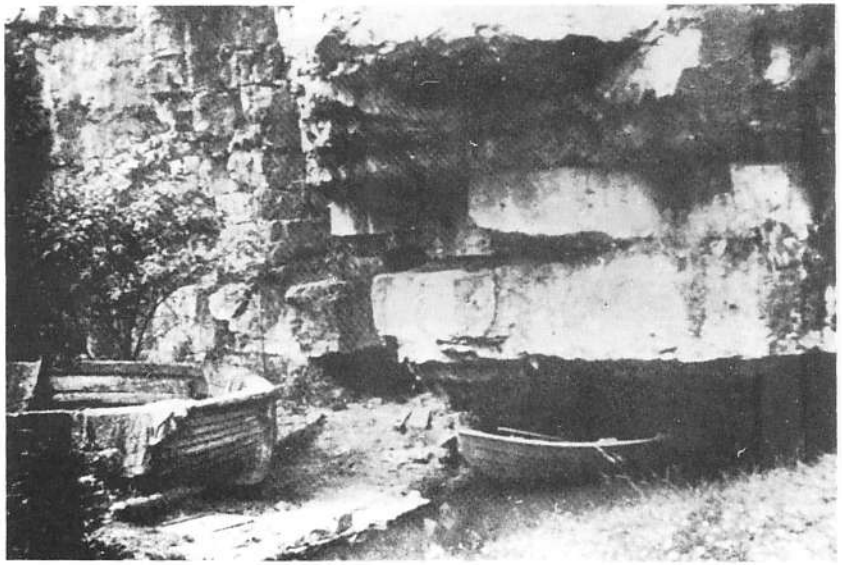


Plate 1. Entrance to the Nentforce Level, showing the canal and a boat in the early 1900's (Richardson Coll.)


Plate 2. Plaque from the Nentforce Level, now stored in the Town Hall at Alston (H.M.Parker)

Plate 3. Wellgill dressing floor in about 1897. Note Quaker Meeting House in background, built in 1722 (Richardson Coll.)

Plate 4. Mine pony at the entrance to Rampgill Mine in about 1897 (Richardson Coll.)

Plate 5. Vieille Montagne Co. miners at the entrance to Smallcleugh Mine in about 1897 (Richardson Coll.)

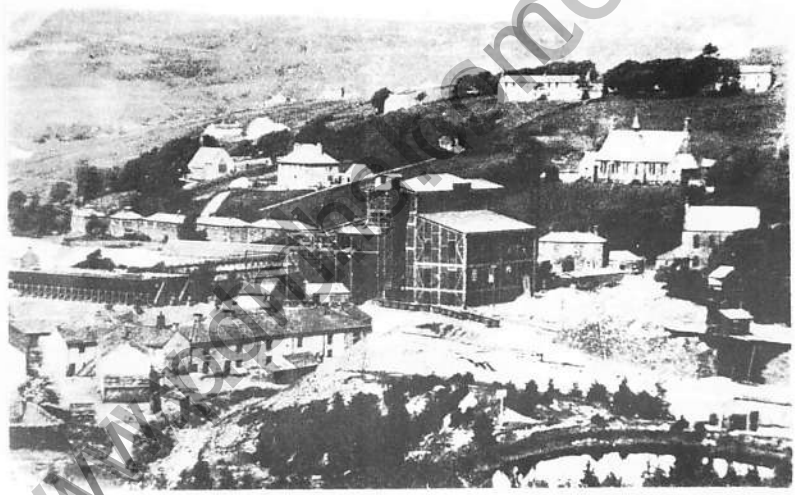


Plate 6. The Vieille Montagne gravity dressing plant at Nenthead in about 1910. Note hoist for lifting full mine tubs to the top of the building (Richardson Coll.)

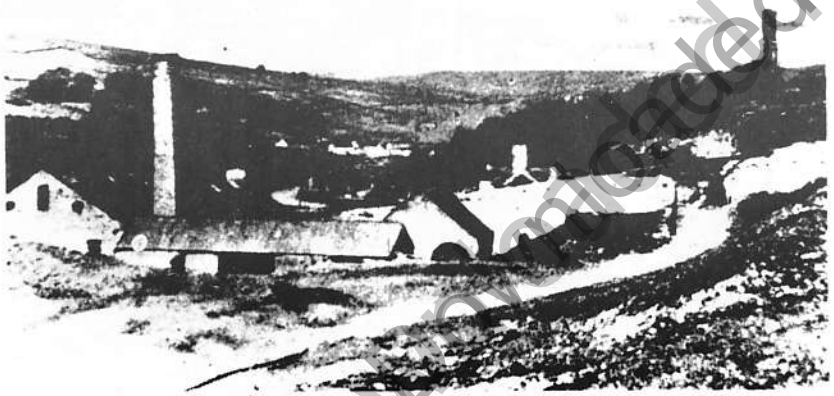


Plate 7. The Nenthead smelt mill in about 1910. The tower to the right was above the Brewery Shaft and gave an extra head of water to the hydraulic compressors (Richardson Coll.)

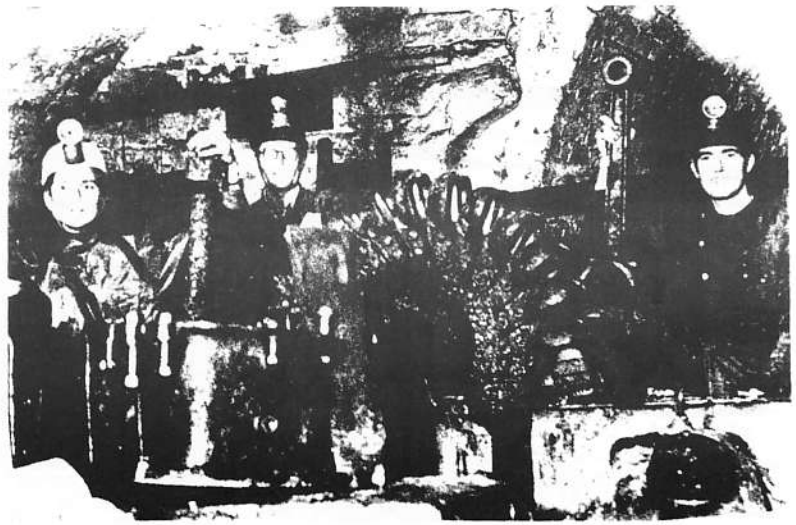


Plate 8. The Pelton Wheel at the foot of the Brewery Shaft. This was one of two wheels which drove air compressors and an electric generator. Date unknown, but probably late 1950's or early 1960's (Parker Coll.)

In 1810 a shaft being sunk at Lovelady Shield was connected with the level. Later, a branch from the Nentforce Level at Lovelady Shield was driven to connect with the Hudgillburn Mine in 1829 (Wilson, 1963). By 1815, the shaft at Nentsberry Haggs (NY766450) had been sunk 102 yards (93m) and was estimated to be about 20 yards (18m) above the line of the Nentforce Level (Greenwich Hospital, 1815). The Nentsberry Shaft was stated to be the largest on Alston Moor and was equipped with two water wheels for pumping and hoisting (Forster, 1821). The shaft was sunk to ventilate the Nentforce Level and to continue the drive eastwards. However, by 1815 it had been decided that it was uneconomic to continue the level at the original altitude of 890ft (271m) and the eastern continuation from Nentsberry was 270ft (82m)higher at 1160ft O.D. (353m).

All previous reports on the Nentforce Level published this century state that the Nentforce Level changes elevation at Lovelady Shield Shaft. However,all the contemporary reports concerned with the level clearly record that the change occurs not at Lovelady Shield, but at Nentsberry Shaft. Taylor (1823) stated:-

> "I approve the departure lately made from the original line of the level, by taking one higher up from Nentsberry Shaft, for as the Scar Limestone and the deeper beds have hitherto proved so unproductive, it is better to try the ground near the bearing measures (Great Limestone), and to establish a level more within reach of the mines."

Bewick (1869) also noted;-

> "The first four miles [of the Nentforce Level] to Nentsberry Shaft is driven so nearly level, that by damming the water at the mouth, it is navigable by a shallow boat for a considerable distance, and the craft is propelled by taking hold of plugs fixed in the sides at regular intervals and a convenient elevation. The dimensions of this level are about 6 to 8 feet square, and its continuation from Nentsberry to Nenthead, a distance of about a mile, is at a higher random [altitude] than the first portion."

If the level had risen at Lovelady Shield, then Nentsberry Shaft should be only 70ft (21m) deep. On a recent visit to the shaft, it was found to be open to an estimated depth of 300ft (91m). A quick calculation shows that if the shaft collar is at 1230ft O.D. (375m), and the Nentforce Level (lower portion) at 890ft O.D. (271m), then the true depth of the shaft is about 340ft (104m). The continuation of the level at the higher random should be about 70ft (21m) below the shaft collar. These calculations were verified by a descent of the shaft in 1981 (Wilkinson, 1983), when the shaft was found to be 360ft (109m) deep with the upper continuation at 200ft (61m). The rise in the level is thus only about 160ft (49m), not 270ft (82m) as reported by Taylor (1823).

Taylor (1823) estimated that the Nentsberry Haggs Shaft would connect with the lower portion of the Nentforce Level in Spring 1824. Taylor recommended that further ventilation shafts would have to be sunk near Gudhamgill Vein (Wellgill Shaft) and Rampgill Vein (Brewery Shaft). He also recommended that a water wheel be removed from Nentsberry Haggs Shaft to Wellgill Shaft. The level to Wellgill Shaft was completed in 1842 and was commemorated by a stone plaque placed above the portal at Alston. The plaque is now stored in the Town Hall at Alston (Plate 2). The total length to Wellgill Shaft is 4.25 miles (6.8Km), and the cost to complete the level to the shaft was about £81,271 (Greenwich Hospital Report, 1860). Sometime after 1842, but before 1856 the Nentforce Level was extended to the Brewery Shaft at Rampgill Mine, bringing the total length to 4.94 miles (7.95Km). Wallace (1856) suggested extending the Nentforce Level eastwards along Scaleburn and Rampgill veins to prove these veins in the lower strata. These trials were not undertaken, however, a branch was driven north eastwards from the Brewery Shaft along Rampgill Vein to the Low Whimsey Shaft by the Vieille Montagne Zinc Company in the present century.

The Nentforce Level failed in its purpose of discovering any major new lead deposits. It did, however, facilitate the exploration of the mines it drained. During the working for zinc under the Vieille Montagne Zinc Company, the level was used as an important spillway for water from the compressors and turbines in the Brewery Shaft.

## 5. HISTORY OF THE MINES UP TO THE TWENTIETH CENTURY

The developments of the principal London Lead Company mines at Smallcleugh and Rampgill have been discussed in sections 3 and 4. In addition to these two mines and the trials of the London Lead Company, there are several other mines which, although smaller in size, were just as successful as the larger mines. Many of the small mines were worked by a few partners rather than by constituted companies, the main exception being the Alston Moor Mining Company, which was founded by Jacob Walton in the early nineteenth century. The Alston Moor Mining Company operated several of the mines around Nenthead, but unfortunately, there is little contemporary documentation of the company's operations.

### 5.1 BROWNLEY HILL

The principal development of the Brownley Hill Mine started in the late nineteenth century, mainly for zinc ore. The first record of this mine, in 1735, was at the general letting of mine leases by the Commissioners of Greenwich Hospital. The mine was not taken at that time, but it was said to have been worked previously by Alderman Ridley (Wallace, 1890). The Brownley Hill Mine was not finally leased by the Greenwich Hospital until 1748, when Thomas Westgarth obtained a lease to work the mine. The London Lead Company acquired the mine in 1751, but in 1765 the lease passed to Messrs William Armstrong and William Hutchinson and then to the Brownley Hill Company in 1795. From 1816 and throughout most of the nineteenth century, the mine was developed and worked by Jacob Walton and his associated company: - the Alston Moor Mining Company. Initially, Walton was in partnership with Thomas Shaw. The final working, prior to the take-over by the Nenthead and Tynedale Lead and Zinc Company, was under the Brownley Hill Mining Company (1874-1890).

### 5.2 CARR'S MINE

There were several workings along the Carr's Cross Vein, but the two principal developments were at Carr's Mine (also known as Carr's East of Nent) and at 'Carr's West of Nent'. Carr's Mine is shown on the the 1773 Alston Moor plan (Fig.3), and it was operated by the London Lead Company from at least 1848 to 1881 (Dunham, 1948). A Carr's Mine was leased to Mr. Thomas Hayley in 1736, but it is unknown as to whether this was the Carr's East of Nent (Monkhouse, 1940a). The mine principally worked the Hangingshaw Vein (east) and the Smallcleugh Vein, beneath the Smallcleugh Mine.

The exact location of Carr's West of Nent is uncertain, the name could refer to workings along the Carr's Vein from the Caplecleugh High Level. Alternatively the entrance to these workings could be the collapsed level opposite the Smallcleugh Mine entrance (called Thompson's Level by Jackson, 1969b). Carr's West of Nent was worked by John Wilkinson and Company between 1864 and 1871, then by William Hall and Company (1872-1876). The Carr's West of Nent Mining Company worked the mine from 1872 to 1877, finally the London Lead Company owned the workings from 1877 to 1881 (Burt et al, 1982).

### 5.3 CAPLECLEUGH MINE

A grant to work the Caplecleugh North Vein was made to Mr Adam Wilkinson on the 18th June, 1754 (Wallace, 1890). The exact location of Wilkinsons' workings are unknown; they must have been extensive, for Wallace stated that a dividend of £10,000 was obtained in one year. In 1780, the lease passed to Henry Errington and Company and then to the London Lead Company in 1799. Originally, the Caplecleugh North Vein was probably worked from surface shafts and the Caplecleugh High Level. The London Lead Company developed the Caplecleugh and Caplecleugh North veins in the Great Limestone from the Caplecleugh Low Level. At the time of Wallace's report (1856) the low level had been driven along the Caplecleugh Vein as far as Cowhill Cross Vein. At the same time the London Lead Company was driving a branch level (known as James Hill's Branch Level) along the Caplecleugh North Vein.

Plate 9. Wellhope Shaft at Nentsberry Haggs Mine with the winder house to the right, Jan. 1981 (M.F.Critchley)

Plate 10. The Nenthead smelt mill, March 1981 (M.F.Critchley)

Plate 11. The entrance to Capleeleugh Low Level, May 1980 (M.F.Critchley)

Plate 12. Shop and entrance at Capleeleugh High Level, May 1980 (M.F.Critchley)

Plate 13. A London Lead Co. boundary stone:- "L & Co 1849". Sept. 1981 (M.F.Critchley)

Plate 14. Working levels beneath the flats on Wellgill Vein in Brownley Hill Mine, May 1981 (M.F.Critchley)


Plate 15. Signalling system at the foot of an incline in Caplecleugh Low Level:- "Lower Signal when you get to the Top. Danger when up, CLEAR when down". Sept. 1982 (M.F.Critchley)

## 5.4 DOWGANG MINE

The Dowgang Mine was developed from surface shafts along the Dowgang hush, and underground from the Caplecleugh Low Level, which was driven by the London Lead Company. The principal development was undertaken by the Alston Moor Mining Company up to 1871, when the workings were taken over by the Dowgang Mining Company (1872-1885). W. Dickinson worked the mine from 1886 to 1890, followed by the Nenthead and Tynedale Lead and Zinc Company from 1891 (Burt et al, 1982).

## 5.5 GRASSFIELD MINE

Wallace (1890) stated that the Grassfield Mine was opened in 1803 and produced 21,905 bings 5cwt of ore during the following seven years. After 1810 output decreased and in the early 1860's little ore was produced. John Carruthers and Company owned the mine in the second half of the nineteenth century (Burt et al, 1982)

## 5.6 GUDHAMGILL MINE

Gudhamgill Mine was opened up in the High Coal Sill from the Gudhamgill High Level. At the time of the 1735 letting, the Gudhamgill veins were being worked by Thomas Errington, but they passed into the hands of the London Lead Company in 1751. The London Lead Companys' workings on the Gudhamgill Vein were not profitable; in the 9 years up to 1796 the company lost £291 on the enterprise. References to the workings in the London Lead Company Minutes cease after the end of the eighteenth century and the lease probably passed to the Brownley Hill Company. During the nineteenth century, Gudhamgill Vein was developed in the Great Limestone from a branch of the Brownley Hill Horse Level.

## 5.7 HODGSON'S MINE

South of the Nenthead Smelt Mill, on the SW bank of the River Nent is the Hodgson's Low Level. The London Lead Company plan of the Nenthead mines during the latter part of the nineteenth century (LLcP) shows that this level worked the Cowhill Vein and the western extension of Hangingshaw Vein. The Hangingshaw Vein was tested without success in 1822-24 by A. Wilkinson (Wallace, 1856). Further up the valley to the south east, Hodgson's High Level also worked the western part of the Hangingshaw Vein. The early history of the low and high levels are unknown. A Mr Robert Hodgeson, however, was agent for Wilkinson, during the latter's working of Caplecleugh North Vein. Robert Hodgeson could well have instigated one or both of the levels which now bear his name.

## 5.8 HUDGILLBURN MINE

Hudgillburn Mine was one of the most successful small mines in the Nenthead region. The Hudgillburn East and West veins, and the Hudgillburn Cross Vein were leased by the London Lead Company in 1799, but their workings were abandoned without success in 1808 (Wallace, 1890). At about the same time (1800), the Flow Edge Company commenced trials on the Hudgillburn Vein system by driving a level for 250 fathoms (456m) from the north side of Middle Fell (Sopwith, 1833). Some flat mineralisation was discovered during this venture, but it was not encouraging. The Flow Edge Company abandoned its trial in about 1804, having spent £1,929 on development.

The lease of the trial was taken up by Messrs John and Jacob Wilson and company in 1812. They continued the level commenced by the Flow Edge Company, but drove a little to the south. In 1814 a good vein was discovered in the shale beneath the Tuft. On rising up into the Great Limestone a large flat of lead Carbonate (cerussite) was discovered. During the first 9 weeks of working

in the flat, 4 miners raised 300 bings of ore, with a wage of nearly £10 per week each. Forster (1821) recorded that the annual production from the mine was 12,000 bings of ore and that there were 80 miners employed. The company spent £360 before discovering the rich mineralisation, and for many years they reaped profits averaging £30,000 per annum. The ease of working of the soft ore contributed greatly to the profits from Hudgillburn Mine. Records of ore production from Hudgillburn Mine cease after 1870, and the mine probably closed not long after that date (Dunham, 1948).

### 5.9 NENTSBERRY MINE

The earliest workings at Nentsberry were concentrated on short trials along the Nentsberry Green veins, on the west side of the Nenthead-Alston road. The main workings at Nentsberry were developed from the Nentsberry Haggs Horse Level, but the date of commencement of the Haggs Level is unknown. In 1821, the workings were under the control of Jacob Walton, through the Alston Moor Mining Company (Forster, 1821). The initial workings from the Haggs Level were confined to the ENE striking Nentsberry Haggs Vein, and the NNW Wellgill Cross Vein. By 1852, the Haggs Level had reached the High Raise Vein (Dunham, 1948). During later developments in the second half of the nineteenth century, and early part of the twentieth century, barytes was extracted from the High Raise Vein (Smith, 1923) by the Nentsberry Mining Company (1894-1908) and then by the Lugsdale Chemical Company from 1908 to 1914 (Carruthers et al, 1915).

## 6. TWENTIETH CENTURY DEVELOPMENTS

Throughout the nineteenth century, the London Lead Company continued to improve their mining and processing methods. Nevertheless, the best production was reached by the 1820's and output then declined. The low price of lead during the second half of the nineteenth century caused a decrease in the London Lead Company's revenue. But the company still made consistent profits up until 1882, when it decided to rationalise its operations, and the mines and associated buildings at Nenthead were put up for sale.

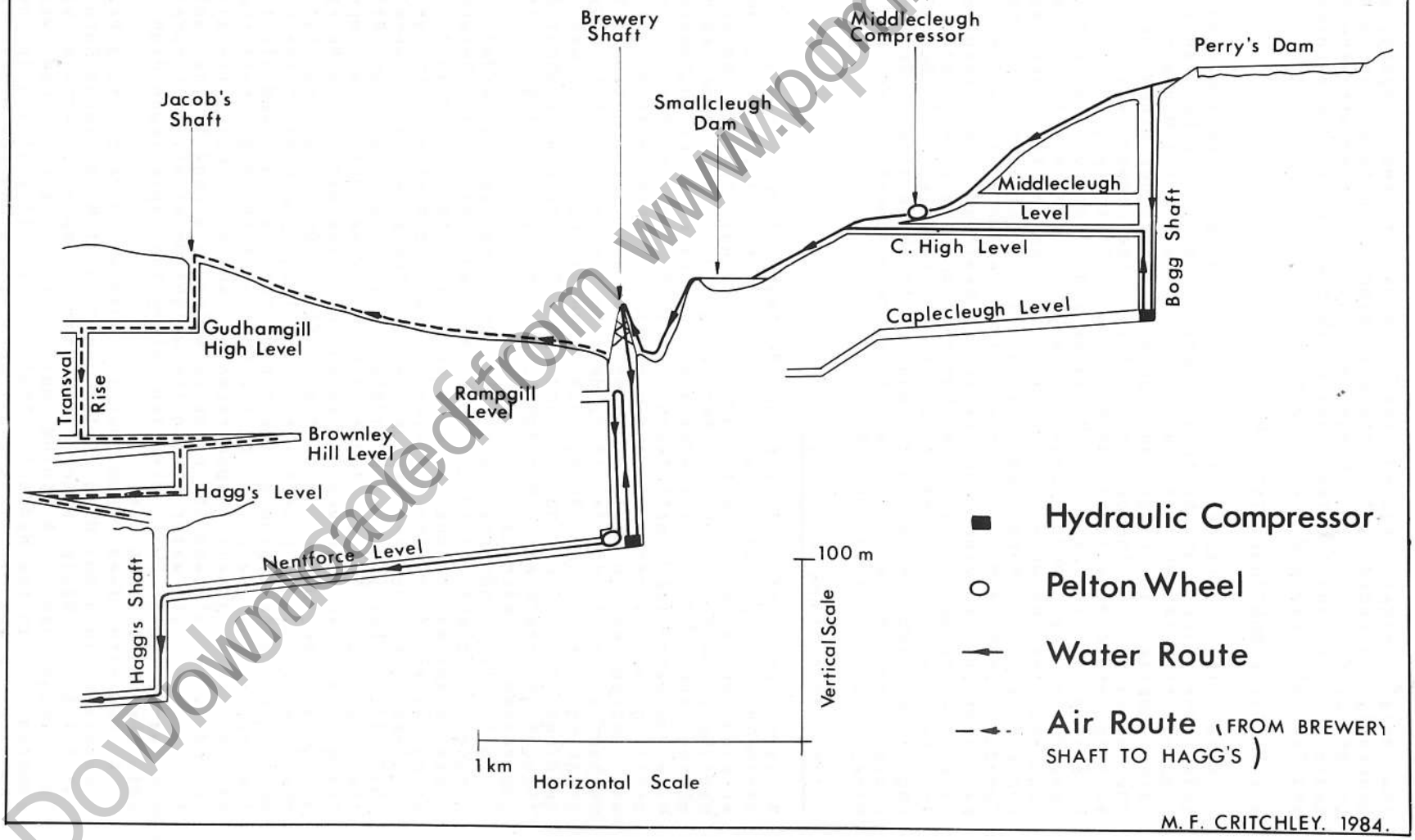
### 6.1 NENTHEAD AND TYNEDALE LEAD AND ZINC COMPANY

The Nenthead and Tynedale Lead and Zinc Company was formed in 1882 to acquire the London Lead Company's assets on Alston Moor along with the purchase of a zinc smelter on Tindale Fell. The promoters of the company were John Cameron Swan and his brother Joseph Wilson Swan. The Swans were already in possession of the Tindale Smelt Mill, which they acquired in 1886. The smelt mill had been built in 1845 by Henry Attwood on the estate of the Earl of Carlisle, midway between Alston and Brampton (Almond, 1977). The Swans initially operated the smelt mill under the Tindale Spelter Company and in 1879 leased the Bayle Hill and Farnberry Mines near Alston. In 1880, they obtained a lease of the Wellgill dressing plant to process their zinc ore (Plate 3).

The assets of the London Lead Company on Alston Moor were acquired by the Nenthead and Tynedale Lead and Zinc Company in late 1882 for £30,562 7s 6d according to Raistrick (1935), although Almond (1977) gave the purchase price as £50,000. Additional leases at the Dowgang and Brownley Hill mines were obtained in 1891 (Burt et al, 1982). The newly formed company calculated that it could mine 5,000 bings of lead ore and 2,500 bings of zinc ore per annum. The cost of mining, dressing and smelting the ores was estimated to be £33,130. Revenue based on lead sales at £14/ton and zinc at £17/ton, was calculated to be £37,927; giving a yearly profit of over £6,000. The company intended to mine both lead and zinc, in order to overcome the problems experienced by the London Lead Company due to fluctuating lead price and demand.

Between 1882 and 1889, the price of lead and zinc rose and the company made a profit of £2,230 in 1889 (Almond, 1977). Most of the workings in operation had been laid open by the London Lead Company and there appears to have been little new development under the Nenthead and Tynedale Lead and Zinc Company. During the 1890's the price of lead and zinc declined again to all time lows. These

# Fig 5 HYDRAULIC COMPRESSOR SYSTEM, NENTHEAD



low metal prices reduced the revenue of the company, and although revenue generally exceeded costs, interest payments on bank loans and mortgages resulted in an overall loss. Financial losses, coupled with the failure to renew the lease of the land for the Tindale Smelter, led to the winding up of the Nenthead and Tynedale Lead and Zinc Company in 1896.

## 6.2 VIEILLE MONTAGNE ZINC COMPANY

After the collapse of the Nenthead and Tynedale Lead and Zinc Company in 1896, the mines at Nenthead were sold to the Belgian Vieille Montagne Zinc Company for £45,000 (Almond, 1977). The Vieille Montagne Zinc Company owned a large smelter in Liège and operated many other mines throughout Europe during the early part of the present century. The company was also active elsewhere in Britain, especially in mid-Wales (Shaw and Critchley, 1978).

Initially, the Vieille Montagne Zinc Company only held the mines previously leased by the London Lead Company in the nineteenth century. Later, they acquired the Brownley Hill Mine to the north of Nenthead and re-opened the Rotherhope Fell Mine near Garrigill. Following on from the Nenthead and Tynedale Lead and Zinc Company, the Vieille Montagne Zinc Company expanded the exploitation of zinc reserves around Nenthead. This resulted in a new lease of life for the well established Rampgill and Smallcleugh mines and new discoveries in the previously 'small' mines of Brownley Hill, Gudhamgill and Nentsberry Haggs resulted in a rapid expansion of these mines. Between 1896 and 1937 the company had driven 9 miles of new development at Nenthead and Rotherhope Fell Mine, at a cost of £90,000 (A.R., 1938).

### Introduction of new technology

A large part of the Vieille Montagne Zinc Company's success in mining at Nenthead was probably due to the introduction of up to date machinery and working practices. Upto 1937, £40,000 was spent on replacing old and worn out machinery (A.R., 1938). Mechanical drilling commenced in 1898 and was used during the driving of the Hangingshaw branch level southwards from the Rampgill Mine beneath the Smallcleugh Level (Richardson, Pers. Comm.). Initially, dry drilling was undertaken and many miners suffered from silicosis. Wet drilling was introduced in 1913. Hand drilling still continued to be used alongside mechanical drilling in 1913, despite the greater efficiency of power drills in breaking the ground (Anon, 1914). Mechanical drilling was only used in driving headings or in very hard ground. In 1913 there were about 25 mechanised drills throughout the Vieille Montagne Zinc Companys' workings, using 500,000 cu.ft. of compressed air each day.

Initially compressed air for drilling was provided by a steam-powered compressor plant sited in the disused smelt mill. Between 1903 and 1915 the steam plant was gradually replaced by a system of hydraulic compressors (Fig. 5) using water from three reservoirs around Nenthead (though the steam plant was retained for use in emergencies). These reservoirs were the Smallcleugh Dam (NY787431), Perry's Dam (NY785415) and Coalcleugh Dam (NY805451). Water from the Coalcleugh Dam was fed to a Pelton Wheel driving a compressor in the Barney Craig Shaft in the West Allen Valley. The water from Perry's Dam was directed along a pipe to the top of the 349ft. (120m) deep Bogg Shaft (NY785421) and was then fed down a pipe to the Caplecleugh Low Level at the bottom of the shaft. Holes in the feed pipe at the top of the shaft allowed air to be drawn down with the descending water. At the bottom of the Bogg Shaft the water and air were carried into a bell shaped receiver, which collected the air from the water. A second pipe allowed the escaping water to ascend to the Caplecleugh High Level; this column of water giving the weight necessary to compress the air to 90psi. The waste water was directed along the Caplecleugh High Level and eventually into the Smallcleugh Dam.

A separate feed from Perry's Dam was directed to a Pelton Wheel driving a compressor in a building at the junction of Middlcleugh Burn and Old Carr's Burn (NY789426). Waste water from this compressor house was also led into the Smallcleugh Dam. A third outlet from Perry's Dam was intended to supply compressors in the Hydraulic Shaft on Elliott's String in the Smallcleugh Mine. The feed pipes to this shaft were laid along the Middlecleugh Level up to its junction with the Longcleugh Vein. The pipe then followed the Longcleugh Vein

eastwards to a shaft down to the Smallcleugh Level on the Smallcleugh Cross Vein, just south of the Ballroom Flat. From here the pipe was led along to the nearby Hydraulic Shaft, but there is no evidence that compressors were ever installed in the shaft, although much of the feed pipe remains today.

The remaining hydraulic compressors were sited at the foot of the Brewery Shaft (NY782436). Water from the Smallcleugh Dam was conveyed in a 12" (30cm) iron pipe to the top of a 90ft (27m) tower above the 328ft (100m) deep Brewery Shaft (Plate 7). At the top of the tower air was admitted into the feedpipe and was sucked down by the descending water. At the bottom of the shaft the air was again collected in a bell shaped air receiver. The escaping water was led up another pipe to the Rampgill Level 200ft (61m) above and compressed the air in the receiver. This water was then directed back down the shaft via a third pipe to turn an 80hp and a 140hp Pelton Wheel at the bottom of the Brewery Shaft (Plate 8). These wheels drove air compressors and an electric generator. The outflowing water was discharged along the Nentforce Level (Wilson, 1963).

The compressed air was directed underground to the drills and winches by pipes which often took long and complicated routes. The Wellhope Shaft area in the Nentsberry Haggs Mine was supplied with compressed air from the Brewery Shaft (Fig. 5). Initially the compressed air was taken in a pipe to Jacob's Shaft (NY785449) and into the Gudhamgill High Level, then down a rise (Transval Sump) to the Brownley Hill Low Level. A pipe was led along the Low Level on the Wellgill Cross Vein to the Gin Foot Sump and down to the Nentsberry Haggs Level. The pipe then followed the Haggs Level to the workings on High Raise 1st Sun Vein and to the Wellhope Shaft area. A branch took air out of the Haggs Level to the blacksmith's and mill at Nentsberry. Later an air pipe was laid directly across the moor from the Brewery Shaft to the Wellhope Shaft.

In addition to its use for driving machinery, the compressed air was also used for pumping in the Barney Craig and Rampgill shafts and for ventilation throughout the mines. Pumping was undertaken using the 'Mamooth' system, where compressed air was introduced into the bottom of a vertical pipe immersed in the water. The ascending air carried with it a column of water. Pumping was only carried out when the compressed air was not being used for drilling (Anon, 1914).

## Nenthead Dressing Plant

In 1905 the old London Lead Company's dressing plant at Nenthead was destroyed by fire and the construction of a new mill was commenced on the site of the old plant in 1909. Between 1905 and 1910 most of the output from the Nenthead mines was treated at the Smallcleugh, Wellgill and Brownley Hill dressing floors (the Nentsberry lease and mill were not owned by the company at that time). Some ore was also sent into the Brownley Hill Mine and taken along the Dodd Level to a dressing plant at Carrshield in the West Allen Valley (Richardson, Pers. Comm.). The Dodd Level was also used by miners in the 1920's and 1930's who lived in Carrshield and worked in the Nenthead mines.

The new dressing mill was constructed by the Krupps Company of Germany, it commenced operation in July 1910 and at the time was one of the most modern plants in the country (Plate 6). The mill was capable of treating 200t of ore per 12hr day using gravity separation (Anon, 1914). Tubs of ore were hoisted to the top of the building and the ore then passed downwards through the mill. The processing consisted of picking and crushing, jigging and finally separation of slimes using shaking and vanning tables. Complete details of the dressing plant have been given by Anon (1914) and Smith (1923). The lead and zinc concentrates were sent to the Vieille Montagne Zinc Company's smelter in Leige. Power for the dressing plant was provided by two 225hp steam engines driving the equipment by direct transmission and through an electric generator. The capacity of the new dressing plant exceeded the output from the mines and the ore feed was supplemented by re-processing the old waste dumps adjacent to the Rampgill Level mouth. In 1918 only 40% of the 150t of ore processed each day in the mill came from underground workings (Smith, 1923).

## Brownley Hill Mine

The Brownley Hill Mine lay idle after the departure of the Nenthead and Tynedale Lead and Zinc Company in 1896; except for its use as a haulageway for ore from the Nentsberry Haggs Mine. In 1936, the Vieille Montagne Zinc Company decided to reopen the mine on a trial basis. The company concentrated on developing flats in the Great Limestone along the eastern end of the Gudhamgill Vein, but some flat development also took place adjacent to the Wellgill Cross-Vein. The Gudhamgill Flats were particularly rich in zinc (averaging 7% ZnS and 4% PbS (Dunham, 1948). However, the trials at Brownley Hill were only short lived, and were abandoned after about 6 months (Richardson, Pers. Comm.).

## Caplecleugh Mine

The Caplecleugh Level had been extended southwards to the Browngill Vein at the head of the Nent Valley by the London Lead Company, but little ore had been raised because of the low lead content (Dunham, 1948). However, the vein did contain a large amount of zinc ore left behind by the London Lead Company, and zinc predominated over lead at depth. The Vieille Montagne Zinc Company extended the Caplecleugh Horse Level both east and west along Browngill Vein. To the west they stoped a total length of 900m over a height of 18m, and a sump at the western end of the workings connected the Caplecleugh Level to the Whitesike Level from Garrigill (NY758425). To the east stoping took place in the Middlecleugh 2nd Sun Vein, in ground already developed by the London Lead Company from the Capleclugh Low Level. James Hills branch level also gave access to the Caplecleugh and Middlecleugh north veins from the low level.

The principal Vieille Montagne Zinc Company workings, on Browngill (east) and Middlecleugh 2nd Sun Veins, were in the Great Limestone above the horse level. These workings were reached by rises from the level. Several rises at the eastern end of the Caplecleugh Level on the Middlecleugh 2nd Sun were connected with the Smallcleugh Mine above. A deep trial of the Middlecleugh 2nd Sun Vein was made by the Vieille Montagne Zinc Company from the Middlecleugh Sump. There are no details of this trial. Some development of the Dowgang and Brigal Burn veins also took place from the Caplecleugh Level. The main Vieille Montagne workings in the Caplecleugh Mine ceased in 1914, although a small amount of stoping was undertaken on the Middlecleugh North Vein in 1918 (M.R.O. plan no. 7612, dated 1922).

## Caplecleugh High Level

The Caplecleugh High Level was extended eastwards along the Middlecleugh 2nd Sun Vein by the Vieille Montagne Zinc Company to link up with the Bogg Shaft in 1915. The level is concrete-lined and was used as a spillway for waste water from the compressors in the Bogg Shaft.

## Nentsberry Haggs Mine

The Nentsberry Haggs lease was obtained by the Vieille Montagne Zinc Company in 1914 (Carruthers et al, 1915). When the company acquired the mine, the High Raise vein had already been extended across the county boundary into Northumbria. Exploration continued in following the High Raise vein eastwards, and this led to the discovery, in 1923, of the intersecting NNW Sincay, Cox and Dupont veins, and the ENE Treloar, High Raise 1st and 2nd Sun, Liverick and Robinson veins. The oreshoots on these veins were confined to the Great Limestone, and were richest in lead at the intersection of the ENE and NNW veins. Away from these intersections, the veins tailed off into barite and/or witherite gangue.

All production was confined to workings above the horse level, which resulted in no drainage problems. Between 1925 and 1927 the Wellhope Shaft was sunk from the surface, close to the intersection of the High Raise and Dupont veins, to remove ore from this part of the mine. The shaft is 416 ft (126m) deep to the horse level, and was equipped with an electric winder and an aerial ropeway, 6.5km long, linked the shaft to the Rampgill Mill. However, due to problems with the aerial ropeway, the horse level was still used for haulage. Most of the ore was treated at the Haggs Mill, sited opposite the horse level entrance.

A little ore was also treated at the Rampgill Mill. The Haggs Mill had a capacity of 6 tons/hour, and used gravity separation. However, the zinc-witherite mixture found in some of the veins proved very difficult to separate, due to the similar specific gravities of the sphalerite and witherite (Dunham and Dines, 1945). An early attempt to treat these mixed ores involved the removal of galena by jigging, and the residue was then sent to the Blaydon Alkali Company, near Newcastle, who took out the carbonates and returned the sphalerite to Nenthead (Carruthers et al., 1915).

By 1938, most of the lead reserves in the region of Wellhope Shaft had been exhausted. Further exploration eastwards was hampered by the eastward dip of the Great Limestone taking the productive horizon beneath the water table. A trial in the Firestone from Wellhope Shaft in 1910 found no economic mineralisation. In 1946, a winze was sunk from the horse level on Cox Vein and discovered some zinc mineralisation in the Quarry Hazle, but this was not exploited, and the mine ceased operations in 1949. The production from 1913 to 1938 consisted of 39,251 tons of lead concentrate and 4,152 tons of zinc concentrate (Dunham, 1948).

## Rampgill Mine

By the end of the nineteenth century most of the Rampgill Vein above the water table had been worked out. The vein oreshoots terminate at the eastern end of the mine against the Boulder End Cross Vein (Dunham, 1948). The Rampgill Level was linked to the workings of the Coalcleugh Mine further east; between 1899 and 1921 the Vieille Montagne Zinc Company extracted zinc ore from the Barney Craig Flats in the Coalcleugh Mine,using the Rampgill Level for access. The distance from the Rampgill Level mouth to the Coalcleugh workings is about 2.5km and to tram ore this distance by horse must have been slow (Plate 4). In 1902, the first underground locomotive, a 12h.p. petrol driven train, was introduced in the Rampgill Level (Anon, 1914).

On the Rampgill Vein itself, the Vieille Montagne Zinc Company immediately re-opened the Rampgill Shaft, which was started during the later half of the nineteenth century by the London Lead Company in the eastern part of the mine about 2km (1.5miles) from the portal. The shaft had passed through the Rampgill Vein in the Eleven Fathom Plate (shale) at a depth of 300ft by 1902 (Swan, 1902) and was continued as far as the shale beneath the Scar Limestone (372ft or 113m below the horse level). From the foot of the shaft a cross-cut reaches the vein, and a second shaft was sunk down the incline of the vein for 330ft (100m). Unfortunately, these lower trials were not successful, as the vein split up at depth and the lower inclined shaft was abandoned. Some production was obtained from the cross-cuts to the vein in the upper part of the shaft (Anon, 1914). A cross-cut to the east from the shaft formed the link to the Coalcleugh Mine, in the Nattrass Gill Hazle, about 108ft (33m) below the Rampgill Horse Level. Winding in the shaft was provided by a hydraulic engine, which was later replaced by a 35h.p. compressed air engine (Richardson, Pers. Comm.). A double decked cage was installed in the shaft and pumping in the shaft was undertaken using compressed air.

In addition to the link with Coalcleugh, the main horse level also served as a haulageway for part of the Smallcleugh workings via the Hangingshaw branch level. The level was linked through rises to Carr's Level, and from there to the Smallcleugh Level. The main use of the Hangingshaw branch level was to provide a haulageway from the eastern workings of the Middlecleugh/Longcleugh veins and the minor flat workings in the Smallcleugh Mine.

## Smallcleugh Mine

The Smallcleugh Level was not used as a haulageway by the Vieille Montagne Zinc Company, but it was used as access by the company's miners (Plate 5). The principal workings in Smallcleugh were confined to the Middlecleugh and Longcleugh veins, and the mined ore was passed down sumps to either the Rampgill or Caplecleugh levels. Some flat development took place in Smallcleugh mainly adjacent to the Smallcleugh Cross-Vein, between the Middlecleugh 2nd Sun and Longcleugh veins. A large stope in the flats was extracted;today this is known as the 'Ballroom Flat'. On September 2nd 1901, twenty-eight members of the local Masonic branch, together with the company's clerk (C.Harper), held a

dinner in the excavation.

Elliott's String, a small vein between and parallel to Middlecleugh 2nd Sun and Longcleugh veins, was developed by the Vieille Montagne's first manager, J.J.C Fernau, between 1896 and 1902 (Richardson, Pers. Comm.). A shaft, the "Hydraulic Shaft", was sunk on Elliott's String to link the Smallcleugh Level with a sub-level from Carr's Mine. It was intended to link up the sub-level with the Bogg Shaft, but the trial was stopped in 1902 when Fernau left for America.

## 6.3 WARTIME OPERATIONS AT NENTHEAD

During the last war, the Ministry of Supply investigated the Nenthead region for reserves of lead, zinc and barite. Attention was directed towards two sources of mineral at Nenthead: the first source was the widespread mine dumps in the area and the second target was the extension of reserves at the Nentsberry Haggs Mine.

A sampling programme was undertaken on the dumps for the Non-ferrous Ores Committee of the Ministry of Supply, in co-operation with the Vieille Montagne Zinc Company in 1940. The sampling indicated reserves in the Smallcleugh dump and the Rampgill Mill dump of 615,000 tons, with 0.4% Pb and 3.5% Zn (Dunham, 1948). The dressing plant in the Rampgill Mill, which had been idle since 1921, was modernised by the installation of a flotation plant between 1942 and 1943. The plant were capable of treating up to 1000 tons of material a day, and between 1943 and 1946 the production was 19,941 tons of Zn concentrates and 1,385 tons of Pb concentrates (Dawson, 1947). The waste from the dressing plant was transferred to tailing dams along the River Nent between Nenthead and the Brownley Hill Mine entrance. Problems with the stability of the tailings was only partly solved by the planting of turf squares on the slopes of the dams.

At Nentsberry Haggs Mine, Mitchell and Stowell (1942) on behalf of the Non-ferrous Minerals Development Ltd. assessed the remaining ore reserves on the Treloar, 1st Sun and 2nd Sun veins and produced the following figures:-

Estimated reserves = 54,000 tons @ 8.75%Zn, made up of;

| | | | |
|---|---|---|---|
| 1st Sun | 38,400 tons | 8.99% Zn | |
| 2nd Sun | 2,500 tons | 9.82% Zn | 1.03% Pb |
| Treloar | 10,700 tons | 5.75% Zn | |
| Total Mine | 51,600 tons | 8.75% Zn | 1.03% Pb |
| Dump | 2,400 tons | 8.75% Zn | |
| TOTAL | 54,000 tons | 8.75% Zn | 1.03% Pb |

These reserves were estimated to yield about 4,723 tons of zinc. However, although some pilot mining and milling took place at Nentsberry, there was no serious production and operations ceased before the end of the war.

## 6.4 ANGLO-AUSTRAL MINES

In 1949, the assets of the Vieille Montagne Zinc Company at Nenthead were acquired by the Imperial Smelting Corporation Ltd. and put under the control of one of its subsidaries, Anglo-Austral Mines Limited.

The mill at Nenthead was immediately adapted to process fluorspar by the flotation method, probably using most of the machinery remaining from the war time operations. The main sources of Anglo-Austral's fluorspar was from the Rotherhope Fell Mine, in the South Tyne Valley, and from the Heights and Cammock Eals mines in Weardale. Dump material was also treated from the Rotherhope Fell Mine (Dunham, 1952). The mill, as designed, could treat 1.75t of fluorspar ore each hour; in October 1957 this was increased to 2.1t/hr (AAMM. 14/10/57), giving a maximum of throughput of about 50t/day. During most of the 1950's, the mill appears to have been worked at near full capacity, producing on average 350t to 500t of fluorspar concentrate from up to 1150t of fluorspar ore per month. Typically, ore grades were 40% to 65% $CaF_2$, with 73% to 79% recovery

producing concentrates of over 97% $CaF_2$. In July 1960, it was proposed to treat the dump material from the Firestone Level at Rampgill Mine for fluorspar, but pilot tests proved this to be unsuccessful (AAMM, 31/8/60). All the fluorspar produced from the Nenthead Mill was dispatched for use at the Imperial Smelting Corporations Avonmouth Smelter, near Bristol.

From the early 1930's, the Imperial Smelting Corporation was actively involved in research and experimentation concerned with developing a process for smelting zinc concentrates in a blast furnace. The technique was perfected in the mid-1950's and zinc blast furnaces installed in the Avonmouth Works (Richardson, 1974). Most of the zinc produced was from imported ores, but the capacity for zinc smelting may have influenced the corporation's exploration policy in the U.K. Anglo-Austral Mines produced a small quantity of mixed lead-zinc concentrate from the Nenthead Mill as a by-product of fluorspar milling. From the commencement of their leases at Nenthead, the company also took a direct interest in metal mining at the Nentsberry Mine and a phase of exploration and development was started immediately.

The workings at Nentsberry were reopened, and an internal shaft (First Sun Shaft) was commenced from the horse level and in 1950 Jones reported that the shaft had cut the First Sun Vein at a depth of 35ft (11m). The vein in the shaft was 8ft 6ins wide (2.6m), and assayed 13% Pb over 5ft 6ins (1.7m). A few tons of lead ore were extracted from this vein and treated by gravity separation in the Nentsberry Mill. In the same report, Jones (1950) noted that lead ore was concentrated near to the Wellhope Shaft and away from the shaft zinc increased over lead. The First Sun Vein in the eastern part of the mine was assayed at 11.3% Zn. By the end of 1950, the First Sun Shaft had been sunk to 70ft (21m) and a cross-cut was being driven north from the bottom of the shaft in the Four Fathom limestone. An old winze (Cox Staple) was also being reopened (Jones and Burwood, 1951).

Before 1950, comparatively little zinc ore had been raised by the Vieille Montagne Zinc Company. Favourable zinc prices and the new, more efficient, zinc smelting process at the Avonmouth Smelter, prompted Anglo-Austral Mines to consider zinc mining. To secure initial reserves at the mine, the 54,000 tons of zinc ore indicated by Middleton and Stowell (1942) was developed by the end of 1950. However, the zinc ore contained up to 20% of witherite ($BaCO_3$), which presented serious problems for milling. Witherite has a similar specific gravity to sphalerite and thus it is difficult to separate the two using gravity. The solution suggested was to obtain a rough zinc-witherite concentrate using the existing gravity plant at Nentsberry Mill, and then to produce the zinc concentrate by flotation, using an extension to the flotation circuits at the Rampgill Mill.

Access to the mine also presented a problem to mining; the Haggs Level was narrow, and had previously restricted transport to horse drawn wagons. The mine's superintendent did consider using a battery loco', but this was never installed. It was also decided not to recondition the Wellhope Shaft, because of its isolation, and previous trouble with the aerial ropeway.

A further report by Jones in 1952 indicated probable reserves of 100,000 tons of zinc ore at Nentsberry and concluded:

> "...that with the price of zinc and lead metals not less than half their present price (£190 per ton), it [Nentsberry] could become a successful mine for 20 to 50 years, with a production of about 50,000 tons of ore per a year." Jones, quoted in Edwards (1953).

This optimism was not shared by Hiscock (quoted in Edwards, 1953), who reported that sufficient reserves had not been indicated and that more exploration was needed. Hiscock (1953) calculated that the reserves present would produce about 3,500 tons/year of zinc concentrate (from 50,000 tons of ore), but it would require an expenditure of £300,000 for production and equipping the mill. Furthermore, a market price of above £100/ton of zinc metal was required to make a profit, and he concluded that at the time Nentsberry was not economic.

Early in 1953, the tests beneath the horse level were abandoned and exploration was directed towards extending eastwards the drive along the 1st Sun Vein. However, the development was going against the dip of the strata, and the Great Limestone was falling beneath the level making the mineralisation more expensive to extract. Edwards (1953) suggested that additional exploration should be undertaken further east, in the West Allen Valley from Carrshield. A level from Carrshield, following the 1st Sun Vein, if found, would be able to keep within the Great Limestone and mineralisation all the way. This proposed level was estimated to add 150,000 tons of 'proved' ore. Edwards' recommendations were not taken up and exploration at Nentsberry stopped with the suspension of operations on the 14th February 1953. The failure was probably due to insufficient ore reserves and low metal prices.

The Nentsberry lease was relinquished on the 31st December 1958, after the mine had been sealed and the Nentsberry Mill dismantled. Surplus mining equipment was transferred from Nentsberry to the Gasswater Mine in Scotland in February 1959. Additional machinery from Nentsberry and the smelt mill stores at Nenthead were written off, amounting to a total value of £7,659-3s-9d. In 1960, the company was offered additional lead-zinc reserves by New Consolidated Goldfields Limited in the Swinhope Mine, Allendale (AAMM 26/1/60), but this offer was declined as uneconomic and the ores untreatable (AAMM 5/2/60).

Fluorspar processing at the Rampgill Mill continued, up to 1960. However, at the beginning of 1960 despatches to the smelter decreased due to the fall off in demand for fluorspar and the shortage of storage at Avonmouth. Already fluorspar mining was proving to be uneconomic in 1959 (AAMM 15/6/59) and the decision to close the Rampgill Mill was made in March 1960 (AAMM 9/3/60).

In May 1960, the Warren Springs Laboratory approached the company, with a proposal to lease the Rampgill Mill for experimental processing. The board of Anglo-Austral mines decided that it did not want to lease the mill and offered it for sale at £10,000 (AAMM 24/5/60). Warren Springs withdrew their proposal in June 1960 (AAMM 28/6/60). Another prospective buyer was the Settlingstones Mine (AAMM 29/11/60). The final batch of fluorspar was processed by mid-January 1961, and the remaining workers were made redundant. The plant was eventually sold to Mr J Banks of Rampgill Mill Limited for £7,000 in November 1961, who had purchased it to recover lead and zinc from the old mine dumps. Anglo-Austral Mines had relinquished all their assets at Nenthead by December 1961 (AAMM 1/12/61).

### 6.5 RECENT OPERATIONS AT NENTHEAD

The Rampgill Mill Company commenced operations by reconverting the dressing plant to treat lead and zinc from the old mine dumps (Houston, 1963). Some concentrate was produced from the dumps adjacent to the Smallcleugh dressing floor and the zinc concentrate sold to the Vieille Montagne Smelter in Belgium. However, the company discontinued operations in 1963, and the lease was taken up by Messrs Richardson and Thompson in the same year; they re-opened the Smallcleugh Mine in pursuit of new ore reserves underground, but little large scale mining took place. In 1970, the British Steel Corporation took up a lease for the whole of Alston Moor to explore for fluorspar.

## 7. NENTHEAD MINES TODAY: SURFACE FEATURES

Unfortunately the condition of many of the surface features connected with mining at Nenthead have become much worse during the last two decades. This is partly due to the natural decay of buildings, but there has also been much 'robbing' of dressed building stone. Nevertheless, the buildings still remaining provide an impressive monument to the long history of mining around Nenthead. The important surface features visible today are described from west to east along the Nent Valley.

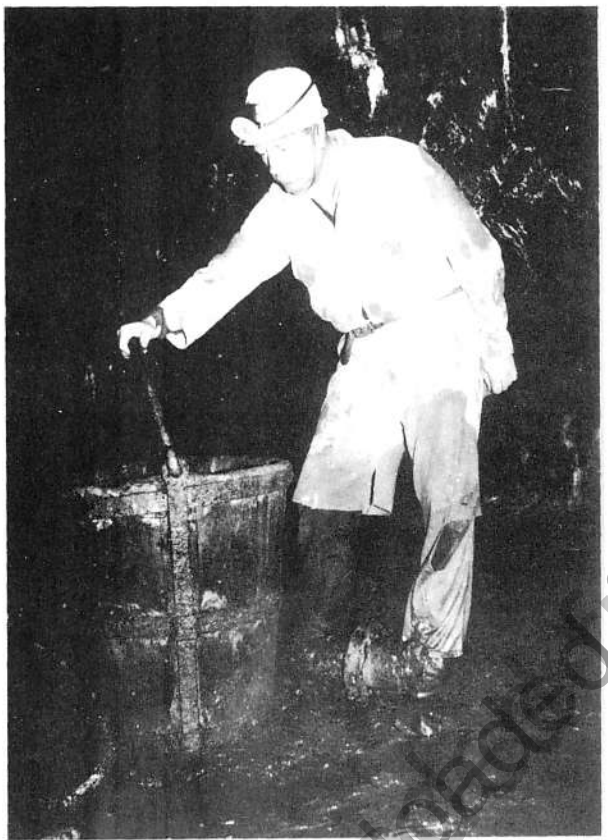


Plate 16. Kibble and 'old man' at the Engine Shaft in Rampgill Mine, Sept. 1980 (M.F.Critchley)

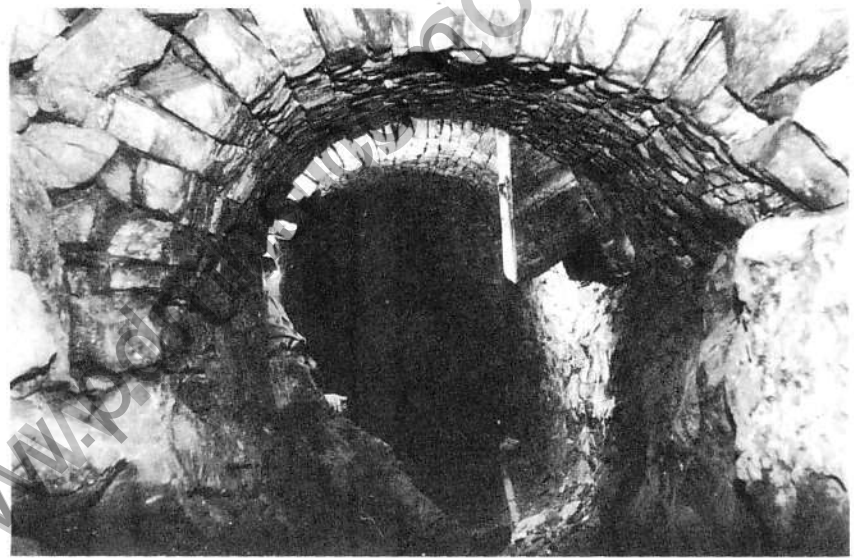


Plate 17. Ore hopper in Smallcleugh Mine, Sept. 1981 (M.F.Critchley)

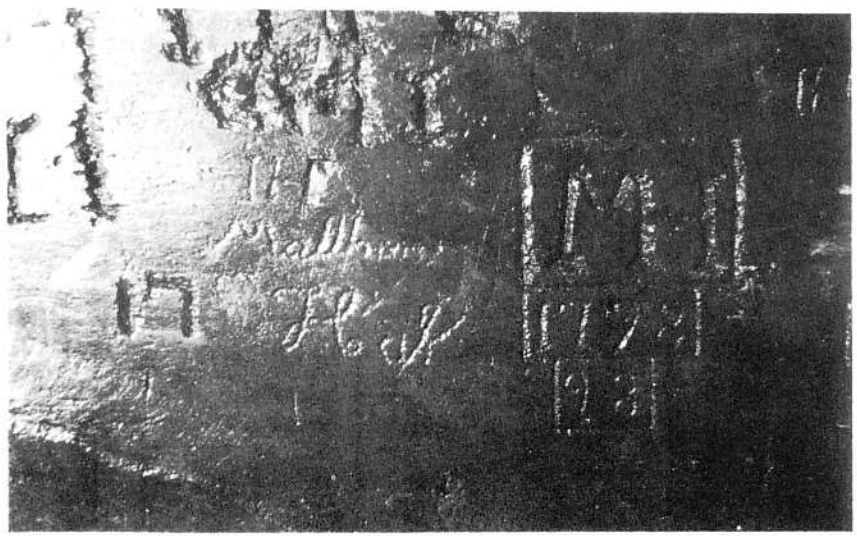


Plate 18. Graffiti above a sump in Middlecleugh Level, Sept. 1982 (M.F.Critchley)

## 7.1 NENTFORCE LEVEL

The original portal of the Nentforce Level was blocked in 1950's, damming the water in the level to feed the Alston Foundry. The entrance is now open, but gated. The plaque which was placed above the portal after the completion of the level is kept in the Town Hall at Alston (Plate 2). During 1981 and 1982 parts of the Nentforce Level were explored from the various ventilation shafts (Wilkinson, 1983).

## 7.2 NENTSBERRY HAGGS LEVEL

The wooden mill buildings at Nentsberry Haggs were pulled down after the termination of operations by Anglo-Austral Mines in 1959. Some of the concrete beds of the dressing machinery still remain. Two groups of stone built buildings at Nentsberry are in a disused state. By the side of the level mouth (NY767450) is the well proportioned miners 'shop'. Across the road is a collection of cottages and outbuildings; presumably one was the mine office and the others the houses of the mine officials.

An outbuilding on the western side of the mine cottages covers the Nentsberry Shaft. This shaft is about 109m. deep and communicates with the upper and lower parts of the Nentforce Level (Wilkinson, 1983). Massive timbers in the roof of the outbuilding carried the sheave wheels for the rope from a winding engine. Water from the Nentsberry Haggs Mine was directed down the shaft to act on water wheels, which in turn drove bellows to provide ventilation.

## 7.3 WELLHOPE SHAFT

The winding house and associated buildings at Wellhope Shaft (NY778467) are still in good repair and are used by a local farmer (Plate 9). The headgear was blown up with explosives in the 1960's, but the shaft is still open beneath the twisted and rusting remains of the headgear. It was descended in 1981 for a mining company investigating the mineral resources and gave access to the main workings of Nentsberry Haggs Mine, at a depth of 120m. below collar. The aerial ropeway linking the shaft to the Nenthead Mill was dismantled in the 1940's and only the supporting piers remain.

## 7.4 BROWNLEY HILL MINE

There is very little remaining of the surface installations at Brownley Hill. The foundations of a small building can be seen adjacent to the level mouth. On the opposite, south, side of the River Nent are the now solidified tailings from the flotation operations at Nenthead Mill during the Second World War. These tailings were covered by square sods of grass to stablise them, but this was only partly successful.

## 7.5 GUDHAMGILL-WELLGILL DRESSING FLOOR

The dressing floor at the joining of Well Gill with the River Nent (NY777443) served the Brownley Hill Mine, and its branch workings on Gudhamgill Vein (Plate 3). The date of the commencement of dressing operations at Wellgill is unknown, but by 1817 the dressing floor was being used for the treatment of zinc ore by Jacob Walton and Thomas Shaw (Almond, 1977). With the cessation of the Nenthead and Tynedale Lead and Zinc Company's mining operations at Brownley Hill, the dressing floor fell into disuse at the end of the nineteenth century. Today the site has been levelled and there are no visible remains.

Wellgill Shaft on the Nentforce Level is also sited in the vicinity of the dressing floor. This shaft is now covered by a Water Board manhole cover. The sheave wheels from the shaft head-gear are in the grounds of Cherry Tree House, Nenthead (NY783436).

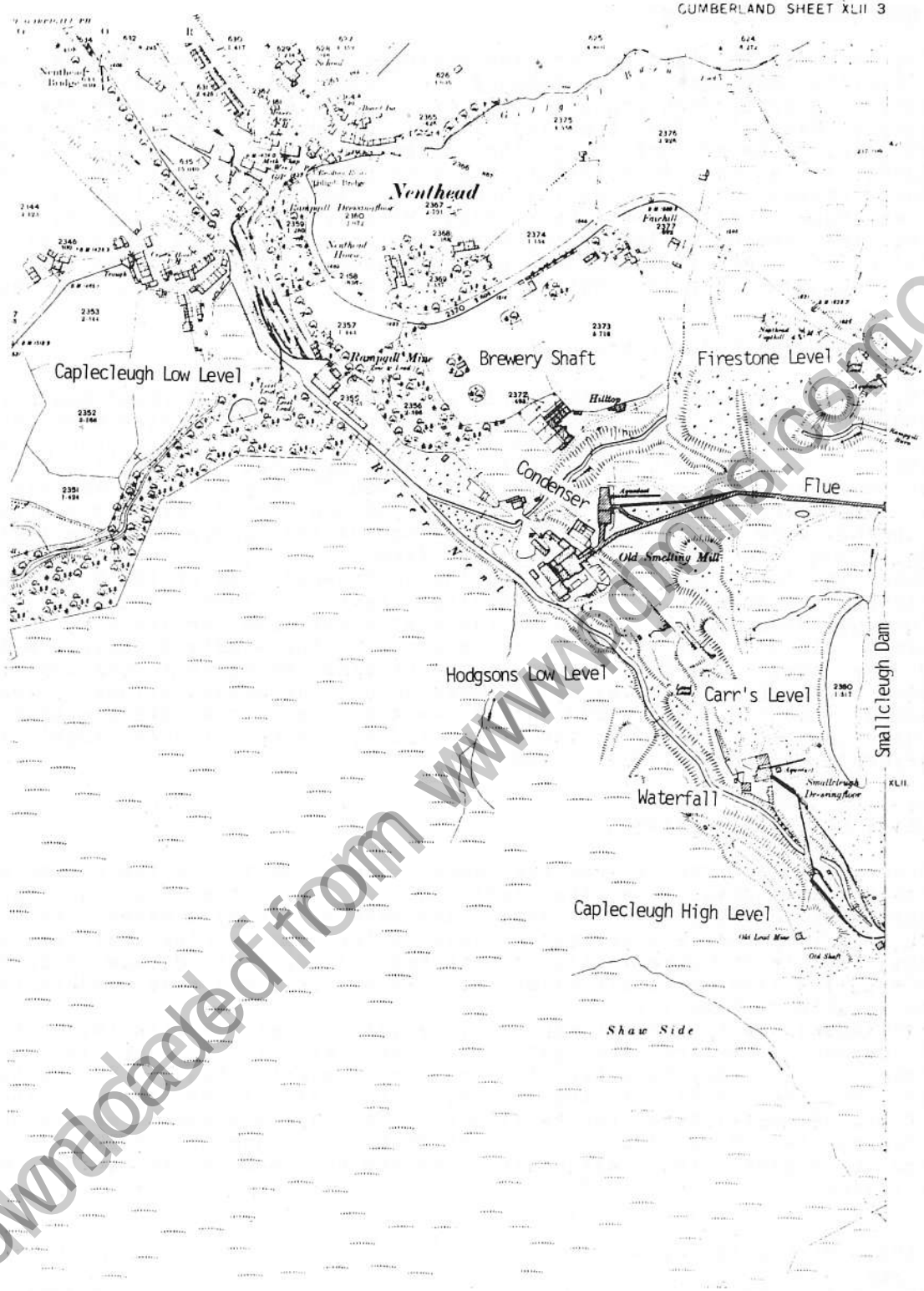



Fig. 6. Reduced 25" Ordnance Survey map of 1890 for Nenthead, showing the Rampgill and Smallcleugh dressing floors and the Nenthead smelt mill.

## 7.6 NENTHEAD DRESSING MILL

The structure standing on the Nenthead Mill site (NY781437) was erected by the Vieille Montagne Zinc Company in 1908 and housed the main part of the company's gravity dressing plant. Prior to 1908, the site formed the London Lead Company's Rampgill low dressing floor. During the operation of the dressing plant the incoming ore from the mines was hoisted to the top of the mill building in a vertical elevator, and then descended through the mill during the various phases of the dressing operation. In 1927 the mill was also linked to the Wellhope Shaft at Nentsberry Haggs Mine by a 4 mile (6.5km) aerial ropeway. During the Second World War the gravity plant was removed and a flotation plant installed to retreat the old waste dumps. This later plant was sold in the early 1960's and today the shell of the mill building is used as a garage.

## 7.7 RAMPGILL AND CAPLECLEUGH MINES

The area immediately to the north-west of the Rampgill Level mouth (NY782435) formed the Rampgill high dressing floor. This appears to have been the earliest dressing floor for the Rampgill Mine, and most of it was probably open to the weather. When the low dressing floor was redesigned in 1818, the high dressing floor may have become redundant. The 1890 25 inches:1 mile map (Fig. 6) shows only rail tracks in the vicinity of the high dressing floor, and presumably this was being used as a siding. The buildings of the woodyard to the south-east of Rampgill Level are now used as a chicken farm.

Opposite the Rampgill Level, on the south-west side of the River Nent is the entrance to Caplecleugh Low (Dowgang) Level. There are two entrances to Caplecleugh Mine: one obvious entrance at river level (Plate 11), and a second entrance at a slightly higher elevation in the woodland above. Water issues from the lower level, and this is the original entrance to the Caplecleugh Low Level. Ore from the level was trammed across the wooden bridge to the Rampgill dressing floor. The second entrance was driven in the late nineteenth century to give easier access to the waste tips on the west (Caplecleugh) side of the River Nent (Richardson, Pers. Comm.).

## 7.8 SITE OF CRUSHING STAMPS

Proceeding to the SE from the Rampgill Level mouth, following the River Nent upstream, one passes on the left to the site of the crushing stamps. These stamps were of the Cornish design and were driven by a water wheel. The leat which fed the water wheel can be seen to the right of the small building. The stamps now lie in the collection of the Regional Open Air Museum at Beamish near Stanley, awaiting reconstruction, but Raistrick (1977) has a photograph of the stamp in situ at Rampgill.

Continuing past the stamp site, a gate is reached with the Nenthead smelt mill beyond. Before the gate, on the left of the track, is a substantial cottage; this may have been the smelt mill agent's house. On the bank of the river, on the right of the track, is the base of the cage from the Rampgill Shaft in Rampgill Mine (see section 6). The cage was double-decked and capable of taking two mine trucks on each deck. The cage was originally wound by a hydraulic engine; this was later removed and used on the surface for lifting rail trucks.

## 7.9 SMELT MILL SITE

The two main buildings standing on the smelt mill site (NY784433) are the Assay House and opposite it a workshop (Plate 10). The substantial wall of yellow bricks formed the back of the smelt mill and carried the flue. The remainder of the smelt mill appears to remain where the buildings collapsed, although much stone work has been subsequently removed.

The smelt mill was begun at this site by Colonel Liddell, during the time of the first trials on the Rampgill Vein in 1736. It was subsequently modified by the London Lead Company in 1745-46 and was continuously updated thereafter.

After the withdrawal of the London Lead Company from the area in 1882, the smelt mill continued to be used by the succeeding Nenthead and Tynedale Lead and Zinc Company and then the Vieille Montagne Zinc Company until it closed in 1902. After 1902, a steam boiler system was retained to provide compressed air for the mines when the hydraulic compressors were inoperative. Of the remaining buildings on the Smelt Mill site, the Assay House is the most impressive; it is a monument to the advancing role the London Lead Company played in the development of lead metallurgy.

On the SW side of the Assay House is the site a small water wheel, presumably to drive the bellows used in assaying. Large water wheels would have been located in the smelt mill itself to drive bellows for the furnaces. The remains of the aqueduct and leat which carried water to these wheels can be seen crossing the track above the smelt mill. In the SW corner of the smelt mill site is a pile of fallen masonary, steel and wood surrounding the base of a chimney. The Robey engines were located in this part of the site and drove the air compressor in time of emergency for the Vieille Montagne Zinc Company (Anon, 1914). The large bunkers which stored coal for the engines can be seen to the east.

## 7.10 CONDENSER

The fumes from the smelt mill were carried away along the flue to the square chimney on the fells (NY794429). In the mid nineteenth century a Stagg condenser was added into the flue circuit, in order to recover some of the lead oxide from the fumes. The large water wheel pit above the smelt mill site contained a water wheel of the side shoot type. The waste water from the wheel was led out of the pit via a tunnel at the base and reused to drive the water wheels in the smelt mill.

The wheel on the condenser site drove three bellows via operating rods on the large stone wall on the southern end of the wheel pit. These bellows forced the fumes from the smelt mill through the condenser. The condenser operated by drawing the lead rich fumes through chambers of water. The lead oxide was precipitated in the water. Brush wood was included in the water chambers to reduce oscillations (Percy, 1870). The building which housed the condenser has been totally destroyed. Its approximate position can be inferred by the area which is devoid of plant life; the soil has been poisoned by toxic lead fumes.

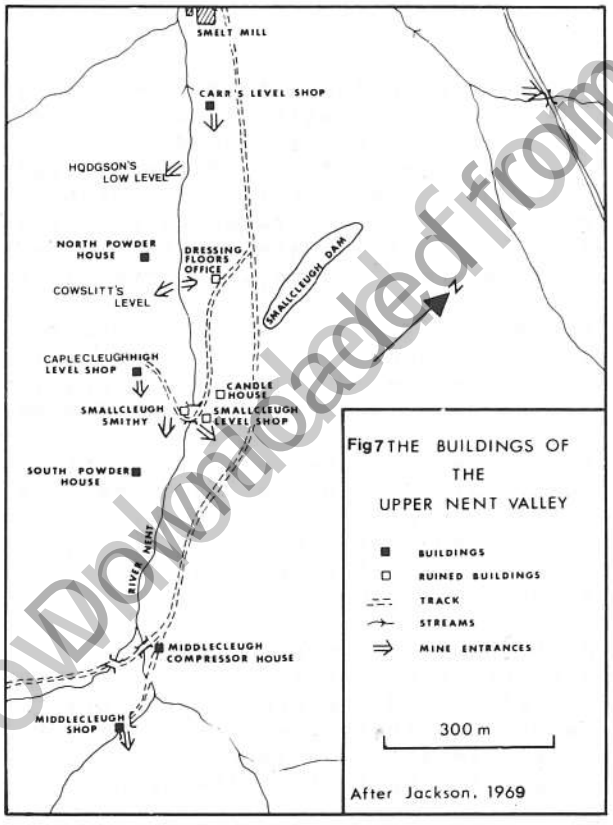



**Fig7** THE BUILDINGS OF THE UPPER NENT VALLEY

## 7.11 BUILDINGS OF THE UPPER NENT VALLEY

The buildings of the Upper part of the Nent Valley have been described in detail by Jackson (1969a). Figure 7 (after Jackson) shows the locations of these buildings. The 'shops' (miner's lodging houses) and the North Powder House were constructed by the London Lead Company. The South Powder House and the Middlecleugh Compressor House were constructed during the time of the Vieille Montagne Zinc Company's operations. The later housed a hydraulic compressor fed by water from Perry's Reservoir (Jackson, 1969a). The small 'shop' adjacent to Carr's Level may have been built by the London Lead Company, but it was certainly still in use during the present century. During the First World War it housed Italian miners who worked in the mines due to

the labour shortage necessitated by the war. The door of Carr's shop has several Italian names carved into the wood.

The office building on the Smallcleugh dressing floor recorded by Jackson (1969a) has now collapsed. The concrete machine beds are visible in the vicinity of the Smallcleugh dressing plant, as are wooden board-covered floors. On the opposite side of the river is fine shop at the entrance to the Caplecleugh High Level (Plate 12).

## 7.12 BOUNDARY STONES

The Alston Moor plan of 1773 (Fig. 3) shows a series of boundary stones between the estates of Alston Moor and Priorsdale, at the southern limit of the Nenthead mining region. One of these stones (No.3) can be seen close to Perry's Dam (NY784418). A nineteenth century boundary marker can also be found on the south side of the Nenthead-Garrigill road, in a field at the western end of the Dowgang Hush (NY771427). The stone marked the limit of the London Lead Company's lease and was erected in 1849 (Plate 13).

# 8. UNDERGROUND FEATURES

The principal accessible levels in the Nenthead region are described below. These levels can still be followed for several kilometres, and connections are possible between some of the different workings. The main haulageways are generally in good condition when well arched - but the principal hazard is where the arching has collapsed in the shale wall rocks. In such cases ground conditions can be very bad with large slabs of shale hanging in the roof and deep water is often backed up behind shale falls. Wooden pit work in the shafts and rises is now rotting, and although some ladder ways are still climbable they should be treated with care. Collapsed rises form blockages to many of the levels.

## 8.1 NENTSBERRY HAGGS LEVEL

The entrance to the Nentsberry Haggs Level on the Nenthead to Alston Road is closed by an iron gate (NY767450). A moderate volume of water flows along the level and is channeled out of the level mouth beneath the main road. From the entrance the level runs generally ENE for about 610m in the sandstone beneath the Four Fathom Limestone. Passing up through the strata into the Great Limestone, the NNW trending Carr's Cross Vein is reached. Between Carr's Cross Vein and Wellgill Vein (210m further east), the strata are downthrown in a trough. Wellgill Cross Vein is reached 775m from the entrance,where the level branches both north and south.

The branch to the right runs SSE along the Wellgill Vein for about 600m to a large chamber containing two large wooden ore hoppers directly beneath the workings of the Brownley Hill Mine. During the Vieille Montagne Zinc Company's trials in the Brownley Hill Mine ore was passed down these hoppers and trammed out of the Nentsberry Hagg's Level.

The main branch of the Haggs Level is to the left at the Wellgill junction. The first part of the level rises steeply, until after a further 200m the level turns to the right. Ahead, a back-filled flank level rises upwards along the continuation of the Wellgill Vein. It is believed that the flank level gives access to the western part of the High Raise Vein. Past the bend the main level continues on a northerly bearing, and a deteriorating roof condition has resulted in several sections of deep water.

High Raise 2nd Sun Vein is reached 300m past the flank level. The main level here is in the shale 15m below the base of the Great Limestone. Flat mineralisation has been worked above the level during the present century for sphalerite and witherite. Two rises give access to these workings. The first rise, by the side of the main level, is not climbable. A short drive to the east along the High Raise 2nd Sun Vein leads to the foot of the second rise (Bowman's Rise).

Returning to the main level, it continues in a northerly direction for a further 200m, to where the level is totally blocked. During 1981 the workings, past the blockage were investigated from Wellhope Shaft (Richardson, Pers. Comm.).

## 8.2 HUDGILLBURN MINE

The entrance to the celebrated Hudgillburn Mine (NY752456) has now badly collapsed, with little possibility of any access.

## 8.3 BROWNLEY HILL LOW LEVEL

The entrance to the Brownley Hill Low Level (NY776447) can be reached by taking the track which leads from the Nenthead-Alston Road, on the NW side of the village at Nenthead Bridge. The level is driven almost straight for 350m, to the intersection with the Wellgill Cross Vein. At the junction with the Wellgill Cross Vein, a shaft on the right takes water down the branch level from Nentsberry Haggs Mine. During the Vieille Montagne Zinc Company's trials in the Gudhamgill section of the Brownley Hill, ore was tipped down this shaft and trammed out of the Hagg's Level.

Turning left along the Wellgill Cross Vein the level leads over two small falls to extensive flat workings on the right (north) side of the vein. These flats were developed on two levels during the last re-working of the mine in the 1930's, and contain many relics from this period (Plate 14).

Returning to the main horse level and continuing ahead from the Wellgill branch, the passage reaches a second junction 100m. further on. The level here branches north and south along the Gudhamgill Burn Cross Vein. To the right (south) a long stretch of difficult passage leads to a fall, just before the Gudhamgill Vein is reached (Fig. 8). To the left (north) leads to a complex of workings on the Brownley Hill and Brownley Hill North veins, which have not been fully explored by the author.

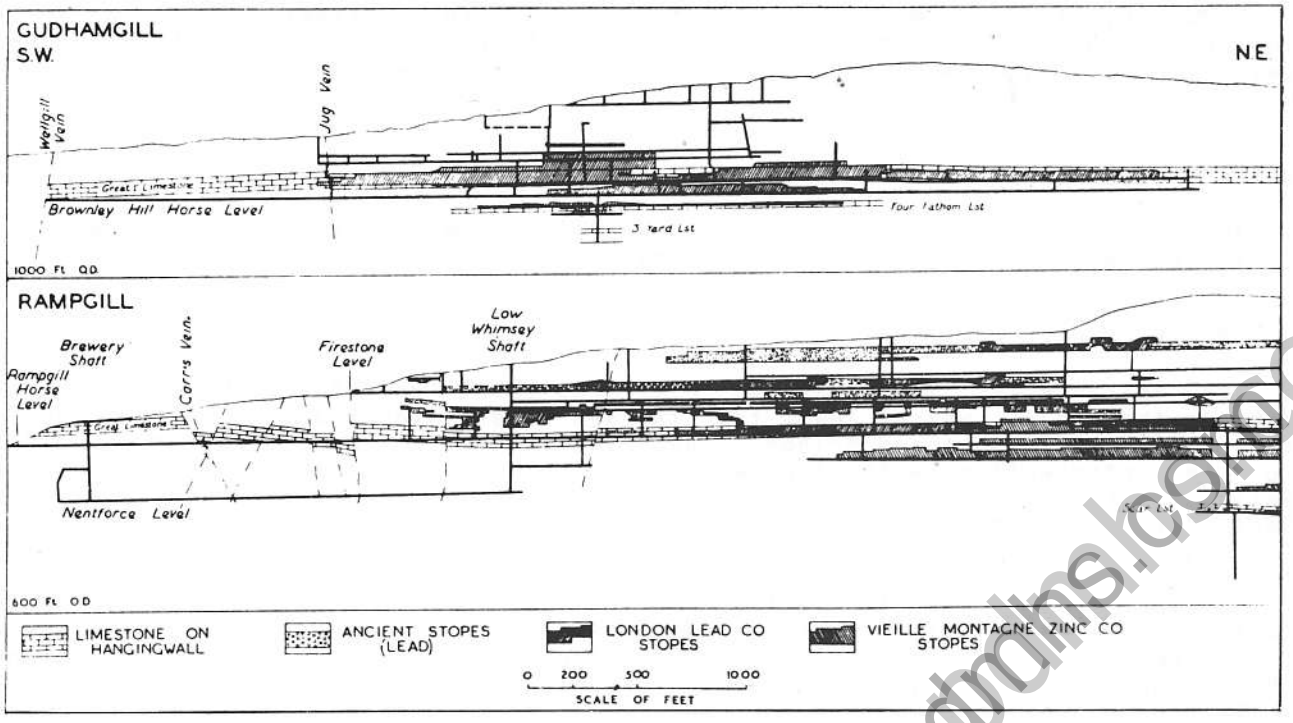
## 8.4 CAPLECLEUGH MINE

The Caplecleugh Level (NY781435) is situated on the west bank of the River Nent, 300m south of the Rampgill dressing mill (Plate 11). It can be reached by following a rough track from the Nenthead village. There are two entrances to the level, but the most commonly used is the obvious one, just above river level. The first part of the level is in good condition and leads past two branch levels on the right. These branches gave access to the workings on the Dowgang and Brigal Burn veins. On the main horse level, just past the second branch, is a breeze-block room, which is believed to have been an underground magazine.

Past the magazine, the level soon reaches the foot of an incline, which was considered steep enough to install a signalling system for the horse drawn wagons (Plate 15). At the top of the incline, the level cross-cuts to the Caplecleugh/Black Ashgill Cross Vein. This section of the level is frequently obstructed by roof falls and deep water.

Eventually the junction is reached with the Browngill Vein. Right at the junction (west) follows the Browngill Vein towards Longholehead Whimsey. Straight ahead are workings on the continuation of the Black Ashgill Cross Vein. To the left (east) at the junction also follows the Browngill Vein, and several rises from the level give access to the flat workings in the Great Limestone (Figs. 8 and 10). James Hill's branch level on the left, 320m east of the Black Ashgill/Browngill junction follows the Caplecleugh North Vein to a forehead. Just before the forehead are the remains of a wooden, water powered ventilation fan.

Continuing eastwards along the Browngill Vein, the level is again obstructed by roof falls and deep water. The foot of the Bogg Shaft is reached a further 320m past the branch to the Caplecleugh North Vein, and is recognisable by the large pile of collapsed wood from the pit work. Past the Bogg Shaft, the Browngill Vein cuts through the Middlecleugh Vein and from here the Caplecleugh




*Longitudinal sections, Gudhamgill and Rampgill veins.*

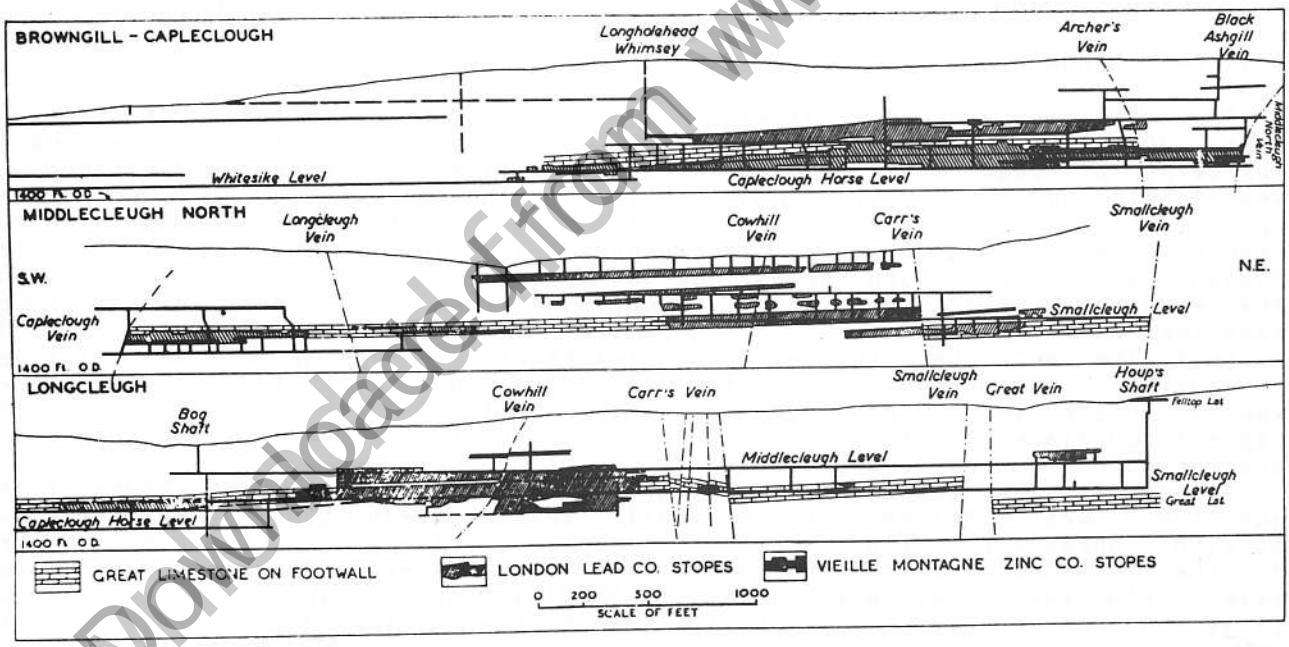
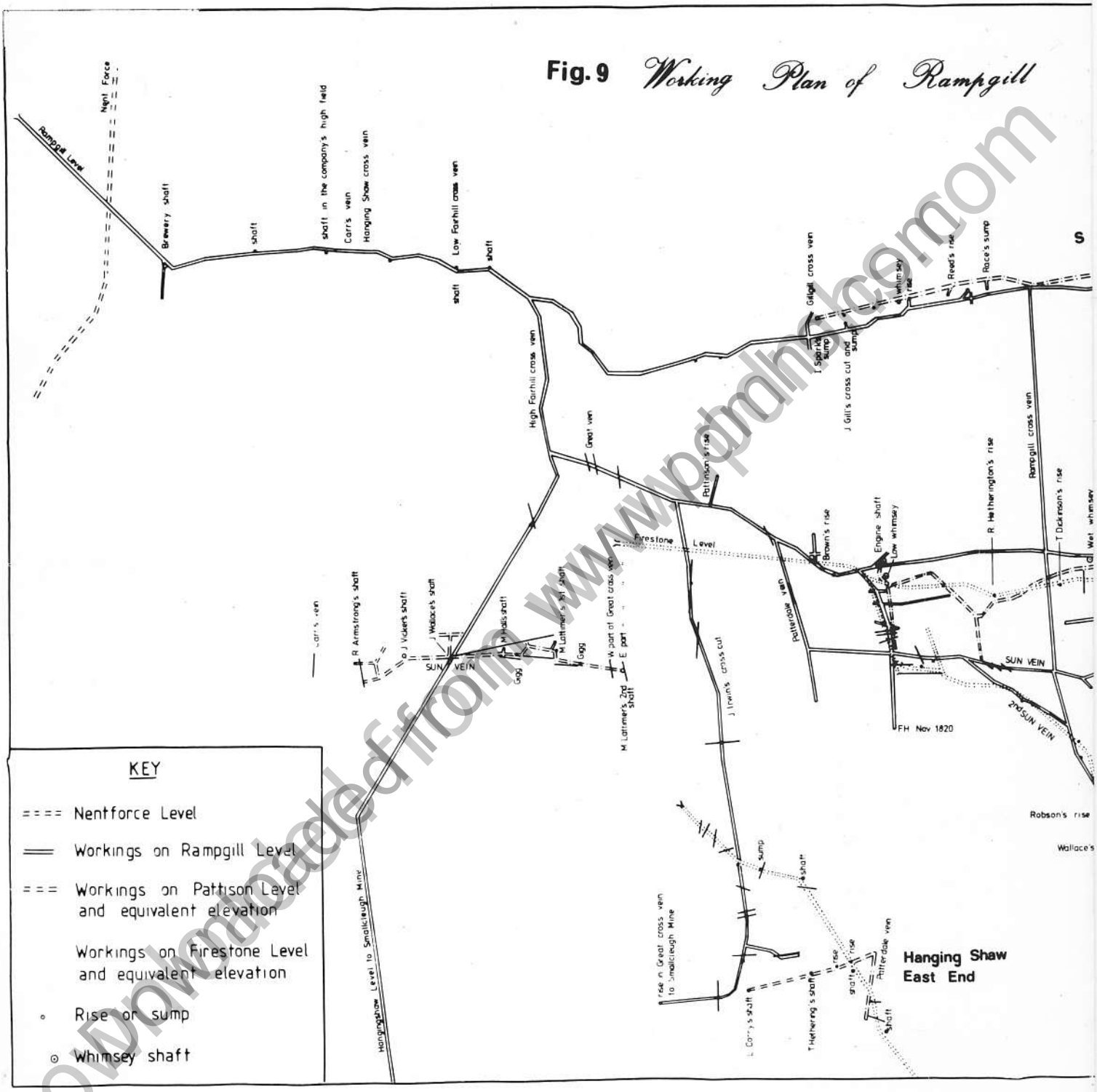
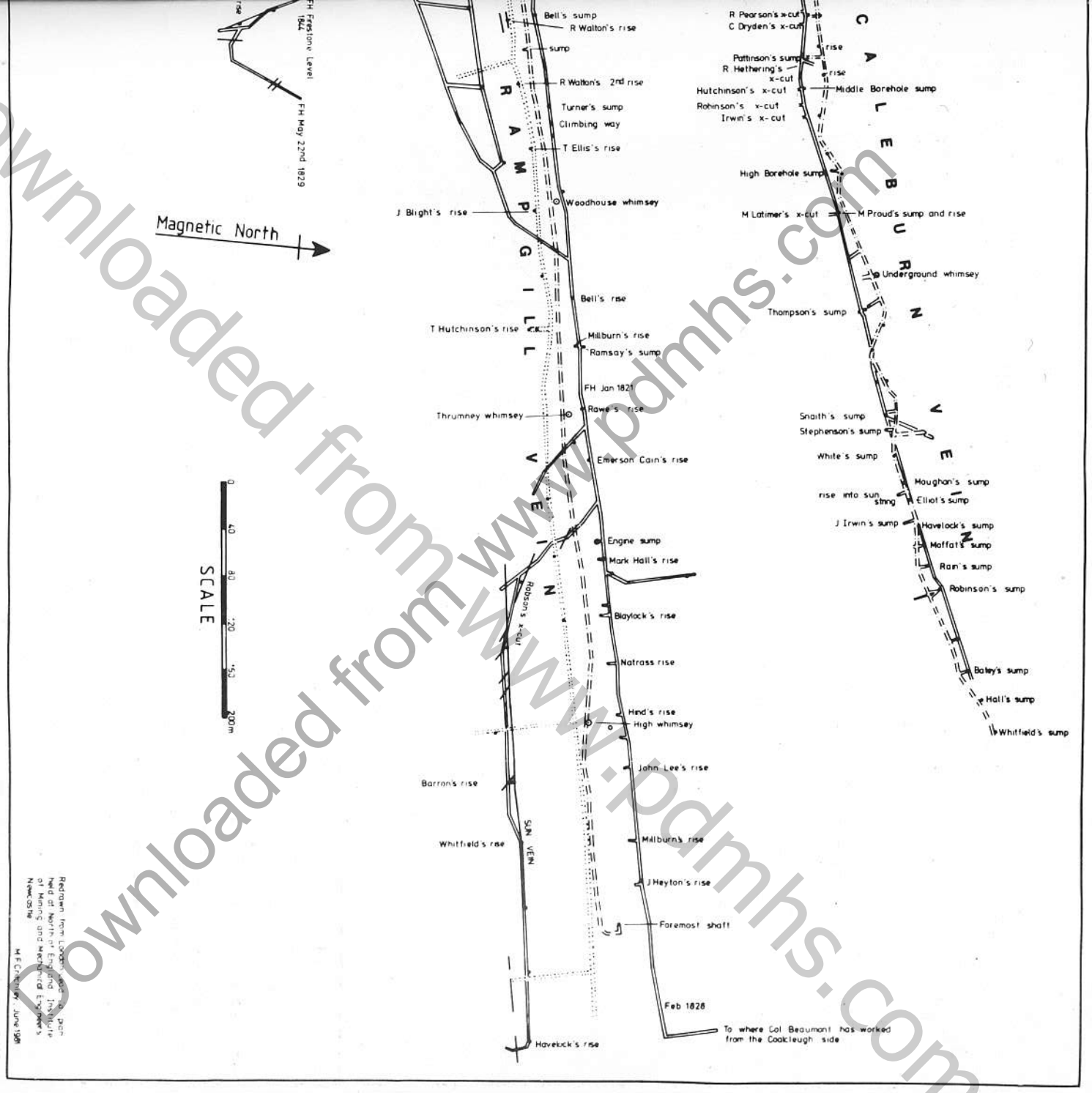



Fig. 8. Cross sections of the principal vein workings at Nenthead (from Dunham, 1948. Reproduced by permission of the Director, British Geological Survey (NERC): Crown copyright reserved)

**Fig. 9** *Working Plan of Rampgill*





Level turns ENE and continues the rest of its course along the Middlecleugh 2nd Sun Vein. At 230m after joining the Middlecleugh 2nd Sun Vein, a short cross-cut is reached on the left, which leads to the flooded Middlecleugh Sump. A short distance past the Middlecleugh Sump, the Caplecleugh Level intersects the Cowhill Cross Vein. A laddered rise, just before the intersection leads up to a sub-level beneath the Smallcleugh Level. A further short rise up from the sub-level enters the Smallcleugh Mine.

## 8.5 RAMPGILL MINE

The entrance to the Rampgill Mine (NY782435) is adjacent to the chicken farm, on the left of the track from Nenthead to the Smelt Mill, and opposite the Caplecleugh Level. The portal is covered by an old iron gate.

### Brewery Shaft

The Brewery Shaft is reached about 100m from the portal (Fig. 9). The level here is 28m (93ft) below the shaft collar and the shaft continues downwards for a further 80m (262ft) to the Nentforce Level. Much of the pitwork and piping associated with the hydraulic compressors can be seen in the shaft. A descent of the shaft in 1982 revealed that the compressors and generators were still in situ at the shaft bottom (Wilkinson, 1983).

Past the Brewery Shaft, the level continues to a junction. Ahead at the junction are the Scaleburn Vein workings. To the right High Fairhill Cross Vein leads to the main Rampgill workings and the branch level beneath Smallcleugh Mine (Hangingshaw's branch level).

### Scaleburn Vein workings

The section of the level along the Scaleburn Vein leads through a series of stopes to a blockage about 400m from the junction. Just before the blockage a series of stone steps of the left gives access to a sub-level haulage system on the Scaleburn and Rampgill cross veins. The rotting remains of wooden rails are present in these sub-levels.

### High Fairhill Cross Vein

Returning to the main Rampgill Level, the right branch at the Scaleburn Junction leads along the High Fairhill Cross Vein to the 'Whiskey Bottle' junction. The branch to the left at the junction follows the Rampgill Vein workings and ahead is the Hangingshaw branch level. The other branches from the junction are short.

### Rampgill Vein workings

Following the Rampgill Vein eastwards (Fig. 8) from the Whiskey Bottle junction, a section of broken ground is quickly reached where the level passes through the Great Cross Vein. The first main branch on the right is another cross-cut to the Smallcleugh Mine and can be followed for 440m to the foot of a rise up to the Smallcleugh Mine on the Great Cross Vein. Beware of bad air circulation in this cross-cut. The second branch encountered along the Rampgill Vein, leads off again to the right. This branch is driven along the Patterdale Cross Vein and leads to the workings on the Rampgill Sun Vein.

The Low Whimsey Engine Shaft is reached at 370m from the Whiskey Bottle junction. This shaft continues down to the Nentforce Level and marks the termination of the Nentforce Level. An old iron kibble stands near to the shaft on the horse level (Plate 16), and just past the shaft a short ladderway leads up to the winding engine chamber.

The main horse level continues eastwards from the Low Whimsey Shaft to the junction with the Rampgill Cross Vein. The workings on the Rampgill Cross Vein can be followed to the north (left) for 200m, almost to the point where the cross vein meets Scaleburn Vein. To the south (right) at the junction, the Rampgill Cross Vein links up with the previously noted workings on the Rampgill Sun Vein.

Thirty metres past the junction with the Rampgill Cross Vein, the main horse level is blocked by a fall.

Hangingshaw branch level

Returning to the Whiskey Bottle Junction, the drive to the south (left if returning along the Rampgill Vein Level) is the Hangingshaw branch level. This level was driven in the mid-nineteenth century beneath the workings of the Smallcleugh Mine, giving access to the eastern ends of the Middlecleugh veins. After 350m the level turns SSE on meeting the Smallcleugh Cross Vein and follows this vein for the rest of its course.

At this point a short branch level on the right follows the Hangingshaw Vein. Old stopes in the roof of this branch level connect upwards to the Carr's Level workings 20m. above. The Hangingshaw branch level has been followed for a further 320m along the Smallcleugh Cross Vein to a fall. The level has not been pushed past this point because of the deep water behind the fall, but it must be close to the beginning of the Smallcleugh workings.

## 8.6 RAMPGILL FIRESTONE LEVEL

The Rampgill Firestone Level (NY787434) has not been explored during the present investigations. It is believed to contain several sections of dangerous false flooring (Jackson, Pers. Comm.).

## 8.7 CARR'S LEVEL

The entrance to the Carr's Level is situated on the east bank of the River Nent, 180m upstream from the smelt mill (NY785431). The portal to the level is partly blocked by waste tailings from the Smallcleugh dressing floor, and the first part of the level is driven through shale beneath the Great Limestone. At 70m from the entrance, the Carr's Cross Vein is reached at a recently timbered section. A branch to the right at this point leads to a blockage after 70m. The far side of the blockage can also be reached from the workings on the Force Vein, at the foot of the waterfall, 170m upstream from the Carr's Level entrance (NY786430).

Ahead, through the timbered section, the Smallcleugh Cross Vein is reached after another 100m. Between the Carr's and Smallcleugh Cross veins are small workings along other cross veins. On reaching the Smallcleugh Cross Vein, the level turns and follows this vein. Soon after joining the Smallcleugh Cross Vein, there is a short crawl over a fall. Past the fall a sump on the right, draining a small volume of water, must link to the Hangingshaw branch of the Rampgill Level, 20m below.

Past the sump, Carr's Level continues to another junction at the intersection of the Smallcleugh Cross Vein and the Hangingshaw Vein. Ahead the level is blocked. It is possible to reach a continuation past the blockage by following a route through the flats above the level as described below. To the left at the junction the workings along the Hangingshaw Vein run eastwards for 90m to a fall at a rise. Just before the fall, a large shaft enters the roof. The position of this shaft coincides with a surface depression to the east of the Smallcleugh Dam (NY788431).

Returning to the junction of the Smallcleugh and Hangingshaw veins, a 12m rise can be climbed to the flat workings above Carr's Level. The flats can be followed to the east, to the shaft just noted on the Hangingshaw Vein. To the south is a complex of small headings following of the line of the Smallcleugh Cross Vein. A branch to the right (west) from the southerly set of flats leads to a narrow shaft in the floor. The passage on the far side of the shaft has been explored to a massive open engine shaft. The surface position of this engine shaft is at the southern end of the Smallcleugh Dam (NY787430). The narrow shaft in the floor of the passage can be descended for 12m to the continuation of the Carr's Level along the Smallcleugh Cross Vein. On re-entering Carr's Level and proceeding southwards, a sump in the floor is reached, which has been descended to the Hangingshaw branch level of the Rampgill Mine. Past the sump, Carr's Level is again blocked, probably not far

from the beginning of the Smallcleugh Mine workings, 19m above.

## 8.8 HODGSON'S LOW LEVEL

Hodgson's Low Level (NY784431) is accessible for a short distance to some small stopes.

## 8.9 CAPLECLEUGH HIGH LEVEL

Caplecleugh High Level (NY786429) is situated on the west bank of the River Nent by an old ruined shop (Plate 12) and opposite Smallcleugh Level. It can be entered directly via the original portal or by a stone staircase 100m to the south. The level is generally 1.3m high and has been followed for 500m to a fall. Up to the fall the level is concrete-lined, as the level was used as a spillway from the hydraulic compressers in the Bogg Shaft. Water is backed up close to the roof on the far side of the fall and because of this the level has not been explored past here.

## 8.10 SMALLCLEUGH LEVEL

Smallcleugh Level is undoubtedly one of the most extensive mines in the Nenthead region accessible today (Fig. 10). The entrance is inconspicuous, on the east bank of the River Nent, 700m south of the Smelt Mill (NY788429). The first 130m of the level follows a sinuous course in the lower part of the Coal Sills, until a shaft is reached in the floor. Care should be taken near to the shaft, it has aleady been the scene of a fatal accident in September 1983. Today this shaft is known as the Water Blast Shaft, but whether it was used for a water blast is unknown. This shaft, along with most of the sumps along the main Smallcleugh Horse Level was sunk to reach the Great Limestone on the west side of the Smallcleugh Cross Vein. The shaft and the sumps would have linked through to the Carr's Level, but only short sections of this level are now accessible by descending one or two of the sumps.

A few metres past the Water Blast Shaft, the Smallcleugh Cross Vein is reached and the level branches. From here there are two routes to the inner reaches of the mine. To the right the main horse level provides a direct, but a wet and occasionally dangerous route. To the left the Hard Cross-Cut takes a dry, but complicated route through the Smallcleugh Flats.

### Main Horse Level

The main horse level follows the Smallcleugh Cross Vein for 870m from the Hard Cross-Cut junction to the Middlecleugh 2nd Sun Vein. The route is straight forward, but is dangerous due to badly collapsed arching and water backed-up behind falls. It is not recommended for the inexperienced.

A few metres after following the horse level along the Smallcleugh Cross Vein, a low passageway ascends on the right. This leads up to a stone arched chamber, which probably housed a horse winding whim. Continuing along the horse level, several cross-cuts originally linked the level to the Smallcleugh Flats on the eastside; although only a few of the cross-cuts are passable today. The first cross-cut on the left is only short, and leads into the 'Old Fan Flats', in which a hand- driven ventilation fan was discovered (Wildridge, 1969). The second cross-cut is the Gulleyback Cross-Cut, and the third is the Old Flat Cross-Cut; neither of these can be followed easily. The fourth cross-cut joins the horse level next to a partly collapsed sump. This is the Flat Cross-Cut, and it leads into the southern end of the main Smallcleugh Flats. This cross-cut can also be reached by following the alternative route along the Hard Cross-Cut.

Ahead, from the Flat Cross-Cut, the Horse Level deteriorates rapidly. A cross-cut on the right leads into the badly preserved workings on the Middlecleugh North Vein (Fig. 8). Continuing along the Horse Level, the passage eventually opens out at the junction with the Middlecleugh 1st Sun Vein on the left. The alternative route through the Smallcleugh Flats rejoins the Horse

Level here. The Horse Level continues for a few metres until the Middlecleugh 2nd Sun Vein is reached, where the level turns to the right and follows this vein westwards. The level at this point is partly obstructed by a fall.

## Hard Cross-Cut

The alternative route along the Hard Cross-Cut reaches the main flats after 250m. The flats open out on both sides of the cross-cut, and the passage straight ahead leads to a blockage. Two other passages enter the flat at roof level. To the left (south) a passage leads to the shaft down to the Rampgill Mine on the Great Cross Vein.

The passage to the right is the way on through the Smallcleugh Flats. Immediately after climbing up, the passage enters a boulder strewn flat which can be followed until a route down through the boulders on the left can be taken. The passage is then a bit easier and, passing a trench in the floor, a short climb up into a chamber is reached. A drop down on the right when entering the chamber leads to a short crawl to a junction. Turning left at the junction leads to an arched horse-way. Following this horse-way to the right, a wooden door is reached; on the far side of this is a ramp up to the 'Incline Flats'. Between the door and the ramp on the horse level are several well preserved ore hoppers (Plate 17).

Continue along the horse-way, going straight ahead at any junctions. Finally, the horse-way turns to the right along the Gullyback Cross-Cut. The way on is to climb up into the flats ahead and then drop down into the Flat Cross-Cut. The Flat Cross-Cut can be followed westwards until it rejoins the main horse level. About 100m before the cross-cut meets the horse level, a passage on the left leads to the 'Wheel' Flats. At the far end of the 'Wheel' Flats, where the passage turns to the left, a low passage on the right leads through to the Middlecleugh 1st Sun Vein. Turning right along the Middlecleugh 1st Sun Vein rejoins the main horse level again.

## Ballroom Flat and Elliott's String

From the junction of the Middlecleugh 1st Sun Vein and the main horse level, turn back along the Middlecleugh 1st Sun Vein for about 30m to a large pile of shale. Two passages branch off to the right: the left hand passage follows the Smallcleugh Cross Vein through a series of stopes, until a branch on the right is encountered along the Elliott's String. The short drive along the Elliott's String leads to the Hydraulic Shaft, which should connect downwards with the sub-level from Carr's Level. Continuing along the Smallcleugh Cross Vein, the next branch on the left leads into the Ballroom Flat. Ahead, past the entrance to the Ballroom Flat, leads over a fall (at a rise up to Middlecleugh Level) to parts of the workings on the Longcleugh Vein.

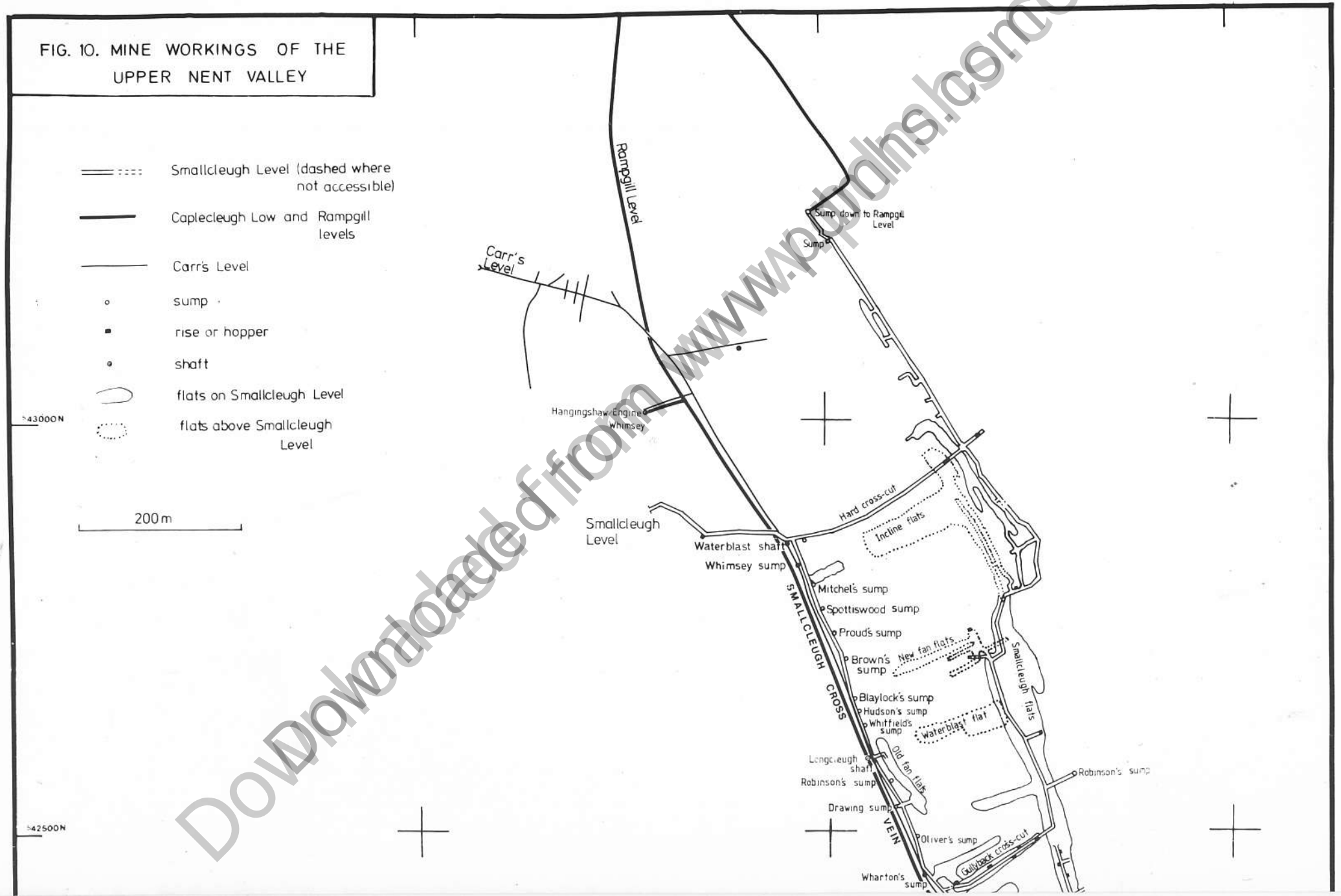
## Middlecleugh 2nd Sun Vein

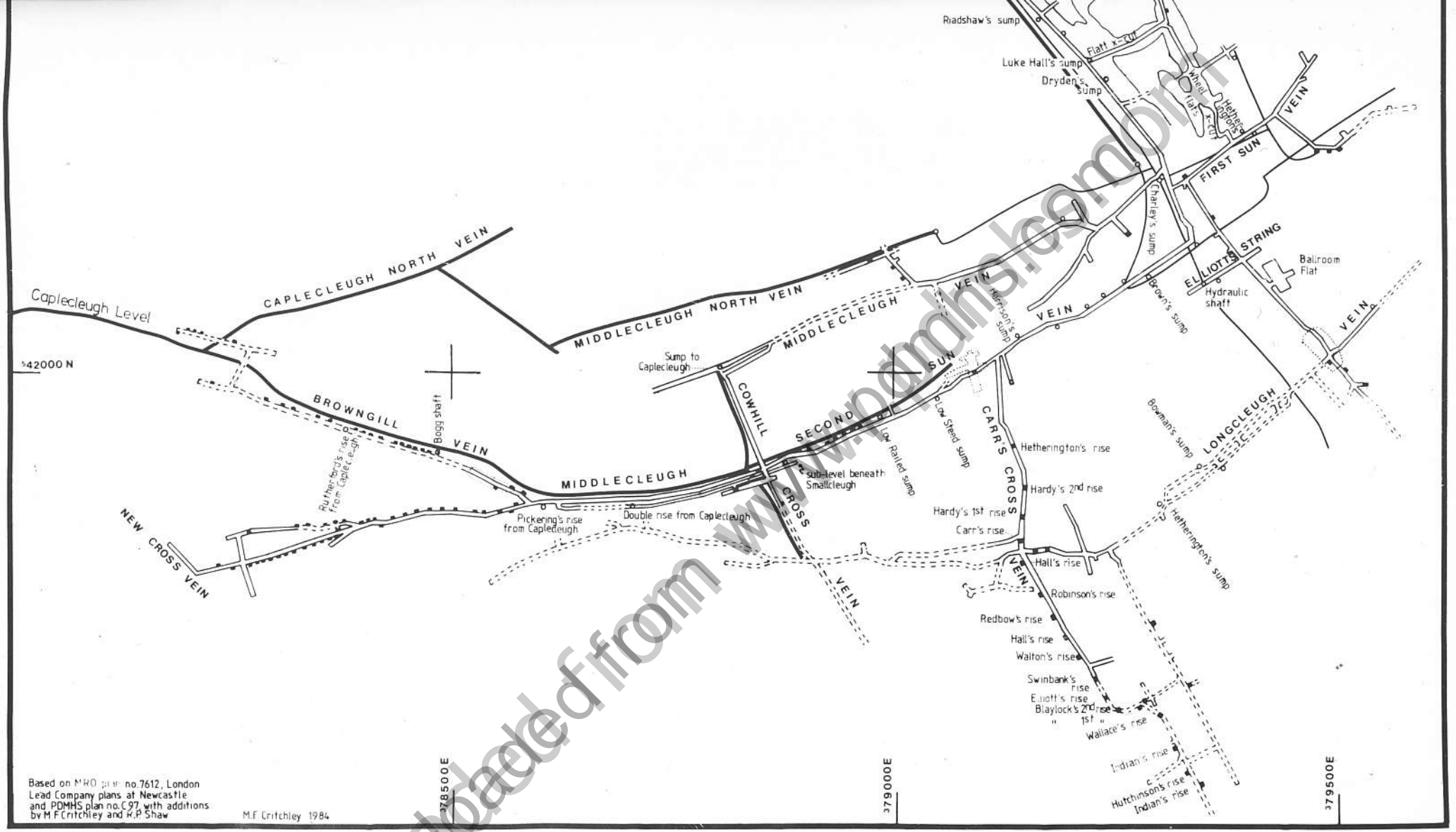
The Middlecleugh 2nd Sun Vein workings can be reached by the direct route along the horse level, or, if preceding via the Smallcleugh Flats, turning left where the main horse level is rejoined. The start of the horse level along the Middlecleugh 2nd Sun Vein is partly blocked by a fall at a rise. Crawling over the fall, the level opens out and 250m further on are two passages on the left. The first passage leads to a sump. The second, a drive along the Carr's Cross Vein, can be followed through some very low crawls to the workings on the Longcleugh Vein. Air circulation is very POOR in this passage.

A further 300m past the Carr's Cross Vein, the horse level on the Middlecleugh 2nd Sun Vein reaches a large shale fall at a collapsed hopper, with passages leading off to the left and right along the Cowhill Cross Vein. To the left leads to a large stope, at the bottom of which is a short drop into a sub-level. This sub-level leads in turn to a laddered shaft (Double Rise) down to the Caplecleugh Level. Returning to the Middlecleugh 2nd Sun Vein, the branch passage to the right at the fall leads to some badly collapsed stope workings on the Middlecleugh Vein.

The fall on the Middlecleugh 2nd Sun Vein, at the junction with the Cowhill Cross Vein, occurred in the late 1930's, when the mine was being abandoned (Richardson, Pers. Comm.). The fall was dug out by members of PDMHS in the

FIG. 10. MINE WORKINGS OF THE UPPER NENT VALLEY





Summer of 1981. The level on the far side of the fall is generally in good condition and can be followed down a shallow incline. About halfway down the incline a short drop on the left leads to a sub-level heading back towards the Cowhill Cross Vein. At the bottom of the incline Pickering's Rise down to the Caplecleugh Level is also passed on the left. Just beyond Pickering's Rise is a junction. Right at the junction should lead to the Bogg Shaft, but the passage is blocked after about 50m. Continuing ahead on the main level from the junction leads to the western forehead of the Smallcleugh workings on the New Cross Vein.

### 8.11 MIDDLECLEUGH LEVEL

The Middlecleugh Level can be reached by following the River Nent southwards from the entrance to the Smallcleugh Mine, until the Middlecleugh compressor house is reached. The River Nent then turns SW and a track on the left (east) follows Long Cleugh Burn. Almost immediately the stream forks and following the right branch alongside the waste tip leads to the entrance to the Middlecleugh Level (NY789425). Most of the workings in the Middlecleugh Level were driven within shales and are thus badly collapsed.

The entrance section of the level is completely straight for 750m to the Longcleugh Vein and carries a large water pipe along its floor. There are several branch passages along the entrance level. The first passage on the left at 350m from the portal follows the Middlecleugh North Vein. About 200m along this branch a drive on the right gives access to several sumps along the Smallcleugh Cross Vein (Plate 18). Past this branch the passage continues eastwards, then turns southwards to meet the Longcleugh Vein. This should follow the Longcleugh Vein back to the end of the entrance level, but it is now blocked. Returning to the entrance level, a backfilled passage opposite the Middlecleugh North Vein branch should lead to the Bogg Shaft.

At 500m along the entrance level a sump on the left takes a small volume of water. Opposite the sump, on the right, is a branch passage which has been followed through several falls to a complete collapse.

## 9. CONCLUSIONS

The Nenthead region formed a major centre of lead mining in northern England, rivalled only by the Beaumont concerns in West Allendale and at Allenheads. The success at Nenthead was due to the compact nature of the mineralisation and to the ease of access from adits, such that restrictive and expensive shafts were less necessary. Also of importance was the controlling influence of the Commissioners of Greenwich Hospital; the Commissioners allowed competition between the various mining concerns in the area and did not impose restrictive conditions on the mineral leases. The London Lead Company was probably the greatest contributor to the success of the mines, not only by introducing a rationalised and unified system of mining, washing and smelting, but also by their invention and introduction of new technology to reduce expense and time. During the early twentieth century the increased demand for zinc led to a revival of the district, however it is doubtful whether the mineral reserves will be sufficient to attract new mining today. The only possible economic reserves are the lead-zinc-barite-witherite deposits at the Nentsberry Haggs Mine, but here the mine levels are too narrow to allow modern mining methods to be used.

The surface and underground mining relics at Nenthead today must form one of the largest such collections in the Pennines. In the past there has been no problem of access to these remains, but increasingly there are objections to visitors, especially underground explorers. I hope that this trend can be reversed so that all those interested in mining history can view these splendid remains. Since 1979, Mine Tours Ltd. have been trying to open a show mine on the Nenthead site. There has been opposition to the plan from some mining quarters, but this plan should help to preserve the mining remains and it is hoped relieve the access problem for those with a genuine interest.

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Plan no. R318B:- Plan No. 3 (of the Manor of Alston Moor?), no date.
Plan no. 1762:- Abandonment plans for Nenthead Mines, Vieille Montagne Zinc Company, 1922 (7 plans).
Plan no. 15093:- Plan of Handsome Mea Cross Vein and the Smallcleugh Flats with a working section of Handsome Mea Vein.

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