

# Friends of Killhope

President: Sir Kingsley Dunham, F.R.S.

SEPTEMBER 1987

## NEWSLETTER No. 9

At the A.G.M. I was able to express my thanks to those contributors to the Newsletter who happened to be present and I would now like to extend thanks to all those who really make the publication a success. I am sure Friends will agree that the quality of the material is first class and the variety quite surprising. We are all indebted to our writers for their labours on our behalf. All submissions are welcome be they large or small, original research, anecdote, drawings, ephemera such as handbills, receipts, etc. which may make an interesting item. There is also a place for the not so serious work and you don't have to be literary giant to make a worthwhile contribution. I hope you enjoy this latest edition.

## MEMBERS NIGHT - an entertainment

Friends are cordially invited to our members night at the Kings Arms, St. John's Chapel at 7.30 p.m. on 11th November when Mrs. Julie Goodhart and Mr. John Kelly will tell the tale of Victorian Leadminer and Poet, Richard Watson through the Teesdale Poet's own poetry and original folk songs written by Julie herself. The performance should be of interest to all folkmusic lovers and people who appreciate dales' poetry. (Mrs. Goodhart is the author of the excellent booklet "Leadmining" published by Dalesman.) Members are asked to bring any artefacts, slides, photographs or questions to add to the entertainment. Friends are assured of a very congenial evening. Do try to attend.

## UNDERGROUND EXCURSION

The Friends October field trip has been fixed for Sunday 25th October beginning at 11 a.m. from Nenthead Post Office. Roy Curry will be the principal guide into the Browney Hill Level. Safety helmets and cap lamps are essential, wellingtons are advised. Numbers must be strictly limited so places will be allocated on a first come first served basis - please telephone Bryan Chambers (not Ian Forbes.)

## SUBSCRIPTIONS

Friends are reminded that subscriptions are due for the current year and if you have not yet renewed you will find enclosed a renewal form. Please note that it will not be possible to send any further Newsletters if your subscription is not renewed.

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WEARDALE AS A GEOTHERMAL AREASir Kingsley Dunham

An area may be classed as geothermal if heat derived from the interior of the earth is available at or near the surface in amount greater than that normally radiated. Geothermal areas are of increasing interest as sources of cheap, clean energy; others, which have had strong geothermal characteristics in their past histories, and of interest for the concentrated deposits of useful minerals that have resulted from the thermal activity. Weardale, in the heart of the Northern Pennine Orefield falls into both categories: this article briefly reviews the evidence upon which this conclusion is based.

Present Geothermal Areas - It has long been known that the temperature rises downwards in the crust. This may not be obvious in the well-ventilated mines of the orefield, with their linked tunnels, rises and shafts but it is obvious enough where development penetrates to depth. Data on the rate of increase of underground temperature with depth (the thermal gradient) was first collected by a long standing committee of the British Association for the Advancement of Science about a century ago, from measurements in mines, shafts and boreholes. The geothermal gradient in the United Kingdom generally lies within the range 20 to 25°C per kilometre (12 to 16°F per 1000 ft). This is a higher background gradient than in regions of ancient PreCambrian rocks, as exemplified by the Witwatersrand (South Africa) and Mysore (India) where gradients as low as 12°C/km permits mining to be carried to depths of over 3.5 km. The British gradient is substantially less than those found in regions of volcanic activity, especially where groundwater is being heated by active igneous magma below. One of the first such areas to be exploited was at Reykjavik in Iceland, where the hot water is used for house heating. The earliest power development, at Lardarello in northern Italy uses natural steam from less than 1 km depth to generate 400 MW of electricity. Other successful projects are at Wairakei, adjacent to the active Ruapahu volcano in New Zealand, and at The Geysers, California. We have no hope of paralleling these schemes since the youngest British volcanoes (those in the Arran - Mull - Ardnamurchan - Rhum - Skye line) are all about 55 million years old and are believed to be cold. A second type of useful geothermal area is found where a permeable rock formation provides an aquifer descending to a substantial depth in the crust; one of the first to be used is in the suburbs of Paris and this has been followed by the establishment of one near Southampton where red sandstone similar to that exposed in the Vale of Eden contains water at 64°C at about 3 km depth in recoverable quantity. The third type of geothermal situation is found where hot, impermeable rock occurs near enough to the surface to permit a fluid, generally water, to be injected into it from a deep borehole, the heated fluid being recovered from a second, shallower borehole. This procedure, known as the 'hot dry rock' (HDR) method, has

been actively under test at Los Alamos, New Mexico for the past fifteen years, and more recently in Cornwall. It has become clear that to succeed, a large volume of the hot rock, perhaps  $1 \text{ km}^3$ , must be broken up by hydraulic fracturing or underground explosion to provide adequate free surface. Weardale potentially belongs to this third class of geothermal areas.

Weardale: The Present Situation- As long ago as 1934 the presence of a granite beneath the Orefield was tentatively predicted to explain the mineral zonation<sup>1</sup>, but specific evidence was not forthcoming until 1957, when a gravity survey showed a widespread negative anomaly indicating a concealed body of low-density rock having the shape of a batholith<sup>2</sup>. The Rookhope borehole, drilled in 1960-61, proved granite beneath Carboniferous rocks at 390 m (1281 ft) below surface; the hole was continued in granite to 808 m (2650 ft = 0.505 mile).<sup>3</sup> After stabilisation, careful temperature measurements in the borehole showed that the gradient in the Carboniferous rocks is  $34^\circ\text{C}/\text{km}$ , and in the granite,  $31^\circ\text{C}/\text{km}$ , both figures being substantially above the U.K. average.<sup>4</sup> The heat-flow, calculated from gradient x thermal conductivity, amounts to 95 milliwatts per square metre ( $\text{mW}/\text{m}^2$ ), nearly twice the national average; and the Weardale granite, with its continuation beneath the Lake District, is the only granite other than those of Cornwall and Devon that may be capable of yielding energy by the HDR procedure in the United Kingdom. However, because Weardale is remote from main centres of population, the recent test hole was sited by the British Geological Survey at Rowlands Gill, over the extreme north-east end of the Weardale granite; the results have not yet been published. The source of part of the heat has been established by measuring the amounts of the three radioactive minerals uranium, thorium and potassium in the granite core; the latest mean figures are respectively 9.6 parts per million, 11.3 ppm and 4.0 per cent. From these the radioactive heat released during decay can be calculated to be 4.3 microwatts per cubic metre ( $\mu\text{W}/\text{m}^3$ ).<sup>5</sup> The thickness of the Weardale granite body has been estimated from measurements on the three-dimensional seismic array at Rookhope suggest a figure of 9 km, in which case the spontaneous heat generated by the granite amounts to  $38.7 \text{ mW}/\text{m}^2$ , or somewhat less than half the total heat flow. The remainder must be derived from the lower crust and / or mantle. Assuming that the gradient measured in the granite holds in depth, a temperature of  $200^\circ\text{C}$  will be reached at 6 km below surface, well within the range of modern drilling technology. On this basis, Upper Weardale might become a HDR geothermal area. It should perhaps be added that the figure given for radioactive decay is not such as to constitute a radion hazard should this be done.

The Situation 290 - 270 Million Years Ago - The thick muddy sediments that formed the Skiddaw Slates were tightly folded, then about 400 million years ago, intruded by the Weardale - Lake District granitic batholith. Deep erosion of the mountain chain so created now followed, until by 350 my, the cupola of the granite between Rookhope, Eastgate and Westgate was exposed at the surface. Then the Carboniferous

inundated the surface, depositing first gravel, sand and mud, then for a period, clear limestone (the Melmerby Scar); then a series of great deltas covered the region throughout the remainder of Carboniferous time, depositing mud, then sand during the advance, coal where sandbanks formed islands, and limestone when the deltas were in retreat, or in the later (Coal Measures) stages of the period, only marine shale during retreats. The whole period, almost to 290 million years ago, was dominated by cyclical advances and retreats. A major geological event brought this to an end, when the South European plate began to push underneath the north European, along a line from Cornwall and Brittany to Bohemia, where there had been a deep trough of muddy sediment. This became the Killas of Cornwall and into it a series of granite rose from below. Our own district, over 400 km away from the main earth storm, was upraised by gentle folding and there were movements of molten basaltic magma below, that led to the filling of ENE fractures to form the Hett, Ludworth, Loo Gill and Haydon Bridge dykes, and from these when the heavy magma was able to rise no further, its injection into the surrounding Carboniferous rocks to form the Whin Sills. But before these events, there had been a powerful heat flow episode, during which the whole of the Carboniferous rocks were heated sufficiently to give a temperature of  $185^{\circ}\text{C}$  at the level of the Great Limestone. The evidence for this comes from vitrinite reflectance measurements on the coals of the Coal Sills Group, just above the limestone, which are now semi-anthracites; study of their textures where they have been further heated adjacent to Whin intrusions indicates that  $185^{\circ}$  had already been reached before the Whin magma arrived<sup>6</sup>. The magma itself produced only restricted local heating, and was not the cause of the regional heating, which can be shown to have existed far remote from Whin intrusions. It is a striking fact that the area in which devolatilisation of coal has occurred corresponds with the outline of the granite batholith below and must be ascribed to the superior thermal conductivity of the granite; not, it should be emphasised, to its radiothermal properties. A temperature of  $185^{\circ}\text{C}$  at the level of the Great Limestone would imply a geothermal gradient of at least  $75^{\circ}\text{C}/\text{km}$ , since there cannot have been more than 2 km thickness of sedimentary cover; from this the heat flow at that level must have been over  $200 \text{ mW}/\text{m}^2$ , less than one-fifth of which came from radioactive heat, the decay rate remaining constant with time. The cause of this high heat flow is not known; perhaps there was a hot spot in the mantle. Nor is it clear whether such a flux could be conducted through the lower crust without producing fusion and thus a new generation in depth of granite. In the absence of direct evidence, this remains controversial. After the arrival of the Whin sills, the general temperature fell until by about 270 my, when the Permian sea came over, normal heat flow had been restored, and the carbonaceous Marl Slate, its first deposit, shows no evidence of heating<sup>5</sup>. During this period of cooling, earth pressures probably connected with the tendency of the low-density granite mass to rise<sup>2</sup> produced a geometrical pattern of ENE, WNW-EW, and NNW fractures. Principal tension in a N-S

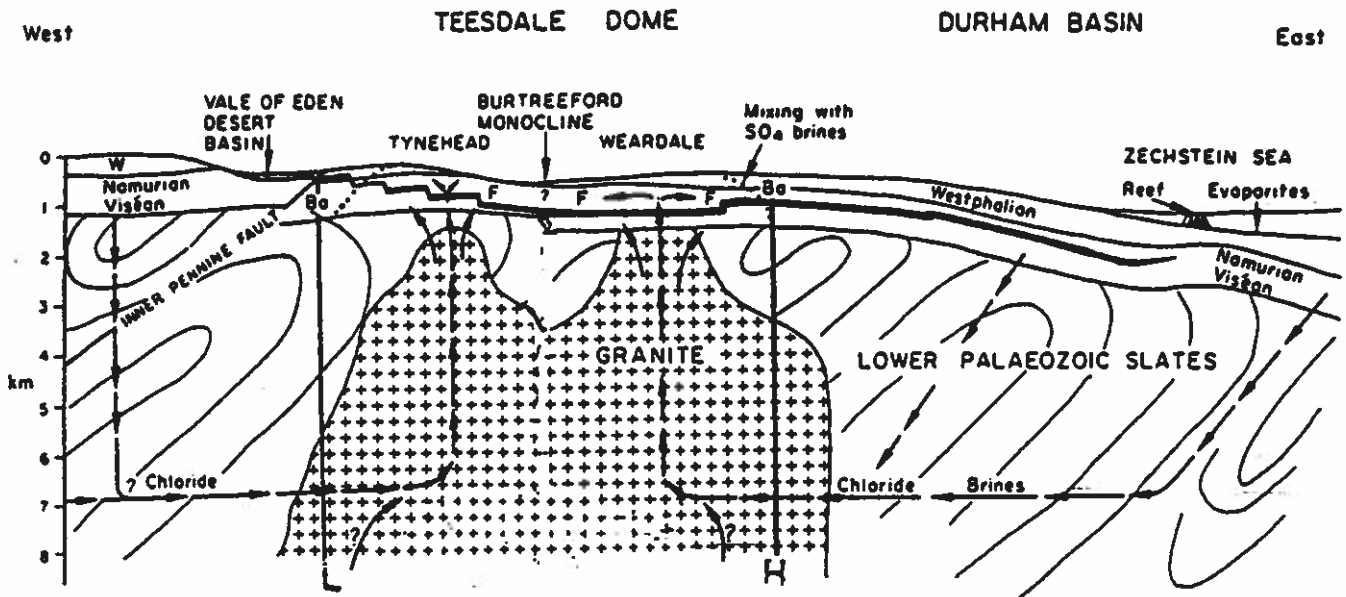
direction promoted opening of the fractures where the physical properties of the rocks were suitable, particularly in The Great Limestone, but in other brittle beds also. As these openings formed, they were filled with strongly saline groundwater that has risen through the granite, but which were probably derived mainly from the wet surrounding rocks. They were driven up by convection related to the higher temperature of the granite, perhaps aided by earthquake pumping. These fluids brought the elements (Pb, Zn, Cu, Si, F, Ba Fe and others of less importance) needed to form the orebodies such as the veins at Killhope and throughout the orefield contained. Their chemistry and temperature is known from the microscopical study of tiny droplets of the fluid caught inside the crystals as they formed<sup>6</sup>; these inclusions contain both gas and liquid phases, but heating them until the gas bubble disappears gives a measure of the formation temperature.<sup>7</sup> The fluid is about six times as salty as sea water, and readily dissolves the metals it carries. Since the boundary between the fluorine and barium zones passes through the uppermost workings on Killhopehead Vein, the temperatures in the Killhope veins were probably in the range 150 - 100°C when their mineral contents were deposited. Some writers have suggested that the general heating of the district was due to the hot mineralizing fluids, but this cannot be accepted in view of the wide spacing of the veins (averaging over 1 km), their small widths (average little more than 2 m) and the clear evidence that they post-date the Whin sills, whereas the general heating preceded the arrival of these. We may look back on Weardale in the Carboniferous - Permian interval as a first order geothermal area, with hot rocks, hot springs like Rotarua or Solfatara, and mineral deposits forming down below.

References - Copies of the following publications are being placed in the Friends' Library:

- 1 Dunham, K.C. 1934 Genesis of the North Pennine ore deposits. *Quart. Jnl. Geol. Soc. London (Q.J.G.S.)* 90, 689 - 720
- 2 Bott, M.H.P. & Masson-Smith, D. 1957 The geological interpretation of a gravity survey of the Alston Block and the Durham Coalfield. *Q.J.G.S.* 93, 93 - 117
- 3 Dunham, K.C., Dunham, A.C., Hodge, B.L. & Johnson, G.A.L. 1965 Granite beneath Vian sediments with mineralization at Rookhope, northern Pennines. *Q.J.G.S.* 121, 383 - 417
- 4 Bott, M.H.P., Johnson, G.A.L., Mansfield, J & Wheildon, J. 1973 Terrestrial heat-flow in north-east England. *Geophys. Jnl. Roy. Astr. Soc.* 27, 277 - 288
- 5 Brown, G.C., Ixer, R.A., Plant, J & Webb, P.C. 1987 Geochemistry of granites beneath the North Pennines and their role in orefield mineralization. *Trans. Inst. Min. Meta.* 96, 865 - 76
- 6 Creaney, S. 1980 Petrographic texture and vitrinite reflectance variation on the Alston Block, England. *Proc. Yorks. Geol. Soc.* 42, 553 - 580
- 7 Sawkins, F.J. 1966 Ore genesis in the North Pennine Orefield in the light of fluid inclusion studies. *Econ. Geol.* 61, 385 - 399

General Reference

Downing, R.A. & Gray, D.A. (Editors) *Geothermal Energy . The potential in the United Kingdom.* British Geological Survey, 1985 187 p EMSO



Cross Section of the Alston Orefield in late Carboniferous - early Permian time - a model to illustrate the pattern of fluid movement deduced from mineralogical and geothermal data. Modified from Trans.Inst.Min.Metall., 80, B272, 1971  
 Cross ornament, Granite ; Solid black, Whin Sills ; F, Fluorine zone ; Ba, Barium Zone

We are indeed privileged to publish the above article. Sir Kingsley has also very generously given to the Friends Library copies of the principal papers mentioned along with some others. (Editor)

NEW BELDON LEAD MINING COMPANY LTD.

Ian Forbes

Published histories of lead mining in the North Pennines have concentrated on the activities of the two major businesses - the London Lead Co. and W.B. Lead (Blackett/Beaumont) with a passing nod to the Derwent Valley companies. These were not the only lead producers though. Particularly towards the end of the 19th Century a large number of small companies were operating.

The Alston Moor Mining Company, the Rodderup Fell Mining Company, John P. Walton & Company, Bewick and Partners, the Greenhurth Mining Company, the Rookhope Valley Mining Company were a few of them; Friends might like to compile a list of leadmining companies for the North Pennines - I suspect it would be surprisingly long.

Beldon was a mine near Blanchland and we were recently given a copy of this share certificate for the New Beldon Lead Mining Company Ltd. The mineral statistics for Durham and Northumberland give only one return for this company: 6.4 tons of ore in 1872.

Can anyone add any more information.

SHARE CERTIFICATE.

THE

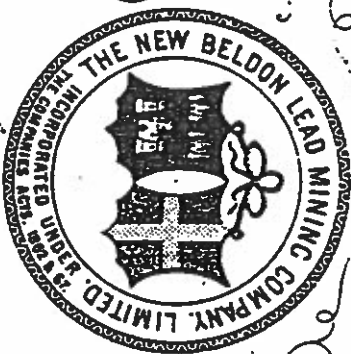
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LIMITED.

# The New Beldon Lead Mining Company

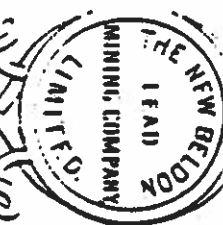
CAPITAL

£10,000.



IN 10,000 SHARES

OF ONE POUND EACH.



This is to Certify that Joseph Newton of London is the registered holder of one Share of £1 each in the Capital of £10,000 of THE NEW BELDON LEAD MINING COMPANY, LIMITED, subject to the Articles of Association and the Statute and Regulations of the said Company, and that up to this day, the sum of Five Shillings per Share has been paid therein.

Obtained under the Signatures of the said Company, the 11th day of May 1890

Geo. Lawrence

Wm. Hills

SECRETARY.

A. Benson

DIRECTORS.

SWINHOPE MINEDr. Frank Gilbert

The long exploratory crosscut to test untried ground and find new veins of ore was a favourite 19th Century device and large sums of money were allocated by the big companies for these levels!

Probably the last of the major new cuts was the Swinhope project of some thirty years ago.

A large area of unexplored ground lay under Killhope Law, where there was about four square miles of virgin Great Limestone concealed beneath younger rocks and the Swinhope level was devised to try to cut veins in this potentially rich area.

Dr. Frank Gilbert, who was at the time Managing Director of Durham Chemicals of Birtley here explains the background to the scheme.

"When I was appointed M.D. of Durham Chemicals of Birtley in 1955 I found I had inherited (among many other things) the Allendale Metalliferous Co. which was virtually moribund, losing money and due for closure. It operated one mine at Swinhope (Map ref. 3834/5474 Eastings first) which was an adit mine with horse level and only extracted bouse for treatment elsewhere. I believe this was at the Rookhope mine site of the old Weardale Lead Co. The mine manager was Amos Treloar.

One of the Allendale Directors was Professor C.E. Pearson who used to be Professor of Metallurgy at Newcastle University and was an old friend of Professor Kingsley Dunham. According to Dunham one of the most attractive unexplored areas in the North Pennines lay to the S.E. of Swinhope and he suggested that before the Swinhope Mine packed up this area should be explored. But neither the Allendale Metalliferous Co. nor Durham Chemicals had any money for speculative exploration. Dunham and Pearson therefore approached Consolidated Goldfields who agreed to spend some £100,000 (at 1956 prices) to carry out the exploration. If they were successful they would form a new Company and give Durham Chemicals a 17% participation. If they were not successful then everything would be closed down and Durham Chemicals would at any rate know there was nothing there. The overriding condition was that at least 2 million tons of ore should be located since under economic conditions then prevailing it would not be worth financing and operating a modern extraction and smelting plant for less than  $2 \times 10^6$  tons. The price of lead in the London Metal Exchange averaged only £72.80 per ton during 1958 and the market was falling. (In 1962 it averaged only £56.27.)

So, Consolidated got to work and sank a new incline at Map ref. 3826/5465 with modern generators, ventilation etc. They drove a square tunnel about 16' x 12' about  $1\frac{1}{2}$  miles before they gave up. The new tunnel did indeed cut several small veins but they struck nothing rich. I remember Professor Pearson telling me that the amount of extractable ore discovered was estimated to be in the region of  $1 \times 10^6$  tons which would have been wonderful 100 years ago, but today was insufficient to justify the capital outlay necessary. So the whole venture closed down and the electrical plant etc. sold by Goldfields. This would be about 1959/60.

This still left Durham Chemicals owning Allendale Metalliferous Co. but the only assets it had was the lease from Lord Allendale to extract minerals. As no minerals were being extracted no royalties needed to be paid.

The Owners of Settringstone Mines Ltd. (a man called Deas) expressed interest in buying out the Company in order to get hold of the lease and the possibility of re-working the spoil heaps and this they did. But the Owners of Settringstones Mines Ltd. had no spare funds and when Settringstones Mines (near Haydon Bridge) which mined witherite packed up, so did the Allendale Metalliferous Co. This would be about 1960/1.

Other than the Weardale Lead Co. which gave up mining galena years ago, I think Swinhope was the last active lead mine in Allendale and Weardale. The original horse level adit is now blocked up and there is little to see. Similarly the newer Consolidated entrance is also sealed up."

A FURTHER CAUTIONARY TALE (see last Newsletter)

Peter Jackson

Take heart, Mr. Short, all was not lost. (Well, not quite .....

I also visited the same office at Nenthead when George Ridley was constructing his plant.

I still have some VM Records from that office relating to coal (see P.22) transported to the mill for the steam engines which drive the standby air compressors, ore brought from mines all over the Dales to the Rampgill washing floors (prior to 1900) and a drawing of a proposed infirmary to be built at Nenthead.

The mice had done their worst by 1966 and the infirmary plan has now melted away but the rest still survive awaiting their place in an account of mining at Nenthead.

Talking of mining, it might be fair to say that some available material on the history of Smallcleugh mine indicates that George Hetherington was the discoverer of the Smallcleugh Flats. I believe that the available information indicates that they were worked from First Sun vein in a northwardly direction.

Cumbria County Record Office DX/616/1 Acc.2497 is a photocopy of a surveying notebook compiled by George Hetherington of Holmsfoot, Nenthead and dates from around 1850, or possibly a little earlier. It includes surveying information for some parts of Smallcleugh mine dating from 1790 onwards.

Plotting this information on a modern survey shows that either the original and the 20th Century surveyors were both good surveyors, or that they were equally bad!

THE DERWENT VALLEY MINES - AN ALTERNATIVE VIEW (lest we take ourselves too seriously!)

Miss Susie Forbes (aged 7 years) walked several miles on the Friends' field trip in the Ramshaw area this June. These are her impressions.

Yesterday we went on a walk  
 with Brian and Dorothy Gorge  
 - Duncan Martin Simon we saw  
 two big chimneys and some  
 cows and sheep and 2 Beetles  
 1.11 spider 2 Baby frogs 1 nuth  
 3 tadpoles and loads of water  
 Beetles and I found  
 some small Pittstones and  
 one big stone that had loads of  
 little crystals on it

Seven year old Friends and Primary schoolteachers will have no trouble reading the above but all our readers should find the little extra effort required to be rewarding. (Editor)

KILLHOPE AND THE ARCHAEOLOGY OF THE SETTLING TANKS

David Cranstone

1987 has seen two separate seasons of excavations at Killhope - from mid February to April Fool's Day and from June 2nd till early July. The first was notable for its frost and snow, the second for its rain and cold: as Oscar Wilde remarked on his visit, "To excavate once at Killhope may be counted as unfortunate, but to excavate twice smacks of carelessness." Once again I am grateful to all those unwary enough to have worked on the excavations and especially to those careless enough to have volunteered themselves for a second stint.

The main intention of both excavations was to complete the interpretation of the washing floor, so that reconstruction could proceed. In practice, frozen ground (in winter) and waterlogged ground (in the alleged summer) barely allowed us to achieve even our main targets on the washing floor, but this did let us loose to do more than planned on two sets of settling tanks, where conditions for excavation were less sensitive. This summer having been my busiest ever for excavations (five so far since April, with another three to fit in before winter,) I haven't looked at the Killhope site records since my team packed them away at the end of the dig (while I and David Gale were distracted by a bank of coke ovens at Maryport) but Friends may be interested by my top-of-head interpretation of what we found.

On the washing floor, we successfully sorted out the launder outlets from the western group of separating structures - some of these fed (moderately) clean water to the eastern set, while others carried foul water to the settling tanks. Further south, the area immediately below the track proved to contain quite a sequence of superimposed layers and structures, beneath the platforms of re-used wooden rails that we had previously uncovered. As well as the base of a probable knockstone, several wooden platforms, and what looks like the base of a rather rickety hotching tub or buddle, this sequence included several layers of plank 'ghosts' - the thin streaks of sediment that had slipped between planks, surviving as the only evidence of robbed timber floors. Obviously the development of this area was considerably more complex than we had believed and I don't pretend to understand it fully. It does seem that the early phases were originally more widespread, but had largely been destroyed when the washing floor was rebuilt in its present form, leaving only the one 'island' of surviving evidence.

The main product of the winter season was the clearance of the settling tanks that had served the mechanised dressing mill (the 'Southern Tanks.')

These are oriented east-west, and in their surviving phase consisted of four tanks fed at their east ends, and discharging at their west ends via a launder into a culvert that doubled back to the 'Eastern Tanks.'

However, it soon became apparent that (like everything at Killhope) their history was more complex; there was a break in construction across the tanks, the earlier western halves being notable for their jerry-built nature, while the eastern additions were quite solidly built of proper squared planks. The key to this problem came when we excavated the culvert outlet, and realised that it cut across an earlier outlet from the east end of the tanks, discharging into the river. To cut a long story short, dirty water was fed into the southern pair of tanks in the early phase, then back along the northern pair, then out to the river; in the later phase dirty water was fed into the east ends of all four tanks, then led from their west ends to the Eastern Tanks. Since the initial construction of the tanks must date from the building of the mechanised mill in 1876-8, the jerry-built construction may reflect the Beaumont Company's morale as the lead price collapsed in the late 1870s, while the alterations probably date from the take-over by Weardale Lead Company in 1883.

The Eastern Tanks were known only from an Ordnance Survey map of 1896 which shows a pair of tanks just to the east of the base of the incline to the mechanised mill; we expected a set of timber tanks like the Southern Tanks and those on the washing floor. Yet again the site surprised us; the tanks have turned out to consist merely of vertical-sided pits in the peat, filled to the brim with very fine lead waste. We are still puzzling over whether these pits could have contained metal tanks (on balance I think not, but how on earth do you empty a vertical waterlogged pit in soft peat?)

The 1987 seasons have brought us almost to the end of the excavation programme at Killhope - the Buddle House is the only major area yet to be tackled. Now my thoughts are turning to writing six seasons of excavations (including Peter Brown's in the Jigger House,) analysis of samples and finds, relating the archaeology to the history .....

Finally, my thanks to all the Friends who have visited or helped in any way, especially those who have helped with analysis and identification and those whose suggestions have helped crystallise my interpretation of the site.

David Cranstone makes little of the enormous difficulties and real hardships experienced by himself and his dedicated team at Killhope during this season's work and in our next Newsletter we will publish what the popular press might call the inside story behind the professional report.

The team will be working at the Derwentcote cementation furnace site from now till mid-November and Friends are welcome to visit them there.

(Editor)

MORE ON GROOVES AND GROOVERS

Peter Jackson

The Surtees Society published an interesting Survey of Wolsingham Manor for 1647 which, amongst other things, has the following account:

"..... we say that there are certeyne mines or grooves of mettle or lead ore ..... the workmen or groovers ....."

"..... Allercleugh Groove ..... Sautishead Groove....." etc, etc.

Parliamentary Surveys of the Bishopric of Durham Vol. 1 Edited by Dr. D.A. Kirby, Northumberland Press, Gateshead 1971. Surtees Society Number 183, 1968.

"KILLHOPE, FEBRUARY 4, 1859 ENGLAND

Ian Forbes

Dear brother I take the pleasur to write to you Again hoping to finde you in good health as it leves us at present, for we have been thinking about you and wondering what was hapened for Jonathen wrote A letter last Apral and we have received no anser back again. but you must recollect you have som frinds yet in Weardale who are often thinking of you although dethe prevales on ever hand .....

Thus wrote Christopher Graham to his brother Joseph. Seven years earlier in 1852, Joseph Graham, born and brought up in the Killhope valley, left home with his friend John Peart of Swinhope, Allendale to start a new life in the United States. He was 28.

Mrs. Jean Cripps tells their story: "Joseph and John left England together in late March or early April of 1852. In America they settled in or near Caton, a small town located in southern New York State. There, not long after their arrival, Joseph entered into an agreement, handwritten on a partial sheet of pale blue, lined tablet paper, to work for a Jonathan Brown for one year for the sum of \$125. He was to receive his board for the year and to make up any lost time at the end of the year. It is likely that John made a similar agreement. They had taken the first step towards becoming farmers in their new country.

During the next 25 years or so, Joseph and John received many letters from their families in England telling of the life which they had left behind. The letters told of the pays and the partners in the lead mines, of the cost of living and of the weather and of the birth and, all too often, the deaths in the families. Many of these letters were carefully saved and handed down to descendants of Joseph Graham."

Now they belong to Mrs. Cripps who lives in Delaware and is the great grand-daughter of Joseph Graham.

Earlier this year Mr & Mrs Cripps visited Killhope and most generously gave us copies and transcripts of the letters with background information about the family.

Extracts from the letters will form a series in forthcoming newsletters. They give us a direct link to the families who lived and worked at Killhope and we are privileged to be able to reproduce them.

Unless otherwise indicated all notes relating to the letters and family are from information supplied by Mrs Cripps.

Christopher Graham lived at Hill Top (G.R.817436)

If you refer to the plan in newsletter 3 you will see he had a 15 acre small farm and 12 stints on the fell. He was of course also a leadminer.

His first letter to his brother to have survived is undated, but internal evidence indicates the year was 1852.

"October 3

Dear Brother when you receive this, I hope you will be in good health as this lives us at present. We are all in good health except our Thomas has been out of health again but is a grate deil better and has started work again but his wife has been confined of a son. you said you wished to know how we ware at home. we are doing well at home but our John (their brother) married in June and his wife was confined in July of a daughter and liven with his old father Jon Kidd (i.e. father-in-law - Jon Kidd was the father of John's wife Ann) and Hannah (the sister of Christopher and Joseph) and Nickel Padon married in May and is going to live at the grain (between Wearhead and Cowhill - I.F.) in one of his father's houses so that is all I can say of them as the rest of our brothers and sisters is well and sends you there bests wishes bout our Hannah telled me to send you word that she would like to see you again. so I have nothing more to say about them. but I will tell you that we have a vast of thunder this summer but we had general good crops this year and good fog. (i.e. the grass following the hay crop- I.F.) and stock of all kinds is selling well espechly sheep which is very dear and so I have nothing more to say so you moust write as soon as posable but not pay for your letters so this is not paid. (letters to America could be paid on despatch or arrival - I.F.) we received your letter 24th August.

So I remain your brother

Christopher Graham. Killhope"

October 3

Dear Brother when you receive this I hope you will be in good health as this lives us at present we are all in good health except our Thomas has been out of health again but is a grate deil better and has started work again but his wife has been confined of a son you said you wished to know how we ware at home we are doing well at home but our John married in June and his wife was confined in July of a daughter and liven with his old father Jon Kidd and Hannah

Some further observations on "The Bruntons and their Buddle"

Colin Short

## 1. William Brunton &amp; Co.

A recent brief opportunity to visit Plymouth Reference Library filled in a few gaps about the company that supplied cloth for Killhope's Brunton Buddles (see Newsletter 3.) It was established at Penhellick, near Pool in Cornwall by William Brunton jnr in the early 1850's, making the (then) standard type of textile fuse. In 1864 a branch factory was opened at Brymbo near Wrexham, also to make fuse and to assemble electric detonators. The company was quite successful and was taken over by Bickford's (the market leaders) in 1898.

Either factory, it would seem, might be capable of supplying buddle cloth, both being involved in textile fuse manufacture.

Plymouth sources yielded no further information, not even an advert. in the Directories (sometimes a useful source of information.) Has anybody any contacts near Wrexham?

Another line of thought suggested that a company making filter cloth for filter presses - such as are used in the clay industries - might also supply buddle cloth. Now, the Cornish china clay industry did not use filter presses to dewater clay until well into the twentieth century, but the technique was well established in the Potteries (to recover slip) by the 1870's. This piece of lateral thinking might suggest the Brymbo factory rather than Penhellick as the source of buddle cloth.

## 2. From playing with mathematics

Although my practice of Chemical Engineering is now over I do retain one or two very general text books, so I thought I'd try to recreate some design equations from a Brunton Buddle (see my article in Newsletter 7.) It struck me that these would be useful when we came to rebuild the Buddles.

Some idea of the typical size of a Buddle can be obtained from the remains at Killhope and these measurements provided some rough guides to the sort of settling distances involved. The basic problem is to calculate conditions such that the minimum settling distance (measured from the feed trough) for the gangue is off the end of the belt. Since the galena is more dense it is necessary then to ensure that the maximum distance for galena is within the available belt length.

On setting up such equations as I could now recover, I found I had no way of taking into account the speed of the belt. If my memory is now flawed (see Newsletter 7) the equation I have now developed for liquid flow down the belt may not be really good enough. From what I did obtain though, making some trial calculations, it would appear that quite a large flow of clean water onto the belt above the ore feed point (see sketch, Newsletter 7) is needed to avoid gangue settling on the belt. I tried some calculations at 40 galls/min - which is a 4ft. deep 45ft. diameter pond for each buddle every 12 hours.... and Killhope had 4 Brunton Buddles! I also tried 100 gpm: this is a lot of water!

One point that became very apparent though was that very small particle sizes were needed to avoid gangue settling on the belt. My first calculations were done at 200 micron (0.2 millimeters) which is clearly too coarse. Moreover the material that was sent to the Bruntons was 'slimes' - and I am not sure at present what particle size we should attribute to 'slimes' (can anyone help me please?) At 10 micron the distances are more reasonable. At smaller particle sizes we can get away with lower clean water flow rates.

Some conclusions from this 'playing with Figures'

Well.....

1. we should not expect to work a Brunton Buddle unless our other processing is yielding 'slimes'
2. we should anticipate having quite a large volume of clear water available, perhaps even a dedicated reservoir

#### A CART FOR KILLHOPE

This summer Friends were able, thanks to Simon Hodgson, to buy and donate to Killhope a wooden cart with original wheels. This now stands impressively outside the mineshop.

Although from Cotherstone, the cart came originally from Ireland. Its previous owner tells the story:-

"The cart was used always on a small farm holding of fifty acres, farmed by the Dinsmore family for three hundred years. In 1977 the last survivor Alexander Dinsmore died aged 94 years a bachelor. The only survivor today of thirteen is Kennedy Dinsmore of Cotherstone. The cart, about 1900, was used for leading peat from the peat bogs near Kilrea, County Antrim and also for taking the potato harvest to the market. It was hauled by a Irish cob that did all the ploughing etc. until 1960. The colours were orange and green on the cart and it was used in orange men parades to carry all the family - ten of them, from one farm."

## PROJECT OFFICER'S REPORT

It's a while since the last Newsletter, so it's time to look back on several months of Friends activities. Events of summer, if that's the right term, began with the barbecue on 17th May. A pouring wet day meant few members of the public at Killhope but a good number of Friends met together and enjoyed the excellent food provided by the Grigg family and friends.

A few days later we had an indoor meet at Allenheads and a full house to hear Frank Unsworth talk on the use of water power in the leadmining industry. Frank detailed the extensive system of watercourses round Allenheads and after his talk we met members of the Allenheads Village Trust who showed us a video film of the hydraulic engine at Allenheads in action. A stimulating evening with lively discussion was enjoyed by everyone.

The 10th June, was A.G.M. night with again a full house in St. John's Chapel. After the business part of the evening, we were indeed privileged to have a "Brains Trust" session with Sir Kingsley Dunham and Mr. Jim Foster-Smith, two old friends who took questions from the floor and played them back and forth in a delightful, urbane and profoundly knowledgeable manner. A real treat.

The following weekend saw our second event organised at Killhope - the Second Annual Quoits Championship. Much to our regret torrential rain lessened the field but those who braved the mud enjoyed a good afternoon's sport. Peter Nattrass eventually running out the worthy winner of the perpetual trophy. Our thanks to Peter who organised the event.

We had a musical feast as well, with Ernest Kirkby and friends on accordin and fiddle and the Davison family from Stocksfield playing the Northumbrian pipes and knee harp. Unfortunately conditions confined the musicians to the mineshop for most of the afternoon, but for some reason the Davisons said they had enjoyed themselves - certainly it is always a real pleasure for us to have them at Killhope.

Joe Heads showed his blacksmith's skills in the smithy and, just as importantly, shared his wisdom with his audience. Joe has popped in at intervals this summer to do some smithying and his presence has enlivened Killhope considerably.

At the end of June, Simon Chapman led a small but interested group of Friends round some of the extensive mining remains of the Derwent valley (see also separate report) and on the evening of St. Swithin's day (it was wet) Frank Unsworth followed up his talk with a walk round Allenheads ending up at the impressive Byerhope reservoir, now sadly breached in line with E.E.C. regulations. It is worth noting that the total water power available in the East Allen valley in 1870 was estimated at 500 hp.

In July we invited our President, Vice Presidents and guests from Industry to view the woodland trail at Killhope and to hear about future plans. Needless to say it was pouring, but our guests were impressed, as all visitors to Killhope have been, by the walk. JoAnn Cullen provided music and Committee members tea and biscuits.

The autumn season began in fine style with Arthur Robert's talk and slide show at Barnard Castle and continued with Bryan Chambers leading an all day walk round the Bollihope valley with personal anecdote and considerable knowledge.

If you haven't been on a Friends event do come; all are friendly and stimulating, for which thanks are due to all our speakers and walk leaders.

Next on the calendar is Trevor Bridges talking in Alston on October 14th on "Lead Miners on slide." Roy Curry leads an underground excursion on 25th October (see page 1) and then it's "Members Night" in St. John's Chapel (details again on page 1.)

Small groups of Friends have been actively helping in the reconstruction of Killhope. We have manhandled loads of veinstuff from a nearby spoil tip to Killhope. Some of this went into the bouse teams and more went to finish off the mine entrance area, making it look much more authentic than when it was covered in limestone chippings.

A start has been made in reconstructing the area at the top of Hazely Hush, with Friends attempting to dig into an early shallow shaft (so far without success) clearing stone from what might have been a level entrance and barrowing stone for building. Much work is still to be done in this area.

Pete Buchanan has been doing a quite different sort of work; he has been engaged in an intensive survey of plant species at Killhope and round the "Stamps" at Nenthead, and will be writing about it in the next newsletter.

Work on the Brunton buddle waterwheel progresses slowly. The cast iron rim segments have finally returned from the sandblaster, who has done a superb job on them and they have been painted with a marine paint. The wheel centre is in position on the wheelpit and reassembly work has begun. Thanks are due to Blue Circle cement works at Eastgate for threading the tie bars for us.

Friends have helped with research into historical and technical aspects of reconstruction; Thomas Wall with his vivid recollections of things like Brunton buddles seen in his youth has been particularly helpful.

Russell Parkin, who has contributed most to the Brunton buddle wheel project, has also made a second "finger point" to lay in the trackway running from the mine, thus completing the system.

Mr. Dick Graham and NEI Parsons continue to come up trumps. Having already cast 20 cast iron tub wheels for Killhope, Mr. Graham readily agreed to make another 20; we are most grateful for his personal interest, and Parson's help.

Other donations have included an Irish Cart which Friends purchased and gave to the County Council (see elsewhere in this Newsletter), some fine old blacksmith's tools from Dorothy Chambers, the letters from Killhope to the United States (see page 13) and a rare nearly complete wooden-bodied tipping mine tub from the last century which Leslie Blakett discovered, recovered and brought to Killhope, where we are preserving it. Dick Ineson has given some photographs of Blackdene Mine and Joe Short a mule shoe found on the moors.

Joe's note tells the story: "In 1925 a mineral prospector J.W. Bell of Hunstanworth found lead on the moor above Whiteheaps Mine. Tom Short and son were sent to explore, it turned out to be the old pack road and the lead had been from a burst pannier. While digging, this mule's shoe was dug out."

Thanks to all the above and thanks also to Michael Crompton who has stepped down from the Friends Committee but who helped guide the Friends through the first important years of our existence.

The Friends library continues to receive papers and articles; additions from a number of people include "Notice on Some Improvements in Dressing Ores" by John Taylor (1831), "An Assessment of Lead Smelting Processes and the use of XRF for the Analysis of resulting Slags" by M.C. Gill, "North Pennine Metalliferous Mining Fields - Glossary of Technical Terms" by J.R. Foster-Smith, "Recollections of a Washing Floor" by John Sanderson, "Burtree Pasture Lead Mine" by Dunham and Hobbs, "Water-Driven Prime Movers" by P.N. Wilson, "Metal Mining and Flood Plain Sedimentation in Britain" by J. Lewin and M.G. Macklin, "Power from Water Wheels" by T.T. Hay, and "Minerals and their Characteristics" by Frank Seeton and G.M. Butler. More articles are always welcome and all can be borrowed from me.

Friends of Killhope have been accepted as members of N.A.M.H.O. (the National Association of Mining History Organisations) and so we will be kept in touch with other groups all over the country and be able to participate in national meetings.

As far as the North Pennines go, some members will be aware of a discussion document on the lead-mining heritage of the North Pennines put out jointly by the three Counties of Durham, Northumberland and Cumbria. This is a very important document for it sets out a strategy for tackling the consolidation and interpretation of the lead-mining legacy in the North. Your Committee has welcomed the document and broadly supports it; anyone who would like to read it should contact me.

Finally, it now looks as though we will get the go-ahead to remove the blockages from Park Level Mine under the supervision of some-one with underground supervisory experience. This work is a big challenge and will entail a good deal of hard graft. Re-opening Park Level will be a real achievement; please get in touch if you would like to help.

Ian Forbes, Projects Officer, Fieldfare, Wearhead, Bishop Auckland, Co. Durham (Telephone: 0388 537470)

### INDUSTRIAL ARCHAEOLOGY

CBA3 offer a joint conference on Saturday 24th October 1987 at the Clement Stephenson Lecture Theatre, Department of Agriculture, University of Newcastle upon Tyne. Applications by 9th October to CBA3 Secretary, Department of Archaeology, University of Newcastle upon Tyne NE1 7RU. Cost - members £5.50, others £7.00 including buffet lunch and coffee. Several distinguished speakers on various aspects of archaeology, from 10.30 to 5 p.m.

A REVIEW OF KILLHOPE AS A TOURIST ATTRACTION IN 1987  
(County Council Spokesman)

The 1987 visitor season is nearly over and it is possible to take stock of how well Killhope functioned as a tourist attraction. The season started with high hopes of a 50% increase in the number of visitors over 1986. 30,000 paying customers was the aim and with more to see, more publicity and a new car park to cope with the hordes, this seemed a realistic target.

In fact numbers were up by 50% in April and May and the increase in party bookings was particularly encouraging. However, at Killhope the weather is all important and the June and July figures were not only down on 1986 but were below the April and May 1987 numbers. August only partly made up for this disappointment with 6,000 customers, compared with 5,000 in 1986. The August Bank Holiday produced a record attendance of 509, the record having been broken earlier in the season on Easter Monday and the Spring Bank Holiday. With the completion of the new visitor centre it should be much easier to cope with numbers well in excess of 500 and still provide a personal service.

During the season very simple surveys were undertaken of the origins of tourists and day visitors. Whilst the poor weather probably resulted in fewer day visitors than in 1986, this was more than made up for by the increase in tourists. Of all tourists surveyed 12% were from abroad. As well as the many family groups there were booked-in groups from Germany, France (2 parties) Italy and Denmark (one of the Danish Groups was a shipyard band who came with their instruments and performed at Killhope.) Of the tourists who were from outside the region, a surprisingly high figure of 49% were from the south and south east of England.

It appears that the total number of paying customers in 1987 will be about 25,000, an increase of 20% over 1986 in a year when many tourist attractions had a fall in their number of visitors. Delays in opening the woodland trail and in publishing "Lead and Life" resulted in much less publicity than there might have been. However, by the start of the 1988 season the whole appearance of the crushing mill and washing floor should be transformed and there will be much more to see on the woodland trail. We should perhaps aim for 35,000 but be content with over 30,000 visitors.

KILLHOPE PROGRESS REPORT

Killhope today is a little like a theatre production at its most chaotic state prior to the dress rehearsal. Nothing much appears to be near completion; a great many individual elements are slowly progressing and the whole enterprise gives little impression of ever coming together. But faith is needed and a glance back to the progress report in the May newsletter should give cause for optimism.

In theatre production there is a belief that it will all come right on the night and it usually does, despite inevitable setbacks. There are increasing signs at Killhope that this will happen, but Friends will have seen few dramatic changes. That is because work has been going on all over the site rather than being concentrated in one area.

The achievements since May are:-

All masonry works to the buddle house gable and side walls have been completed.

The buddle house roof trusses, purlins and rafters are all in place - work can start on reslating the roof.

The settling tanks near the saddle house have been restored except for minor works at the eastern end.

The area between these tanks and the brunton buddles has been restored to its original level and refloored with the adjacent wall rebuilt.

David Cranstone and his band of archaeologists completed their investigations of the washing floor and exposed the third set of settling tanks together with watercourses leading to them.

More box watercourses have been reinstated leading from the mine entrance to the washing floor.

The railway has been extended from the mine entrance to the dead heap and the bunting has been constructed.

The Brunton buddle wheel is now being put back in position.

The foundations of the bridge over Killhope Burn have been made sound.

The majority of the workers' huts near the mineshop have been moved onto the new car park.

The drystone wall around the field behind the jigger house has been rebuilt.

The water race which came from the east bypassing the reservoirs has been reconstructed where it crosses the stone culvert leading from the reservoir valves - a section of that culvert has also been rebuilt.

Further material has been excavated from the reservoirs and some work has been done on re-establishing the ditches which served them.

The replica pits in the wood have been completed.

The foundations for the eighteenth century stable block/ tool store in the wood have been excavated and much more building material has been moved up to the clearing where that display will be.

The display of early eighteenth century ore dressing at the top of Hazely Hush, being undertaken by Friends, is slowly taking shape.

A great deal has been done to satisfy safety requirements on the woodland trail.

Some explanatory boards have been erected along the woodland trail.

After completing that list the writer feels much happier about progress over the last four months! The workload from now until Spring 1988 includes:-

Completing the roofing of the buddle house including the pipe through the roof between the jigger house and classifier.

Fully restoring the settling tanks near the saddle house and on the washing floor.

Installing the second double hotching tub, restoring the running buddles and watercourses on the washing floor and flooring out where appropriate.

Producing more replica mine tubs and replica tubs which carried ore from the washing floor.

If Friends can find the right rails, relaying the rails on the washing floor and leading from there to the crushing rollers and the dead heap.

Installing doors and windows in the buddle house.

Filling the reservoirs.

Reconstructing the remaining section of the stone culvert from the original valves downwards.

Largely completing the building of the eighteenth century stable and gin-gang.

Completing the display at the top of Hazely Hush on ore dressing and progressing the work on the level.

Making substantial progress on the new visitor centre.

AN ARCHITECT IN THE LAND OF LEAD

Mrs. June Crosby has submitted an important article on the work of Ignatious Bonami based on her recent exhibitions at Bowes Museum and Durham and it is with regret that we have had to hold this over until the next Newsletter due to lack of space. However, Friends should note that this interesting exhibition may still be seen at the Durham Heritage Centre, St. Mary-le-Bow for one day only on Saturday 31st October.

**Vielle Montagne Zinc Co.**

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Coal from { Alston.  
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by Hobmes Cartman.

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