

BLOOMERY SITE AT TURNERS GREEN
HEATHFIELD, Sussex.

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UNPUBLISHED MANUSCRIPT

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1st century AD

A Composite Wealden Ironworks of ~~Early Saxon~~ Date
Report of Excavations at Turners Green, Heathfield.

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Summary

Bloomery operations on a Wealden site were found to include a composite ironworks with three domed furnaces of unusual design, a bloom re-heating furnace and a stone built section for both bloom refining and for smith's work incorporating a stone sill. C14 determination of charcoal has provided * a date of ~~567 A.D. +/and - 45 years~~ but the remains of a timber and wattle structure underlying the smith's section has not been excavated or dated. Pottery and metal objects found mostly on the surface are listed and some operating figures for the works are suggested. This report is condensed from a 1972 manuscript.

Location and environment

In the Parish of Warbleton at TQ64⁰⁸22⁷ 1949, this site stands on the main Wealden watershed. Its soil of the Ashdown Sand provides a "brick earth" mixture of blown sand and silt such as has been much used by local brick yards. 250 m away some friable sandstone is exposed, it is highly impregnated with brown limonitic iron but was never found on the site as a feedstock for the furnaces. Less than a km eastwards, there is an orange stained stream indicating a body of iron ore which however was never located. However Carbonate iron ore abounds in these lower portions of the Hastings Beds, particularly in the Wadhurst clay, this very common source of ore can be found within 3 km of the site. Bearing in mind that there are at least 11 bloomery sites within a radius of six km and that at a much later period there were seven blast furnaces operating at about the same distance away, it seems reasonable to assume that when these small works were in being, there would be an abundance of suitable ore to be gathered on or near to the surface of the ground and at a practical distance.

* Second half of first century AD (revised Haswell dating)

Ancient forest still survives nearby with oak, holly, alder, hazel and some birch. There are springs in the immediate vicinity and from neolithic flints picked up on the site itself as well as a nearby flint flaking assemblage, it would seem that the area is one that at all times has favoured settlement.

Communication would be provided one field away by the Roman trackway (1) . It should perhaps be noted that it is within one km to the north or south of that trackway that ten of the other bloomery sites mentioned above, are to be found. The stream described above, is a feeder to the river Dudwell thus providing a valley through the Weald and, finally to the river Rother which would have given water transport onwards to the sea and to the Kent coast. Map fig. 1 .

The Survey

In 1968, a major bloomery site was disclosed with three other patches of bloomery debris at distances of between 100 to 200 m away. A small ore roasting site was examined 250 m distant at TQ6441 1958, it contained charcoal, roasted ore and untreated ore very similar to the nature and size of materials at the furnaces .

Mechanical ditching operations not only disclosed the major site but made attention to it a matter of urgency. Fortunately the owner Mrs R.C.C.Honey authorised an adjustment to the ditching which has saved the site for the present. At the suggestion of the Department of the Environment a magnetometer survey was made this being most generously undertaken by Mr C.J.Ainsworth and team. Although the pattern of readings thus obtained was affected by the proliferation of iron bearing materials such as small heaps of roasted ore, the survey was of the greatest value in delineating the area which would have to be examined in detail.

Charcoal from a bottom layer of furnace shell and slag debris was accepted for C14 determination by the British Museum, A date of 567 A.D. + ~~and~~ - 45 years being thus provided.

(See page 1)

During the survey, it was noted that the natural gully in which the main site was situated, has now been turned into a drainage channel so that the water from a spring as well as surface water, flows through the site. 15 m upstream a swampy depression was examined as a possible clay puddling pit. There was evidence that both the fields adjoining the mainsite i.e. on each side of the gully, had been levelled for agriculture, detrital earth had slid down from the higher ground to cover the main site. Further, the absence of slag heaps was remarkable, having regard to the number of furnaces in the immediate area. In this connection it is highly probable, that slag from these fields would have been removed for the building of the turnpike road now running parallel to the alignment of the Roman trackway already mentioned. This turnpike was built in 1813 and the minutes of the Trust, mention the use of "cinder given by local landowners". Map fig. 2.

The Excavation

The lager of the outlying bloomerjes was examined. Although blacken^{ed} soil mixed with slag and broken furnace shell debris, covered an area of 18m dia. the actual bloomery furnace operation had been confined to a circular patch not more than 4m dia. as shown by reddened base soil which lay beneath the concentration of heaviest slag. Here, a few large pieces of furnace shell remained below the level of cultivation as well as some heavy tap slag and furnace bottom pans of slag. One piece of furnace shell was constructed of creamy buff clay rolls or cylinders pressed together much in the manner of making large pottery vessels from classic times down to the present day. Plate 1 A .

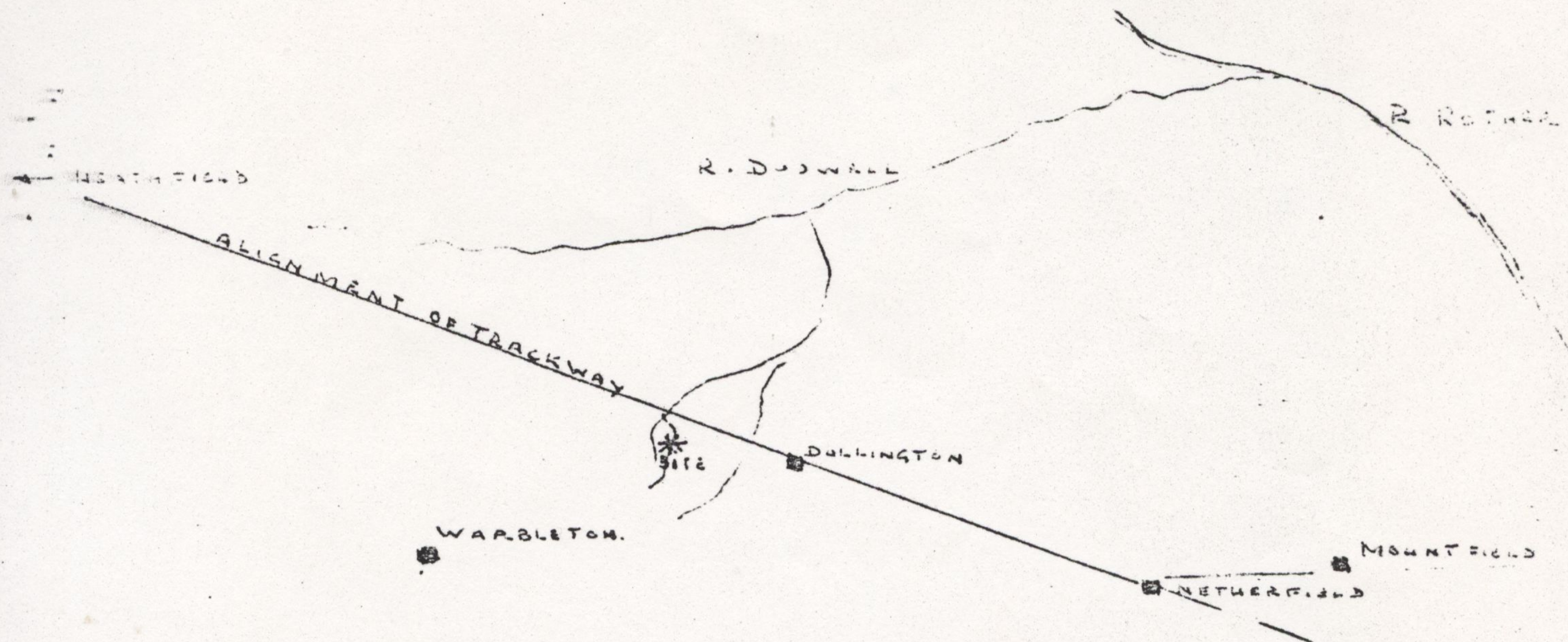


FIG.1 SITE LOCATION

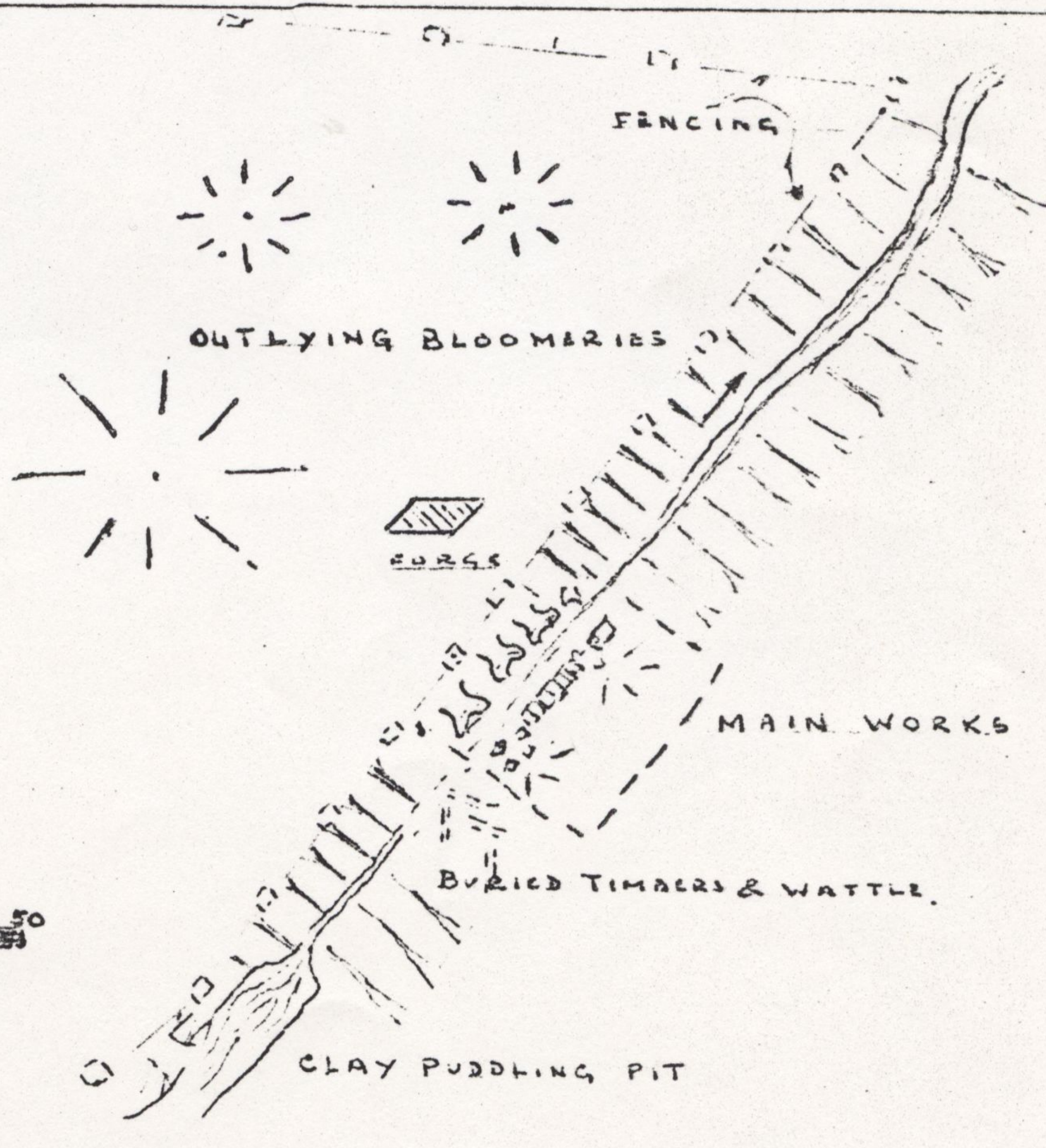
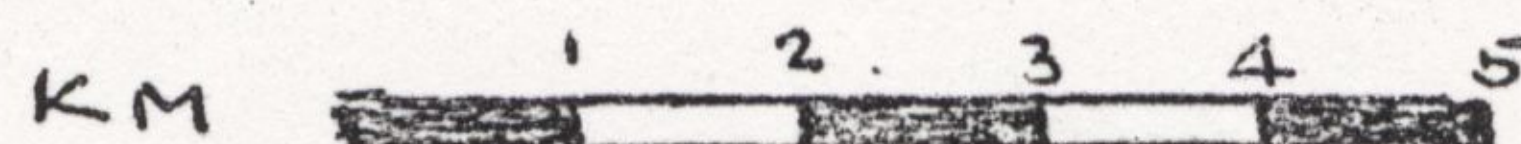


FIG2 SITE PLAN



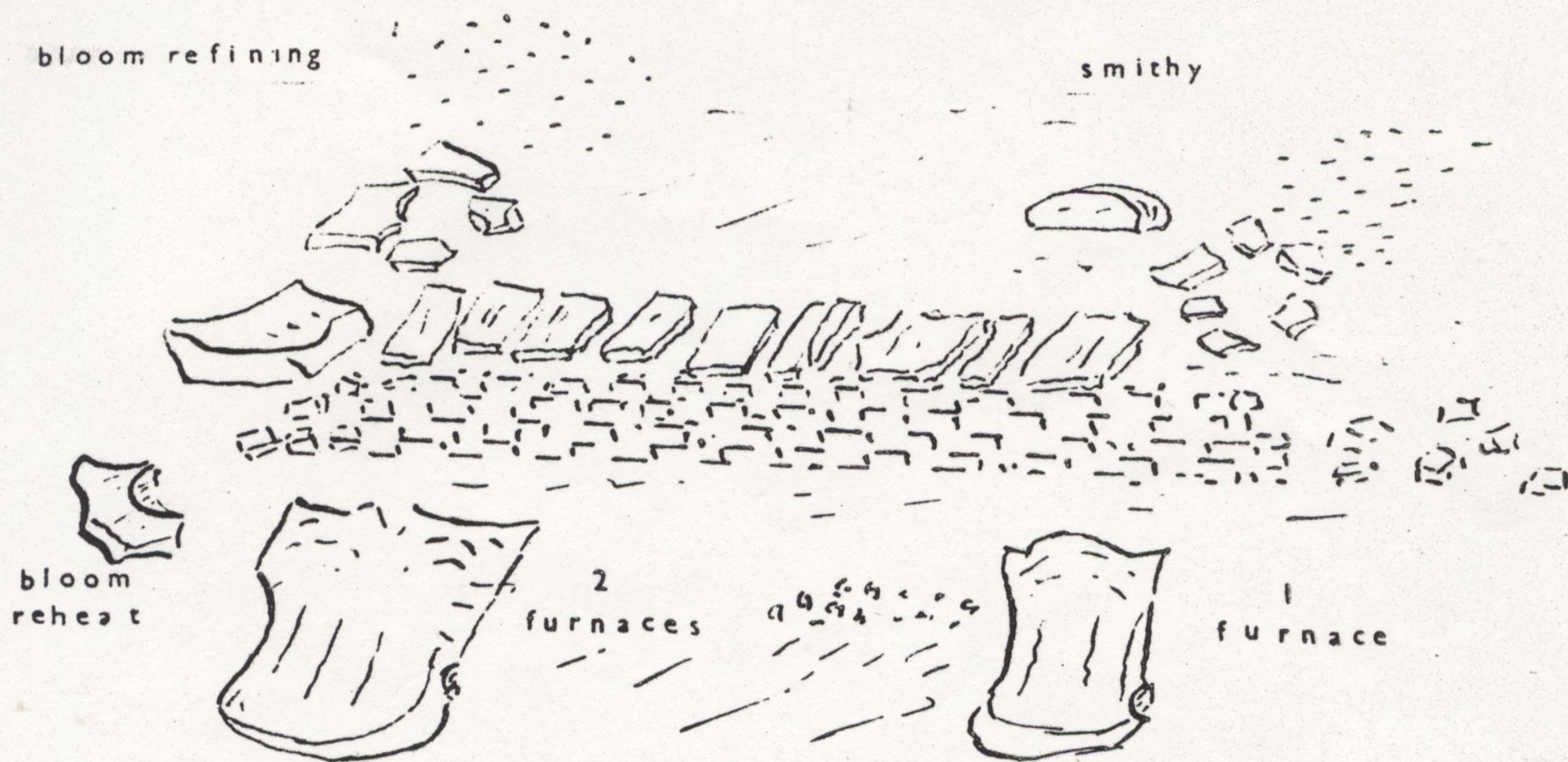


FIG 3- SKETCH PLAN MAIN SITE

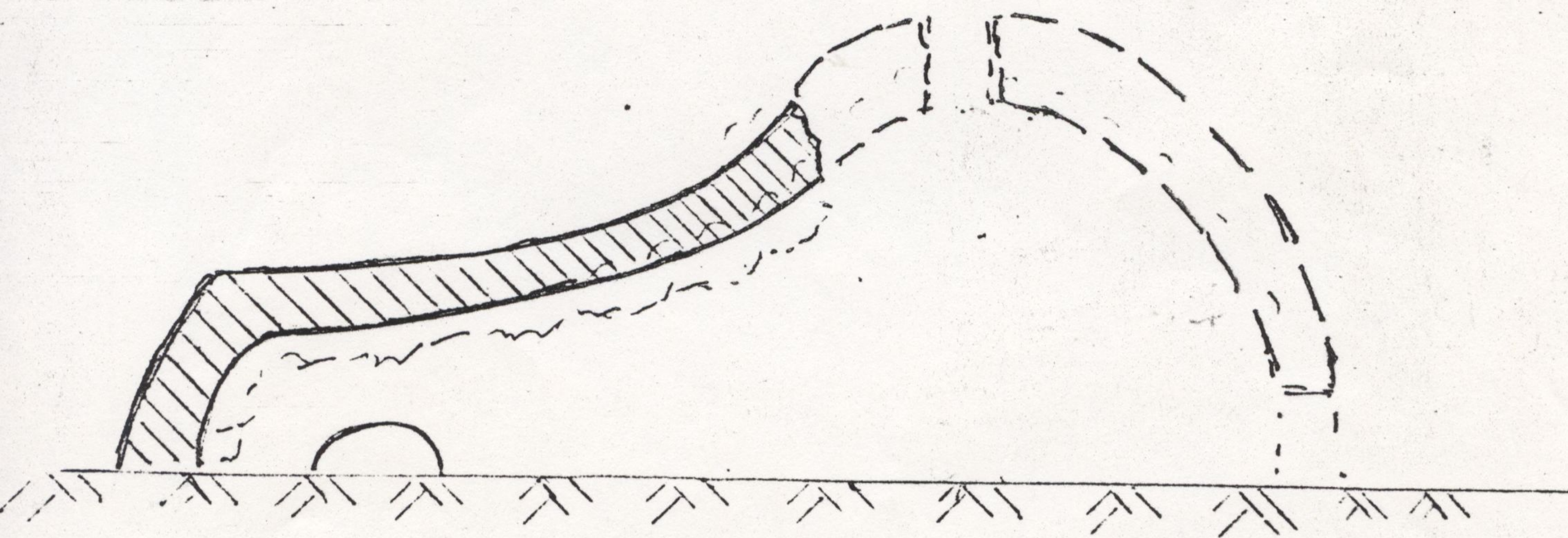
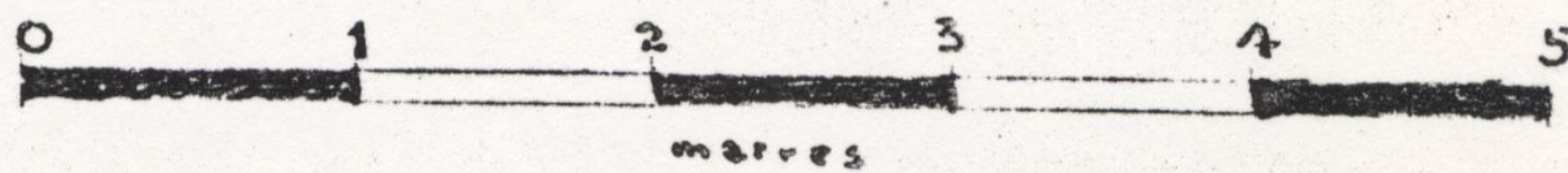
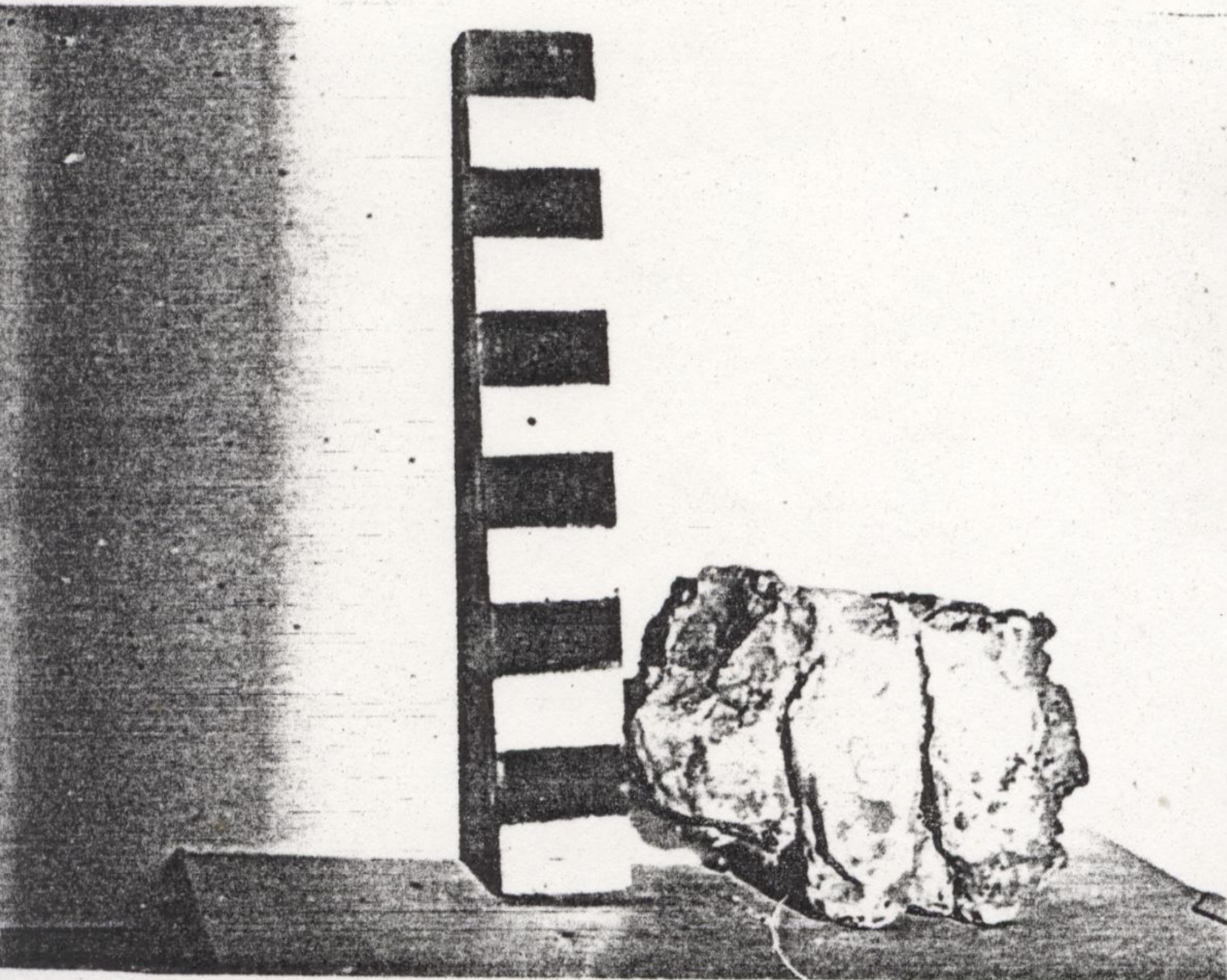


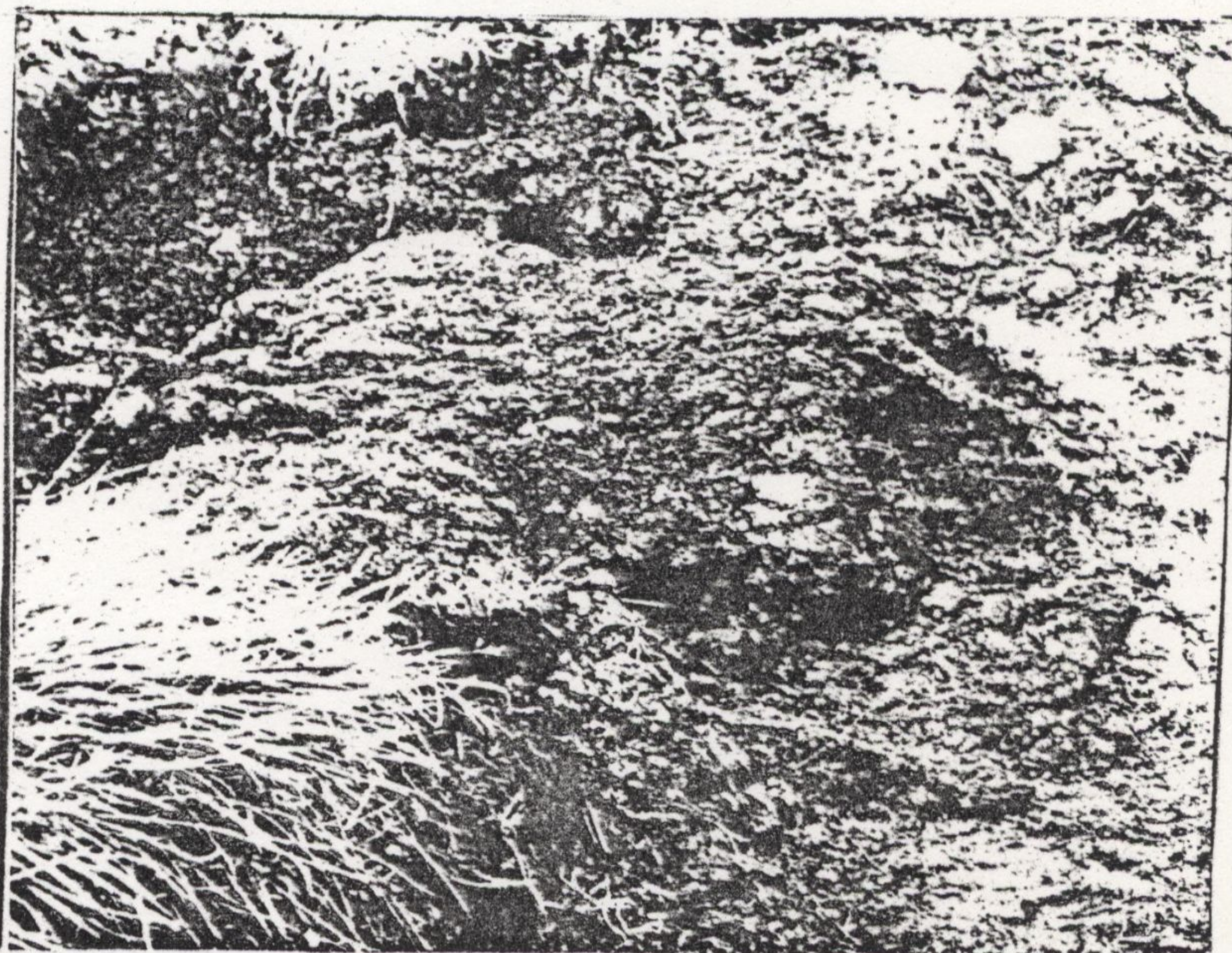
FIG 4 SECTION ON FURNACE

SCALE ONE TENTH

Plate I



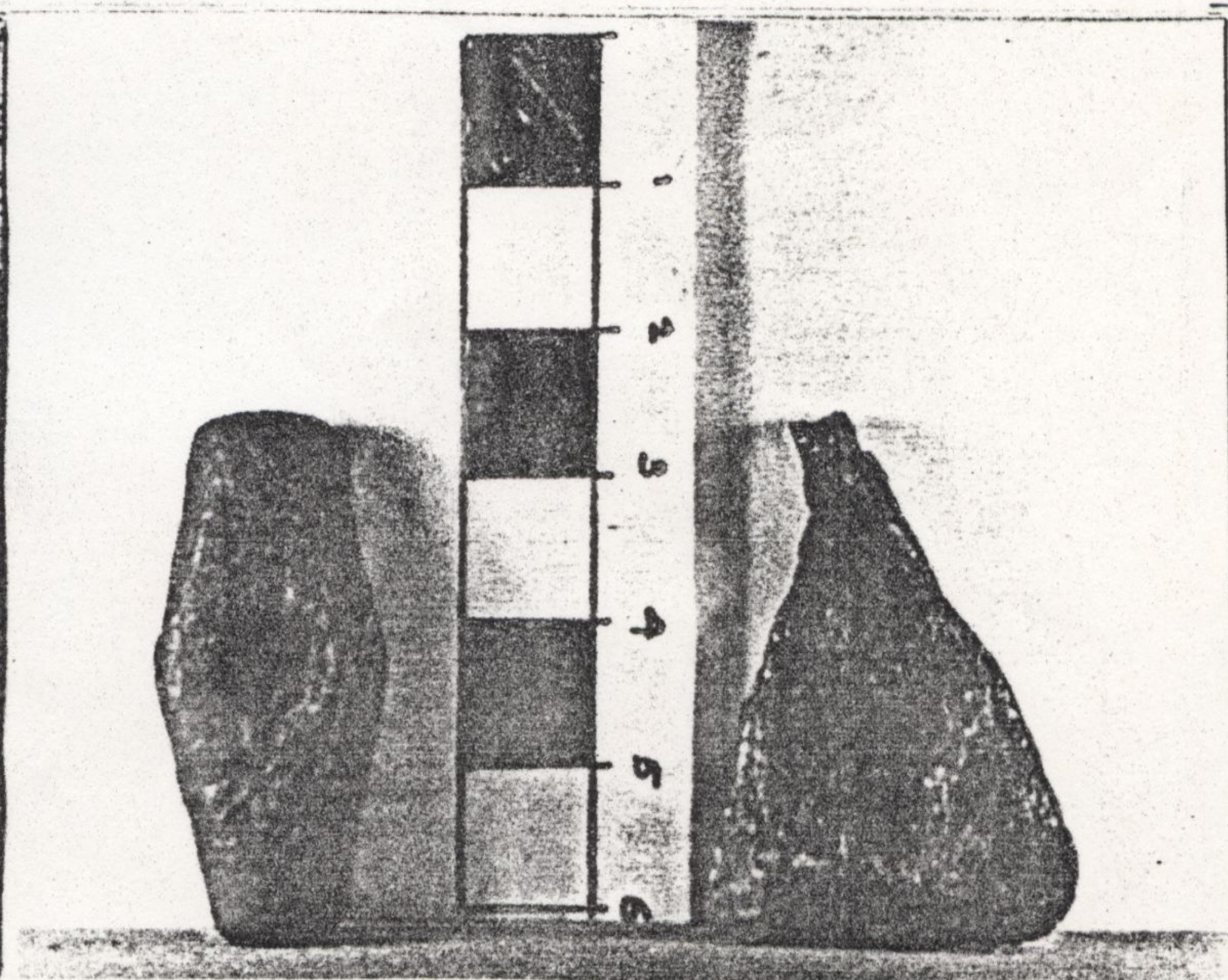
A. Piece of pre-formed
furnace shell
scale is in inches



B. Two Furnaces with
Bloom re-heater behind



C. Bloom refining area
scale is inch



D. Surface finds of small
hammer and adze

A group of clay pieces had been vitrified by great heat and some of them could be placed together to form part of a circular opening which would have been about 7cm dia. Several pans of slag from the furnace bottoms lay about, they were never more than 12cm thick, slightly elongated and up to 28cm long and 24cm wide. No hollowed out hearth formations could be found on any of the base soil nor any slag tapping pits or bowls. It appeared that when a new furnace was to be built, the only base preparation had been to level off the surface with fine debris. Later when the less damaged furnaces of the main site came to be examined, it was clear that the methods of construction as well as the operating practice had been the same as for the outlying furnace .

Midway between this outlying furnace and the main site, a quite different black patch of soil was examined. Here there was only fine charcoal and small droplets of slag. At 52cm depth two distinct pads of base soil were found each 25cm square with a post hole. There was no reddening of the base soil. This had possibly been a small primary or secondary bloom refining forge.

At the main site the mechanical ditcher had already laid bare the front of two furnaces, these and a third stood in line on the west side of a natural gully , on the opposite side and parallel to these furnaces a stone sill had been laid out, it was supported at the front by five courses of roughly cut sandstone block walling. At the north end of the sill an area had been used for bloom refining, here there was a large red stained and chipped sandstone block, next to this stone which may have been an anvil block, there had been arranged a small hearthlike circle of smaller ~~sandstone blocks~~. Although this assembly of stones had a few droplets of slag in its centre, there was no evidence of heat and it is assumed that they had been used to position a stand to raise an anvil to working

height. Plate 1C.

At the other end of the sill which was 3.35m long, there was another circular assembly of stones behind which was much flaked iron oxide and fine charcoal spread over an area of 1.5m dia. This debris probably derives from a smithy operation and the stone formation may mark the position of an anvil support. It has been noted (2) that illustrations of both Roman and Saxon smiths at work show the anvil to be raised above ground to working height. At this point a semi-circular piece of sandstone curved to 15cm radius and 3cm thick was found. There were two post holes here of 12cm dia and a charred piece of post of about the same thickness lay on the stone sill.

On both sides of the main site areas of at least 1m square were left undisturbed for any future reference required.

A test pit was dug at the South end of the sill to establish that no previous operations had taken place and covered by the site as examined. In fact this disclosed substantial oak beams and some wattle made of Alder lying in waterlogged clay and overlaid by densely packed slag. The piece of cleft oak 3m long and some small quantity of broken wattle which had been exposed to air was removed for preservation otherwise this sub area was left undisturbed. A piece of timber was also extracted in 1971 for carbon dating but the British Museum were not able to take this into their programme due to pressure of other work. No further effort has been made to establish the date of this underlying building.

What appears to be the remains of a much oxidised arrow head on part of its shaft was found on the top of number three furnace of the main site. A piece of the shaft was sent for examination to the British Institute of Archaeology but of this nothing further was heard. The wood was of an unusually long fibre. Figure 3 provides a plan of the main site which shows that a complete ironworks had been built within an area of 7m X 5m and planned as a whole.

Furnace Details

The furnaces are of the shallow dome type with a rectangular rear extension. On the main site three of these are arranged in straight alignment, two are built together in a single block but the third is placed by itself 3m away. Plate 1 B shows the two furnace block. The principal internal dimensions of the two furnaces which are built together are: maximum width of domed portion 20cm and 35cm respectively, height of what is left of this domed portion 38cm in both cases but a greater height must be assumed for an undamaged unit. If the same curvature is followed as now exists for the remaining parts, then an internal height of about 45cm would be possible. The third furnace had suffered more damage but generally conformed to the larger set of these dimensions. The internal length of the rear extension is 50 cm, the width 35cm and the height 15cm. The undamaged furnace would have been about 1m 45cm in total internal length. Fig 4. If the furnace bottom pans of slag which are described on p 4 are to be taken as an indication of hearth size, then this was very shallow- not more than 12 cm and 28cm X 24cm in area. On such a basis the active zone must have been confined to the domed portion with the rear extension serving as a wind-box into which air blast would have been admitted at one or more openings. Tuyures were totally missing from the whole site. The only evidence of furnace top openings were the pieces of vitrified clay shell reported on p 4 above, they could be arranged to give part of an opening which would be about 7cm in diameter. The clay shells of the furnaces were all constructed as described on p 3 the rolls of clay being placed longitudinally from front to back. The lining was

4to6cm thick but in all cases had a further internal coating of slag so that the average thickness was about 10cm. In all three the furnaces are filled with partially reduced ore of walnut size, it would seem that operations had stopped abruptly. As seen on Plate 1 B there is a small furnace of simple construction placed near to the two furnace block, it has no residue inside and may be a bloom re-heating furnace or muffle. From trickles of slag remaining at the front of the first furnace it would seem that slag disposal was a very simple procedure and neither on the main or the outlying sites is there any evidence of slag pits or wells.

Discussion.

Furnaces of this type have not so far been reported within the Wealden area but they are reported in the Englesbachtal Valley in Germany by P. Weierhausen (4) R.F.Tylecote (5) and by J.G.Rutter and R.H.Hayes (6). at anyrate so far as a dome type furnace is concerned. These references are spread over a wide span of time from pre-Roman through to medieval periods and in location from Northern Germany to Northern England. The Englesbachtal Valley is South of Siegen in what would have been Frankish territory during late Roman times but as far as can be ascertained from more recent German reports (7) the particular features of the furnaces under present discussion do not appear within the span of the Imperial Roman iron making industry in Germany. Recorded history of this area of Sussex of the sub Roman phase is unclear but 491 A.D. is usually accepted as the date when the Western Saxons "destroyed" the Britons at Pevensey Fort (20km to the South), again 568 A.D. is a date when an attack was made by these Saxons on the Kingdom of Kent. This site presents a C14 dating of

} no longer relevant

dating of 567 A.D. I and - 45 years, what could be Frankish influence in furnace design and some continental as well as Romano-British ware including Rhenish ware but all surface finds. These factors may indicate that Romano-British iron workers were still continuing in the Weald perhaps under the control of the Frankish mercenaries who would be aligned towards Kent at that time rather than towards the West Saxons who appeared to be intent upon breaking up any remaining Britons .

(see page 1)

An attempt has been made in appendix 1 to estimate the operating results of the works. If the figures can be accepted as "order of probability only", then it will be seen that after some two hours a bloom of 500 grams could be produced.

ACKNOWLEDGEMENTS

The writer wishes to acknowledge gratefully the help of many without which this piece of work would not have been possible. The owner of the site Mrs R.C.C.Honey for allowing the work to proceed, the British Museum for the Cl4 dating and for examination of some of the pottery and for other pieces examined by Mr N.F.S.Norris. Mr C.J.Ainsworth and his team for the magnetometer survey, Dr W.H.Manning for advice on the small hammer and Mr J.Upton for the photography of the furnaces. The team of site workers included Messrs C.Booth, A.Flood and Miss C.Flood who brought training and experience from work on other sites and who assisted with surveying and drawings, Mr T.J.Goode and Miss J.Goode and from time to time other members of the Sussex Industrial Archaeology Society. During work in Germany in an attempt to sort out the puzzle of past references much help was received from Dr Hingst of the Landesamt fur Vor-und Frugeschichte von Schleswig - Holstein and from Frau P.A.Weimar in Bremen.

Appendix I.

Furnace Operation. Suggested order of Probability

Volume of active zone of furnace	20,000 cm ³
Charge required in proportion of one part ore (roasted) to 4 parts charcoal	roasted ore 1.332kg charcoal 5.328
	6.660kg
Air blast per minute	0.400 m ³
Duration of one smelting	1.75/2.00 hours
Total materials per day of 12hours 3 furnaces working 3 smeltings each	
	Roasted ore 12kg Raw ore 16/18kg charcoal 48kg to 60kg Timber to be cut and carbonised each day 400/500 kg
Metal production	
	Fe in 12kg roasted ore @ 50% 6kg
	Loss to slag @ 18% 1.08
	refining loss @ 5% of crude bloom 0.246
	Finished metal 4.675 kg per day

Labour on works

Iron master	1
master smith	1
bellows men	6
helpers, strikers etc	3
	<u>11</u>

Outfield labour

Ore gatherers	2
Charcoal makers	2
Clay puddlers	1
	<u>5</u>

Total labour 16 people.

If the three bloomeries out-field were operating concurrently with the main works then the quantities would be doubled.

Appendix 2.

Pottery and Metal Objects

Pottery

Eighteen sherds were found, all within the confines of the main or the outlying sites. No piece is more than 18 square cm in area and the variety is confusing. Unstratified finds must remain inconclusive but it may well be that modern deep ploughing across the outlying sites, has brought to light material hitherto undisturbed. All the surrounding fields were walked after ploughing for a number of seasons, but it was only on the sites that any material of significance was found.

Item Number

- 1 -3. Dark grey Romano-British wheel-turned part of small jar
- 4 Grey hand-made with fine grog inclusions, piece of bowl
- 5 Red-brown outer surface, dark grey inner, piece of bowl
- 6 Yellow sandy colour throughout, lip of mortaria with lattice pattern. Imported Rhenish ware.
- 7 Red finely made wheel-turned lip of jug, external groove Imported.
- 8 Same as 7 but no groove.
- 9- 10 Grey-yellow sandy ware both with groove, one with impressed pattern round rim. Continental Saxon.
- 11 Pink fine ware with trace of glaze Samian ?.
- 12 Same as 1 - 3.
- 13 - 14 Thick coarse grey corky hand-made ware with crushed flint grog. R - B domestic ware
- 15 Thick dark grey hand-made but denser than 13 - 14.
- 16-17 Similar to 5.
- 18 Pink wheel-turned, sandy texture, thin.

Cement Plaster

- 19 This is a piece of white cement wall or floor covering 1.5 cm thick and 30 square cm in area. Well defined grooved pattern of half circle between two lines. The back shows red tile or brick fragments adhering and a squared impression where it had been plastered onto its backing. Roman opus signinum.

Appendix 2 cont.

Metal Objects

- 20 Wrought iron hammer 9 cm long and faced at both ends. The hole for the shaft is round and of 1.8 cm dia. The shaft had been wedged with two round-headed nails which are still in position. Weight 550 grams. Roman characteristics, Good condition.
- 21 Wrought iron adze 6.5 cm on cutting edge and 8 cm from blade edge to neck of fastening which had been broken at that point. Splitting of several laminations showed low temperature welding by smith, also shows the many small pieces of metal from which the tool was originally made. Impossible to date. Fair condition.
- 22 Small tapered iron object heavily oxidised. 4 cm long and 1.7 cm at widest part of its oval cross section. Found in strata with thin charred wooden shaft 12.5 cm long. May be an arrow. Condition fragile.

All material with owner.