BRITISH MINING No.8

MEMOIRS 1978

Hunter, J. 1978 “Hemerdon Ball - Rolling Again”
British Mining No.8, NMRS, pp.43-48

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.

ISSN 0309-2199

HEMERDON BALL - ROLLING AGAIN?

J. Hunter

Despite the alarming fluctuations in tungsten prices over the past few years, the anticipation of a continued growth in western world tungsten production during the next decade has prompted the re-evaluation of three former wolfram producing mines in England. The best known of the three is Car rock Fell near Penrith, where recently Carrock Fell Mining Co. Ltd. (part of the Amalgamated Industrials group) has optioned the property from the owners, WECO Development Corporation of Denver, Colorado. This old mine has been sporadically worked for over 100 years and may soon be in production again if sufficient ore can be outlined. In Cornwall, South Crofty Limited last year obtained permission to drill two boreholes close to its abandoned Castel-an-Dinas mine near St. Columb which was last worked at the end of World War II, while nearby in Devon, what might eventually become the largest metalliferous mining project in the U.K. this century is progressing very rapidly at Hemerdon Ball, seven miles northeast of Plymouth.

The occurrence of scattered wolfram in a small granite outcrop at Hemerdon Ball hill had been known in the early years of this century by prospectors and miners who worked at the two nearby tin mines, Bottle Hill and Wheal Mary Hutchings, but the existence and nature of the stockwork orebody was not recognised until the middle of the 1914-1918 war. The demand for tungsten required for tools and ammunition motivated representatives from the Ministry of Munitions to visit Devon and Cornwall to stimulate the production from known sources and exploration for new deposits. The first significant discovery at Hemerdon was an outcropping quartz vein in granite averaging 26 inches in width with a tungsten content of 0.97% WO_3 and minor tin values. This lode could be traced for a strike of 150 feet through a small quarry. It was later traced a little further westwards, but towards the east, trenching failed to find any distinct “lode”, only soft kaolinized granite containing innumerable small quartz veins, practically all of which were mineralized to some extent. Further pitting and trenching confirmed their developing suspicion that Hemerdon Ball was underlain by a sizeable wolfram-tin-china clay stockwork deposit.

An option on the property was secured by a small company and pits were then sunk more systematically to depths of 12 to 20 feet. These pits defined the area of the granite intrusion and it was soon discovered that although the quartz veins continued for a short distance into the metamorphosed killas, the tin and tungsten values dropped off sharply at the contact. A bulk sample of 109 tons of ore, amounting to approximately half the quantity excavated from the pits, was taken to a nearby mine for assay and concentration testing. Of the 0.8% combined tin and wolfram content determined by chemical assay, 0.62% was found to be recoverable in concentrates assaying 51.3% WO_3 and 17.1% Sn. However, in view of more recent research into Cornish mill and concentration practice, the battery pulp assay was more likely to have been 1.17% WO_3 + Sn, with the vanning assay indicating an ideal recovery of 53% against the actual test recovery of 45.5%. The main loss of mineral was attributed

to high values in the considerable quantities of slimes, although a portion of this mineral was found to be recoverable with an adequate slimes plant.

[43]

These results were deemed satisfactory, and plans to build a 100 ton/day mill were drawn up. After an urgent request from the Government however, the scheme was almost immediately revised and enlarged to treat 400 tons/day on an understanding that the Ministry of Munitions would maintain the price of wolfram for a postwar period of two years. It was particularly galling for the Ministry at this time that most of Germany's tungsten supply, which had enabled such a rapid increase in pre-war munitions manufacture, had come from Cornwall, where it was thought to be a supposedly useless by-product of tin mining.

Mill construction was started in July 1917, and an order was placed with Messrs Tangyes Limited of Birmingham for three horizontal two-cylinder gas engines, each rated at 240 bhp for continuous running, together with three complementary producer-gas plants. It was calculated that only two engines would be required to drive all the mill and auxiliary machines, with the third engine available as a reserve. It was proposed to feed ore trammed from the quarry benches through bar grizzleys, from which the oversize would proceed to the 50 head stamp battery, while the undersize would be sluiced down to disintegrate the soft kaolinized matrix and then tromelled to 3/8 and 1/8 inch fractions. All plus 1/8 inch material was returned to the stamps, while the fines were transferred to a spitzkasten . The coarse fraction from the spitzkasten was then tabled, and the fine overflow settled out to recirculate the water. Concentrates from the shaking table were dried and separated in an improved Wetherill type magnetic separator. A considerable amount of redressing was necessary for all the middlings and most of the finer products from the James tables, and any simplifications in the concentration process due to the relative absence of sulphides and valueless oxides was more than compensated for by the large proportion of clay-slimes and the decomposed and "chatty" nature of much of the wolframite.

The mill was finally completed in February 1919, three months after armistice, and a month later, despite all previous agreements, the Ministry announced that no more wolfram would be accepted after April. Only 16,000 tons of ore had been dressed when the plant shut down, hardly sufficient to be able to estimate plant efficiency and working costs. Final wolfram concentrates averaged 60% WO_3 with 1.5% Sn, while the tin concentrates graded 67% Sn with 4.7% WO_3, mainly as scheelite.

Throughout the period of mill erection and pilot plant operation, the extreme shortage of skilled and semi-skilled labour meant that only general labourers were available for employment in the engine room and stamp mill, while girls proved the only class of labour available for the concentration plant. An estimated 61 persons were thought necessary for the full production capacity of 400 tons/day, when total operating costs would probably have amounted to 8s 0d per ton of ore treated.

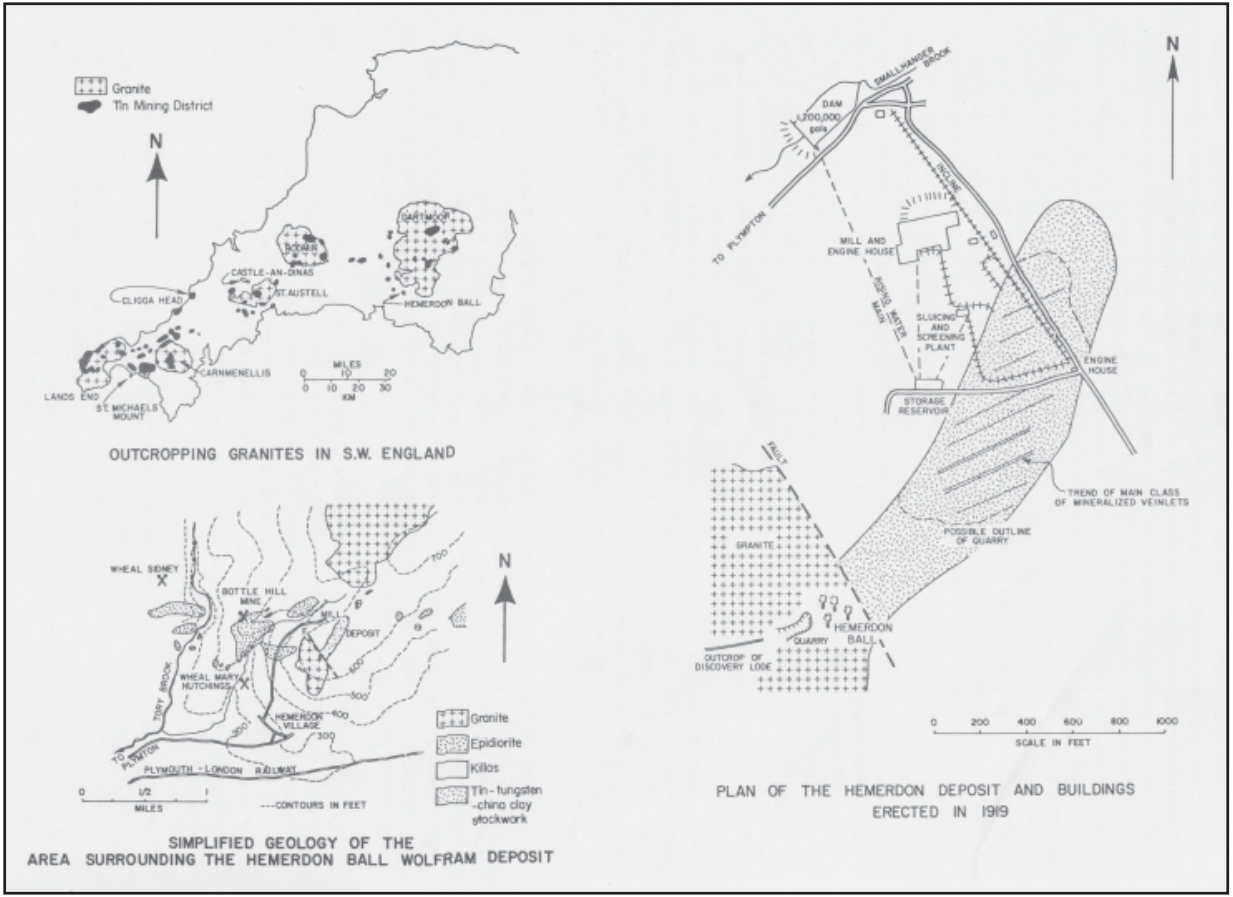
Foreign overproduction, large Government stockpiles and adverse economic conditions continued to depress wolfram prices after the war and many potential producers remained dormant for a prolonged period. Interest was renewed at Hemerdon in 1935 however, when trial sampling began which led to the acquisition of the lease on the property by a private company called Hemerdon Wolfram Limited. The company began erecting a 250 tons/day mill in late 1939 which [44] came into operation in the early summer of 1941. Although many details of this plant are lacking, it can be assumed that the original stamps and gas engines were abandoned and other forms of crushing and power supply were introduced. New Harz jigs were installed to handle the coarser fractions from the tromells, but the bulk of the sands, fines and slimes passed over the James tables left behind from the 1919 milling operation.

During the operation of this mill in 1941, the Non-Ferrous Metallic Ores Committee of the Ministry of Supply came to an agreement with Hemerdon Wolfram Limited, whereby a comprehensive sampling programme and feasibility study was carried out which led to the acquisition of the lease by the Ministry of January 1st 1942. A 2000 tons/day mill was begun by Non-Ferrous Minerals Development Limited as agents for the Non-Ferrous Minerals Development Control. The general increase in demand for tungsten during wartime was accelerated in 1942-43 by the capture of Burma, an important source of raw material, and the design capacity of the new mill was then increased to 3000 tons/day. Operations finally began in October 1943, when the smaller mill, which had run quite satisfactorily at 400 tons/day since 1941, was closed down.

With the development of a more favourable war situation in 1944 the demand for tungsten fell again and the new mill, which had only averaged a daily throughput of 850 tons/day, was shut down after nine months of operation. During this period it has been estimated that some 201,600 tons of ore were mined from two benches in the quarry and dressed to yield 181 tons of combined WO_3 + Sn in concentrates assaying 42.6% WO_3 and 11.9% Sn. At that time the workable area of the deposit was 2000 feet x 450 feet (i.e. about 21 acres), and reserves calculated to a depth of 60 feet were estimated at 4,500,000 tons of ore containing 6,400 tons of WO_3 and 1,650 tons Sn. This would have given a working life of about five years at an extraction rate of 3000 tons/day. The tungsten grade was very low (3.19 lb/ton or 0.14% WO_3) and the recovery was only about 2 lbs of mixed concentrates per ton.

From the end of 1944 the price of tungsten fell continuously for two years, with weak demand due to the impoverishment of the final consumers and the lack of credit for investments. In 1946 the British Government abandoned the state monopoly for tungsten and molybdenum, although the large stockpiles were maintained, and the price fell to a low of 65s per long ton unit.

In 1949 public attention was again drawn to Hemerdon by an auction of surplus stores and spares by the Ministry of Supply. Many interested parties thought that this indicated that ·the mill would be dismantled again after it had been kept on a care and maintenance basis for five years (costing nearly £3,000 per annum), and complaints were made about the mine not being re-opened. As a result of this outcry various negotiations ensued and eventually in 1952 the China Clay group of companies


Granite
Tin Mining District
N
DARTMOOR
BODMIN
CASTLE-AN-DINAS
ST AUSTELL
CLIGGA HEAD
HEMERDON BALL
CARNMENELLIS
LANDS END
ST MICHAELS MOUNT
MILES
KM
OUTCROPPING GRANITES IN S.W. ENGLAND
WHEAL SIDNEY
BOTTLE HILL MINE
MILL
DEPOSIT
WHEAL MARY HUTCHINGS
TORY BROOK
HEMERDON VILLAGE
TO PLYMPTON
PLYMOUTH - LONDON RAILWAY
MILES
---CONTOURS IN FEET
Granite
Epidiorite
Killas
Tin-tungsten -china clay stockwork
SIMPLIFIED GEOLOGY OF THE AREA SURROUNDING THE HEMERDON BALL WOLFRAM DEPOSIT
SMALLHANGER BROOK
DAM 1,200,000 gals
INCLINE
TO PLYMPTON
MILL AND ENGINE HOUSE
RISING MAIN
SLUICING AND SCREENING PLANT
ENGINE HOUSE
STORAGE RESERVOIR
FAULT
TREND OF MAIN CLASS OF MINERALIZED VEINLETS
GRANITE
POSSIBLE OUTLINE OF QUARRY
HEMERDON BALL QUARRY
OUTCROP OF DISCOVERY LODE
SCALE IN FEET
PLAN OF THE HEMERDON DEPOSIT AND BUILDINGS ERECTED IN 1919

was entrusted with making further tests with a view to restarting the mill. Meanwhile war had again broken out, this time in Korea which is another important tungsten producer. With the involvement of the United States in the hostilities, the tungsten price moved from 95s to 120s/ton unit between April and June 1950, and by March 1951 had risen to 680s, an increase of 700%'.

[45]

As a result of the investigations by the China Clay Group at Hemerdon, it was reported that poor recovery values for the minerals in the previous milling operations had been due to the following four factors:

1) The incapability of the sluicing to disintegrate the china clay matrix in the ore.

2) The failure of the concentration plant to prevent serious loss of mineral in the slimes.

3) The inadequate size of the Dorr thickener to deal with all of the slimes, which were excessively dilute to begin with.

4) The poor quality of workmanship and design in the plant construction.

The first factor was by far the most important, as the persistence of clay lumps in the ore pulp affected the performance of all the following concentration machinery. This problem was subsequently eliminated by the construction of a washing tromell to replace the Pool washing system. By July 1953 the mill had been repaired sufficiently to allow an eight hour shift test run, when 545 tons of ore were treated assaying 0.24% WO_3 and 0.04% Sn per ton. The recovery values were still low however, at 48% WO_3 and 66% Sn, although the combined value of 59% could probably have been improved to 65% or even 70% if the modern machinery available at the time had been used.

Despite the encouraging results from the 1953 test run, market conditions once again intervened and prices fell to 310s/ton at the end of the Korean war, eventually reaching their nadir of 100s/ton in February 1954. By the summer of 1954 all thoughts of an immediate resumption at Hemerdon were given up. Several rumours circulated about disposal of the property into private hands again, but none of these came to anything. Finally in 1960 the plant was purchased from the Ministry for disposal and all useful equipment and machinery was removed.

What might be called the present chapter in the mine's chequered history began at about this time. Events leading up to the formation of a company called Hemerdon Mining and Smelting Limited are a little obscure, and a large proportion of the share capital of this Bermuda registered company was raised in Ontario, Canada. Mr. Richardson, an original promoter of the company and a veteran Canadian prospector was involved in limited exploration at Hemerdon for the next 15 years until the chairmanship of the company passed to Mr. Carl Schwartzwalder in December 1976. During this period the tungsten price had steadily climbed again from 1964 onwards

until it reached the record value of £38/long ton in 1970. Since then however the price dropped and continued to seesaw, with numerous imponderables rendering any supply-demand forecast for the end of the decade little more than guesswork.

Hemerdon Mining and Smelting Limited pursued its activities in the 1970's and after encouraging results from the first stage of a more organized and intensive exploration programme, involving some 3600 feet of drilling in 45 [46] holes, the company sought planning permission from the Devon County Council for the second phase of the programme. Necessary finance was raised by seeking partnerships with larger mining houses. Agreement was eventually reached with Amax Corporation (American Metal Climax Corporation) in December 1977, and a further stage of 6000 feet of drilling was initiated, with holes planned to reach depths of 400 to 500 feet. In April 1978 it was decided to proceed with the third and final phase of the programme before the second phase was completed. The drilling results to date are said to indicate ore reserves of 20,000,000 tons grading 0.15% WO_3 and 0.04% Sn to depths of 330 feet, and the final phase involves at least 15,000 feet of drilling to depths of 600 feet.

Feasibility studies and metallurgical testwork will then follow, as the problem of liberating the minerals from the china clay has never been solved satisfactorily. The tailings of a more modern operation could however provide an important source of kaolin, silica sand and mica as by-products. It has also been announced that the joint venture partners have reached an agreement with the English China Clays Group allowing them to explore on adjacent land near the Lee Moor operation, with E.C.C. retaining royalty rights on all metallic minerals and first refusal rights on any kaolin by-products.

Tin-tungsten stockworks in Cornwall are distinctly separate phenomena, unrelated to and older than the tin/copper vein-lode mineralization that has made the West Country mining industry famous. They are controlled by a specific association of joint systems in the upper 600 feet of small granite cusps, and this means that stockworks are relatively rare. However, surface evidence from the twelve outcropping "small granites" in S.W. England indicates that perhaps others may lie buried at a shallow depth below the surface, where the erosion level appears to be within a few hundred feet of the tops of many small "cusps" and subsidiary intrusions of the batholith. Of the twelve outcropping small granites, three appear to be exposed at the correct erosion level for the preservation of stockwork mineralization and these are Hemerdon, Cligga Head and St. Michaels Mount. Only Hemerdon, where the original roof was probably only 50 feet above the present summit is likely to prove viable as an orebody at present, although Cligga Head is thought to contain at least 4,000,000 tons of "visible" ore grading 0.2% combined tin and tungsten. It seems that detailed gravimetric surveys, litho-geochemistry, aerial photograph and satellite imagery interpretation may stimulate a re-examination of the potential of the southwest peninsular for this type of orebody.

The cyclic behaviour of the prices of both tin and tungsten can be expected to be the main stumbling block in the development of a large scale mining operation at Hemerdon. Another major problem may be in obtaining the necessary local

Government planning permission to operate a mine, as current permits only cover exploration and expire in 1979. Local environmental opposition has been minimal so far, but the planning of a large open pit is bound to call for a public enquiry at a later stage. Finally the current confusion arising from the entangled shareholdings in the company will need to be ironed out, and hopefully the appointment of trustees in Bermuda will soon establish a sound financial framework essential for the successful operation of any mining company.

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Author's Notes

1) The ton referred to throughout the text is the long ton (2240 lbs), and tungsten prices were quoted per ton unit; a unit is equal to 1% of a ton of WO_3 contained. Prices are now quoted per tonne unit (1000 kg).

2) The term "chats" refers to the tendency of bladed mineral grains like wolframite to break across, rather than along the mineral/gangue boundaries during crushing, and not separate cleanly into concentrate and waste. It was later thought that chatting was only a minor problem at Hemerdon.

3) Copper anomalies were detected in the streams around Hemerdon in the regional geochemical stream sediment survey over western Dartmoor described by the author

in the N.M.R.S. Memoirs for 1977 (British Mining No .5). These anomalies were probably caused by the east-west trending line of epidiorite (greenstone) outcrops crossed by the southerly flowing drainage. The Hemerdon ore-body itself was probably not detected in the regional reconnaissance survey.

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