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SMELT MILLS OF THE YORKSHIRE DALES - KELD HEADS AND PRESTON MILLS

by Richard Smith

SYNOPSIS

The remains of Keld Heads Mill are now covered with the rubble of a quarry and the flues which led to its condenser are rapidly being reclaimed by nature. The site is so overgrown that it is best visited in winter. Despite this, there is much to see and even more to interest the visitor who has taken the trouble to learn about the site as it was. For the inquisitive, the precise site of the older Preston Mill has still to be settled. Here is a site where watercourses abound, where mine, dressing floor and smelt mill are intermingled and where new features are found with every visit.

LOCATION

Keld Heads Mill is best approached from the Redmire to Leyburn road, which runs nearly parallel to the disused railway, which until recently served Redmire Quarry. Turn onto the eastern approach to Preston village, crossing the railway near Wensley station, and a group of houses is encountered. One of these is named Preston Mill and is shown on old maps as a corn mill. Leave the road, taking the track through the buildings. The extensive dressing floors are on the right of the track and can be found by following the smaller path which leads away directly in front. Here is the site of a garage and it is courteous to ask permission to visit the dressing floors.

The track leading past the chimney and engine house goes to the site of Keld Heads Mill by way of Tullis Cote Farm. The peat house is found at the site of the mill, the foundations of which are covered by quarry spoil. From here one of the most interesting smelt mill sites in Yorkshire can be explored. A word of warning, however. Much of the site is in dense woodland and some of the features can only be seen to advantage between autumn and spring when the trees are bare. Nevertheless, this is one of the most unusual situations for a Dales mill and one which will always repay a second visit.

HISTORY OF THE MILLS

The accounts of Clough, Raistrick and Gill refer to very few historical sources for either Preston or Keld Heads mills. In contrast, the metallurgical activities at Keld Heads mill have been described by Percy and Fallize and these accounts have been widely quoted by others.[1-5]

Both mills stand near the Chaytor Rake, which runs north to south from the Swaledale watershed in the north to the River Ure in the south. The Cobscar Rake runs roughly east to west from Apedale Beck and joins the Chaytor Rake just east of Cobscar Smelt mill. This would have been the most convenient mill for both veins as long as ore from the Chaytor Rake was being drawn out of shafts at the middle and north sections.

According to Backhouse, who was relying on oral tradition around 1906, the Keld Heads mines were opened by the Darwen Mining Co. and then by Keld Heads Mining Co from about 1844.[6] The latter company included Messrs Kirkby, Weston and Bowman. The mines were last worked by Kirkbys, a Leeds company, under the management of Thomas Dymond. The last agent was Mr F. Rodwell, a sanitary engineer from Leeds. Backhouse's account is self-contradictory in several places, while the *Yorkshire Mineral Statistics* show that the ownership and management was confused by some similar names and titles. (Table 1)

Table 1 - Management of the Keld Heads Mines and Mill[7]

Company		**Manager/Agent**		**Secretary**	
Keld Heads Co.	1860-75	A. Johnson	1866-68	J. Bowman	1860-65
		J. Coatsworth	1869-74		
Keld Heads Mining Co.	1876-79	T. Davidson	1875-76	T. Kirkby & Co.	1877-79
		C. Rodwell	1879-85		
		J.A. Rodwell	1879-81		
Thomas Dymond	1880-87	J.A. Rodwell	1886-93		
Lord Bolton	1888-97	Lord Bolton		F. Rodwell	1894-97

An indenture of June 5th 1854 in the Bolton Hall papers, however, refers to a more intensive development of the southern end of the Rake:-[8]

> *"And whereas the above have found it expedient to make new and extensive levels and other works, and it being requisite for the proper and economical working of the mine to convey the great bulk of lead ore .... along a newly made level which brings to the surface a great distance from Cobscar Smelt Mill, it has in consequence been found very inconvenient to carry such ore to Cobscar Smelt Mill. With the object not only of remedying such inconvenience, but with the object of adopting a new process for smelting .... it was some time ago agreed to lease Cote Green* [pasture], *and to erect at their own expence a New Smelt Mill with machinery, Buildings etc and a Patent Condensing House in Gill Plantation and a horizontal chimney up to the Old Cobscar Smelt Mill.*
>
> *Millage need not be paid as it was at Cobscar Mill. New Mill to be Lord Bolton's at the end of the Lease, and until the 24th July 1859 when the Patent for the Condensing House expires to be freed from the Duty of 1/6th Royalty from the smoke on the Condenser only and Flues.*
>
> *Mill, Chimney, Condenser etc, Flue of considerable length already complete but it is not certain whether the smoke will be sufficiently free not to be noxious, it has been decided to extend the flue to the moors.*

Lease of Cote Green and Thouker Pit, also Keldheads Smelt Mill with the Roasting House, Metal House, Ore Bins, Coal, Coke and Soot Houses and other buildings recently erected, Chimney to moor etc, the Agents House and Office, the Surface Agents House and Garden, Out Houses and Premises there unto respectively belonging to the Engine House, Workshops and other buildings and erections recently erected.

Lessor and other Lessees to have liberty to use the New Mill, paying 2 pence per cwt millage. To pay £4 - 4s - 2d rent. Half of the smelters to be appointed by Lord Bolton."

The clause referring to freedom from duty on fume caught by the condenser and flues is interesting. Typically it was the Mineral Lord's custom in Yorkshire to provide a smelt mill for the use of lessees and they were to return it in good repair at the end of the lease. This ensured that the Lord obtained his Duty in lead rather than in ore and eliminated a number of methods of cheating. The cost of putting in a condenser, with the risk of doubtful performance, high capital and maintenance costs, was only likely to be met by the Lord - the lessees were usually short of cash and preferred to use this for mining rather than to prevent smelting losses. (For example, when the question of installing a condenser at Surrender arose to alleviate damage to pastures around 1880, this very problem became apparent. Sir George Denys was prepared to fund the condenser, but wanted a share of the fume in return. The lessees were unwilling to accede and the condenser was never built. The mill closed soon after.) At Keld Heads, the lessees were obliged to install a condenser because of the proximity to low-lying pastures and received a relief of duty to recognise the asset which would revert to Lord Bolton at the end of the lease.

The 1856 O.S. map (surveyed in 1854) shows the condenser in place, but with the flue extending only shortly beyond, to about 1000 feet from the mill. The indenture shows that the mill and condenser had in fact been built by 1854 and that the extension of the flue to Cobscar chimney was completed in a later phase.[8] This map also shows that, in 1854, many of the significant features of the site had not been constructed, particularly the system of dams. The water supply relied heavily on the dam situated immediately north of the mill buildings (D2). This was fed from Keld Heads Gill and from mine levels near the chimney. The only other dams shown on the map of 1856 are the old disused one, which served Preston Smelt Mill, and a very small dam in the upper part of Gillfield Wood which was later extended (D7).

The routing of watercourses to the mill and condenser house was changed significantly after the extension.

The mill buildings shown on the 1856 map do not include the peat house or the large addition to the smelt mill (B2) at the NW corner.

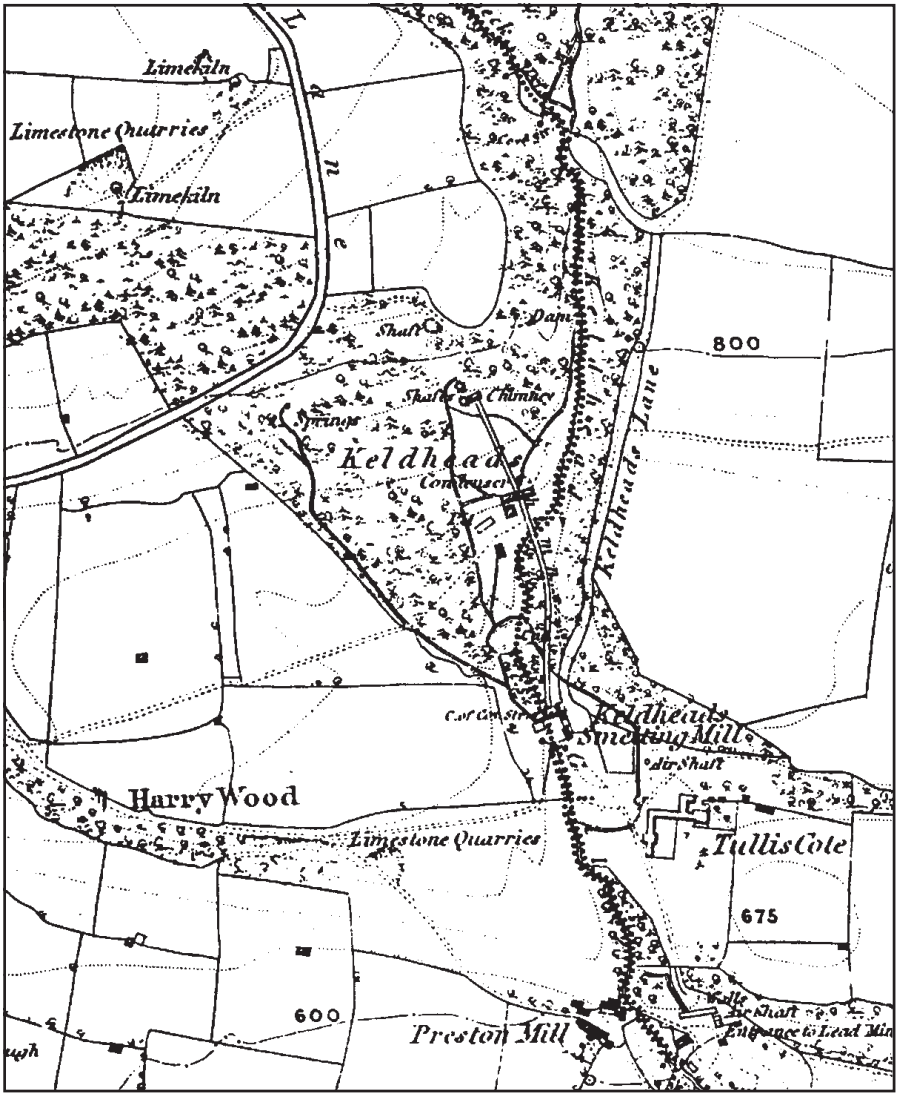

Fig.1 Keld Heads mill as shown on the O.S. 1/10560 Series 1856 Edition, Sheet 68.

Cobscar Mill is shown on the First Edition, 1/10560 O.S. map as '*Old Smelting Mill*', with no flue.

Smelting accounts shows that *"Waste Lead from the Chimney and Condenser of Kellheads Mill"* was produced from 1852 when 27 tons 8 cwt of metal was obtained.[9] The account ends in March 1860 and has the annotation *'free from duty'*. This is somewhat longer than the patent limit of July 24th 1859, referred to in the indenture. An account of *"Lead Produced from Smelt Mill Waste & Roasting Furnace - Belonging to Lord Bolton"* is not included here as the quantities are small (typically 1 to 10 tons/year) and it is not clear if this was Lord Bolton's share of a larger amount or not.[9]

Table 2 - Lead Produced from Chimney and Condenser, Keldheads Mill

Year	Date	Tons	Cwt
1852 to	21 August	27	8
1853	28 May	29	7
1854	9 August	46	15
1855	10 November	76	16
1856	20 December	85	0
1857	19 December	120	0
1858	9 October	86	2
1859	31 December	276	10
1860	12 March	40	11

In 1864/5 the mine was described as a silver producer and between 1875 and 1881 the silver content of the ore was equivalent to two to three ounces per ton. This should not be taken as evidence that silver was extracted from the ore, as at this level the return would have been marginal using either the Parkes or Pattinson processes. The only justification for silver extraction would be if parts of the ore had been richer. Raistrick states that silver was extracted and that in 1880 Keld Heads made 190 ozs (when the *Mineral Statistics* show 250 ozs of silver contained in ore).[2] This was possibly done in a small refining furnace with its own chimney, but the author has been unable to substantiate this statement from the references given by Raistrick.

Accounts of Keld Heads' smelting equipment by recent authors are confusing. Raistrick says the mill had three ore hearths, a slag hearth and possibly a refining furnace with its own chimney. He says there was no calcining furnace and that ores were not roasted before smelting. Furthermore, *"....flue dust was collected and calcined in a slag hearth until it began to melt and cohered in lumps which could be broken up for smelting...."*. Gill, quoting Percy, says that in 1868 *"...ore was no longer calcined before being put in the ore hearth...."*, suggesting perhaps that at some time it was, whereas Percy said that *"The ore at the Keld Heads Company's Works is not previously calcined"*.[3] The indenture of 1854 clearly refers to *"a Roasting House"*. In the late 19th century the New CB mill in Arkengarthdale had a roaster which

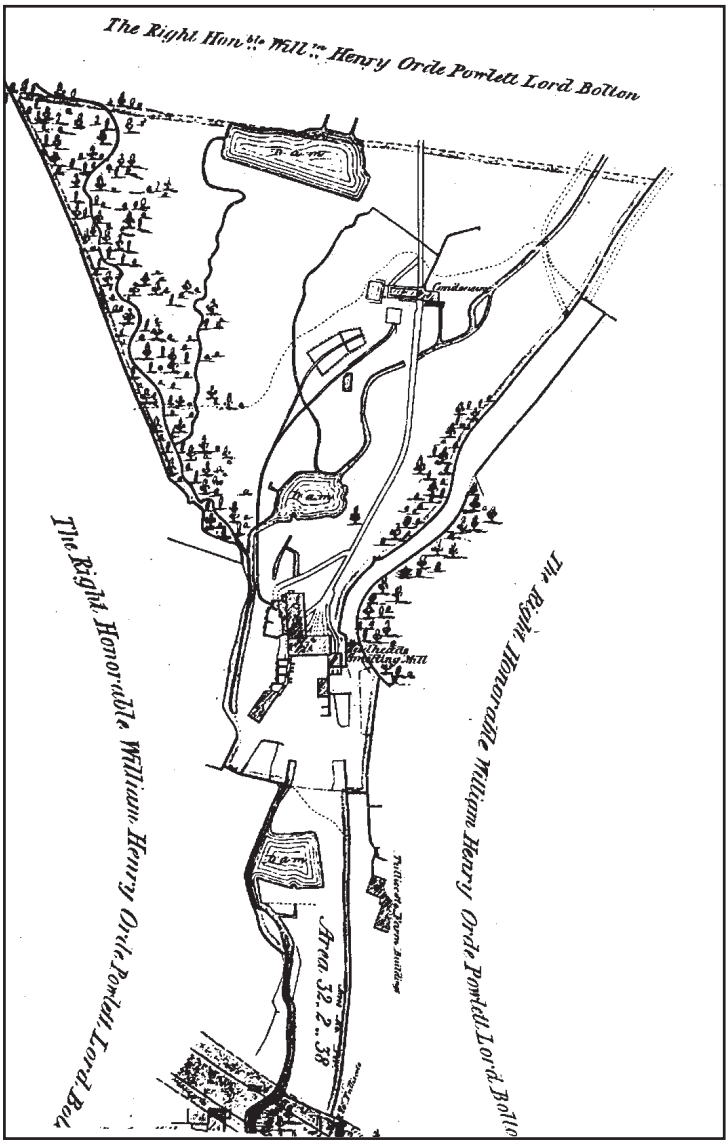

Fig.2 Plan showing a portion of the authorised and proposed lines of railway passing through the surface works of the Keld Head Mines 1866. (ZBO(L) 19 - MIC 2018/83-85).

the smelting accounts show was not used for treating '*bouse ore*', but was used for agglomerating soot and for roasting '*waste ore*', which were later smelted in a slag hearth.[10] If similar practices had been adopted at Keld Heads, the roaster would have been an important part of the smelting

equipment, although it would not have been used for '*bouse ore*'. This reconciles Percy's account with the 1854 indenture and has led to misinterpretations by later authors.[4]

Clough's reconstruction of the mill was undertaken at a time when it was covered in rubble and undergrowth and he gives an unusual complement of two slag hearths and three ore hearths with no roasting furnace.[1] As one slag hearth would be needed for about one day in every fortnight for three ore hearths, this seems unbalanced. In his second edition, he shows a photograph [Plate I] of the ruined mill and one of the settling floor and condenser wheel house [Plate II], both taken by James Backhouse in 1906.

Percy's account of Keld Heads states that, between June 1856 and June 1857, 1374 tons of lead were produced from ore and slag hearths and that the quantity of lead extracted from fume was 96 tons 13 cwt. (p.456).[4] His other data (p.283) give a smelting rate of 1.1 tons per shift for a single ore hearth. Therefore, if 1200 tons/year of lead were produced from the ore hearths in 300 shifts, the plant would have needed four hearths running to capacity on single shifts to achieve this total. Percy's data indicate that only one shift per day was worked at Keld Heads.

On the basis of the number of flues, it is proposed here that there were four ore hearths, one slag hearth and two roasting furnaces, one of which was part of the pre-1854 mill described in the indenture. When the extension to the mill was built, the new roaster was placed in a more accessible position for treating condenser fume.

The *Yorkshire Mineral Statistics* show that the Keld Heads and up to seven other mines (including Crina Bottom) produced ore until 1888, after which the mines are described as '*standing*', although it is possible that the mill closed in 1884 when ore returns only are recorded.[7] Backhouse states that after Captain Hill from Grassington carried out a survey on rising water, he advised closing the mine and this was done in 1888.[6] By 1906, the smelt mill was mostly dismantled and the condensing house was in ruins.

SITE FEATURES

The Keld Heads smelt mill site is one of the most complex in the Dales. Three main phases in its development are apparent:-

a) Pre-19th century workings and smelting typified by Preston Mill.

b) Intensive, focused lead mining of the mid-late 19th century when the Keld Heads operation was at its most active.

c) 20th century quarrying which overlies some of the earlier detail. The aerial ropeway, its support plinths and the large mound to the north of the site are examples.

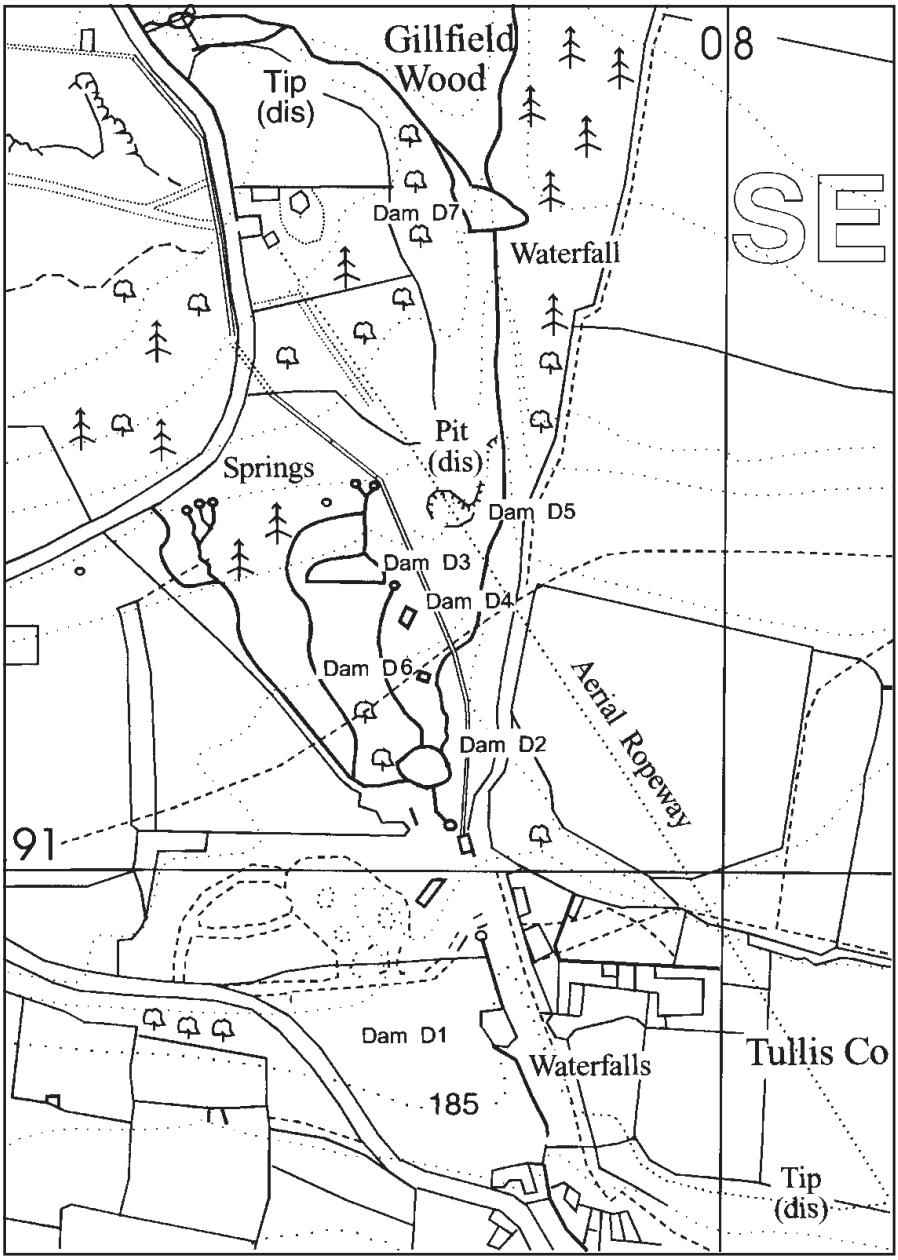

Fig.3 Plan of Keld Heads mill site showing watercourses, dams and flues.

It is convenient to divide the smelting site into five main areas and to list the features which occur within each:

1. The Peat House

1.1 The peat house is situated in a clearing at the side of the public right of way which runs north to south from the engine house to the private road leading to Tullis Cote Farm. Photographs are included in Clough and Raistrick.[1,2] Since these were taken, the roof has been replaced with one of corrugated steel and the building is now used by the farm. The peat house exemplifies the style built at Grinton, Blakethwaite, Marrick and the New CB Mill. It has four arches, side by side along the front wall, sufficiently large to permit the entry of a cart. There are windows above the arches to allow ventilation and it is situated near to the smelting house where the peat was to be used.

1.2 Keld Heads Gill emerges at this point from two culverts which run underneath the mill. Waste slags can be found on the east bank of the gill at this point. The slags are typical of many Dales mills (eg Surrender, Old Gang, Octagon, New CB, Prosperous, Providence and Cockhill) in that they have been crushed or granulated in water and have then cemented together by the action of air and water.[9]

1.3 The outflow runs into a dam (D1), which is now silted. It provided water for the dressing floors lower down the gill and is shown on the 1866 and 1912 maps. Opposite the lower buildings of Tullis Cote Farm, it is now evident as a wet marshy area with the gill running through. A loose print of the dam, "*Old reservoir below smelt mill - Keld Heads, the dam opposite Tullis Cote Farm*" is included in the Backhouse MSS, but is not on microfilm or photocopy.[6]

2. Smelt mill, Lower Flues and Smelt mill Dams

2.1 Behind the peat house and spilling over to the east side is a mass of quarry waste which covers most of the Keld Heads mill. By the main track, a single flue can be found, running into an annexe of the mill (Building B3). If this is followed, it leads to a complex of flues coming from the main smelt mill buildings and a track over the gill. The remains of the northern extremity of the mill project from the spoil heap.

2.2 Comparison of the site with the 1912 O.S. 1/2500 and earlier maps is not straightforward as some significant changes in the watercourses have taken place. The embankment, which runs north from the spoil heap, carried a small track or tramway connecting the smelt mill with the settling pits at the condenser house. The tramway crossed a branch of the gill at a bridge, the stone abutments of which are in place. The embankment swept round to the east and became the wall of the smelt mill dam (D2) about 50 metres above the mill. This dam is about four metres high and is of substantial construction. It has been breached at the centre where the gill now flows

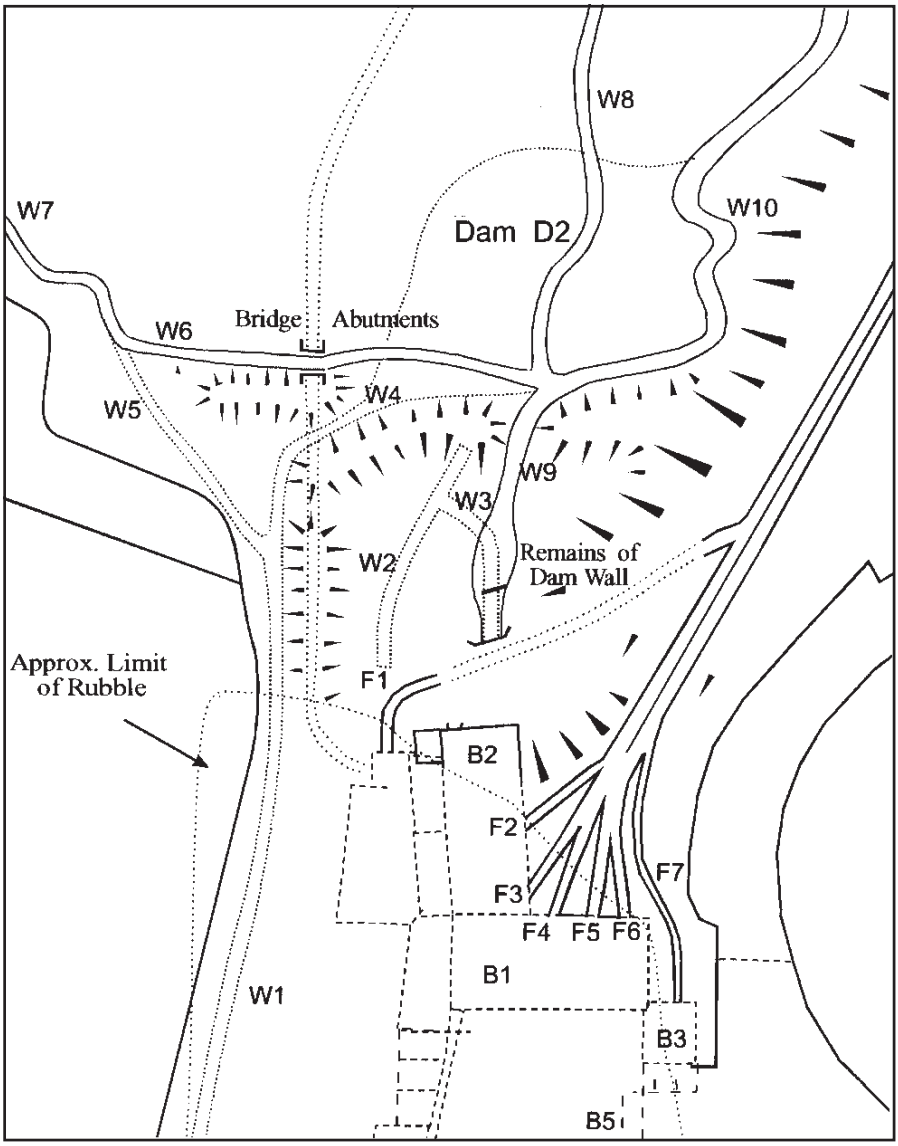

Fig.4 Detail of present features at the south part of the Keld Heads mill site.

and where pieces of railway track used for strengthening can be seen. The outflow to the mill was taken from the centre of the dam, where a section of masonry wall can be found. The leat to the mill shows as a shallow depression running south from this point.

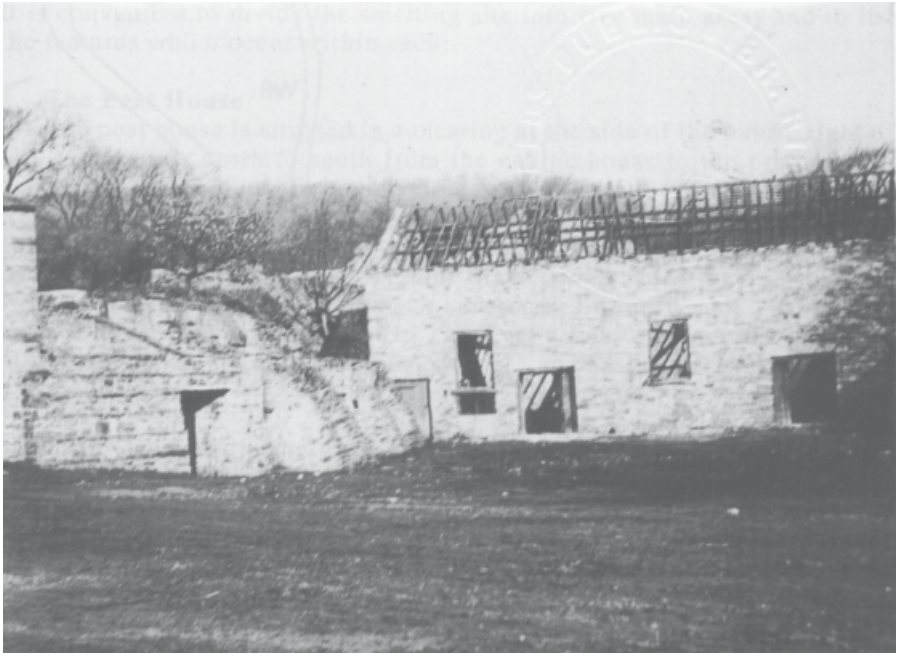

PLATE I. Keld Heads Smelt Mill (Leeds City Libraries - Backhouse Coll'n).

The main outflow from the dam ran westwards along W4, around the tramway embankment and passed about 20 metres west of the mill before going underground near the peat house. It then ran south-east to reappear at the emergence below the peat house (see 1.2). The beck, W7, which comes from the west side of the area, bypassed the dam, D2, and the smelt mill.

If the shallow depression (W2), which carried water to the mill, is followed southwards, traces of a spillway (W3) can be found running towards the stream. There is evidence that this was lined with stone and that a path ran alongside. It joins the stream (W9), which now carries the full flow of Keld Heads Gill just above a fractured weir of later date. The gill passes into a culvert which runs under the mill and reappears below the peat house.

The 1856 and 1866 maps show that all the streams on the west side of the site bypassed the dam, D2, and went into watercourse, W1, which ran round the west side of the mill. The 1912 O.S. 1/2500 map shows some changes - a cross-cut, W6, has been built to take water directly to dam D2 but the section of stream W5 has also been retained. The tramway crosses W6 at a masonry-lined cutting and also crosses the main dam outlet, W4, just before this. The crossing of W4 occurs at the point where the embankment sweeps round to form the dam wall and is evident as a gap in the embankment.

The watercourses were probably diverted because of the spoil heap which covers the mill site. This also covers the old course of Keld Heads Gill, round the west side of the mill (W1), as well as the leat (W2) which ran from the dam. The culvert, which now carries Keld Heads Gill, is shown on the 1866 map and was clearly built to carry a considerable flow of water, but not used for the waterwheels which were on the west side of the mill. The most probable reason for the culvert is that before the building of the smelt mill, Keld Heads Gill ran through the middle of the site and an underpass of some description would have been needed to take either surface water from the ravine south of the dam or leakage from the dam itself. It would have been relatively easy at this stage to construct the culvert before building the mill above. There is more than sufficient flow to power an undershot waterwheel, but this would have put the position of the wheel on the centreline of one of the furnace buildings and is, therefore, unlikely.

2.3 Before the extension, watercourses in this area were very different. There was no bypass around the west end of the mill, and mine drainage or spring water from above Tullis Cote Fram was also directed into the dam, D2.

Although the 1856 O.S. map is still not clear after enlargement, it suggests that the culvert's outflow was much nearer to the mill than it is today.

2.4 The smelt mill (Building B1) and peat house were laid out on two sides of a yard, around which there were ore bins, a rectangular building (B5, possibly an office, assay house or metal store) and a square annexe (B3) with its own flue. A second rectangular building, B2, approximately similar in size to the pre-1854 mill, ran at right angles and had three flues running from it. At the rear of this building were more bins and here the tramway embankment terminated.

The layout of the complex strongly suggests that it had been planned to accommodate the expected flow of materials. Ores from the dressing floors to the south would be carried by horse and cart to the bins in the smelt mill yard. Coal and peat would also be brought in and lead pigs would be taken from here. The yard would be the focal point of the smelting complex.

Settlings from the condenser would be brought along the tramway and the waggons tipped into the bin at the end of the line. One might expect that part of the bin would be covered to protect against rain and that some advantage could have been taken from the nearby flue to dry the settlings. The flue runs below the level of the embankment at this point and the 1866 map suggests that such an arrangement may have been used. It is, therefore, reasonable to suppose that the single flue (F1) on the west side of building B2 came from a roasting furnace used to dry and agglomerate fume settlings.

There are two single flues (F2, F3) coming from the east side of building B2. If the materials flow model is followed, at least one of these would have

served a slag hearth, which would have been appropriately situated to treat ore hearth slags or roasted flue dust.

The second flue (F3) joins three flues (F4-6), which run into building B1. These four are, in fact, two pairs and, from their construction, appear to have been built at the same time. Careful exploration along the flues, which all end in tumbled stone, has been necessary to confirm this.

Flue F2 joins the two pairs (F3-6) almost at right angles and could have been added afterwards. Flue F1 is completely separate and joins the system high above the gill. It is missing for some of its length, but the junction and its resumption just after crossing Keld Heads Gill can be found.

Flue F7 is of somewhat inferior construction and wall thickness than the others and runs round the east side of building B1 to the annexe B3. The remote siting of B3 away from the waterwheel and source of air suggests that it was not a slag or ore hearth. This is supported by the fact that the flue runs at ground level and enters the rear of the building directly, with no evidence on the 1866 map of an external riser or settling chamber. Building B3 could have housed a roaster or refining furnace. It is present on the 1856 O.S. map, although no flue connection is shown. It is most probably the '*roasting house*' referred to in the indenture of 1854. Although suitably placed for treating incoming ores or slimes, it would have been inappropriately positioned for treating fume settlings from the condenser.

Given Percy's data, the smelting equipment at Keld Heads around the peak production years 1855-60 was likely to be four ore hearths (three in building B1 and one in building B2), one slag hearth (in building B2) and two roasters (buildings B2 and B3). At some stage the roaster in building B3 might have been converted to a cupellation furnace for the production of silver.

2.5 The end of building B2 projects from the rubble and is the one vestige of the smelt mill buildings which remain today. It consists of a room 4.45 metres wide by 3.7 metres long, having a door in the south-east corner and what appears to be a chute in the north-west corner. A hole in the north wall gives a dramatic view of Keld Heads Gill rushing through the culvert underneath. There is a small recess in the floor which may be a drain. On the west side is a 3.57 metres wide pit with a recess at the north end and a wall along the west side. It is difficult to reconcile Clough's plan of the mill with either this fragment or with the 1866 map.

This part of the site will remain an unsolved mystery until some local builder can be persuaded that the tumbled stone which covers it is worth removing.

3. Condenser House and Settling Pits

3.1 The arrangement of the building which housed the Stokoe Patent Condenser, fans, waterwheel etc has been described by several authors and

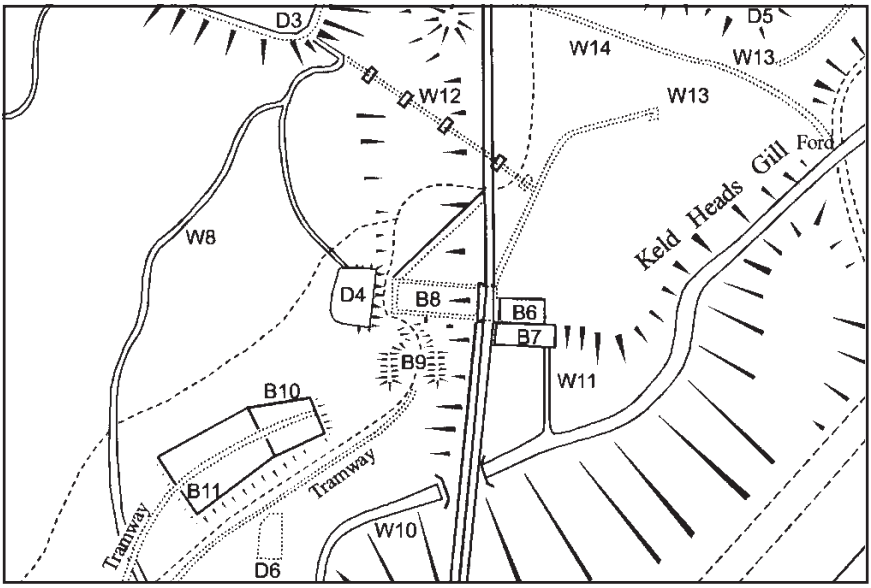

Fig.5 Detail of present features in the area of the condenser house.

is confirmed by the maps.[1,2,4,5 & 12] The foundations and part of the walls of the fan house (B6), (B7) and the retaining wall at the east end of the condenser (B8) are present today, but all traces of the condenser (A) itself, which was built mainly of wood, are gone.

Two flues run from the mill as far as the condenser fan house. The western flue terminates here and its gases would have been directed through the condenser by means of fans which, according to Percy, were situated on top of the flue.[4] The return flue from the condenser has practically disappeared, although traces of its lower courses can be made out and establish the general area of the condenser and the junction with the eastern flue. The junction is not clear and there is no obvious trace of the old chimney, which was said to exist before 1855.

Water for the condenser fans was taken from the large dam (D3) to the north-west, which is hidden in dense woodland. The overflow is at the west end and joins the main flow of water which once ran round the west end of the smelt mill. At the east end of the dam there is a sluice, now collapsed, but with a strong flow of water issuing from it. A launder ran approximately south-east from here, towards the condenser house, and its stone foundation pads can be followed across the shallow valley.

A square, stone-lined earthwork (B9) stands adjacent to the position of the condenser, and just to the west is a much larger structure, which has a dividing wall separating it into two unequal compartments, B10 & B11. The larger

structure is shown on Plate II. They had stone-flagged floors and were used as settling pits for soot collected by the condenser. Their number and complexity suggests that they were built with a particular method of operation in mind. The condenser would produce sludge continuously as long as the mill was running and a single settling pond would not be satisfactory here. A small dam (D4) can be found in the woodland above the settling pits and is connected by a shallow leat to the main watercourse coming from the east end of the large dam, D3.

A small rectangular pond (D6), to the south of the large settling pits B10 & B11, is shown on the map of 1866, close to Keld Heads Gill. It is also present on the 1912 O.S. 1/2500 map, where it is shown having a dividing wall running east-west across the middle. Today, this can be identified as a wet area and depression.

3.2 The features described in 3.1 above can be traced on the 1866 map, although the system for supplying water was considerably different before the extension took place. However, there are some features which are evident by field walking and which do not appear. These are parts of the original water supply arrangements and can be found on the 1856 O.S. map:-

Watercourse W13 fed the condenser house wheel from Keld Heads Gill.

Watercourse W14 supplemented this by directing mine water from the central part of the site. W14 appears to extend further than the 1856 map shows to just below the ford. Part of this is lined with stone.

Before dams D3 and D4 were built, the condenser sprinklers were supplied directly from the mine drainage water (see 1856 O.S. map). This leat was then used to supply dam D4.

3.3 The method of operation is not known, but there are some details in Percy's account:-

Water ran through the condenser from sprinklers in the roof and overflowed from the condenser base at a single outlet into a launder which then doubled back around the base of the condenser to return the liquor to a cistern close to the overflow point. The double launder arrangement seems to have been designed to give an extended settling time and would also provide a smooth bottom such that settlings could be easily picked up by shovel. The cistern shown on Percy's diagram then discharged through a vertical pipe into a settling pit. It is not known which of the Keld Heads pits was used for this.

Periodically, a door at the bottom of the condenser was opened for cleaning out heavier accumulations of solids. There was a two metre deep heel of water in the base of the condenser and this could have been emptied into the launder and thence to the settling pit, used for continuous running.

PLATE II. Stokoe Condenser and Settling Pit at Keld Heads Smelt Mill (NMRS Records - Backhouse Collection).

Percy gives no other details on the treatment of collected fume, but two further stages would be essential. Collected solids from operations of this type must be dried before smelting or roasting. Today this would be accomplished using a filtration device, such as a filter press, rotary vacuum filter or belt filter. A less satisfactory approach is to build a large enclosure with low walls, sometimes subdivided by temporary banks of slag or earth, and allow water to escape by overflow, seepage or evaporation. Eventually, and with the help of a period of good weather, a solid residue which can be handled is produced. A large, shallow drying bay is required for this and pit B11 would be very suitable. Before discharging liquor to the gill, it would be necessary to ensure that settling of solids was as complete as possible and, therefore, a final clarification stage would be necessary. This would be important with a continuously irrigated wet condenser, rather more than with a long flue which would be washed out periodically. Pond D6 was probably

used for this. It is in an appropriate position and is shown on the 1856 map with an outlet running to the smelt mill dam, D2.

The Backhouse photograph shows that pit B10 was connected by a channel to the condenser and this was no doubt the means by which it was filled.

4. Upper Flues

4.1 The single flue leaving the condenser house runs uphill through the wood. The structure of the flue is not apparent and in some places even its route is unclear, although some fragments of an arched configuration can be seen shortly before it passes underneath the road. The point at which it changes from slab-topped to arch is not evident. If the flue is followed further, two tunnels can be found which allowed livestock to be brought underneath the road and flue. The line of the flue then turns abruptly through a right angle to cross the pasture on the way to the chimney of Cobscar Mill.

4.2 The junction with the Cobscar flues is interesting as immediately before this point the foundations of a now-demolished chimney can be found. It is situated on the Keld Heads flue, which continues afterwards for a few yards to join the Cobscar flue. Raistrick's plan, on p.103 (Vol.1), incorrectly shows the Cobscar flue joining that from Keld Heads, but the reverse is in fact the case. The short square Keld Heads stack is shown in Frank Woodall's photograph of Cobscar Mill on p.82 of Raistrick and as Plate 41, p.95 of Clough. At first glance it might be taken for the existing Cobscar chimney, but it appears to be shorter and on lower ground.[1,2] The reason for two chimneys is unclear. The photographic evidence suggests that the plume from the Keld Heads stack came to ground very nearby, whereas the Cobscar stack would give much better dispersion. There are two likely possibilities:-

(a) Keld Heads flue and chimney were completed first and were later joined to the Cobscar flue to take advantage of its better dispersion. The 1856 O.S. map for Cobscar shows it as an "*old smelt mill*" with no long flues.

(b) The Keld Heads flue joined the Cobscar flue and the chimney was added soon afterwards as a result of difficulties in balancing the draught at the two mills.

5. Upper Dams

The Keld Heads site contains several dams, and the water collection and management arrangements are one of its most interesting aspects. One (D3) is fed directly from the series of Keld Head springs, one of which emanates from a mine level. This dam is undamaged except for the sluice gate on the east side. This has disappeared, but a strong flow of water comes out from a fracture. At this point, the water for the condenser house wheel was taken across some low ground by means of a launder, the stone foundations of which can still be seen. Another branch from this exit served the small dam, D4, providing water to irrigate the condenser. The masonry wall is

well constructed and there is an overflow on the west corner. Unfortunately, access is impeded by dense vegetation and so visits are best made in winter.

The uppermost dam at the top of Keld Heads Gill (D7) is larger and has an overflow and spillway of dressed stone. Its date of construction is not known. At the side of the spillway is an underground chamber, which can easily be missed and in which there is a large valve and cast iron pipe which could possibly have been connected to an electricity generator some considerable way below. Whether this eventually went to the '*power house*' which stands near the dressing floors is uncertain. The chamber has access through a tunnel running alongside the spillway and also through a short shaft immediately above the valve.

PRESTON MILL

Raistrick placed Preston Mill on the east bank of Keld Heads Gill, in an area now covered by the dressing floors of the Keld Heads mine. His justification was based on a mill, marked as such, on Greenwood's map of Yorkshire, 1817 and Teesdale's revision of 1828. This was shown to be erroneous by Gill, who pointed out that Preston Smelt mill was named on plans of Preston township of 1723 and of Lord Bolton's mines of 1851.[3] Raistrick's mill was in fact the corn mill which still bears the name of Preston Mill today and which is marked as such on some of the old surveys.

The Bolton archive contains many surveys of the property within the lordship and Preston Mill is clearly marked as a smelt mill on some and as an unnamed building on others. As Gill points out, it was on the west side of Keld Heads Gill, somewhere near the Condenser House, but the location of the site has not been accurately determined.[3]

Tracings of the 1728, 1778, 1800 and 1828 maps were made and photographically enlarged. They were superimposed on enlargements of the 1912 O.S. 1/2500 and current 1:25,000 maps. The positions of field boundaries assisted considerably with the process of enlargement and registration of the overlays. The different maps gave the position with varying degrees of precision. The 1723 map had fewer field boundaries, but seemed particularly accurate with regard to the position of Keld Heads Gill which forms the boundary between Preston and Leyburn at this point. Unfortunately, however, there was also some damage in relevant parts of this map. The 1828 map had field boundaries with an accuracy which closely matched the O.S. maps, but surprisingly Keld Heads Gill was shown as an almost straight line. This technique allowed the position of Preston Mill to be determined to within approximately 50 metres of the position of the Condenser House wheelpit - exactly where Gill had said.

Field walking, over several years, has not given any better location of the site. The area between the bridge, which carries the flues and trackway over the gill, and the paved ford higher up the gill has been examined in detail.

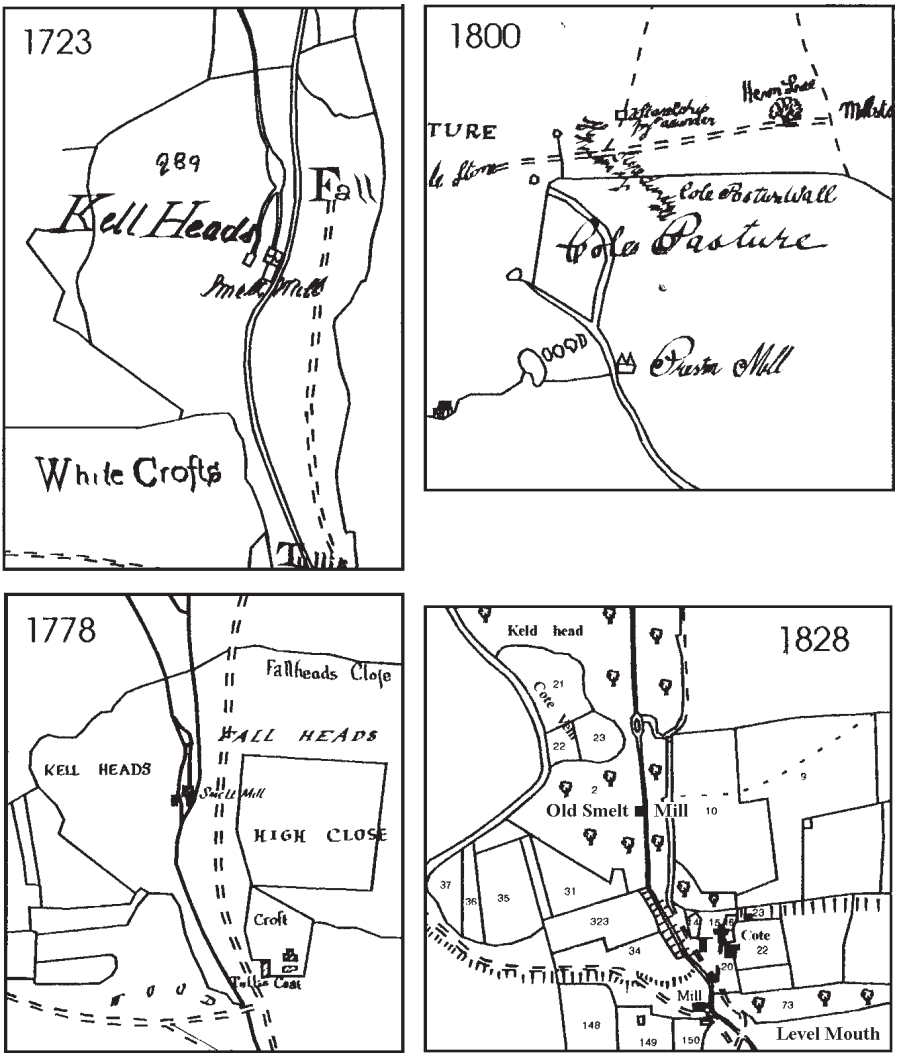

Fig.6 Comparison of maps showing Preston Smelt mill.

Slags have been found on the west side of the bridge, but these could have been moved to make the road. Odd pieces can be found on the east side about 80 metres below the ford, but, as there is no flat area here for siting a building, it is reasonable to assume that these pieces are erratics.

The maps show two leats coming south from the position of Preston Mill dam (D5), which can be clearly identified, although it has since been developed as a small quarry or trial quarry. The dam wall can be located and breaches in the wall can be identified in the possible positions of the

sluices. Between the dam and the condenser wheelpit is a flat meadow which has no trace of watercourses running south from the dam as shown on the old maps - indeed the only gullies run obliquely across the face of the dam wall and join Keld Heads Gill near the ford. The condenser house is situated on the top of a steep bank, which offers the best clue to the siting of Preston Mill. An overshot waterwheel could be positioned at the bottom of this bank and would have its tailrace above the level of Keld Heads Gill. A wheel in this position could have been served by the dam (D5), or by a leat coming from Keld Heads Gill with a take-off just above the ford. There is ample space between the bank and the gill to site a mill, although the subsequent building of the condenser house, wheelpit and flues would have destroyed most of the earlier structure.

The spot since occupied by the condenser house and wheelpit appears to be the most appropriate location for the larger of the two buildings of Preston Mill. The smaller building was nearby and may well have been incorporated into the arrangement of settling pits as the masonry-lined structure, B9.

MAPS IN THE NORTH YORKSHIRE RECORD OFFICE

ZBO(M) 1/1 - MIC 2000 Plan of Wensley & Preston 1723 showing Preston Smelt Mill.

ZBO(M) 5/1 - MIC 2000 A Plan of the Manor of Wensley & Preston belonging to His Grace the Duke of Bolton 1778, showing Preston Smelt Mill.

ZBO(M) 6/5 - MIC 2000 Plan of Preston & Redmire 1779 (Wm. 1794), shows Preston Mill and dam as on ZBO(M) 5/1

ZBO(L) - MIC 2000/450Beldon to Cranehow copied May 1800 by William Brown. A note on the map refers to spring 1799 West Park showing Preston Mill on east side(!) of Keld Heads Gill.

ZBO(M) 9/1- MIC 2000 Plan of Preston 1803 also showing Preston Corn Mill, not labelled. A small rectangular building is shown on the site of Preston Smelt Mill.

ZBO(M) 13/5 - MIC 2000 Maps of Redmire & Preston 1824. Preston Smelt Mill is shown as an unnamed building. Keld Heads off map.

ZBO(M) 13/6 - MIC 2000 Wensleydale 1828 Lord Bolton's Mines in Wensleydale 1828. Showing "*Old Smelt mill*" at Cobscar with two chimneys on roof; also mills at Preston; Apedale and Bobscar.

ZBO(L) 21 - MIC 2018/99Plan of Ground Leased to Keld Heads Company 1828. Cobscar mill is shown as "*Old Smelting Mill*" with two chimneys on the roof. House on Cobscar Rake is shown as "*Calamine House*".ZBO(L)

19 - MIC 2018/83-85 Plan showing a portion of the authorised and proposed lines of railway passing through the surface works of the Keld Head Mines 1866.

O.S. 1/10560 Series 1856 Edition, Sheet 68 Keld Heads works shown with shorter flue terminating shortly after the position of the condenser house.

O.S. 1/2500 Series 1912 Edition, Sheets 68/1 and 68/5 Keld Heads works shown in detail.

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