# MEMOIRS
# 1963




Wade, J.C. & Richardson, D.T., 1963
"Buckden Gavel Mine - Field Report"
Newsletter Vol.1 No.3, NCMRS, pp.31-34

Published by the

THE NORTHERN CAVERN & MINE RESEARCH SOCIETY
SKIPTON U.K.



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**BUCKDEN GAVEL MINE - FIELD REPORT.**

J.C. Wade & D.T. Richardson A.R.I.C.

The Society has devoted five meets to the mine each with a varying degree of satisfaction.

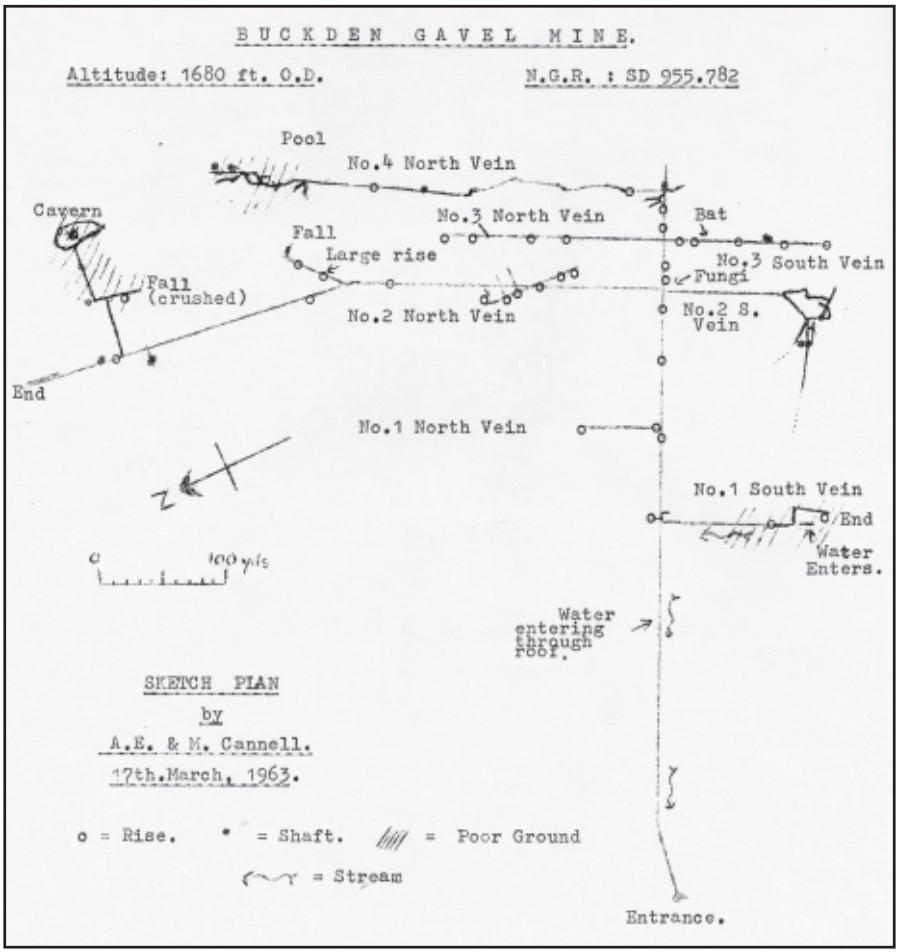
We have now explored all the shafts descending below the crosscut level with the exception of one shaft in the flat working to the extreme end of No.4 North Vein (the furthest point from the entrance). This shaft was observed on June 23rd., 1963 but was left alone because of its apparent dangerous condition. On August 11th. 1963 our objective was to ladder and descend two shafts in No.2 North Vein for which we had to take in a belay. The shafts were descended but were of little interest being in sound rock and less deep than anticipated – 28 feet and 22 feet respectively. The deeper shaft was traversed to a large chamber with an approximately flat roof and a deep hole in its floor. The walls of this chamber were of shattered rock or stacked deads in precarious attitudes being so exploration was not considered. A rise in the vein near this chamber was climbed but this ended in shattered ground.

On our return towards the entrance attempts were made to climb several rises and we were surprised to find we had not attempted to climb a rise situated halfway along No.2 North Vein although it was noted on our plan. It was relatively easy to climb and proved quite extensive. Trials had been driven in both directions at about 20 feet above the crosscut level and one passage lead off at the top of the rise some 45 feet above the crosscut level. The two lower trials were explored but we did not manage to enter the upper passage.

We have remarked about the fungus observed in the mine in an earlier Newsletter. There is now no doubt that the fungus is the Dry Rot fungus. It is present in old timbers and has obviously travelled (as is typical of this fungus) along the passage in search of new food supplies. The accompanying photograph shows the spread very well indeed.

Of the bat seen in the mine we have seen no further evidence and it may well be that it was an isolated specimen. It is true however that we have not made a deliberate search – so the matter remains to be cleared up.

There is very little water in the mine. The water flowing out of mine entrance originates in a limestone fissure in No.1 South Vein. In [31] addition water spouts from a fissure in the roof of the main crosscut. The only other water encountered occurs in a pool immediately before the stopes in the Far North Vein.




As is now Society practice samples of water have been subjected to chemical analysis and the results of the analyses along with the analysis of a surface spring water from near the mine entrance are given in the accompanying table.

The results are extremely interesting. It is to be noted that the water from the pool immediately before the stopes in the Far North Vein has a completely different composition to any of the other waters sampled. The unusual feature of this water is its high magnesium content – the concentration of sulphates in this water is however not as high as was originally thought – but it must be remembered the first insight into this was obtained from the analysis of an extremely small sample brought out of the mine on an earlier occasion - where we had to rely on qualitative rather than quantitative tests.

Two theories have been put forward to account for the magnesium content of this water:-

(i) that it comes from magnesium limestone ($MgCO_3.CaCO_3$) - a mineral known to occur in the area.

(ii) that it is a result of the decomposition of ankerite a complex mixture of carbonates of magnesium, calcium manganese and iron.

We are indebted to A.E. Cannell for the following explanation which is based on the fact that we were, in the first place under the impression that the proportion of sulphate in this water was very much higher than it has subsequently proved to be. Nevertheless the explanation merits a place in our writings as it may well be the key to other unexplainable problems.

It In the northern half of the North Pennine ore field – and there is no reason to suppose that the southern half differs in any basic measure – the veins are commonly associated with large amounts of ankerite – in fact there exists an abundance of it. It is a compound of carbonates having the general formula $(MgCO_3.CaCO_3)(FeCO_3.CaCO_3)(MnCO_3.CaCO_3)(CaCO_3)$ Analyses of typical samples show that the magnesium carbonate component can be as high as 40% of the total. Ankerite is intimately associated with the lead ore. Further, in the ore field (as in others) an oxidation zone has long been recognised to exist above the later table in which circulating ground water oxidises minerals on its descent to the water table.

Thus lead ore (lead sulphide-PbS ) would become anglesite (lead sulphate – $PbSO_4$). The water, therefore, would be sulphate laden and such water is known to react with ankerite to form epsomite (magnesium sulphate –$MgSO_4,7H_2O$). Epsomite, being readily soluble in water, is only found in the solid form in dry mines and thus one would expect to find it in solution in pools, etc. in the vicinity of ore. This theory could of course be strengthened by searching the area for epsomite and/or [32] analysing the water for manganese and iron – the other components of Ankerite."

A.E.C.

As will be seen from the analysis of the waters given in the accompanying table this has in fact been carried out. The sulphate content of the water is relatively low compared to its magnesium content, the iron content is average and no traces of manganese could be detected. In view of this it seem doubtful if the ankerite theory is the correct explanation in this case. particularly if one remembers that the water has a low sulphate content. The water is however a good example of a magnesium limestone water. No attempt has however been made to look for epsomite.

| ANALYSIS OF SAMPLES OF WATER COLLECTED 23rd.JUNE, 1963, FROM BUCKDEN GAVEL MINE AND THE IMMEDIATE VICINITY OF THE MINE. | | | | | |
|---|---|---|---|---|---|
| Location. | | Surface Spring Near Mine Entrance. | Water Entering Mine in No.1 S. Vein. | Water Spouting From Roof in Cross-Cut. | Pool in Far North Vein. |
| N.G.R. SD. | | 9558.7809 | 9554.7816 | 9554.7816 | 9554.7816 |
| Altitude O.D. | | 2025' | 1700' | 1700' | 1700' |
| Total Hardness | (as $CaCO_3$) | 38.3 | 86.3 | 119.6 | 348.0 |
| Temporary Hardness | ( " ) | 30.0 | 70,0 | 111.0 | 335.0 |
| Permanent Hardness | ( " ) | 8.3 | 16.3 | 8.6 | 13.9 |
| Calcium salts | ( " ) | 30.2 | 68.5 | 89.0 | 122.7 |
| Magnesium salts | (as $MgCO_3$) | 6.7 | 15.0 | 25.5 | 189.8 |
| Iron | (as Fe. ) | 0.04 | <0.04 | 0.08 | <0.04 |
| Manganese | (as Mn ) | Nil | Nil | Nil | Nil |
| Chlorides | (as NaCl) | 17.0 | 16.0 | 16.0 | 15,0 |
| Sulphates | (as $SO_3$ ) | 10.5 | 6.8 | 9.6 | 19.4 |
| Free Carbon dioxide | (as $CO_2$ ) | Nil | 2.0 | 3.0 | Nil. |
| p.H. | | 8.1 | 7.9 | 8.2 | 9.0 |
| Water Temperature °C. | | 9° | 6° | 7° | 7° |
| Air Temperature °C. | | 12.5° | 6° | 8° | 8° |
| Results in milligrammes per litre (parts per million) | | | | | |
| Analyses carried out by D.T. Richardson, A.R.I.C. | | | | | |



Analysis of Samples of Water from Buckden Gavel Mine, etc. (continued)

**NOTES:**

Asumming that the water, before it enters the mine workings, has a composition similar to that of the surface spring (N.G.R. SD.9585.7809) it is obvious that both the running waters which appear in the mine have picked up considerable amounts of hardness salts, the water spouting through the roof of the crosscut roof having picked up more hardness salts than the water appearing in the limestone fissure in No.1 South Vein.

The water from the pool at the end of the Far North Vein contains an unusual magnesium and calcium content, and in this respect is quite different from the other waters in the mine. The exact reason for this is not known but theories have been put forward.

All the waters in the mine had temperatures in the 6 to 7°C range. There is no analytical evidence to show that the waters have come in contact with degenerating ankerite, manganese being absent, neither is the sulphate content of any of the waters unusually high.