

## SHOTHOLES CONTAINING LIME IN A MENDIP LEAD MINE

by

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### ABSTRACT

Shotholes in an 18th century lead mine were tamped with a mixture of lime and grit, possibly to keep the gunpowder charge dry by absorbing moisture. Lime-blasting was not used at this site.

### INTRODUCTION

Explorers of the old mine workings that are accessible here and there on the Mendip Hills, in Somerset, are accustomed to seeing the remains of holes bored in the solid rock for blasting purposes. Usually one side or the end of the hole is preserved. The miners used drills or borers of various diameters up to about 40 mm, the depths or lengths of the holes sometimes exceed 40 cm, and the angle of drilling tends to be subparallel to the centre line of the gallery or shaft being driven or sunk. Occasionally a hole is found that was drilled almost vertically upward, which, as modern cavers will know, requires a disproportionate expenditure of energy.

It is natural to assume that the holes were used for blasting in the conventional sense, using gunpowder, which was first introduced to the Mendip mines about 1683 (Gough, 1967). Gough quotes (p. 167) an account written in 1684 by John Beaumont (of Lamb Leer fame) describing 'shooting the rocks', or gunpowder blasting, a practice brought to England by German miners in the 1670's (perhaps to make up for the introduction, from the same source but a century earlier, of the divining rod, which was then used exclusively in the search for metalliferous ores).

Beaumont's account shows that 'shooting the rocks' was a fairly complicated operation. The completed shothole was carefully cleaned and dried with a rag, then 2 or 3 ounces (c. 70 grams) of gunpowder were placed at the end and covered with a piece of thin paper as a shield against sparks. A length of metal rod, the 'Gun', was pushed into the hole until it pressed against the paper. The Gun was fixed firmly in place by the 'Quinnet', a thin iron wedge that was hammered into the shothole against a taper on the side of the Gun. Presumably the Gun was a good fit in the shothole. Then a wire was poked down the thin hole drilled in the Gun to pierce the paper, a fuse such as a powder-filled straw was inserted, and a train was laid and lit. At this point the miners "goe out of the work before the Powder comes to take fire".

The Gun was needed to confine the explosion within the shothole; it served the same purpose as the sand, mud or water tamping that is all the confinement required in modern shothole blasting, which employs 'quicker' explosives. Shotholes blasted by gunpowder should therefore be clean, without traces of tamping materials, when the Gun was used. In Cornwall, however, gunpowder was commonly tamped with clay (Earl, 1968, p. 43).

In a few old Mendip mines, the shotholes contain traces of a whitish or greyish substance adhering more or less firmly to the smooth surface. To the naked eye, and under the microscope, the substance has the appearance of old mortar: a mixture of white lime and stony grit. The strong reaction with dilute hydrochloric acid indicates that it is now largely calcium carbonate.

Several authors have described the use of quicklime by miners to split rock, avoiding the use of explosives. Kirkham (1968, p. 70) writes that in Derbyshire "...lime-blasting was used. A row of holes was bored in the rock and filled with quicklime. A wooden plug with a hole in it was inserted, then water was poured through the hole causing the lime to expand and crack the rock. In old workings an experienced miner can distinguish lime-blasting from powder-blasting."

Ford and Rieuwerts (1975, p. 14) expand Kirkham's account: "A hole was bored in the limestone and into this was placed a quantity of quicklime. A wooden bung was plugged into the drill hole, water then being poured through a small hole in the bung itself. The action of the water on the quicklime is very intense. The quicklime is converted into slaked lime with expansion and the generation of great heat. This violent chemical reaction is sufficient to split the rock."

Earl (1968, p. 36) gives a brief description of lime-blasting by Cornish miners: "The lime was put into a hole about 3 inches in diameter, some water poured in, and rammed tightly with clay stemming. As the quicklime was slaked to the hydroxide, great heat was developed, expanding lime and water and so splitting the rock."

#### OBSERVATIONS

On Mendip, in an old lead mine at Charterhouse ('Grebe Swallet', Barrington and Stanton, 1977, p. 91), shotholes in two vertical shafts contain the remains of a lime fill. The shafts were sunk following a thin vein of clay carrying dispersed granules of galena, by the simple process of scooping out the clay and then splitting off 0.3 m to 0.6 m of rock from the sides of the vein. Vertical shotholes about 23 mm in diameter and nearly 0.5 m deep were drilled for this purpose. On the underground tip, a good specimen was found of half a shothole still packed with lime (Plate 11).

The filling material was not pure lime. A proportion, up to about one third of the total, was stony grit, consisting of several different kinds of limestone and some crystalline calcite. It appears that, as the hole was being charged, every now and then a small stone was pushed in and beaten down with a ramrod so violently that it sometimes fractured in a

radiating pattern. The centre of the filling was compressed more than the edges, so that successive layers of lime and grit are concave upwards.

It was originally thought that the shotholes had been used for quicklime-blasting, and in fact the first draft of this paper assumed that such was the case. However, critical comment by the Editor and his referee, concerning the reason for the incorporation of stony grit, and the process by which the quicklime would have been slaked, led the writer to re-examine the shotholes. Owing to the presence of very unsafe stone walling in the shafts the previous inspection of shotholes, as distinct from tip samples, had been hasty. Now the walling in one shaft was stabilized with cement and a fuller examination of the shotholes was made.

Nine long sections of shotholes containing a lime fill were found and measured. From them, a diagram of a typical shothole was constructed (Fig. 51).

Shothole length varied between 39 cm and 48 cm. The diameter was always close to 23 mm, except at the neck which was sometimes widened by the battering it received from the stem of the borer. Around the mouth of the shothole the rock was often pockmarked by blows from the hammer head. The lime and grit fill extended, usually rather incompletely, in concave-upward layers, from the mouth to more than halfway down the shothole. In some shotholes the rock was split along a crack running lengthwise from the end of the hole towards the mouth, roughly at right angles to the rock face.

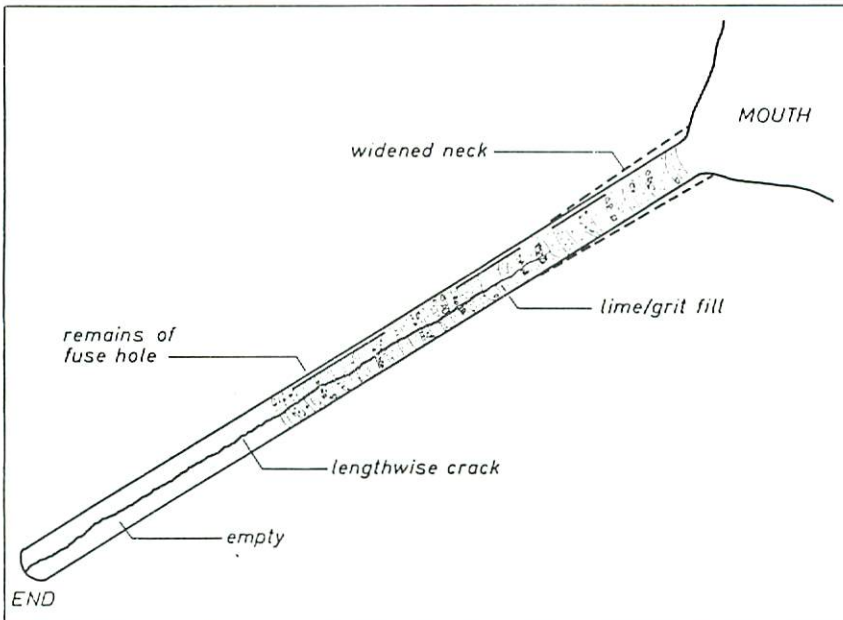


Fig. 51. Long section of a typical shothole, 45 cm long.

## DISCUSSION

Two factors make it virtually certain that the lime played no part in breaking the rock:

- a) In no case did the lime fill reach to the end of the shothole. The final 17-20 cm was always empty.
- b) One shothole sloped gently upward from the mouth to the end. In such a case, slaking the lime fill would be an awkward problem.

It therefore appears that the lime and grit fill was no more than the tamping applied to a charge of explosive that occupied the innermost 17-20 cm of the shothole. The explosive was probably gunpowder, in view of a date, 1753, scratched in mud by a miner. Gunpowder was in general use for blasting until the 1860's. A fuse of some kind must have run down through the tamping to the gunpowder, and in one hole there is a groove c. 4 mm wide in the lime and grit fill, against the shothole wall, that may be the remains of a fuse hole.

The battering round the mouths of some holes is so extensive as to make it seem that the mouth was purposefully deepened to allow extra penetration by the drill. Every inch added to the depth improved blasting efficiency. As well as hammer marks, impressions of a pick point can be seen in some mouth areas.

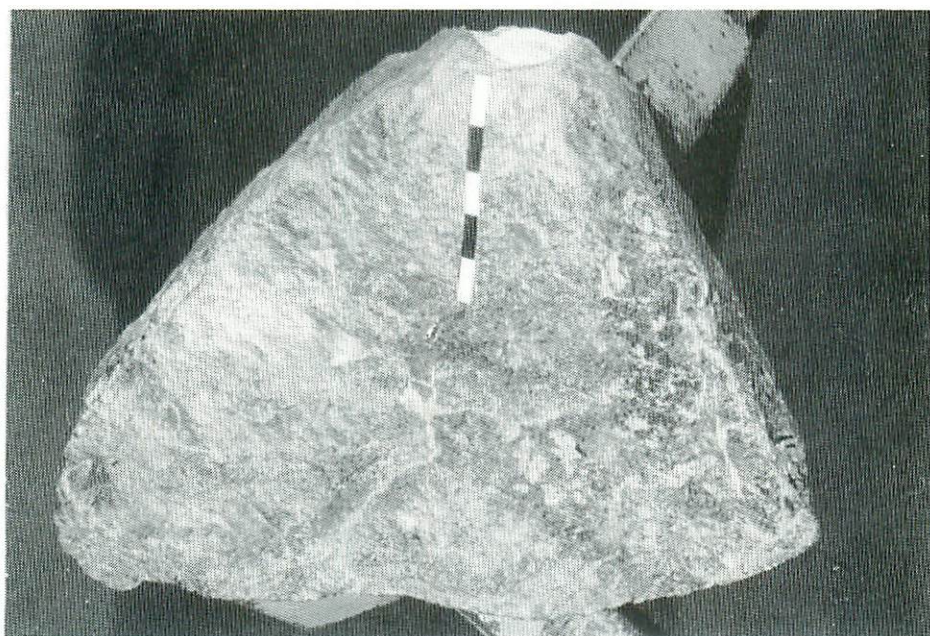
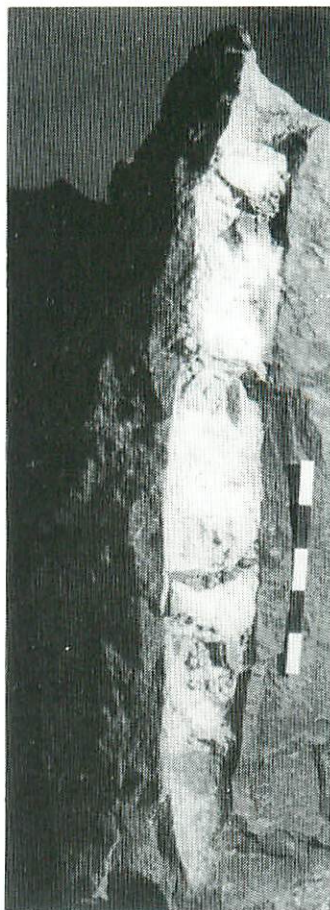
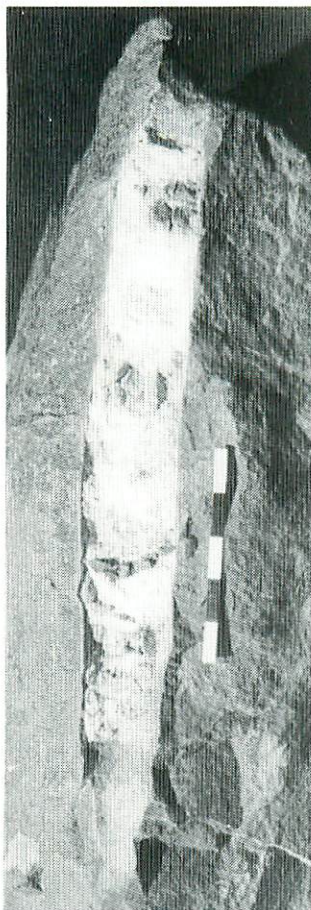
Why did the Grebe Swallet miners tamp their shotholes with lime, instead of using the mud or clay that was plentifully available on site? Lime tamping must have offered some significant advantage. If the lime and grit mixture could be left until it set, like mortar, the tamping effect would be enhanced—but this would take many hours, and the gunpowder would probably get damp.

A more likely solution is that the lime was in the form of quicklime, or even half-slaked lime, which would protect the gunpowder from damp by absorbing any moisture in the shothole. Mixing the quicklime with grit would give it 'body', and would reduce the intensity of the heat generated if it did meet with moisture.

On Mendip in the 18th century, quicklime would have been easily obtained from a local limekiln.

At Grebe Swallet there are clean unbroken stalactites and flowstone only a few metres from the lime-tamped shotholes, where they would certainly have been broken or dirtied if modern explosives had been used. This fact seemed originally to support the theory of quicklime blasting, and it must now be taken to illustrate the relatively low power of gunpowder, which split, rather than shattered, the rock.

The writer has recorded a lime and grit fill in shotholes in Triple Hole on Sandford Hill (possibly worked about 1810) and in Banwell Stalactite Cave (worked about 1757 or later than 1824). No doubt there are many other examples awaiting discovery in other Mendip mines.



*Plate 11.*

A) Long section of part of a shothole, with lime and grit fill (cm scale).

B) Cross section of a shothole, with lime and grit fill (cm scale).

*Photos: Tony Philpott*

## REFERENCES

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