BRITISH MINING No.11

MEMOIRS
1979

Harvey, W.S. & Downs-Rose, G. 1979 “The rebuilding of two smelting hearths at Wanlockhead” British Mining No.11, NMRS, pp.82-86

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.

THE RE-BUILDING OF TWO SMELTING HEARTHS AT WANLOCKHEAD.

by: W.S. Harvey & G. Downs-Rose.

Introduction.

One of the principal features of the Open Air Museum at Wanlockhead is the Pates Knowes Smelt Mill where two lead smelting hearths were re-built in 1977. The decision to re-build the hearths, together with part of the furnace house, arose from excavations made on the site between 1973 and 1976 and already described in British Mining No.8. As well as uncovering foundations and wheelpits, these excavations found a number of the original cast iron hearth stones. Few such stones remain for any eighteenth century British smelt mills and their finding made it most desirable that they should be displayed as a definitive feature of the Lead Mining Museum.

By the autumn of 1976 the Museum Trust had decided to put the project in hand and possible layouts were discussed with various bodies. One suggestion was to re-build one of the hearths and house this, plus models and displays, in a custom built visitor centre on the site. This led to students of the Department of Architecture, the University of Edinburgh, undertaking design studies which included all relevant facilities as well as the visitor centre. Many of the finished designs would have been both suitable and viable, but the scale of the venture meant it had to be put aside.

Instead it was decided to re-build two of the hearths in situ and to display them in some semblance of their original setting by building up part of the walls of the furnace house around them. The completed feature would be open to the weather, so had to be strongly made. It was also decided that efforts should be made to recover the section of waterwheel which had been found, and to display this with other relevant artefacts.

The landowners, the Buccleuch Estates Ltd, gave their permission and promised support. The necessary labour was available under the Job Creation Scheme. The Museum was already making use of this service, but the existing programme meant that the major part of the smelt mill project had to be completed during 1977.

The History of the Smelt Mill.

A two hearth mill was built at Pates Knowes by Crawford and Company in 1764. Previously there had been three small smelters around the village, and recent research suggests the Pates Knowes mill was on or near the Upper Mill, built by Alexander Telfer sometime prior to 1744. The Pates Knowes Mill was enlarged with the addition of two more hearths and reverberatory furnace circa 1780. At that time its maximum output seems to have been about one thousand tons of smelted lead per annum. A thumb-nail sketch on a plan of the mines dated 1840 shows the smelt mill to have been a long rectangular building with two chimneys, presumably one to each pair of hearths, and with the tailrace flowing from the centre; a layout confirmed by the excavations. In 1842 the Duke of Buccleuch and Queensberry took over the management of the mines. The following year the Pates Knowes mill was completely

demolished and the stone and hearths taken to build a new smelter about a mile down the Wan lock valley. Those hearth stones which were found nearly 150 years later are greatly burnt and had no doubt been discarded.

[82]

Although the mill worked into the nineteenth century, its construction was of the older style with open hearths, chimneys above, and no provision for fume recovery.

The site subsequently became covered with mine spoil, and there was no vestige of the original buildings when excavations began by members of a Glasgow University, Extra-mural Department, Summer School in 1973.

Planning the work.
Even though only a small part of the furnace house was to be re-built, the work demanded a knowledge of the plan and elevation of the original; its furnishings and the materials used. Apart from the tiny drawing referred to, no sketches or paintings of the area have come to light, nor any details of the appearance of the old mill. The authors were then very much aware of the problems faced. Al though the excavations had revealed much of the layout, more research was needed to fill the gaps in the archæological record and to provide the particular details needed.

Various authorities were consulted but, while much helpful comment was obtained, it was the published references which provided the information needed. R.T. Clough's "Lead Smelting Mills of the Yorkshire Dales", with its professional attention to architectural detail, was perhaps the most valuable source. When the excavation plan of Pates Knowes was compared with Clough's drawings it was seen that the Marrick Mill in Swaledale was very similar in outline. Corroboratory evidence was provided by a drawing of the single hearth mill built at Blackcraig, Kirkcudbrightshire, in 1792 and reproduced by I. Donnachie in his "Industrial Archæology of Galloway". Details of ore hearths, whose dimensions closely compared with the hearth stones discovered, were found in the metallurgical account of J. Percy, H.F. Collins, H. Pattinson, etc.

All this information provided the confidence needed to go ahead with drawings, and it was decided the re-building would be on the eastern part of the site. Practical considerations meant that the walls of the furnace house had to be terminated at about head height, but details of the still extant Marrick Mill allowed the shape of the chimney vaulting to be kept in mind. Features considered essential were the arches which partitioned each hearth space from the rest of the furnace house, and which are shown in smelter drawings back to those made by Agricola in the fifteenth century.

Building the smelt mill.
The re-building of the walls of the furnace house followed the practice of previous conservation work on the site. The original foundations were cleaned of soil and loose stones, and the massive walls were taken up using large stones on the outside with a fill of smaller material. There were no large building stones left on the site and

suitable pieces had to be collected. For sound practical reasons, concrete was used instead of mortar. Without the cover of a roof, rain would have permeated into mortar-set walls and winter frosts would soon have broken the whole apart.

It became clear that an arch in front of one of the hearths was as much as could be attempted. The span was 12 feet and expert advice was that it would be foolish, if not foolhardy, to attempt to make the arch in stone. Instead, a light arch in reinforced concrete was recommended. However this advice did not take into account the mettle of the JCS team. Having [83] successfully built the two small arches over the doorways behind the hearths, they set about finding enough dressed stones for the front arch. The stones were carefully set out to a curve marked on a flat piece of ground, and those that did not fit together were further trimmed with hammer and chisel. Timber was then obtained, and falsework to support the arch constructed and secured between the abutments on each side wall. Once all was ready, the arch stones were set in place. The result was a great success and is a fitting monument to men who had never tackled such a task before. Excavation had uncovered slag pits by the hearths, and although Agricola refers to slag being broken by being thrown into water, no reference to the precise construction of such pits could be found. The pits at Pates Knowes were then finished to a rectangular shape.

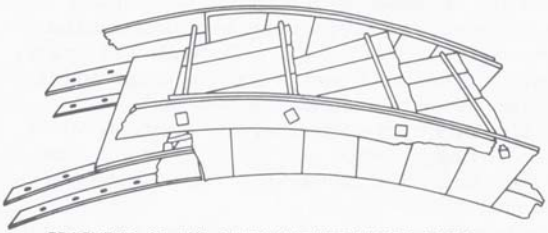
The construction of the ore hearth had already been explored by a trial erection, and then presented no difficulty. By fortunate chance, a lead pot was found in the village about that time and it was carried to the site and included in the arrangement. The construction of a slag hearth is described in detail in the 'Leadhills Diary', but not enough pieces were found on the site. However Pattinson claimed that slag hearths were usually made from discarded parts of ore hearths, and as there was a surplus of the latter, this course was followed.

The Waterwheel.

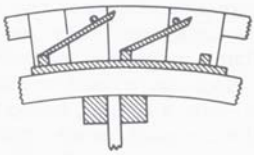
Plans to recover and preserve the section of the old wheel which had been found at the bottom of the wheelpit also went ahead. Advice was sought from the Research Unit, National Museum of Antiquities; and A.R. Smith, of the Museum of Transport Glasgow, provided helpful references particularly relating to work on ships' timbers.

Examination of pieces of loose timber from the wheel showed the condition of the wood was quite good, with deterioration limited to about 10mm on the surface. To explore the effect of drying out, a number of samples were placed in various situations and the loss of weight recorded at regular intervals. Dried samples were also treated in various ways to check the effect of protection and surface hardening.

But before the section could be preserved it had to be raised out of the wheelpit. Calculations showed the section was unlikely to weigh more than 500 Kg, excluding the mud, which it was hoped would come away. Practical considerations meant the section would be most easily lifted from each end. To see if the main timbers were strong enough, samples were subjected to a transverse breaking test. This gave an average value of 46.8 Kg/sq. cm. Although less than 1/10 of the figure for sound timber, it was enough to show the section would carry its own weight.

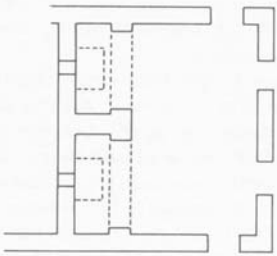


FRAGMENT OF THE PATES KNOWES WATER WHEEL

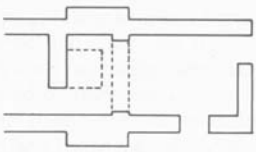


Detail showing Construction

PLAN OF EAST FURNACE HOUSE, PATES KNOWES



PLAN OF MARRICK FURNACE HOUSE



PLAN OF BLACKBRAIG FURNACE HOUSE

One summer afternoon, calculations were put to the test when the lifting was begun. It was decided to carefully try each end in turn. As the strain was applied, the situation was monitored by an observer at the bottom of the pit. At first all seemed to be going

well, but after one end had begun to lift, it was seen that the mud still around the float boards was pulling these and the side boards away from the rusted fasteners. Eventually the whole operation had to be called off. However the intention to recover the section of wheel has not been abandoned and it is hoped that some way around the difficulties will be found.

[84]

Although the main section of the wheel still lies in the mud, enough fragments were found to show a small portion could be assembled. The conservation of the fragments is being carried out by students from Loughborough College. Once the work is complete, and the pieces assembled, it is intended to have the whole on display.

REFERENCES.

W.S. Harvey and G. Downs-Rose. A Report on Excavations at the site of the eighteenth century lead smelter at Pates Knowes, Wanlockhead. British Mining No.8. N.M.R.S. 1978. pp.1-9.

G. Downs-Rose and W.S. Harvey, Lead Smelting Sites at Wanlockhead, 1682-1934. In Williams, J. & Cormack, W.F. (Eds.), Wanlockhead and Leadhills Volume, Transactions of Dumfries and Galloway Natural History and Antiquarian Society, 3rd Series Vol.54, pp.75-84.

R.T. Clough. Lead Smelting Mills of the Yorkshire Dales. 1962.

Ian Donnachie. Industrial Archaeology of Galloway. 1971.

J. Percy. Metallurgy of Lead. 1870.

H.F. Collins. Metallurgy of Lead and Silver. 1899.

H.L. Pattinson. An Account of Methods of Smelting Lead Ore and Refining Lead. Transactions of the Natural History Society of Northumberland, Durham and Newcastle. Vol.2. 1831. pp.152-177.

Leadhills Diary. 1745. MSS in Galloway Collection. Ewart Library, Dumfries. Also transcript in Leadhills Library, Leadhills.

23 Orleans Avenue,
Glasgow,
G14 9LA.

[86]