BRITISH MINING No.11

MEMOIRS 1979

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Challis, P.J. 1979 “Greenside Mine: Ore dressing c1900 - The dam disaster 1927”
British Mining No.11, NMRS, pp.75-81

Published by the

THE NORTHERN MINE RESEARCH SOCIETY
SHEFFIELD U.K.

NB
This publication was originally issued in the A4 format then used by the society. It has now been digitised and reformatted at A5. This has changed the original pagination of articles, which is given in square brackets.

GREENSIDE MINE: ORE DRESSING c1900 - THE DAM DISASTER 1927.

by P.J. Challis.

The mine, situated near the head of Ullswater in a spur of the Helvellyn range was first worked at a height of approximately 2000ft OD. The washing and dressing plant was reportedly primitive, consisting of stamps, buddles and possibly hand jiggers (Shaw 1975). Due to the exposed position of the dressing floors work was impossible during the winter months.

About 1830 crushers, rollers, jigs and buddles were introduced driven by waterwheels. Further improvements took place in 1871 with the addition of a new mill and turbines to assist the waterwheels. About 1910 the circular buddles were replaced by Record Vanner Tables which treated the fines from the classifiers and the slimes went to Luhrig Buss tables and belt vanners, forming a continuous process (Postlethwaite 1913). The next major change occurred when the Basinghall Mining Syndicate Ltd., took over in 1936 and installed a new crushing and dressing plant including ballmills and a flotation plant capable of processing 250 tons of vein material per day. This was not immediately successful and was rebuilt incorporating the best of the 1871 mill (Shaw 1975). At this time the waterwheels and turbines were replaced by an electrical plant supplied partly from the National Grid and partly by the Company's own hydro-electric generators (Connors 1951).

The Mill 1903.

The vein-stuff comprising galena, pyrites, chalcopyrites and barytes was contained in a fine grained, brittle volcanic rock, locally called 'Greenstone' from which the mine name may have originated (Connors 1951). Due to the hardness and distribution of the vein-stuff, difficulties were encountered in milling, requiring a great deal of labour (Postlethwaite 1913).

The plant was designed to run on the principle of continuous ore-dressing and 70% of the produce was delivered to the ore-bing ready for the smelt mill which entailed only two handlings after passing through the stone-breaker. In 1903 the total labour costs including picking the crude vein-stuff at the grates, (containing approximately 7% lead-ore) to the delivery of the ore at the smelt-mill – the latter containing 82% metallic lead – was 52½p per ton of ore.

The ore was brought out of the Lucy Tongue Level by electric locomotives and was discharged into stone hoppers. At the bottom of the hoppers two steel barred grates were fixed, one above the other. The roughs on the top grate were handpicked and conveyed directly to the stone-breaker and the smaller material on the second grate went to the roll crushers; the material passing through was sent to the Green's plunger jiggers and the fines and slimes were caught in settling tanks.

The picking grates were situated 150ft below the crushing and dressing plant and the several sizes were taken, as required, up the incline in self-tipping waggons. Wm. H.

Borlase, the mine manager at this time claimed to have erected the first of its class in Britain in 1873 at the Ruthers iron mine, Cornwall, from a design of his father's. The power employed to operate the incline was derived from the No.1 20 horsepower vortex turbine.

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At the tip two hoppers were employed at one point, the roughs went straight to the stone-breaker and the smalls were directed to the crushing rolls, alternatively they could join the material from the stone-breaker and thus could be crushed together or separately. The stone-breaker was powered by the No.2 turbine of 15 horsepower.

The crushers were driven by a 30ft diameter over-shot waterwheel 4½ft wide which used the exhaust water from the No.1 turbine. They comprised three sets of rolls each 16 inches diameter and 17 inches long. The top set of fluted, chilled iron rolls dropped the vein-stuff onto two sets of plain rollers. Below the rolls was a revolving screen cylinder, (trommel), A on the diagram. The roughs from the screen were (unlike most dressing mills, in which they were returned to the primary crusher) taken to a crusher with large Cornish rolls and crushed separately which, in the opinion of Borlase, improved the flow as it consisted of material varying from ½-1 inch cubes and when mixed with the larger roughs tended to escape the rolls and thus had to be returned several times. This vein-stuff was caught in a hopper and trammed to the crusher on the second floor. After treatment it was classified for four jigs, similar to the first floor jigs. Both sets were driven by the No.3 12 horsepower turbine.

Ore caught in the first compartment of the jigs Nos. 1, 1a, 2, 2a, and 3 was separately conveyed to a cleaning jig, No.12 and was then sent to the ore-bings. The ore in the first compartments of jigs Nos. 3a, 4, 4a, 5, 6 and 7 was tipped into a rectangular buddle. A clean stream of water was run through the ore as it was thrown against the sloping head of the buddle, washing out the impurities which escaped the jigs. This produced lead-ore containing 82-84% metallic lead.

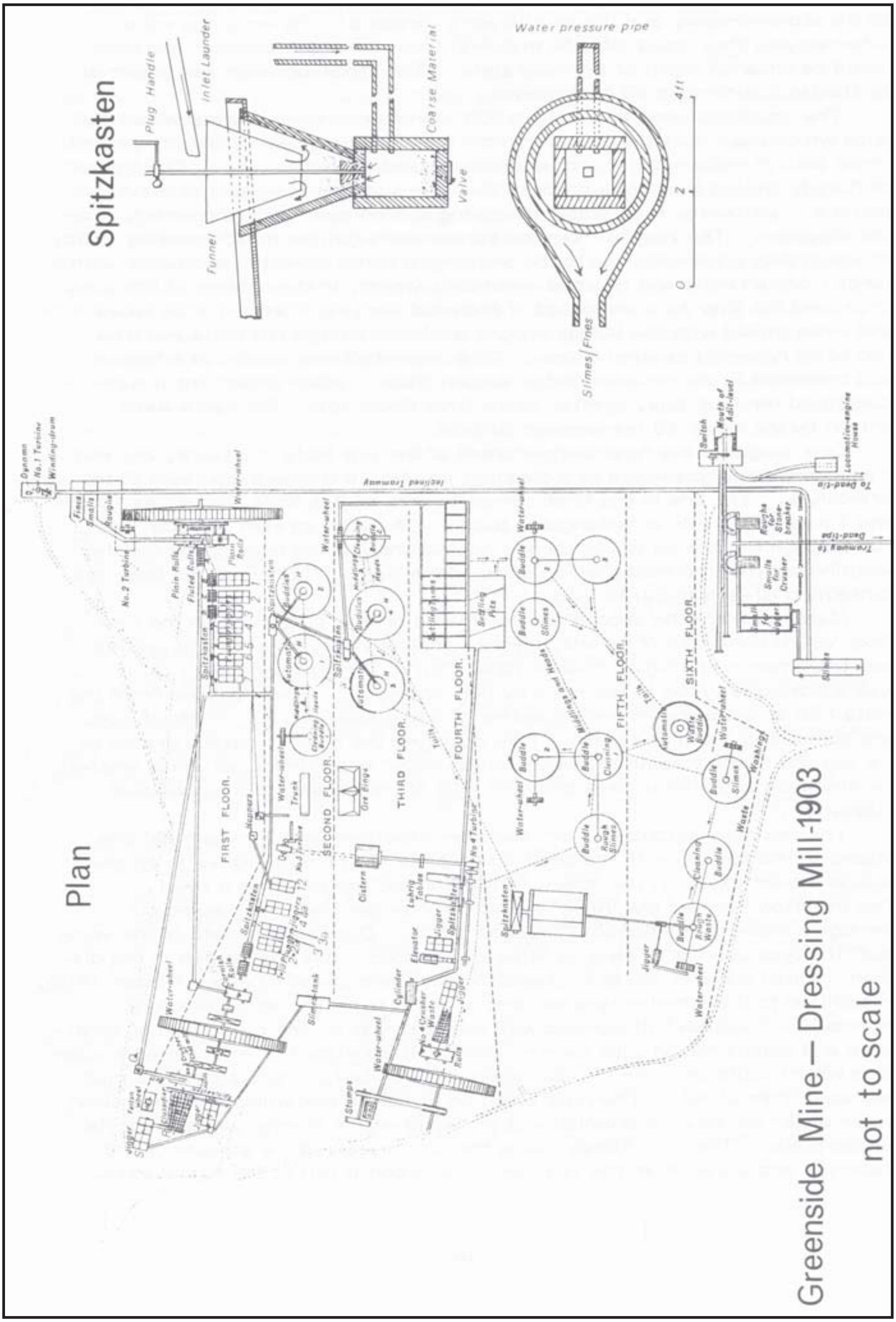
Material from the second compartments of jigs 1, 2 and 3 on the first floor which consisted of galena, blende, chalcopyrite, barytes and pyrites was trammed to the No.3 crusher (chat-mill). From the hopper, Q. it was automatically fed to the rolls by belt conveyor. It was passed from the rolls into an octagonal cone-shaped revolving classifier, R., made of wood and containing a spiral screw. This conveyed the heavy, coarse grains to the top end of the classifier, where clean water was introduced which washed the fine lead and slimes back over the ribs of the screw, to a spitzkasten classifier.

The ordinary spitzkasten or 'surface-classifier' was a pyramidal box placed in the stream with the point downwards. The pulp flowed in on one side and overflowed on the other, inflow and outflow being on a level. The overflow carried the 'fines' whilst the coarser material passed out through a valve at the bottom (Truscott 1923). Due to the nature of the vein-stuff the type used at Greenside Mine was probably like that shown in the diagram, which were in use at Frongoch Mine, Cardiganshire (Neve Foster 1910), in addition to the simpler type evident on the plan. The spitzkasten or ‘hydraulic-classifier’ illustrated was used to treat an ore consisting of sphalerite and galena mixed with country-rock. It consisted of an inverted wooden cone which could be more or less completely closed at the bottom by a plug operated from above. The cone stood on a wooden box which received clean water under pressure and which was provided with a discharge valve, a flat hinged plate. The iron funnel inside the cone received the stream of ore material and water from the launder, whereupon it fell to the funnel base.

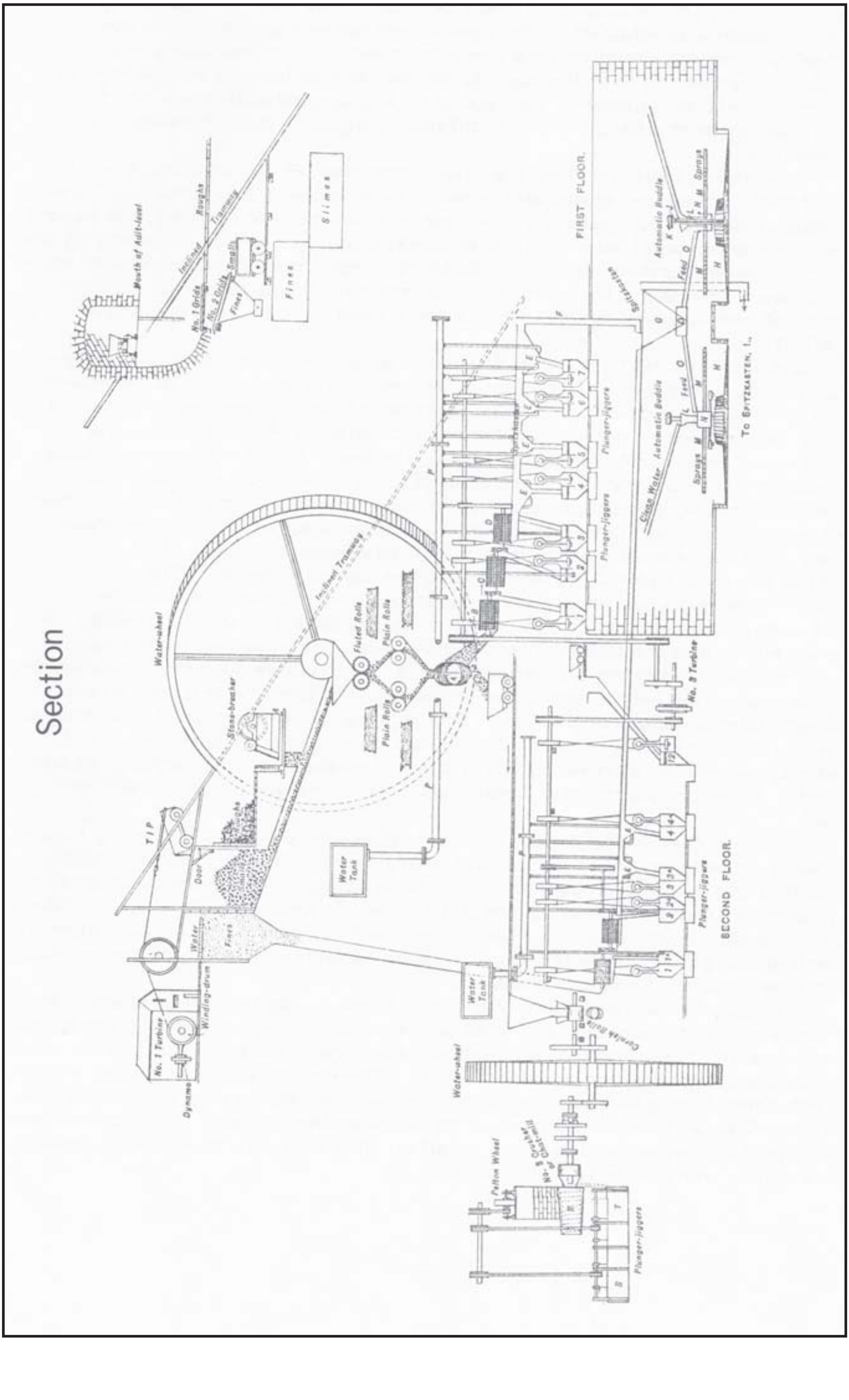
There it met with the upward current of clean water and the separation or classification was effected. The coarse and heavy material which overcame the stream passed into the box and flowed out continuously while the ‘fines’ were carried over the top edge of the cone which was surrounded by a circular wooden launder. By regulating the upward water flow and the diameter of the discharge orifice, different ranges of classification could be achieved.

The coarse material from the cone-classifier, R fell into jig, S which was fitted with copper plates and worked at 200 strokes per minute. This produced almost 100% galena in the first compartment of each jig, the second compartments contained a mixture of barytes and sphalerite with some galena which required further jigging. The third compartments contained a mixture which was returned to the stamps. The machinery was driven by a pelton wheel 12 inches diameter, working under a head of 400ft. and running at 1,400 RPM.

Returning to the first floor, the material passing through trommel, A was conveyed, in water, to trommel, B, the material passing to the end of this was fed into jig No.1. The plunger ran at 140 strokes per minute and made four grades, the first compartment consisting of 75% galena; the second, galena, barytes and sphalerite; the third and fourth compartments produced waste or chats with ore attached. Trommel C, received the material passing through screen B, the rougher sizes went to No.2 jig where the results were similar to those of No.1 jig except that the first compartment produced almost 100% galena. The next screen, 0, supplied its coarse material to No.3 jig which had three compartments. The plunger made 180 strokes per minute and produced, from the first compartment, 80% galena; the second compartment produced galena, barytes, pyrites and sphalerite whilst the third contained the above ores mixed with the chats. From this point the classification was continued through four spitzkasten, E, each supplied with water under pressure. In turn the spitzkasten each supplied three compartment jigs. The jigs ran at an average of 225 strokes per minute and produced the following results:- first compartments, 80% galena, second compartments, a mixture of galena, barytes, sphalerite and pyrite: third compartments, small particles of ore attached to fine quartz etc.


Spitzkasten
Plan
Greenside Mine – Dressing Mill-1903
not to scale

GREENSIDE MINE: ORE DRESSING C1900 - THE DAM DISASTER 1927.



The overflow from the last spitzkasten was taken via the launder, F to a large spitzkasten, G on the second floor, from which the heavy material supplied two automatic buddles, H, of convex type. The overflow from the spitzkasten went to another on the third floor, I, which supplied two automatic convex buddles with fine material. The overflow from I was then caught in settling tanks for further treatment in buddles on the slime-floor below, when sufficient material had accumulated.

The buddles were capable of treating large quantities of low grade material. They were 24 ft diameter, the head or centre was 8ft diameter. Each buddle was capable of treating the fines from the crushers escaping the jigs for a run of 200 tons with little or no supervision. The contents of the buddles were divided into four qualities, the tails were run directly to a spitzkasten on the fifth or ‘waste-floor’ and consequently on to another buddle. The second and third partings were hand-fed to a small buddle, while the heads were treated in a small, mechanically driven buddle.

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On the fourth floor the third compartments of the whole of the fines from jigs No’s.3, 4, 5, 2a and 3a were further reduced in the small stamps battery and classified; the roughs were jigged and the fines passed to Luhrig tables. The tables also treated the material from the third compartments of jigs No’s.6, 7, and 4a. The contents of the fourth compartment from jigs No’s.1 and 2 and the compartment of jigs No’s.1 a and 2a were taken to No.4 crusher and subsequently classified and jigged. The fines were sent to the Luhrig tables.

The table house was equipped with a very fine jig which ran at a speed of 280 strokes per minute. The overflow of the classifier supplying this jig passed successive spitzkastens, and in turn, each supplied a table. At a later date more Luhrig tables were installed to treat the slimes caught in the zig-zag settling pits, which in Borlase’s time were treated by buddIes on the wastes and slimes floor.

The dynamo, shown in the No.1 turbine-house was belt driven off the turbine by clutch gearing and supplied the smelt-mill, offices, workshops and dressing-mill with electric light.

<u>The Dam Disaster 1927</u>

The 1927 dam failure was the second incident involving the Greenside Company’s reservoirs. About 1870 the Company’s Top Dam burst and the resulting flood partially demolished the silver-refining house, carrying off a 1,000 ounce silver plate, which despite careful search was not recovered. However it was later rumoured to have been found and spirited away (Shaw 1975).

The scene of the 1927 disaster, Kepple Cove Tarn, a natural lake, ties at a height of 1,750ft on the NE slopes of Helvellyn. Red Tarn, also a natural lake, lies on the eastern slopes of Helvellyn. Between the two tarns the hill of Catsycam rises, at the base of which the overflows from the tarns united. The water flowed through an open watercourse, 1" miles long to a wooden tank. From the tank it was conveyed for a distance of 1,080ft in 15 inch diameter cast iron pipes. The fall at the turbine house was equivalent to a vertical fall of 400ft and the effective horsepower was approximately 200 (Borlase 1894).

Kepple Cove Tarn covered an area of seven acres and was 30ft deep. The dam was almost completely natural, consisting of the debris of a terminal moraine. At the level of the bottom of the tarn it was over 300ft thick and the embankment, or dam wall, consisted of large boulders in a matrix of clay and gravel. The external and internal faces had a flat slope with a natural overflow at one end, into which a sluice was built. The face of the dam had a natural beach of stone and the outfall remained at its natural level. However, some additional rough walling was built at the water level. The accident occurred during the early hours of Saturday 5th November 1927, (Shaw's account gives the date as 29th October 1927). During the previous afternoon the sluice was raised and the water observed to have been below the maximum level. The night saw one of the gales, accompanied by torrential rain that only the Lake District seems to experience. The breach occurred shortly after midnight and within a few hours the stream had returned to its normal level, but it had left a trail of damage and destruction behind.

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The damage in Glenridding village was extensive, although nobody was injured. The bridge over the stream was badly affected and farms, hotels and houses were inundated. The contents of a bank and the Post Office were damaged and a counter of a food shop was driven through the window whilst its merchandise was swept into the street, even as far as the lake. At the tarn, a deep gully formed in the dam wall, with nearly vertical sides, some 30-40ft deep and 70ft wide. Large masses of debris littered the channel which was deeper than the bottom of the lake. The overflow remained undamaged.

The cause of the accident was attributed, by the mine-engineers, to a phenomenon that had repeatedly been observed. The wind, forming a vortex in heavy gales caused the water to swirl in the tarn and as the induced waves struck the dam wall clouds of spray were carried over the top. This water normally sank into the ground, but in this incident it was thought that the quantities were great enough to develop channels on the dam's outside wall, which in cutting into it eventually released water from the top. Once started, the channel would rapidly deepen and eventually burst 'instantaneously'.

The disaster marked a turning point in the fortunes of the old Greenside Mining Company. Compensation paid out following the disaster, coupled with the prevailing low price of lead forced a re-organisation of the Company and the injection of new capital. Despite these efforts however, the mine closed for two years in 1934, to be taken over by the Basinghall Mining Syndicate Ltd., who worked the mine until its final closure in 1962, (Shaw 1975).

Note. The Dressing Mill diagram is taken from Borlase 1902-3.

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