THE EXCAVATION OF A BLOOMERY FURNACE AT HACKENSALL

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THIS bloomery furnace, probably of eighteenth-century date, was situated at the foot of the twenty-five foot high, boulder-clay cliffs at Hackensall, National Grid reference, SD346475. A second furnace, situated a few yards south near where Hackensall Lane descends the cliffs to the beach, was washed away in 1962. At this point the cliff is a steeply-sloping grass-covered bank, and the furnace was built into the slope so that it could be fed from the top of the cliff and cleared from the level of the beach. The floor of the furnace was a few feet above high water mark, and so was reached by only the highest tides. Only the lower part of the structure remained, and it was sectioned and cleared in the early summer of 1963 by the Pilling Historical Society in conjunction with the Harris Museum, Preston, and with the permission and co-operation of Imperial Chemical Industries Ltd., the owners of the site.

The bloomery furnace consisted of a kiln and a fore-hearth or working-area in front of the kiln. The first stage in construction had been the excavation of a carefully shaped trench, the eastern or inner end of which matched the profile of the completed kiln. A large stone flag was laid in the bottom of the trench to form the floor of the furnace, and the kiln walls were built up on this. The lining of the kiln consisted of squared blocks of local gritstone, averaging 4 inches high, 6 inches wide and 4 inches thick. They were bonded with puddled clay, which had baked very hard and in some places fused with the iron slag, traces of which remained on the kiln walls. The blocks of the kiln lining were all neatly coursed; the heat of the furnace had caused them to become very friable, which quickened the collapse of the furnace. The 9-inch space between this lining and the back of the trench was filled with boulders from the beach, most of them ultimately derived from the boulder clay of the area, and all laid in such a way as to leave large air-spaces between them. These spaces had become filled with grey rain-washed silt, and there were traces of soot on and between some of the boulders. The function of these packing-stones was probably the double one of insulation and drainage. Heat loss

Plate 16.

FORE-HEARTH AND FRONT OPENING OF THE KILN AT HACKENSALL

to the surrounding clay would have been considerable in such a half-buried furnace, and the air-spaces would have helped reduce such losses; indeed, colour changes in the clay due to heat from the furnace were not great, although one must remember that this could also suggest a short life for the furnace. One of the great dangers of a partly-buried furnace is the risk of water percolating into the structure and causing an explosion as it turns to steam. This space all round the kiln would have helped carry the water away quickly, though any arrangements at the front of the kiln to lead the water away to the beach have long been eroded away by the sea.

The lower 6 feet only of the kiln survived, forming an in-

Plate 17.

THE KILN LINING SEEN FROM ABOVE THE REAR OF THE KILN

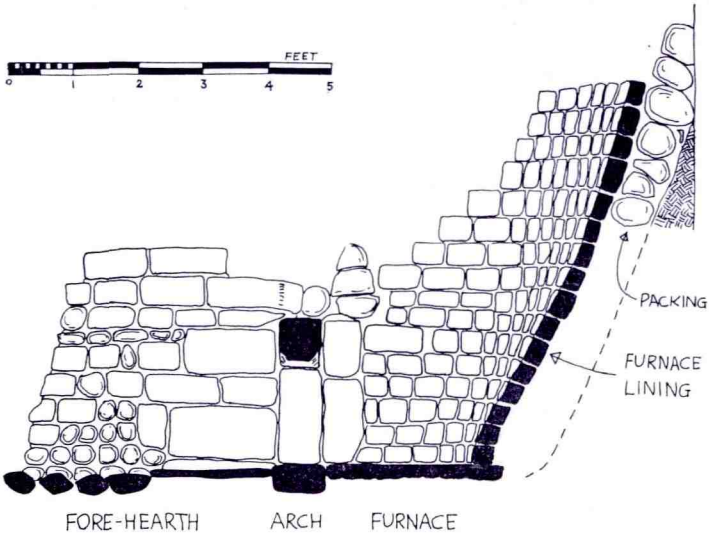
verted truncated cone, some 1 foot 3 inches by 3 feet at the base, widening out to about 6 feet in diameter, although the original maximum diameter would have been rather greater. At the front of the kiln was an opening 1 foot 3 inches wide and 1 foot 6 inches tall, formed by a slightly cambered lintel of Triassic sandstone resting on two vertical sandstone columns or jambs. Beyond this was a flagged working-area or fore-hearth, bounded by two sturdy retaining walls of cobbles and Triassic sandstone blocks set in mortar. These had been at least 5 feet long, were up to 18 inches thick, and stood just over 3 feet high. Near the kiln and its arch were signs that these walls had been corbelled inwards, thereby forming a small tunnel, both higher and wider towards its mouth, which would not only have retained the clay cliff on either side, but supported

the wider parts of the kiln, and also doubtless have funnelled the prevailing westerly winds into the furnace, for the opening faced west.

It is less easy to reconstruct the furnace above this level. The maximum diameter of the furnace is not known, but is not likely to have been very great, perhaps little more than 9 feet; above the point of maximum girth the walls would have either risen vertically, or narrowed towards the top, as in a blast furnace. The height is also uncertain, but cannot have been more than between 15 and 20 feet, for it is unlikely to have exceeded the height of the cliffs, from the top of which it would have been fed. Traces of a pile of limestone, probably used as flux, can still be seen on the cliff-top above the furnace.

There can be little doubt that this was a bloomery furnace, and not a blast furnace. It is too small a structure to produce the high temperatures necessary in a blast furnace, and had no bellows to give a blast. Nor were there any facilities for drawing off the molten metal and slag separately; there was but one opening, with a flagged floor in front of it, which, though cracked, had obviously not been subjected to a very intense heat.

Evidence for dating the furnace is unfortunately scanty. An "upper" date is provided by the fact that sandstone blocks from the furnace structure were incorporated in the sea-wall built in front of it in the middle of the last century. The first edition of the Ordnance Survey six-inch map, surveyed in 1844, marks the site as a limekiln. This must represent either a re-use of the furnace in the first half of the last century, or a guess at the function of a structure resembling a limekiln and having a pile of limestone near its mouth. So by 1844 the furnace had either been put to other uses, or perhaps more probably had been disused for some time and its function forgotten. A "lower" date is less easy to suggest, but circular-sectioned blast furnaces were first built after *c.* 1650, so that an eighteenth-century date emerges as a median date, supported by the late appearance of the mortared stonework. This can be amplified by considering the probable setting of the furnace. Haematite, presumably from the Furness region, can still be picked up on the Wyre estuary, and must have been brought by coastal vessels trading with Wardleys, the harbour for the port of Poulton. This trade, which reached to the Baltic and America, was at its height in the second half of the eighteenth and early nineteenth centuries and this falls well within the possible dates for the Hackensall furnace. The boat building and repairing trade at Wardleys flourished with the commerce of the harbour,



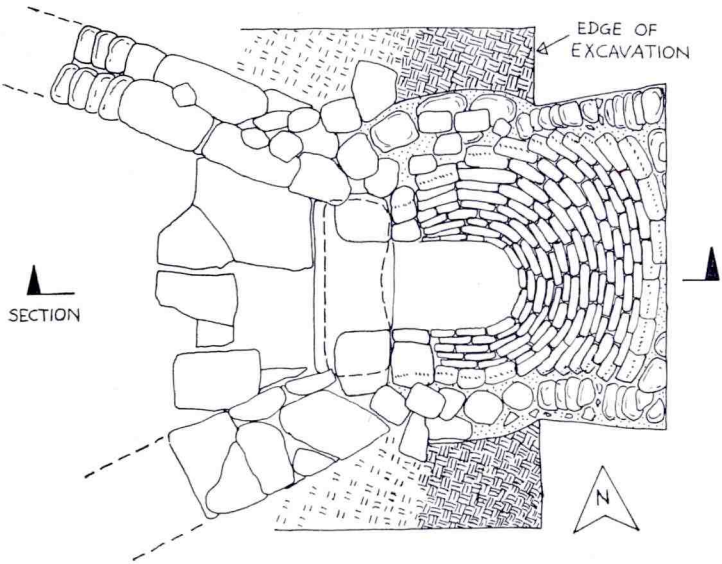


Figure 10.

ELEVATION AND PLAN OF THE BLOOMERY FURNACE AT HACKENSALL

and would have created a demand for wrought iron, and this the Hackensall furnace could supply, for, by using hard black peat from Pilling Moss, mixed with charcoal—as was done about 1725 at Yealand Redmayne in a similar but square-sectioned furnace, according to Lucas in his *History of Warton* —iron ore could be reduced to an impure iron, or bloom, which could be beaten by a bloomsmith into the pure metal. Peat is an unsatisfactory fuel, but was the ubiquitous domestic fuel of the region, and, when supplemented with charcoal and helped by a strong draught funnelled to the bottom of the furnace, would be capable of producing suitable temperatures.

There were no small-finds, and no iron blooms were found, but samples of the slag from the furnace filling and from the walls of the furnace itself were sent to Imperial Chemical Industries, who reported: "Analysis by emission spectroscopy showed that the principal elements present were iron and silicon together with a moderate quantity of titanium and small proportions of sodium, magnesium, chromium and aluminium, with traces of lithium and boron. The composition is consistent with the hypothesis that the structure from which the slag was taken was a furnace for smelting iron."