PORTH Y RHAW
COASTAL PROMONTORY FORT
SOLVA, PEMBROKESHIRE
ARCHAEOLOGICAL EXCAVATIONS
1995-1998
DRAFT REPORT

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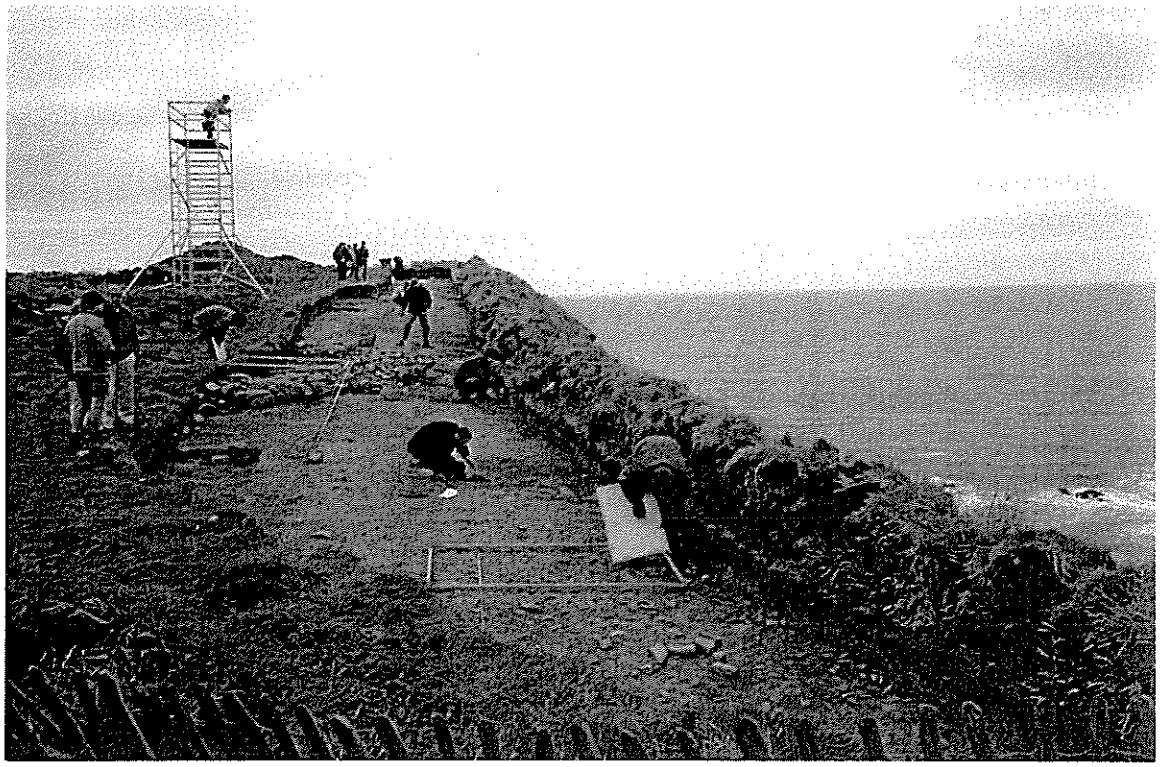

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Summary

Porth y Rhaw is a massively defended multivallate coastal promontory fort, much reduced by cliff erosion. Part of the interior and a small section of inner bank were excavated, together with two trial trenches in the outer defences. These areas were considered to be the most vulnerable to further erosion. Radiocarbon dating suggested that the construction of the defences began in the early to mid Iron Age, but archaeomagnetic results and the find of a glass bead point to a later date. The partial remains of at least eight roundhouses were identified, some of which were rebuilt a number of times. Pottery from later interior phases of occupation indicate that the site was in use from the first century to the fourth century A.D.. Evidence of both bronze- and iron-working was found on the site.

Introduction

Dyfed Archaeological Trust undertook an assessment in 1993-94 of all the coastal promontory forts of west Wales on behalf of Cadw: Welsh Historic Monuments, to identify the current land use of each site and to record exposed sections of archaeological importance. The project also highlighted severe coastal erosion as presenting a major threat to a number of forts. These sites are, by their nature, very exposed to the elements, and the larger and more complex defences tend to be sited on the more naturally defensive promontories, on high cliffs, which are more susceptible to being undermined by the sea.

The survey identified Porth y Rhaw as one of the seven most vulnerable forts, and one where no practical action could be taken to halt or slow down further erosion. The site is a scheduled ancient monument and, in 1995, Cadw commissioned four evaluation

trenches, positioned in areas most vulnerable to erosion, to test the potential for any future work. Following this, two areas were excavated in the summers of 1997 and 1998, the main research objectives being to provide dating for the fort and to recover all possible information about the occupation of the fort from within the areas most at risk of erosion. These excavations were again funded by Cadw, with some sponsorship in the final season from Barclays County Focus, arranged via the National Trust, who acquired ownership of the site in 1996.

Although there are approximately sixty promontory forts around the coast of west Wales, the only major excavation undertaken in the last fifty years was the work on the fort at Dale in Pembrokeshire, started by Professor W F Grimes in 1966. The excavations continued until 1983 although, with the exception of the first interim report (Grimes 1966), the site remains unpublished. Limited area excavation took place at Tower Point, Pembrokeshire in 1970 (Wainwright 1971), including one roundhouse and a section through the inner defence. Further work was subsequently undertaken at Dale in the late 1980s, concentrating on the defences and a separate small area within the enclosure (Benson and Williams 1987, Ramsey and Williams 1992). A small amount of work on comparable sites has been undertaken in south-west England, notably that on the defences of Embury Beacon, Devon (Jefferies 1974) and on a more limited scale in Cornwall (pers comm. Peter Herring, Cornish Archaeological Unit, Herring 1994, Smith 1988). Within the context of this limited number of excavations on coastal promontory forts, the work at Porth y Rhaw, although restricted to a quarter of the present interior and three trenches in the defences, has made a significant contribution to knowledge of these sites.

Topography

Porth y Rhaw lies on the coast 3.5km east of St David's in Pembrokeshire, 2km west of Solva (Illus. 1), and adjacent to the Pembrokeshire Coast Path (SM 786242). The remains of the fort (Illus. 2 and 3) lie above the eastern side of the inlet of Porth y Rhaw, a rocky cove at the end of a steep sided valley, down which a stream flows. The two promontories occupied by the fort are undoubtedly the eroded remains of a single much larger area (Illus. 4), projecting south-westward into St Bride's Bay. The promontories comprise vertical sandstone and mudstone cliffs 35m high, the bedding layers of which are, to a great extent, in near-vertical formation (Illus. 5 and 6). There are two major sea caves below the fort (Illus. 2). The western one is at least 40m deep and is situated beneath the western end of the second defensive bank of the fort; the eastern cave is more than 50m deep. There is a lesser cave over 20m deep beneath the fourth bank. The backs of all of these caves are blocked by storm-deposited pebbles; they are nearly inaccessible and the entrances fill with the tide. (The directions and edges of the caves as indicated on the plan are only approximate.) The high ground of the promontories is somewhat separated from the flat hinterland by a minor stream, issuing from a spring opposite the fort's entrance, and flowing down a valley, initially shallow, but which widens and deepens as it slopes towards the cove.

The remains of the multiple banks and ditches are still very impressive, especially as the inner defences are on much higher ground than the outer bank. The full depth of the defences, four banks with three ditches, survives on the western side of the site. The inner three ramparts are closely spaced and curve around the hillslope, while the third ditch and fourth bank run in a straight line along the edge of the valley bottom (Illus. 2). The inner bank and inner ditch presently form a very steep, continuous face,

approximately 4m from the top to the bottom. The second bank is far less pronounced, rising about 1m above the inner ditch fill (Illus. 2, Profile A-B) and, on the eastern side of the central area of the defences, appears as little more than a counterscarp bank (Illus. 2, Profile C-D).

The present base of the second ditch is some 2-3m below the top of the second bank, with the top of the third bank approximately 1-2m above the ditch bottom. The second ditch and third bank are both large and steep-sided, although it is unclear whether the western end of the ditch butted or turned southwards (Illus. 2), this area now being lost. However, there is a suggestion that the third bank runs, along the eastern side of the western promontory, albeit at a much reduced height. Near the mid point of the defences the second ditch turns sharply northwards and passes through the third bank. To the east there is no surface evidence of a second ditch and the area to the rear of the third bank is flat until near its eastern end, close to the entrance, where the bank rises up to form a mound (Illus. 2).

Both of the promontories are enclosed by the third ditch and the fourth bank. The central part of the bank may be just a counterscarp and there is no trace of it at the eastern end. The bank has also been utilised by a much later hedge bank and part of the Pembrokeshire Coast Path now runs along the top of it. The maximum height of the fourth bank is at its western end, where it is nearly 2m above the bottom of the third ditch. The bank and ditch enclose the western promontory, possibly to form an occupied annex, as well as denying a strategic platform to attackers. Between the third ditch and third bank, on the western promontory, there are some slumps or scoops on the hillside (Illus. 2), possibly quarrying. There may be a suggestion of a filled outer ditch on the eastern side of the entrance, although this could be a natural feature.

The entrance was located at the eastern end of the defences, where the valley is less deep and nearest to the springs, although this was also the naturally weakest defensible point. The access through the outer defences appears to have been eroded away on its eastern side, but the entrance still survives through the inner bank, where there is an in-turn to the western terminal. On the eastern promontory, some 25m inside the entrance, there is a suggestion of a hut circle, noted both by the OS Survey (1973), and Rees (1992) (Illus. 2); these indications were confirmed in the 1995 evaluation. Towards the southern end of the interior, at the highest point, there appears to be a low bank.

There are suggestions of the remains of late hedge banks over the eastern end of the third ditch and over the western end of the inner ditch. A small bank in the central area of the inner ditch could be also be the remains of a hedge bank (Illus. 2). Indications of former excavation trenches survive around the entrance on the inner and third banks.

While the original interior area of the fort cannot be precisely estimated, the size enclosed was probably in the region of 4500m², allowing for a small sea inlet between the surviving promontories. The maximum interior may have been as great as 6000m^2. The surviving interior area is roughly 1000m², approximatly one fifth of the probable internal area. Trench 4 covered 230m², representing about one quarter of the surviving interior.

While the rate and extent of erosion cannot be accurately calculated, the rate of loss for the interior, based on an original area of 4500m² reduced to 1000m² over c. 2500 years would represent a loss of around 1% every 30 years. However, erosion along this coast tends to occur in sudden land slips and cliff collapses, rather than steady,

gradual wear. Although the last detailed Ordnance Survey 1:2500 map was up-dated in 1966, the cliff edge does not appear to have been amended, and may be based on the 1887 first edition 6 inch to the mile survey. Comparison of aerial photographs taken in 1955 and the current survey indicate that there has been little loss except at the southern end of the interior. About 3 metres has been lost from the same area between the detailed surveys in 1993-94 and 1997.

Porth y Rhaw is a somewhat unusual promontory fort, in that it is separated from the mainland by a short valley. This natural defensive feature has been significantly enhanced by the several banks and ditches of the promontory fort, and the distance from the innermost defence to the top of the valley slope opposite is approximately 75m. It is impossible to overlook the site from less than 120m distance to the east or 220m to the west; given that the effective range for a sling shot is 60m (Cunliffe 1983, 77), its defensive strength is clear. While the eroded banks and ditches today provide a sharp climb, the original appearance of the defences and the interior would have been an imposing sight, impressing outsiders from either land or sea with its strength and status.

Historical Background

The first description of Porth y Rhaw was provided by the antiquarian Richard Fenton, who visited the site in 1808/9. He recognised that much had already been eroded away (Fenton 1903, 76-7). Fenton carried out excavations within the ramparts on the summit of the cliffs, on an extensive grassy area, by two large stones, and found charcoal, limpet shells and signs of much fire. He also noted 'hut sites' between the third and second ramparts; he may have been referring to the slumps or scoops which

can be seen on the north-western side of the promontory between the third bank and the cliff edge (Illus. 2). These features may be quarrying, and could be associated with post-medieval activity in the valley, possibly a mill site, which only ceased working about 1915 (Warburton 1944; Raggett 1990, 36-7). The inlet at Porth y Rhaw was occasionally used by small trading vessels in calm conditions, into the beginning of this century.

In the mid-nineteenth century, a descriptive text, and a somewhat inaccurate plan, were published (Jones and Freeman 1856). Although the drawing is distorted, it shows two distinct promontories, with much of the inner bank lying directly above the cliff edge. In the early twentieth century, a large worked stone was found in the third ditch (RCAHM(W) 1925); its present location is unknown.

In *The History of Solva* (1944), Warburton's description of the fort (p10) refers to "a shallow circular depression on the summit, 13 feet [4 metres] in diameter, and excavation showed that this was probably a cattle pond" [cattle pound?]. The highest part of the site is now the southern end of the eastern promontory, but this is actively eroding and what was described as the summit in 1944 may now be lost. Warburton also states that about 1800 'charcoal and limpet shells were found near the pond', almost certainly a reference to the investigations by Richard Fenton (although there is no such mention of a pond in Fenton's account). The excavation of the 'cattle pond' may have been undertaken by Warburton or may possibly have been carried out by Dr Felix Oswald, who assisted with the 1944 history. Oswald, known for his work on Samian pottery had a holiday home in Solva, where he later retired. There are local accounts of Oswald having undertaken work on the site, and the possibility of his having pottery from the fort at his house in Solva, although no excavation records or

finds from Porth y Rhaw have been found.

The banks of the fort were reputed to have been used for small arms practice during the Second World War, and a .303 calibre spent bullet was found in the topsoil of Trench 1. It has been reported that the headland was a post for the Home Guard.

The Ordnance Survey (OS 1973) gave a brief description of the site and a detailed plan, drawn in 1966 (Illus. 2). Here the third bank's western end is drawn with a turn to the south to the cliff edge; also of note is the probable hut circle inside the entrance. Local eyewitness reports of digging of holes on the site 15 to 20 years ago, possibly to look for treasure, may relate to old trenches visible around the entrance on either side of the inner bank and immediately to the west and south of Trench 2 (Illus. 2).

The 1994 assessment of the coastal promontory forts of Dyfed noted that a considerable length of the surviving inner bank was now critically close to the cliff edge, along with the exposed south-western end of the inner ditch. Furthermore the western side of the interior appeared to be fissuring parallel to the edge and a cliff fall in this area was probable in the near future. Analysis of the history of this site concluded that a large proportion of the interior had been lost before any records were made, and the later records indicate that erosion has continued.

The 1995 Excavations

The evaluation took place over four weeks in the summer in extremely dry conditions, during which time four trial trenches were excavated (Illus. 2). Trench 1 was further excavated in 1997 and Trench 4 was continued in 1997 and 1998; these are described in detail later.

Trench 2

This was positioned to establish whether the present end of the third bank on the west side of the entrance (Illus. 2) was the original end of the bank or if it had been lost to erosion. The main trench was not excavated down to bedrock, for both safety and logistical reasons. A lower, voided large-stone rubble layer was only partly excavated; it may perhaps represent the upper layer of a (possibly deliberately) backfilled ditch, below the third bank. A post hole was found in the terminal of the third bank, possibly for either a palisade or revetment. The form of the bank layers appeared to indicate that the present shape of the bank end is due to erosion and that the outer entrance has been lost over the cliff edge.

The results from this trench suggest that the outer defence around the entrance was remodelled, rather than unfinished. The surface evidence of the flat area inside the third bank on the eastern side of the defences possibly suggests that this area may have formed an occupied outer defence over the former second ditch.

Trench 3

This was excavated to determine if the third bank continued along the surviving western promontory (Illus. 2). The results showed a buried soil sealed below a probable small bank; there was no sign of any outer revetting. It is possible that this minor bank was a counterscarp bank for a ditch now lost over the cliff.

The 1997 and 1998 Excavations

The excavations took place over two short summer seasons, with a small team of professional archaeologists assisted by a few students and volunteers averaging ten people. Initially, conditions in the 1997 season were mainly very dry and clear,

causing problems with soil colour differentiation. Heavy rain during the latter part of the season rendered the site unworkable. In 1998 conditions were more favourable, but rapid drying caused problems with soil colours. At the end of each excavation the trenches were backfilled and re-turfed.

Both for safety reasons and in order not to exacerbate erosion after reinstatement, no excavation took place within 1 metre of the edge of the cliff. During the excavation both the open areas and the spoil-tips were frequently scanned by metal detectorists; a large number of anomalies were detected, the majority of which later proved to be natural. It is therefore considered that little if any stratified artefacts went undetected.

Trench 1

This trench was located approximately 7 metres from the western end of the inner bank and ditch. The inner bank was constructed on the top of the hillslope and now stands just over 1m high. In 1995 a narrow trial trench was cut through the bank and across the ditch and in 1997 a small area of the bank, measuring 6m by 4m, was excavated to examine the rest of a hearth previously found within the bank construction.

The ditch

The trench cut through the upper fills of the ditch; the bottom was not reached. The exposed ditch section in the cliff edge (Illus. 7) was, however, projected onto the excavated section (Illus. 8). The ditch cut (30) had been made into mudstone bedrock, which at this point is in near-vertical planes. The profile of the ditch bottom at the cliff face suggested re-cutting.

While there were probably primary fill(s) in the unexcavated bottom of the ditch,

these could not be seen in the cliff section, due to a spill of debris. The lowest fill excavated (29) was quite deep, and comprised of a clay loam with small angular shale fragments, and no apparent lenses. Later fills (27, 28) consisted of very large stones with some soil infill, while the fill (26) between these contained only smaller stones, some possibly burnt. These fills appeared to have been deposited at roughly the same time and relatively quickly, and also appeared to be dipping eastwards along the axis of the ditch. The three fills (23, 24, 25) above these were similar in composition to deposits from the bank as well as from the ditch sides.

Above these fills was a layer (22) of shattered shale and pea grit, Although this layer was on the same slope alignment as an upper layer (31) of the bank and composed of similar material, the layers were not joined and were not considered to be stratigraphically the same. However, at the critical junction an eroded footpath has caused some slumping of the bank material, as well as cutting into the bank itself. The upper ditch fill (3) immediately below the topsoil (1) appeared to be the same material as the upper deposit (35) on part of the bank. The upper part of the inner edge of the ditch and the outer face of the bank above was riddled with animal burrows.

The bank

Geological features lay directly below a cut (21) and a trench (20). The edge of a natural feature filled by deposit (47) lay on the same line as the cut (21) (Illus. 8); it is thought that the most probable explanation of this alignment is that the edge of the cut (21) utilised this natural fault for easier digging. Uncertainty regarding the interpretation of the this feature remains.

Excavation appeared to indicate that cut (21), at the rear of the bank, was earlier than a second cut (20), 350-400mm away from the bank (Illus. 8 and 9). Charcoal from the

fill (16) of the cut (21) gave a radiocarbon determination of 2420 ± 80 B.P. (Beta-124341). Some of the lower fill (18) of the outer trench (20) was considered to be packing for uprights. However excavation showed that, if this was clay packing, it was no longer *in situ*, and apparently mixed between the lower parts of both cut (21) and cut (20). The north-west side of cut (21) was vertical, possibly designed to support upright timbers which subsequently rotted and were replaced by fill (15).

Below the bank there was an upper geological deposit, comprising a layer of silty clay (13) below a buried soil (12) (Illus. 8). The buried soil was approximately 180mm thick and sloped slightly down towards the exterior edge of the bank. Pollen recovered from the buried soil indicates a predominantly grassland environment with some weeds and possibly hazel woodland in the area (See environmental report, sample 563).

Above the natural layers, the lowest bank deposit (11), as seen in the north-east facing section of the trench (Illus. 8), was a fairly uniform silty clay loam with random angular stones and cobbles, which probably derived from the initial cutting of the ditch, and/or the rear revetment features. In the south-west facing section, however, the stratification was more complex, with two or three separate layers forming the lower part of the bank; while this *could* be a primary bank, it is very low, being less than 500mm high.

A post hole or pit (5), with a substantial packing (6), had been cut through the lower bank deposit (11); the post pipe was 100mm in diameter and at least 580mm deep. The upper part of the post packing, and the surface of the lower bank deposit was considerably fire-reddened by a hearth (9) (Illus. 8). The fill of the post pipe, partly voided, contained some soil, together with a large amount of charcoal and a flint flake.

The charcoal and soil appeared to be the same material as that above the hearth, and probably fell into the void created when the timber post rotted.

The hearth appeared to have been built in a slight hollow (Illus. 10); near the centre was a protruding stone, the upper surface of which was fire-reddened. Part of a blue glass bead (431) and two fragments, possible globules, of bronze, were recovered from a charcoal-rich deposit (4)(Illus. 8) above the hearth. Radiocarbon determination of charcoal samples from layer (4) gave results of 2470 ± 70 B.P. (SWA-101) and 2430 ± 60 B.P. (Beta-124342), whereas archaeomagnetic sampling of the hearth material produced a date range from second century B.C. to first century A.D. Analysis of the glass bead was not conclusive, but suggested a Roman date or, possibly, late Iron Age (see Sablerolles and Henderson, below).

The upper layers of the bank (10, 2), comprised clay loam with small stones, the lower layer (10) being more compact. Both appeared to have been eroded after any facing materials had gone and before the build-up of topsoil and turf (35, 1).

Interpretation

The evidence for re-cutting of the ditch may be supported by the nature of the second bank, which appears to be more of a counterscarp deposit from clearing of the inner ditch rather than a defensive construction. However this could not be proven without excavation. The silty deposits, which filled the ditch to a depth of roughly a metre, probably derived from gradual erosion of the upper shaly part of the bank and ditch sides, almost certainly predating any major collapse of the bank. The very large stone rubble subsequently deposited over the silts probably came from the bank.

The boundary between the large stones and the silty deposits above was of very uneven depth and dipped steeply across the one metre wide test trench. While it is possible that this boundary may represent a recut, it was considered unlikely and it did not give the impression of a cut during excavation. The later deposits probably, at least in part, derived from the collapsing and eroding bank material and ditch edges. As only one narrow trench was excavated across it, the section may not be representative of other parts of this 100m long ditch.

The present day profile of the inner bank and ditch is continuous and excavation revealed no evidence for a revetment on the outer side of the bank, although any such evidence would almost certainly have been lost through erosion, due to the nature of the very steep, almost vertical, cut of the inner ditch face and the character of the rock formation. Furthermore, features (e.g. spaced post holes) lying outside the relatively narrow excavation area would have been missed. Any external face would probably have been built, at least partially, in stone, due to its local availability and durability, although other materials such as timber or turf, or a combination, could have been used. The layer of very large stones within the fill of the ditch was seen in both the exposed section in the cliff edge and within the test trench. The most probable explanation for this would appear to be the collapse or slighting of an outer face containing a substantial quantity of stone, as the bank matrix appeared to contain a much greater proportion of soil with few large stones towards the front of the bank.

While the exact nature of the outer face of the defences is uncertain, the substantial trench and cut at the rear of the bank suggested that this side was originally constructed as a revetment, possibly partly built with stone uprights in the trench, supporting a timber revetment further inside the bank. Some 50m further east, where

the rear face of the bank is now right on the edge of the cliff, upright stones approximately 1m high have been exposed in the edge of the eroding bank. Although there was no surviving evidence of individual settings for uprights within the trenches, the clay fill, possibly packing, was apparently mixed between the inner and outer cuts, as might occur during robbing. This fill was also considerably less compact than surrounding material, suggesting some disturbance had taken place comparatively recently, possibly during construction of the post medieval mill in the valley nearby.

The hearth found within the bank is considered to have been a temporary and an early feature, in use during the bank's construction. The presence of a mostly unburnt stone protruding through the hearth indicated considerable settlement of the material below the hearth after it had gone out of use, implying that the lower layers of the bank had not yet been consolidated, either over time or by deposition of additional bank material on top. There was no evidence for a cut to insert the hearth into the bank, nor does there appear to be any evidence of, or reason for levelling the bank to a height of less than 500mm, and then rebuilding, subsequent to the use of the hearth. A substantial re-building cannot, however, be entirely ruled out.

Although their presence within this context may be coincidental, the fragment of blue glass bead recovered from above the hearth, together with the two small fragments of copper alloy, suggest that this hearth may possibly have been utilised for jewellery repair or manufacture. However, some fragments of calcified bone were also found, implying that some cooking functions were also undertaken and the hearth may well have served a number of purposes.

The disparity of the dates between radiocarbon and archaeomagnetic methods is problematic. The large amount of charcoal immediately above the hearth was unlikely

to be residual and the two radiocarbon samples gave similar results of 792 to 394 cal. B.C. (SWA-101 Porth y Rhaw) and of 780 to 385 cal. B.C. (Beta-124342), both at the 95 per cent probability level. The sample from the rear revetment of the bank, which could be expected to be of the same period, gave a similar date of 790-370 cal. B.C. (Beta-124341). The archaeomagnetic analysis, on the other hand, could not be more precise than second century B.C.-first century A.D., due to the apparent settlement of the hearth after its use, causing anomalies in the samples which did not allow for more accurate dating (Tarling 1998). Chemical analysis of the glass bead fragment (431) strongly suggested a Roman date, although a late Iron Age date could not be ruled out. It is also possible, especially given the animal disturbance in the upper part of this bank, that the bead is intrusive.

Although the inner bank still looks impressive, the remaining deposits were only just over one metre high. A large amount of the bank must have fallen into the steep sided ditch and much of the interior side is now being eroded along the cliff edge. If there is evidence of any external facing, or internal bracing, it is likely to be best preserved in the area of the entrance, which is safe from cliff erosion, at least for the immediate future.

***Trench 4* (Illus. 11)**

While every side of the promontory showed steady erosion, an apparent fissure in the ground surface on the western side, combined with the angle of the geological bedding, appeared to indicate a collapse in the near future; the southern end and western side of the promontory were therefore chosen for excavation. Given the varied nature of the underlying geology, geophysical survey was considered unlikely to give meaningful results.

The internal area of the fort was relatively level (Illus. 2, profile C-D), rising slightly from the entrance between the inner banks to a hut platform, confirmed by the 1995 trial trench. The ground continued a gentle rise to a low bank 20m short of the southern end. South of the bank, the end of the promontory was quite level. The interior was covered mostly with maritime fescue grassland, forming a very thick and springy turf, up to 300mm deep.

Trench 4 lay along the entire western side of the promontory. The total length of the trench was just over 61m, the width varying from 3m to 5.5m, with a wider area encompassing the southern end of the promontory. The 1995 evaluation trench, which had already confirmed the existence of part of a stone footed roundhouse (VIII), was incorporated into the northern end of the site. The area to the south of roundhouse V (Illus. 11) was almost totally excavated.

The natural subsoil, where visible, appeared to have some variation and was only seen to any extent where full excavation took place, on the end of the promontory. It consisted mostly of very light brown silty clay loam with a varying quantity of angular shattered stone; within this there were virtually stone free areas and also patches of clay soil, some of which could be a later buried turf.

The results of the excavation are described from south to north, except for the two stone footed buildings (VIII and IX), which are described last. A layer of shaly/shattered stone and soil, possibly representing occupation activity, extended over most of the site, but was not found over roundhouse VIII and lay below structure IX. All other roundhouses were demonstrably below the shaly/shattered stone and soil layer, or could not be seen until this layer was removed.

A layer of almost stone free, brownish grey, fine silty loam covered the whole site,

except where it was disturbed by animals, and appeared to be post-occupation build-up with no artificial activity. The turf above the stone free soil was very thick in all areas except for the southern part of the promontory, where at its far end it was non-existent.

The southern end of the promontory (Illus. 12)

There was a scatter of flints over most of the site, probably of late Mesolithic date. The distribution of these flints had a concentration towards the soutern end of the promontory, probably as a result of this end being excavated down to the geology, as a large number of flints lay just above this level.

Roundhouse I

The earliest proven feature was a gully of a probable roundhouse (I) (Illus. 11), with an overall diameter of 8.6m. The cut into the subsoil was relatively small, 50-120mm deep, 200mm wide and rounded in cross section. The gully was cut by a second gully for a later roundhouse (II) to the east, and could only be traced for a short length within that structure. Although it is possible that some post holes nearby could be associated with roundhouse I, this could not be established and they possibly respect the later structure (II). A charcoal sample from a stratigraphically early post hole within roundhouse (I) gave results of 2550 ± 80 B.P. (SWA-288).

Roundhouse II

Approximately 25% of roundhouse II lay within the excavated area, and appeared to consist of two phases. A gully and a post hole (probably one of a pair) and probably representing an earlier phase, were found within the entrance of the roundhouse. The later phase comprised a gully (overall diameter 9.25m, 200mm deep, 200-300mm

wide, steep sided with a round bottom), with an entrance consisting of a pair of post holes, possibly part of a porch, and a worn hollow between them. The fill of the gully contained a large number of packing stones (Illus. 12). Most of the stones were fire reddened, and apparently burnt before re-use as packing. The interior of the roundhouse may have contained a thin occupation layer or floor although, if so, it was very disturbed or very fragmentary. While there was no evidence for internal structural post holes, there were two areas of burning (running into the main sections) and a number of stake holes within the house, although they may not relate to this structure.

There were a number of post holes on the end of the promontory to the south of, and possibly respecting, roundhouse II, although due to the small area under investigation the form of any post-built structure could not be recognised. Some of the post holes still contained stone packing and would have supported substantial posts, up to 300mm in diameter. A charcoal sample from the largest of these postholes gave a determination of 2430 ± 70 B.P. (SWA-287). There were a number of other small features within this area, including a possible terminus of a shallow gully and a shallow pit.

Overlying the southern part of roundhouse II was a layer of "metalling" of shaly stone, which sealed the southern gully of the roundhouse and the latest post hole further to the south. This "metalling" filled a hollow (possibly worn) and lay below the shaly/shattered stone and soil layer.

On the northern side of roundhouse II there were three shallow pits, located on a natural rise and at the highest point of the present-day fort. These pits were cut 170-180mm deep into an apparently geological deposit of clay which was found only on this part of the site. All were approximately circular, 500mm, 850mm and 700mm in

diameter (south to north respectively); all contained burnt stone and charcoal. Samples were taken of apparently burnt material from the northern two pits. Environmental analyses indicated marginally more burnt seeds than in other samples from the site. Charcoal from the northernmost pit gave results of 2350 ± 80 B.P. (SWA-286). There were signs of fire reddening of the clay around the central pit, which also appeared to have associated stake holes adjacent to its edge. Just north of the southern pit there was a possible structure or structures, consisting of at least 14 stake holes and a small post hole. All these features were apparently sealed by the shaly/shattered stone and soil layer.

Area north of the low bank

Roundhouse III (Illus. 13)

In the area immediately to the north of the low bank there were two groups of gullies, probably representing several rebuilds of roundhouse III, although the relationship between the two groups could not be conclusively proven. The outermost gully was approximately 11.8m in diameter, the innermost 7.5m; the three outer gullies were more substantial than those of roundhouses I and II. The southern part of this roundhouse showed four, or possibly five, distinct gully cuts (Illus. 13 E-F and G-H), but in the northern section only three cuts were visible (C-D), although it is quite probable that re-cutting may have obscured earlier gullies.

There were a number of post holes within the roundhouse, all of similar dimensions; the majority appeared to form part of a post-ring. All the post holes were less substantial than those on the southern end of the promontory. In the southern area of

the roundhouse was a thin charcoal layer, possibly representing earlier occupation not necessarily associated with this structure, which was cut by the two inner gullies.

The innermost gully was very shallow, cut a maximum of 180mm into the subsoil (and 330mm wide). There was no relationship between this inner gully and any of the outer gullies, but it was cut by one of the interior post holes and would not, therefore, appear to represent the latest phase of this structure. A very small spindle whorl (438) was found in the fill of this gully. The next gully outward terminated in its northern section, possibly for an entrance. The gully was round bottomed, up to 200mm deep and 400mm wide. The eastern side of the possible entrance was obliterated by a much larger later gully just outside it.

The relationship of the two outer gullies was not firmly established but suggested that the outermost one was earlier than the larger, re-cut gully just within it. This outer gully was round bottomed and cut a maximum of 170mm deep (and 300mm wide) into the subsoil. The cut for this gully was not discernible on the northern side and appeared to have been removed (or partly so) by later re-building on the same line.

The latest gully was the largest of the cuts, especially on the south side, where it was over 450mm deep and 800mm wide, with a narrow bottom; the northern segment was less deep, 280mm, and 400mm wide, and had a rounded bottom. The southern segment appeared to have been re-cut, although this may have been derived from later in-filling. Both segments contained a considerable amount of fire reddened stone. A radiocarbon determination from a charcoal sample from the latest gully fill was dated to 2320 ± 90 B.P. (Beta-124344). A possible pair of late post holes on the northern side may have formed part of an entrance. These post holes and the latest gully cut the

outer gullies of a roundhouse immediately to the north (V) and possibly also a roundhouse (IV) to the north east.

Roundhouse IV (Illus. 14)

The gullies of roundhouse IV were not as substantial as those of roundhouse III. There were two distinct gully cuts, 8m and 7.3m in diameter; both were about 100mm wide, and dug only 50mm deep into the subsoil. Both contained packing stones and there were indications of the bases of stake holes in the bottom of the gullies. The outer gully appeared to have a terminus and possibly two substantial stone packed post holes, suggesting a possible entrance on the west side. However either of these post holes could be associated with the later roundhouse V to the west. There was a very slight suggestion of an arc of a third gully 500mm further out; a fused but broken cluster of glass beads (452 and 453) was recovered from above the fill of this gully, the analysis of which suggested a Roman date (see Sablerolles and Henderson, below).

There were a number of post holes within roundhouse IV and a horseshoe-shaped gully (X), approximately 1.8m in diameter, and just 130mm wide, with a narrow bottom, cut up to 80mm deep into the subsoil. Possibly associated with this gully were two post holes on opposite sides of the circumference. This feature may lie within the possible entrance, although neither the gully X nor the post holes may be associated with roundhouse IV.

Roundhouse V (Illus. 14)

This consisted of at least four separate gullies but neither its northern extent nor the interior were fully excavated. The two latest gullies were cut by the latest gully of

roundhouse III. Two inner gully arcs appeared to be on almost the same circumference, one possibly being a later, shallower re-build, centred just to the west of the excavation area. The diameter of the inner gullies could not be clearly established as only a small part was defined, but they were approximately 6.5m across. These inner gullies were cut by two outer gullies, probably just under 7m in diameter, which appeared to be centred in the region of a hearth. The maximum depth of all the gullies was about 200mm deep by 250mm wide with rounded bottoms. The profile of the outer gully indicated at least one re-cut, although the fills were indistinguishable; stake holes were also observed in some parts of the gully bottoms. There were a number of post holes within the roundhouse; they were relatively small and several of them appeared to be similar in character, although they were not necessarily contemporaneous with the roundhouse.

The hearth was keyhole shaped and narrowest to the south. It was a maximum of 700mm long, 400mm wide and cut 100mm deep into the subsoil and the edges showed considerable fire reddening. The fill of the hearth contained a clay loam with occasional charcoal. The hearth sides, together with a second fire reddened area, immediately to the east, were sampled for archaeomagnetic dating. The results (see Tarling, below) indicated a date range of 200B.C. to 100A.D. at a 95% confidence limit. The fire reddened area may have been caused by heating of the underlying soil, which mostly appeared to be a thin layer of clay loam containing charcoal flecks, lying immediately above the subsoil.

Fragments of a crucible (473) were recovered from a shallow cut 1m south-west of the hearth. This crucible, used for bronze, is unparalleled (although a number have been found recently at Castell Henllys, Pembrokeshire. Pers comm K Murphy) but would

appear to be consistent with the early Roman period. A glass bead (432) was recovered 300mm south west of the hearth, and could be late Iron Age. In the northern area of the roundhouse a fragment of a glass bead (483), probably Iron Age, and an amber bead (435) were found. None of the beads were securely stratified.

Roundhouse VI

Roundhouse VI consisted of three slight arcs of very shallow and narrow gullies, probably all on the same centre, and from 6m to 8m in diameter. The outer gully was 80mm wide, cut 400mm deep into the subsoil and contained the remains of some stone packing. The middle gully was more substantial, 250mm wide by 100mm deep. The inner gully was not continuous but was a maximum of 220mm wide and 120mm deep. All three gullies contained indications of stake holes within them. A possible interior post hole, with stone packing, was visible at the edge of the excavation. A large proportion of this roundhouse was probably removed by a cut for a platform created for the construction of stone footed roundhouse VIII.

Roundhouse VII

Segments of at least two adjacent substantial gullies of roundhouse VII were found in a test trench, most of the structure having been eroded away beyond the western side of the excavation. The gullies were estimated to have been approximately 9m in diameter and both were cut about 300mm deep into the subsoil. The section suggested that the outer gully may have been re-cut, and the inner gully was later. The inner cut was 550mm wide at the top, with a curved profile down to a flattish bottom 180mm wide; the fill contained a large amount of stone, much of it fire reddened.

The northern end of Trench 4

Three trenches were excavated to the north of roundhouse VII and west of roundhouse VIII. The southern trench was cut from the western section up to and through the footings of roundhouse VIII, and revealed a deep gully or ditch (XI) dug 750mm into the subsoil. The two lower fills were very pale in colour and similar to the subsoil into which the feature was cut, but contained charcoal flecks and a little iron slag. The fill above these was a very dark soil with charcoal flecks; radiocarbon determination on this charcoal gave a result of 2120 ± 70 B.P. (Beta-124345). A sherd of oxidised wheel-thrown pottery, a bronze socketted axe or chisel (464) and some burnt bone were also recovered from this layer. A post hole was probably cut through the eastern edge of this dark fill but then disturbed when the footings for roundhouse VIII were constructed.

Gully XI appeared to continue into the middle trench but was not excavated. Its upper fill was cut by a clay-lined pit, pre-dating the footings of roundhouse VIII. In the middle and northern test trenches were the remains of the edge of a metalled surface of pebbles, lying within a hollow, possibly with a small gully running along its south-east edge. This pebbling may have extended into the area of the southern trench but, if so, was very fragmentary.

At the extreme northern end of the excavation area there were a number of shallow post holes and a gully cut into the underlying subsoil. These features were sealed by a metalled trackway consisting of a layer of pebbles. Only a small section of this layer in the western half of the trench was removed and the underlying features did not form part of any recognisable structure. On the south side of this metalling was a gully running parallel to its edge which appeared to be contemporaneous. A fairly substantial post hole with packing was located two metres to the south.

Sealing the gully, post hole and earlier trackway, and extending in a wider band to the south, was a later layer of pebbled metalling. Both of the metalled areas appeared to be aligned upon the fort entrance between the inner banks, to the north east. These trackways probably continued outside the eastern end of the outer defences where the cliff edge has eroded, as there appeared to be a layer of pebbling below a hedge bank near the outer defences (Illus. 2).

In the far northern corner of the trench there was another possible pathway made up of large flat stones, although these could be the result of tumble from the inside of the rampart. No further excavation took place at this end but this possible pathway lay immediately above artificial deposits.

Roundhouse VIII (Illus. 15 and Illus. 16)

Only a small section of roundhouse VIII lay within the excavation area but its outline could be traced in the grass to the east. The roundhouse was constructed on a platform created by the cutting in of the slightly higher ground to the south and the probable re-depositing of this excavated material towards the north. The northern section of wall, laid on the built up material, was more substantial; the southern, thinner section, constructed on the platform cut acted partly as a retaining wall against the slight rise in the ground.

The walls were constructed of soil-bonded stones and, where larger facing stones had been used, survived mostly as one course high, *c.*400mm. However, in one section smaller stones had been employed for the face and here the wall stood four courses high. There was only a small amount of tumble around the wall, which suggested that it had not originally stood much higher than its present level. The external diameter was about 9.5m and the maximum width of the wall was 1.4m; where it functioned as

a retaining wall there may not have been an outer face. The external face consisted of a series of slightly irregular arcs, whereas the internal curvature appeared to be more uniform. A considerable number of the internal face stones were fire reddened.

There was an entrance on the south-west side of the roundhouse, apparently an original feature, with a step down to the interior which was faced with thin upright stones. There were three pairs of small post holes outside the entrance, probably for a porch. On the northern side of this structure there were other similar sized post holes, possibly rebuilds of earlier phases of the entrance. Extending south-west from the entrance was a hollow, apparently worn, rather than excavated, in the centre of which was a line of flagstones forming a path. The hollow and path post-dated roundhouses VI and VII to the south. A silty fill above the pathway contained a very large nail, the only one found on the site.

Within the roundhouse lay part of a stone-capped drain. The drain cut was only 80mm deep and the base of the cut was not lined, although some parts of the sides were constructed with stone. Both the inlet and outlet lay outside the excavation area; the drain flowed from the southern edge of the interior and across the entrance before turning sharply to the north-east. The capping was formed of well laid, large, flat stones; one massive flat stone had a hole 80mm by 50mm cut through it. This hole did not appear to lead into the drain and the stone may have been reused.

A thin layer of soil containing a large amount of burnt material, charcoal and daub, lay around and slightly over the stone capping, and also filled part of the drain where either there had been no capping or this had been disturbed. A small amount of slag was recovered which appeared to be associated with low temperature smithing. This thin layer was apparently the result of occupation, probably the disturbance of the

underlying material with some additional deposits. A sample of charcoal from this layer gave a determination of 1720 ± 70 B.P. (Beta-124343). The layer also contained twelve fragments of Black Burnished Ware.

Above the occupation layer there was a small tumble of stone and soil against the interior of the roundhouse wall, which contained a sherd of Samian Ware, dating to *c.*160-200 A.D., and two sherds of an oxidised fabric. Following this minor collapse, the interior appeared to have gradually silted up, with little stone in the soil. This would seem to be consistent with the site having been abandoned, although the silt did contain some residual Black Burnished Ware jar fragments. A similar comparable tumble from the exterior wall contained another sherd of Samian Ware, also of *c.*160-200 A.D., but probably not from the same vessel; a sherd of a tankard rim, of fourth century date and possibly from the Severn Valley, was also found (see Webster, below). All of the pottery recovered from the site, except for one sherd from the metalling towards the entrance, came from within or adjacent to roundhouse VIII.

Structure IX

Part of a late circular stone-built feature was located on the low natural bank, towards the southern end of the promontory, above the shaly/shattered stone and soil layer. It consisted of a curving stone wall footing (IX) (Illus. 17), one course high, the northern and eastern sides of which appeared to have been robbed. There was no evidence to suggest that the footing had ever stood much higher. Only a part of the outer facing of large angular stones remained, together with some of the core of shattered grey shale, set on edge; the estimation of diameter, therefore, is far from certain, but appeared to be in the region of four metres, although it may have been much larger. Butted against

the south-west side of the footing there was a linear feature of stones, with a small section of possible wall facing.

Interpretation

There were the partial remains of what appeared to be at least eight roundhouses within the excavated area. The earliest recognisable structure was the gully of roundhouse I; this was partly cut by roundhouse II, which was of a similar size, both in diameter and dimensions of gully. There was no evidence for contemporaneous internal structures within either of these roundhouses. Both of these were single gullied and they appeared to be very similar in construction to the more lightly built roundhouses (IV-VI) further to the north, which had narrow, shallow gullies and some evidence of post packing. There were a number of substantial post holes in the vicinity of roundhouses I and II. While it was not possible, within such a small area of excavation, to recognise any structures (such as four posters etc), these post holes could have been associated with roundhouses without below-ground wall features, as has been suggested elsewhere (Williams 1945, 226). However charcoal from one post hole within roundhouse I produced the earliest radiocarbon determination for the site of 829 to 404 cal. B.C. (SWA-288) at 95% probability and charcoal from another post hole, outside to the south, gave a determination of 787-379 cal. B.C. (SWA-287) at 95% probability and it is likely that the with adjacent groups of post holes these are some of the earlier structural features on the site.

Three shallow pits and an adjacent group of stake holes, possibly a small structure, appeared to respect the perimeters of both roundhouses I and II and the larger roundhouse III. The pits, cut into clay, all held water, and could have been used for indirect cooking; there was little evidence of fire reddening within them, but they

contained a large amount of burnt material. Environmental analyses suggest that the more frequent burnt seeds may be due to waste material being used as a fuel. Charcoal from one of these pits gave a radiocarbon determinations covering a very large range with the earliest date of 762 cal. B.C. and the latest at 202 cal.B.C. (SWA-286) at 95% probability.

Some of the adjacent stake holes appeared to form a horseshoe shape, which could have been the remains of a clay oven, formed on withies. However, there were a large number of stake holes at this location, not necessarily contemporaneous, and a structural form could not be identified with any certainty.

Roundhouse III was very different in form from either those to the south or immediately to its north, having larger wall gullies with less steep sides, and evidence of at least four rebuilds. One of the earlier builds may have had an entrance on the northern side. The much smaller and shallower inner gully, which would only be found on well preserved sites, may represent an internal wall, possibly to provide insulation as suggested by Cunliffe (1983, 98) although, given the very shallow nature of the gullies of roundhouses IV-VI, it may simply be a smaller roundhouse on the same centre. There was an internal post-ring, although it was not possible to associate this with any particular phase of the roundhouse, other than it was probably later than the inner shallow gully. There were also other post holes that were not on the same circumference as the post-ring, but were similar in dimensions; they were probably associated with this structure, possibly for repairs to an ageing roof (pers comm P. Bennett), although they were not necessarily construction features.

The radiocarbon date of 760 to 635 cal. B.C. and 560 to 175 cal. B.C. at 95% probability, obtained from the southern gully of roundhouse III, appeared to be from

the post packing of the latest phase of the roundhouse. However there was no correlation possible between the southern part of this roundhouse and the northern gullies, the later part of which cut the later builds of roundhouse V. The sample (Beta-124344) was taken from a single 15g lump of charcoal that could be residual, given the amount of charcoal fragments around on the site, and it is suspected that a later date for the feature from which the sample was obtained is more probable.

The roundhouses IV, V and VI further to the north were all constructed on narrow ring gullies and were only partly excavated, but all appeared to have at least three wall phases. Stake holes within some of the gullies suggested that the wall construction may have been of wattle. There were substantial post holes associated with the circumference of roundhouse IV and a possible entrance to the west. The small horseshoe shaped feature X may have been the footing for a wattle structure and possibly associated with the entrance. Roundhouses IV and VI did not appear to be contemporary as their projected circumferences overlapped, although their relationship could not be determined within the excavated area. The western roundhouse V was later than IV, but both could have co-existed with the smaller builds, at least, of III.

Within roundhouse V there was evidence of considerable activity. The keyhole shaped hearth may have been associated with the area of reddening to the east (Illus. 11). The crucible (473) and glass bead (432) were both found nearby and, although not necessarily associated with the hearth and burning, were consistent with the late Iron Age-early Roman date obtained by archaeomagnetic dating. The glass bead fragment and the amber bead could not be associated with any features.

Roundhouse VII and roundhouses IV-VI appeared spatially to be respecting each

other; without clear dating evidence or stratigraphic relationships this could not be clearly established. There were at least two phases of construction of roundhouse VII, and the gullies were of similar shape and size to the large roundhouse III, which was thought to be of late construction. Only a small sector of the building was excavated and its relationship with gully XI seen in the trench to the north was not tested, but the roundhouse was thought to be later than the gully. As the porch for the stone footed roundhouse (VIII) to the east cut/overlay it, roundhouse VII is either pre-Roman or, at the latest, early Roman in date.

Gully XI was too large to be a roundhouse construction gully, and was more probably a drainage feature. Only a short segment was excavated, however, and it was not necessarily a linear feature. Its lower fills appeared to be re-deposited natural, but contained occasional slag fragments, possibly being deliberately backfilled not long after excavation. Analysis of the slag indicated smithing activity and was also suggestive of higher temperature processes such as welding (see Young below); a small clay lined pit in the next test trench to the north may also have been associated with this activity. The pottery sherd recovered from the upper fill of gully XI, although undiagnostic, is wheel thrown and could date from the first to the fourth centuries; however the radiocarbon determination of 360 to 280 cal. B.C. and 250 to 100 cal. B.C. (Beta-124345) at the 95% probability level is earlier than the deposit. The reason for this discrepancy is thought to be because the charcoal recovered for sampling was in small fragments or flecks and probably redeposited. It is possible that the upper layer was deposited to fill up the remains of this gully immediately prior to the construction of the stone footed roundhouse VIII.

The post holes and gully, located on the west side at the north end of the trench, were

probably part of a number of larger, complex features that may well have extended under the unexcavated part of the earlier metalling. This metalling appeared to be leading westward from the entrance towards an area of the site which has now been eroded away. The later metalling was much wider and appeared to curve around roundhouse VIII, but again may have been leading to a part of the interior lost to erosion. Outside the fort, below a hedge bank on the cliff edge, there was a layer of pebbles which appeared to be a continuation of a metalled trackway running down from the inner entrance. If this was so, it might suggest occupation of a more than intermittent nature; such effort would not appear to be worthwhile for sporadic use (Harding 1974, 68). However, metalled and elaborate entrances may have more to do with status than practicality, and there was no evidence for any substantial wear on the surfaces.

A layer of shaly/shattered stone and soil extended over most of the excavated area (except roundhouse VIII), and possibly represented occupation build-up or disturbance. Most archaeological features could only be defined after this layer had been removed, except in a few places where some stones from lower features appeared through it. There were a number of animal disturbances into this layer. Above this "occupation" layer was a nearly stone-free layer which appeared to be a natural build-up after the site was abandoned.

Only a small sector (approximately 25% of the wall and 15% of the interior) of roundhouse VIII was excavated, and consequently few overall conclusions can be made. However, a considerable amount of effort appears to have gone into its construction, a platform having been created on the slope before building the walls with good stone faces and rubble core. The porch on the south-west side appears to be

an original feature, although the flagstone path out from the centre of the porch appeared to have been laid after the development of a worn hollow.

No evidence was found for the date of the drain inside roundhouse VIII, and it may have been much later than the original construction. The drain's purpose is unclear, but may have been to remove small amounts of groundwater from the southern end of the interior of the roundhouse, which had been cut into the subsoil. There were indications of much burning within the roundhouse and fire reddening of the inner wall face, suggesting a possible conflagration.

The wheel-thrown sherd from gully XI, below the hollow, indicated that this roundhouse could not have been constructed until the Romano-British period. All other pottery from the site was, with one exception, from within, or adjacent to, roundhouse VIII and was deposited after its construction. The pottery ranged in date from the first to the fourth century, and was supported by the radiocarbon determination, taken from a very large fragment of charcoal which was unlikely to have been redeposited. Pottery in the tumble from the wall dated into the fourth century. The stratigraphic evidence suggested that roundhouse VIII continued in use until the site was abandoned.

Structure IX would appear to have been too small to be a typical Iron Age/Romano-British roundhouse, although the diameter was calculated from only a very small section; stratigraphically this feature must be later than most of the occupation on the site, as it lay above the shaly/shattered stone and soil. The structure was possibly a very small roundhouse of cell-like proportions, and could represent a phase, or re-occupation, later than the mid-Roman period; it could be contemporaneous with the other stone footed roundhouse VIII. It may, however, belong to a period after the

abandonment of the fort, possibly even being as late as post medieval in date; this feature was on the highest present-day point of the fort's interior and could perhaps have been an observation tower. It may also be the feature reported by Warburton (1944) which he described as the remains of a 13 foot cattle pond (*pound*?) 'on the summit'. The stone linear feature on the south west side may be the remains of a straight wall footing, although it could simply be a spread of wall tumble.

Flint: assessment

Dr Andrew David

These were recovered as scattered residual finds, except for a concentrated area towards the southern end of the promontory.

There were 206 lithic items altogether, all but four of which were flint. At least 16 were natural or unmodified and these, along with 24 flints smaller than 10mm, are not included in the following commentary.

Of the remaining worked flints, most, 136, are un-diagnostic flakes or fragments of flakes. In addition there are three blades, a bladelet fragment, two bladed cores, eight core fragments, three flaked lumps, and one miscellaneous fragment. Two pieces had coarse retouching.

There are six tools. Four of these are 'denticulates', one 'end-tool' and two microlith fragments. All these fall within the suite of tool types familiar from surface lithic scatters along the western Welsh coast, and in the Solva area in particular. By analogy with material from other sites, and especially with the collection from the Nab Head Site II (David 1990), these are likely to be late Mesolithic and are probably residual on the promontory fort. There are no items of distinctively earlier or later appearance.

The non-flint pieces may all be natural and unworked. However, one piece from the "occupation" layer on Trench 4, although unworked, could be a fragment from a 'bevelled pebble', another common tool in late Mesolithic coastal assemblages.

Amber

Nina Crummy

An annular amber bead (435; Illus. 18) was recovered from the northern part of roundhouse VIII while cleaning the general occupation layer, but was probably associated with a feature that could not be distinguished from it. It was found complete, but now cannot be fully reconstructed from the fragments into which it shattered immediately after excavation. External diameter 19 mm, thickness 4 mm.

Amber, a fossil resin, is primarily sourced from submarine deposits around the coast of the Baltic. It was prized in antiquity not only for its appearance but also for its electrostatic qualities, which must have appeared magical. It was traded extensively in Europe from the Bronze Age (Cunliffe 1994, 327, 350, 440), but may not only have reached Britain by overseas trade, for occasionally raw lumps of amber can be washed up on the East Anglian coast (Shepherd 1985, 204). Amber objects, including dagger pommels and cups, are found as early as the early Bronze Age in Britain (e.g. Fox 1964, 75-7, 81, pls 33, 35). Deep collars made of amber beads and spacers are in Bronze Age southern Britain a characteristic form of jewellery matched by similar collars of jet in the north (Shepherd 1985, 213; Johns 1996, 26), though examples were also found as far north as the Orkneys (Clarke *et al*, 1985, 282).

By the second century B.C. the trade in amber on mainland Europe was at least partially under Roman control, passing from the north through Hungary and the

colony of Aquileia to the Mediterranean (Cunliffe 1997, 220). Annular amber beads make only a sporadic appearance in Iron Age Britain, but whether this paucity was a direct result of the highly organised trade with the Mediterranean countries is uncertain. Three were found at Danebury, one in the grave of a female (Cunliffe 1984, 396-7; 1993, 97-8); and one in the grave of a young female with a new-born child at Kirkburn, East Yorkshire (Stead 1991, 93). Stead suggests that the recovery of single beads in graves may indicate that they were used as ear-pendants. It may equally reflect great value. Amber is rare in Wales, with only two other pieces being recorded from the Iron Age, both from west Wales (David 1998, 95).

When and how the Solva bead reached St Bride's Bay can only remain uncertain. Though direct and recent trade is the perhaps most likely, the possibility remains that it was of some antiquity when deposited, and may have been an heirloom, or even recycled from a much larger and earlier object. It would certainly have been highly prized.

The counters

Nina Crummy

Disc-shaped counter (433; Illus. 18): Possibly from the general occupation layer but more likely from fill of roundhouse II gully. Well worn disc-shaped counter of brownish shale, slightly chipped at one point on the edge. Diameter 19.5 mm, thickness 3 mm. The very flat surfaces indicate that this is a deliberately-made counter, not the opportunistic use of a natural shape, and the flat edge shows that it was brought to its circular form by the abrasion of a roughly-shaped original, a

process paralleled by the production of counters from recycled pot sherds, broken tiles, and stone veneer (Crummy 1983, 93-4).

Conical counter (442; Illus. 18): Unstratified (spoil tip). Highly polished jet, with part of the edge broken off. Convex to conical in section, with a flat base and bevelled edge, diameter 19.5 mm, height 6 mm. Just to one side of the apex of the upper surface is a small flat patch that lacks the polish of the rest of the surface. Cut into this patch is the characteristic ring and dot of a spur centre from a pole lathe. The edge is faceted, and the upper surface is also very slightly faceted, though the facets are obscured by the high polish.

Disc-shaped counter (445; Illus. 18): From general cleaning of the headland area and probably from within roundhouse II. Well worn disc-shaped counter made from the local dark grey shale. Diameter 25 mm, maximum thickness 3.5 mm. The shape appears to be produced entirely naturally, the edge being either gently tapered or smoothly rounded. Any adaptation of the form would have resulted in a flat edge, as seen on 433 above. Part of one face has flaked off, almost certainly the result of natural erosion before the piece was used as a counter, and still shows as a dark un-abraded streak across the face. This same face bears an incised flower, faint, but neatly-executed.

Three counters, all very different, were recovered from Trench 4. One is a disc of the local shale, and fits into the Iron Age and later tradition of manufacturing counters by first forming a blank from a piece of stone, a pot sherd, or a fragment of tile, and then grinding the edge to remove the major areas of roughness without necessarily working it to a perfect circle. The other two may not be counters, but their size and shape suggest such a functional attribution.

One is also disc-shaped and shale, but in this case appears to be a naturally produced pebble. However, on one face is incised a simple depiction of a flower. The design of the flower can best be described as 'naif'. It has four sub-circular petals around a circular centre, a short stem, and two more or less ovate leaves rising from the base of the stem. It is the flower drawn by, and for, all young children: '..... there were flowers, each with a couple of green leaves. They grew individually, dotted around the rolling green' (Pratchett 1996, 202). It is both simple and naturalistic, and cannot be matched to any of the forms, motifs or patterns of Celtic design (Kilbride-Jones 1980, 39-67), nor be found in the repertoire of, for example, Roman wall-painters (Davey and Ling 1982, 44) or mosaicists (Rainey 1973, 171-91). The design is today a base line of artistic expression, and is best therefore viewed as an equal base line from an earlier culture, without attempting to place it within a Celtic, Roman, or Romanised Celtic artistic tradition.

The other is a more or less conical piece of jet, not dissimilar in shape and size to the shale and jet buttons of the Bronze Age (Shepherd 1985, 208-9). Its identification as a counter is not certain. It bears a lathe-centre mark near the apex. Jet, like amber, has been a prized material since prehistoric times, and its electrostatic properties were well known. In Britain the main source is Whitby on the North Yorkshire coast. Other dark fine-grained materials with a close resemblance to jet were also exploited in antiquity, notably Kimmeridge shale, lignite and Cannel coal, but all were suited to being worked on a pole-lathe. Analysis, undertaken by Phil Parkes of Cardiff University, revealed the distinct phases on the scanning electron microscope image which are characteristic of Cannel coals (Davies 1993), and would suggest that the object is manufactured from a Cannel coal rather than jet.

A frequent process employed in the manufacture of jet and shale jewellery was to use the lathe to cut out first an armlet, and then make spindle whorls or beads from the waste inner disc removed during the operation. The lathe-centre mark on the Solva piece suggests that it, too, originated in this way, while the facets on both edge and upper surface indicate that it was finished with hand-tools.

Any number of the naturally rounded and polished pebbles on the site may also have been used as counters, but cannot be confirmed as such by any sign of working or use.

Board games using counters were a popular form of recreation among both the Celts and the Romans. A set of glass counters and fittings for a board were found in a rich La Tène III grave at Welwyn Garden City, Hertfordshire (Harden 1967, 14-16; Stead 1967, 19, 31-6), and two native British graves dating to the immediately post-conquest period at Stanway, near Colchester, Essex, each contained a set of glass counters and board fittings (Crummy 1997, 66, 68). Irish epic narratives, committed to manuscript in the Christian period, are often taken to represent the much earlier pre-Christian Celtic society of the oral tradition. Fraught with dangers though this approach may be, it is worth noting in particular the references to the board game of *fidchell in The wooing of Etain* (Gantz 1981, 52-3). Furthermore, in the medieval Welsh *The Dream of Rhonabwy*, a story attached to the *Mabinogion* that deliberately looks back to an earlier heroic age, the action centres around a series of games of *gwyddbwyll* played between Arthur and Owein, son of Urien (Jones and Jones 1970, 145-50). The game-boards in both the Irish and Welsh texts are described as silver and the pieces as gold, in each case a poetic device used both to reinforce the high status of the protagonists and to enhance the atmospheric web of wonder spun in the telling of the story. However, combined with the earlier archaeological evidence, the picture appears of a

warrior society where skill at board games was a recognised talent, and could be combined with gambling for high stakes.

The games are likely to have been of the race, strategy, or hunt varieties, new versions of which would have been introduced by the Romans during the conquest of Britain. Game counters of glass, bone, pottery and stone are ubiquitous in Romano-British military establishments and civilian settlements (e.g. Allen 1993, fig 22, 18-20; Pitts 1985, 34), indicating that playing board games was by no means confined to an elite. How far the random scatter of counters found on sites such as Solva can be related to the playing of board games either before or after the Roman conquest of south-west Wales is uncertain, but it certainly suggests that among the tribes the practice was also not confined to a wealthy elite.

Glass beads

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Remains of three beads and a cluster of at least six beads were recovered (Illus. 18)

(Diam.= diameter; Perf.= perforation; rec.= reconstructed)

431. From a hearth deposit, possibly associated with the construction phase of the inner defensive bank. Approximately half of a small, irregular, flattened globular bead of faintly translucent dark/sky blue glass; metal contains many small bubbles, causing some small holes visible on the surface of the bead and on the fractures.

Height= 4.3mm Diam.= 7.4mm Perf. 1= 2.8mm Perf. 2= 3.0mm

432. From close to the hearth within roundhouse V, found in cleaning of the general occupation layer. Complete, flattened globular bead of faintly translucent ultramarine

blue glass; the bead is irregularly wound, causing a difference in height; the surface of the bead shows two small indentations which are probably flaws in the production of the bead.

Height= 4.8-5.5mm Diam.= 9.5mm Perf. 1= 3.8mm Perf. 2= 3.9mm

Bead clusters 452 and 453 originally formed one cluster of at least six fused beads. They were found 250mm apart, possibly from the fill of a third outer gully for roundhouse IV, but recovered while cleaning the general occupation layer.

452A. Complete, flattened globular bead of faintly translucent dark/sky blue glass similar to 431; irregularly wound causing a difference in height; slightly heat-affected and fused to 3.2B.

Height= *c.* 3-3.7mm Diam.= 7.1mm Perf.= 2.9 mm

452B. Probably complete, partially molten and deformed globular bead, or possibly two beads, of faintly translucent dark/sky blue glass; fused to 452A.

Diam. reconstructed= *c.* 7-8mm

452C. Approximately half of a flattened globular bead of apparent translucent reddish glass, which - when looking at the fractures - is actually made of a translucent pale blue matrix coloured red by bright opaque reddish streaks; joins with 453B.

452D. Small part of a, probably flattened globular, bead of faintly translucent brownish green glass; fused with small part of 453C.

453A. A complete, flattened globular bead of faintly translucent sky/dark blue glass; slightly heat-affected and deformed.

Height= *c.* 4mm Diam. reconstructed= *c.* 7mm

453B. Approximately half of a flattened globular bead made of a translucent blue matrix coloured red by bright opaque reddish streaks; joins with 452C.

Height= 3.9mm Diam.= 7.2mm Perf.= 2.8 cm

453C. Almost complete, flattened globular bead of faintly translucent brownish green glass; small part missing (see 452D), light iridescence on fracture, slightly heat-affected.

Height= 3.5mm (min.) Diam.= 6.9mm Perf.= 2.5 mm

483 (not illustrated). Recovered during cleaning of the general occupation layer, situated in the northern part of roundhouse (V). A small part of a globular bead of faintly translucent, turquoise glass with some small bubbles (appearing as bright spots in the matrix/on the fractures).

Height= 5mm (min.) Diam. rec.= *c.* 7mm Perf. 1 rec.= *c.* 3.5mm Perf. 2 rec.= *c.* 3.5mm

2. Chemical analysis (X-ray fluorescence analysis)

The technique

The glass beads from the site were chemically analysed using energy-dispersive X-ray fluorescence spectroscopy. The Philips system in the Department of Archaeology, Nottingham University incorporates a 50 K.V. X-ray tube with rhodium anode, a 2.5mm collimator and a lithium-drifted silicon detector. The system was run at 30 K.V. under vacuum for 30 minutes to produce the series of qualitative analyses that were used as a basis for the following discussion.

Compositional characteristics of the beads

431. This cobalt blue bead is of a soda-lime-silica (SLS) composition. The bead has been coloured with a cobalt-rich mineral, the cobalt being associated with zinc and copper oxide 'impurities' - and probably ferric oxide. Ferric oxide may also have been introduced as an impurity in the sand source used. Judging from the cobalt oxide to

iron oxide ratio the type of cobalt is likely to be that used after the second century B.C. (Henderson 1991); in other respects the colour and shape of the bead fits a date of the second century B.C. or later. The lead oxide levels of between 3 and 5% however strongly suggests a Roman date because such levels have not been found in glass of Iron Age date that have been analysed. Nevertheless a late Iron Age date for the production of the bead cannot be entirely ruled out.

432. Cobalt blue of a SLS composition. The ratio of copper oxide to zinc oxide is very similar to that found in 431, so the cobalt used may be from a similar source. However, the detection of less than 1% lead oxide shows that the glass was certainly melted at a separate time from that used to make 431. This could be of late Iron Age production date judging from the cobalt and its associated impurities.

452A. A cobalt blue bead of a SLS composition with a relatively high lead oxide impurity level of between *c.* 5%. The presence of lead oxide suggests that this is a Roman product (Iron Age glass invariably does not contain such high lead levels). Again the use of cobalt as a colorant has introduced impurities of iron, copper and zinc oxides.

453A. The translucent cobalt blue glass bead contains slightly elevated potassium oxide levels above the general levels detected in Iron Age glass (*c.* 0.5-1.0%) so this glass bead may have been made using a slightly different alkali source from that used during the Iron Age (Henderson 1985). The iron to zinc oxide ratio in the glass suggests that a similar cobalt source to that used to make 452A has been used. The bead also contains between 1% and 2% lead oxide which suggests a Roman date of production, which agrees with the excavation date.

452C / 453B. This colour of glass is by far the most unusual of those found at Porth y Rhaw. It is translucent pale blue with streaks of opaque red glass running through it. It is of a SLS composition and again contains c. 2-3% lead oxide. The glass contains a relatively high level of manganese oxide, but the colours are due to copper in the presence of reduced (ferrous) iron. The translucent blue colour in this case is not caused by cobalt but by ferrous iron ions in the glass - it results in a much weaker blue colour than that produced by cobalt oxide in a soda-lime environment. The iron oxide would have helped to generate a reducing atmosphere which, in turn, would have helped to develop the opaque red colour caused by cuprous oxide crystals. The glass is also different from the other Porth y Rhaw glasses because it contains a higher potassium oxide level. This may possibly be due to the presence of an alkaline feldspar impurity, or alternatively, and more likely, a slight change on the source of the alkali used. No beads of Iron Age date produced using this technology are known. The technology is again consistent with a Roman date of production.

452D. This small fragment of bead appears to be of a 'black' colour, but is in fact a deep translucent brownish-green colour. Like the other beads it is of a SLS basic composition. The colour is caused by the presence of high iron oxide (ferrous) level which is associated with a trace of lead; it also contains copper and zinc oxide. Judging from this range of metallic components it is possible that a small amount of metal slag has been used in colouring the glass. The glass contains traces of antimony trioxide. A slightly elevated potassium oxide level may have been introduced as part of the slag, if used. Like 452A, based on the compositional characteristics, the production date for the bead is liable to have been Roman.

453C. An almost complete 'black' deep translucent brownish-green bead which contains traces of lead oxide, copper oxide and zinc oxide and may (like 452D) therefore have been coloured by using a small amount of metal slag. A relatively elevated level of potassium oxide may have been introduced as part of the slag, if used.

483. A translucent turquoise SLS glass with a low lead oxide impurity level. The colour is caused by cupric oxide (as opposed to the reduced form of copper oxide-cuprous oxide - which has been used to colour 452C/ 453C) associated with an impurity of iron oxide. Compared to the other beads analysed this glass contains relatively low impurity levels. Indeed the low titanium dioxide level detected is in contrast to the relatively high levels detected in the other beads analysed and could indicate that a different sand source was used to make this bead (Henderson 1985). This bead has a typical Iron Age composition.

Small (flattened) globular beads of translucent blue glass (421, 432, 452A and B, 453A) are very common in the Roman period and can still be found in fifth-sixth century necklaces. They are also known from a few native sites of earlier Iron Age date, for instance from Meare Lake Village, Somerset (fifth to second century B.C.), from 'Loughey', near Donaghadee, Co. Down where they formed part of a first century B.C. - first century A.D. necklace and from a galleried wall-fort at Dun Ardtreck in Skye (first century B.C. to first century A.D.); these fall into Guido's (1978) Group 7 (iv). Chemical analyses support a Roman date for the beads, although an Iron Age date is possible for 432 (and cannot be entirely excluded for 431).

Beads of translucent turquoise glass, on the other hand, are not very common during the Roman period. They are more frequently, although not commonly, found in late

Bronze Age and Iron Age contexts, e.g. annular beads from Rathgall, Co. Wicklow (Ireland) of a late Bronze Age date (Raftery and Henderson 1988) and an annular bead from Meare Lake Village of an early Iron Age date (Gray 1966). Chemical analyses indicates that the Porth y Rhaw bead (483) is of a typical Iron Age composition, rather than the very different late Bronze Age composition of the Rathgall beads.

The beads in the clusters (452, 453) are certainly Roman in date, something which is also supported by the chemical analyses of the beads. The technique of colouring a bead by introducing coloured streaks in a translucent matrix is not a common Roman technique though (452C, 453B) - and has not been found in Iron Age glass. It was once observed by Y.S. in three large globular beads (with matrix of colourless/pale blue glass coloured by streaks of white, green, grey-blue and purple/reddish glass) from the early Roman harbour-fort at Velsen (Velsen I, prov. North-Holland, The Netherlands) which is dated between *c.* 15 - 30/39 A.D. (unpublished data).

Bronze

Dr C S Briggs

A bronze wedge-shaped object 464, was found in context 1209, from the upper fill of gully XI below the footings of roundhouse III. It measures 50mm long by 37mm max width and weighs 29-30gms. It was originally about 10mm in section, but the thickness is now increased by some 3-4mm due to heavy corrosion incrustation. Virtually the entire object is covered in a heavy oxidation product, leaving little original surface visible, and making it difficult to conjecture its precise shape. A notable feature of this corrosion deposit is a significant iron content, presumably the result of panning through impeded drainage in the surrounding soil.

At first sight this artefact appears to be like a much degraded Late Bronze Age socketed axe. The section drawing (464 Illus. 18) is of limited value in this regard, since it shows implement section complete with crust. Without this extraneous material the wider, outer, edge looks more convincingly like a cutting blade. There is more than a passing resemblance here to the type of small bag-shaped axes (Evans 1881; fig 170, p.139), some of which characterise Late Bronze Age Irish hoards (Eogan 1983), some British (Coombes 1975) and some Breton forms (Briard 1965). This bronze derives from a deposit which has yielded a radiocarbon date of 2179 ± 70 B.P. (Beta-124345) which calibrated to 385-20 B.C. at 95% probability, but was found with a sherd of Romano-British pottery.

It is generally believed that most types of Late Bronze Age implement did not survive in use as late as this. However, although they were supposedly abandoned during the period *c* 750-500 B.C., little is understood of what kind of tool actually replaced the Late Bronze Age repertory. Indeed, not only is the literature silent about the technological developments which happened during the continuum after *c*500 B.C., but if the accredited dating of the finds is to be accepted, so far, at least, the record from excavation can only be described as having been coy.

There seem to be at least three alternative explanations as to why this artefact occurred in such a late context. First, the artefact may be a genuine Bronze Age loss, and is residual. Secondly, its occurrence in a later content could be due to the bag-shaped axe having been handed down and used beyond its generally accepted continuum. The third explanation is that this really is a more recent and entirely different kind of artefact, for which it is at present difficult to find parallels. There is a possibility that metallographic analysis (Northover 1980) might assist a better understanding of this

problem, though, so far, much analytical work has been interpreted in a vacuum of ignorance as to ore types, casting methods and the effects of cold-working on some of the tools (Briggs and Williams 1995).

The only other bronze recovered was two globules from the hearth in the inner defensive bank and, in the layer above, a 20mm long rod, 2.5mm diameter, possibly with three incised lines. However this last object was found very close to the topsoil and could be modern.

Iron

(Not illustrated) There were very few potential iron objects, all were X-rayed and cleaned. Two pieces appeared to be pins from buckles or brooches: one was complete and was from above or in the fill of a later gully of roundhouse III; the other was incomplete and was located in the northern part of roundhouse V. A large iron nail, 83mm long, its tip missing, was recovered from the porch area of roundhouse VIII; it had a square tapering cross section and probably had a square domed head. There was also part of another probable nail and three small unidentifiable objects.

Stone

Spindle whorl (438; Illus. 18): Probably made from local stone. Diameter 25mm; thickness 4mm. The upper surface is smooth, either trimmed or polished; the underside is rough and uneven, suggesting that the disc has broken laterally and is incomplete. The upper edges were rounded and the sides of the perforation slope inwards from 7mm to 4mm. The dimensions of this object, even at the probable original thickness, indicate that it must have been used for the production of very fine thread. Found in fill of shallow inner gully of roundhouse III.

Spindle whorl (441; Illus. 18): Slate. Irregular in shape, with one roughly curved side, two tapering straight sides and one smaller uneven side. Diameter 45-50mm; thickness 3mm. Perforation semi-oval, 6 x 10mm with smooth, curved upper and lower edges, indicating that this hole was probably drilled, rather than punched. On one face there were slight traces of three to five radial lines, possibly intentional. Found while excavating general occupation layer.

Spindle whorl (444; Illus. 18): Manufactured from a fine grained buff stone, slightly reddened, probably by fire. Diameter 43mm; thickness 15mm. Perforation 6-7mm in diameter, slightly inclined and off centre. The outer edges are rounded and the object appears to be well made. There was one chip out of the outer part of one face. From packing of post hole near southern end of the promontory.

Spindle whorl (462; Illus. 18): Of local mudstone, irregular in shape, upper edges curved. Diameter c.50mm, thickness 7mm. Perforation from 3mm to 8mm on surface and bored from both sides. From fill of early inner gully of roundhouse III.

There were five broken crudely made probable spindle whorls of local slate/shale stone (not illustrated). One fragment of mudstone may have a deliberate notch cut in it (not illustrated). There are a number of beach pebbles of varied sizes on the site, but of indeterminate purpose. These could be possible slingshots or pot boilers and the larger ones may have been used as tools; some good-sized beach pebbles, often with a broken end, could have been hammer stones.

Pottery *(following comments by Peter Webster)*

A total of 88 sherds or fragments were found; some of the very small fragments were recovered from sieving. All the pottery came from the later phases of the site and

some will have been residual. The date range is from the first to the fourth centuries A.D. and the majority of the sherds were Black Burnished Ware. The pottery has only been assessed and a full analysis was not undertaken. The earliest fabric was a sherd (object 455) of Calcite Gritted pottery of probable Iron Age /first century A.D. date, although it could be late Roman and came from the general occupation layer of shaly/shatttered stone and soil. There were two sherds (objects 457 and 477) of Samian Ware from Central Gaul, both form 31, probably not the same vessel, dated 160-200 A.D. These samian sherds were recovered from the wall tumble inside and outside of roundhouse VIII. In addition there were: three un-diagnostic sherds of oxidised ware (objects 458, 465 and 467), from above the floor in roundhouse VIII, the upper fill of gully XI and from the wall tumble in the roundhouse, respectively; a grey sherd containing a lot of mica from a jar, Roman, from the very upper fill of gully XI which was probably backfilled immediately prior to the construction of roundhouse VIII; one sherd (object 456) of Oxford Colour Coated mortaria, 240-400A.D. from just below the general occupation layer outside roundhouse VIII and just north of the porch; a sherd (object 478) of a Severn Valley jar, datable to almost any period, from the wall tumble outside roundhouse VIII; and a sherd (object 479) of orange buff fabric with a thin grey core, a tankard rim, possibly from the Severn Valley (Webster 1976 No 44), of fourth century date, again from the wall tumble outside roundhouse VIII.

Much of the Black Burnished Ware was not diagnostic but there were sherds from several identifiable forms. These included: sherds from a dish (object 439), probably later second century A.D., decoration similar to Gillam 1976 No 5 (late second century) from cleaning over wall of roundhouse VIII; another bowl with looped

decoration (object 450), mid to late second century (probably not the same as the late second century dish) again from cleaning over wall of roundhouse VIII; a shoulder of a jar (object 482), third or early fourth century, from wall tumble outside roundhouse VIII; part of a jar wall with decoration of obtuse angle lattice below double horizontal line, similar to Gillam 1976 Nos. 12-14, fourth century (from context 1236), from above the porch floor of roundhouse VIII; and a sherd from a jar, with decoration of obtuse angle lattice, late third or fourth century (from context 1305), from the fill of the drain in roundhouse VIII.

Metallurgical residues from Porth y Rhaw, Dyfed

Dr Tim Young

Summary

Material was submitted from 19 contexts. These contexts divided into five groups, one group including the general occupation deposit and unstratified material, but with four representing discrete stratified settings: (1) Iron Age features, (2) contexts associated with a furnace or hearth, (3) a post hole near the entrance, and (4) deposits of second century A.D. date mainly associated with roundhouse VIII. These four settings yielded correspondingly discrete assemblages of metallurgical residues. The Iron Age deposits yielded three fragments of a dense grey slag derived from a smithing hearth cake. The furnace-associated features contained three sherds of a metallurgical crucible (a single sherd was also present in the general occupation deposit), and one of a probable crucible lid, together with some small fragments of smithing slags. The post hole contained a considerable quantity of smithing slag cake fragments, together with material from the furnace wall. The deposits associated with

the roundhouse contained fragments of vitrified clay, probably from the wall of a metallurgical hearth.

The crucible contained traces of a tin oxide-rich material (both internally as a slagged residue, and as tiny blebs [sic] up to 50mm across on the external vitrified surfaces of the crucible), representing a decomposed tin bronze, from which the copper had been largely lost by dissolution. The decomposed nature of the metal blebs means that no determination of the original metal composition was possible. Concentrations of copper were, however, significantly high to suggest that the crucible had been used for melting bronze rather than tin itself.

The crucible fragments were tantalisingly incomplete, but appear to be of a form without exact parallel elsewhere. The crucible appears to have been of roundedly triangular shape, with one extremely thickened angle, leaving an almost circular "well". The most likely reconstruction of form would suggest some similarity with the "D"-shaped crucibles representing the development of the native triangular crucible during the Roman period, such as have been recorded from Exeter (Fox 1952) and Sutton Walls (Kenyon 1953) in first century A.D. contexts.

The iron-working slags are typical of the varied slags produced during blacksmithing. They vary in chemical and mineralogical composition, possibly reflecting a spectrum of activity from high (context 1225) to low (context 1251) temperature processes. The total weight of iron-working slags recovered is very small and it is therefore difficult to judge the significance of this activity for the site.

Table 1. Summary of the residue archive

Crucibles

Description

(1) Context 1286

Three conjoining fragments of a crucible were recovered from context 1286 (object 473; Illus. 18). A single fragment with identical form was recovered from the occupation material, context 604. A similar, but much thinner, fragment was in context 1760. Both contexts 1760 and 1286 are associated with the small hearth.

The crucible (object 473) represented by three sherds. The base of the crucible is missing, as is around 40% of its wall. The crucible is rounded, but with slightly tighter curvature at two points giving a slightly sub-angular outline. The wall has a rounded rim, dropping vertically internally, but swelling slightly externally, to give the widest point approximately 13mm below the rim. The surviving piece has one of the slightly angular regions at one end, the other angular region centrally and a substantially thickened area at the opposing end. The unfortunate position of the breakage through this thickened area makes its interpretation difficult. The thickening involves the wall increasing from its typical 10mm thickness, to around 15mm at a point 7mm below the rim. The internal margin of the thickened area is damaged, but appears steep, and continues the curve of the internal face of the wall from the adjacent area of normal wall. The internal well of the crucible is therefore sub-circular, with a diameter of approximately 38mm, a maximum preserved depth of 20mm, and an estimated original depth of approximately 29mm, giving a volume of approximately 26cm^3.

The crucible has a grey fabric bearing quartz grains of up to 4mm. The surface of the crucible is vitrified to approximately 10mm below the rim on the side away from the thickening, but extending to at least 20mm below the rim in the thickened area. The

inner face is also well vitrified to at least 10mm below the rim, but below that is generally covered with a skim of slag, which thickens to 2mm in a few places. The external vitrification is dominantly black in colour, change to a reddish tinge over the top of the rim and on to the internal face.

The area in which the wall starts to thicken is marked by a partly annealed fracture running over the rim, and two further fractures cut the thickened area. A region 16mm wide by 13mm high spanning this second crack forms a flat surface, with a less highly reflective vitrified surface. It is possible that this may represent a mark formed by contact with tongs.

(2) Context 604

A fragment of a crucible similar to that described above. The rim bends markedly along the 15mm length of the piece, suggesting that the fragment comes from one of the subangular bends described above. The inner face appears not to be vitrified, but is covered at least in part by a skim of slag. The external vitrification is red for 5mm below the rim and black for at least 15mm below this.

(3) Context 1760

A small fragment (figure 1, D-E) of similar fabric to the crucible fragments described above, but considerably thinner. The piece has one slightly concave, but almost planar face, showing black vitrification, which turns red near the margin and along the edge of one of the fractured margins. The other face curves around to the margin of the fragment, which is 3mm thick at 3mm from the margin and 5mm at 15mm from the margin. This more strongly curved face appears to be less vitrified. The original margin of the fragment is irregularly curved, with a radius of curvature somewhat larger than that of most of the lip of the crucible (473) described above. The planar

nature of this piece, and the apparently strong difference in vitrification between surfaces, suggests that this may be a fragment of a crucible lid.

Analysis

Several small samples were taken for analysis from the larger crucible fragments:

sample a: a <500mm wide flake of black vitrified surface from the outside of the crucible, for SEM.

sample b: a <500mm wide flake of red vitrified surface from the inside of the crucible, for SEM.

sample c: a <1000mm wide flake of slag from the inside of the crucible, for SEM.

sample d: a <3000mm wide flake of slag from the inside of the crucible, for ICP-MS.

Sample (a) showed a well-preserved vitrified surface. At intervals across the surface lay individual grains, or clusters of elongate crystals of a tin oxide. Individual crystals were needles of up to 20mm in length, and typically <1mm across. These crystals were either isolated, or more commonly randomly oriented within patches of up to 50mm diameter.

The vitrified surface of sample (b) showed an elevated concentration of copper, which is usually associated with the generation of the red colouration. Small particles of an iron oxide were present on the surface, and it is uncertain whether these were associated with the slag phase, or were a component of the crucible clay.

The slag, sample (c), showed a layered structure, with laminae rich in elongate tin oxide crystals alternating with fine grained, probably highly altered, silicate slag. The tin oxide crystals formed needles, typically of up to 100mm and locally up to 200mm in length and 1-10mm wide. A larger crystal gave an EDS analysis, which was

contaminated by slag, but which suggested a composition of >85% tin oxide and 4% copper oxide. The chemical and mineralogical form of the copper remains unknown. The slag material appeared amorphous and was cracked. This appearance suggested a weathering product rather than a primary slag phase, a proposition supported by the detectable quantities of chlorine present in the microanalysis. One larger (approximately 20mm diameter), inhomogeneous metal oxide bleb in the slag gave analysis equivalent to >85% tin oxide with around 5% copper oxide. The slag phase contained very little copper, but did contain a very high level of phosphorus (9% as oxide, corresponding to 4 wt% of the element). Such high levels of phosphorus might be associated with alteration, but are more likely to indicate that the crucible contents came into contact with the fuel (possibly also indicated by the high alkali content).

Table 2. EDS analyses from crucible material quoted as wt% of oxide. The totals of material analysed on rough surfaces is very low, so those analyses should only be used as a semi-quantitive guide to composition. Total is given as a hypothetical value were the tin present as a hydrated oxide. < indicates element below detection. The samples did not contain lead, zinc or arsenic in detectable quantities.*

Discussion

The retrieval of only a part of crucible 473 makes comparison with other examples difficult. There are three possible interpretations for the thickened region of the crucible. Firstly it is possible that this not a deliberate feature, and that the crucible is essentially of a sub-angular form. Although some early crucibles are highly irregular in shape (e.g. some of the Glastonbury examples (Bulleid and Gray 1911)) the degree of regularity of the remainder of this specimen makes this unlikely. Secondly the crucible could be of a pinched form (cf. Tylecote 1986, form D1), but one might have

expected to be able to see an out-turn of the external surface approaching the "handle region", but this is not present. The third, and most likely, interpretation, is that the thickened region represents the thickened elongated corner of a D-shaped crucible (Tylecote 1986, form A3).

The earlier Iron Age (?fourth-fifth centuries B.C.) seems to be typified, at least in western Britain, by cup-shaped crucibles (Old Oswestry, Llwyn Bryn-Dinas, Berth, Danebury); the later Iron Age (first-?second centuries B.C.) by triangular forms (Glastonbury, Gussage, Collfryn, Castell Henllys). D-shaped crucibles are of a shape intermediate between these triangular forms and the circular crucibles common on Roman sites. Tylecote (1986) illustrated the form of these D-shaped crucibles with an example from Sutton Walls (Herefordshire), probably dating to the first century A.D. (Kenyon 1953). The Sutton Walls example has walls which diverge evenly upwards, giving an open shape, markedly different to the slightly inverted rim form of this specimen. A very similar wall profile to the Porth y Rhaw specimen is seen in an example from Exeter, also of first century A.D. date, described as being sub-angular (Fox 1952). Neither the Exeter nor the Sutton Walls examples shows the marked thickening of the Porth y Rhaw specimen, but the Sutton Walls specimen does show some slight thickening.

Thus, although the material is incomplete, and is without exact parallel, it appears to fit best with sub-angular to D-shaped crucibles representing the evolution of the triangular crucible during the Roman period.

The residues on the crucible surface and within the altered remnant of crucible slag were extremely tin-rich. The precise mineralogical phase was not identified, but the material was not tin ore (cassiterite), and was probably an hydrated oxide of tin. The

persistent, if low, quantities of copper present in the altered patches and in the slag strongly suggest that the tin-rich patches are the result of the decomposition of tin bronze, with subsequent dissolution of the copper-bearing weathering products. An extreme example of this process was quoted by Tylecote (1986). The highly altered composition of these residues means that it is not possible to use the absence of arsenic, zinc and lead as a provenance indicator. There is no evidence that the crucible was used for making bronze, rather than for remelting.

The Iron-working Slags

Description

The iron-working slags are all rather fragmentary, so little interpretation can be made of their overall morphology, or the original slag cake size. They are all of moderate density and the specimens were all consistent with identification as hearth cake fragments from blacksmithing. However, the identification of non-ferrous metalworking on the site meant that close analysis of representative material was desirable, in order to confirm the nature of this material. Four specimens from three contexts were examined by electron optical techniques (together with an additional four small specimens from two contexts which were problematic in hand specimen, but which proved to be various natural iron-rich rocks, and which are not described further). A single sample was given a full chemical analysis.

Petrology

Sample e: context 1763 (upper fill of posthole near entrance)

This sample is of a fayalite-wüstite dominated slag. Wüstite dendrites of up to 500mm occur distributed throughout, but are particularly spatially associated with the

abundant, and often large, fragments of hammerscale. Hammerscale is up to 2mm in width and 200mm thickness. The matrix to the dendrites is formed of densely-packed laths (500mm x 20mm) of fayalite (generally with a small amount of Ca substitution). This slag is noticeably richer in fayalite than those from contexts 1225 and 1251. The wüstite is locally altered to and/or overgrown by magnetite.

Sample f: context 1251 (Occupation deposit near hearth)

This low density material proved to be mainly a partially melted fragment of sedimentary rock (probably once an inclusion in a hearth wall). At one end the rock is in contact with a fayalite-wüstite slag, similar to that of sample g, but bearing small grains of hercynite (reflecting increased Al supply from the melting rock fragment).

Sample g: context 1251 (Occupation deposit near hearth)

This slag is dominated by wüstite. It contains abundant hammerscale. Details of the silicate mineralogy are frequently obscured by weathering, but subordinate fayalite is present. Irregular regions may contain grains with a leucite-wüstite eutectic. This sample is much poorer in silicate minerals than those from contexts 1225 and 1763. The decreased significance of the silicate component, plus the abundance of hammerscale, may suggest that this sample was produced during relatively low temperature blacksmithing.

Sample h: context 1225 (IA gully below roundhouse)

This material was grey in colour and rather uniform in hand specimen, in contrast to the darker and more heterogeneous materials from contexts 1251 and 1763. The slag was, however, heterogeneous on a fine scale. It was characterised by the co-occurrence of coarse granular wüstite and magnetite. These granular crystals were up to 150mm in diameter. Wüstite crystals were rounded, and bore rounded cavities; the

magnetite grains were angular and bore planar crevices. Some grains contained both minerals, and there was some indication that alteration and/or superposition of these two phases occurred in both directions. Finer wüstite dendrites also occurred. Fayalite occurred as large laths, possibly up to 1mm in length in some areas, but in others fayalite was seen mainly in tiny late-stage dendrites in the glassy matrix. Leucite (commonly as a leucite-fayalite? eutectic) and hercynite occur sporadically, particularly near the vesicles. The texture of this slag is suggestive of its generation in a higher temperature process (e.g. welding) than that producing the slags of samples e, f and g.

Some limited EDS analysis of sample h was, to clarify the mineral compositions involved (Table 3a-c).

Table 3a. Mineral formulae for EDS analyses of olivines, based on a structure with 4 oxygens (context 1225: sample h)

Table 3b. Mineral formula for EDS analysis of magnetite, based on a structure with 32 oxygens and 16 filled tetrahedral sites. (context 1225: sample h)

Table 3c. Model mineral formula for EDS analysis of glass, calculated as if it were a feldspar with 32 oxygens. (context 1225: sample h)

The initial olivine phase is sufficiently Mg-rich to be a ferro-hortonolite (Fo 14), but the margins are fayalite (Fo 9). The magnetite is very heavily substituted (approximately 13% hercynite, 2% ülvospinel). The glass phase contains most of the Ca, Na, K, S and P. The glass is very low in S (as also were the glasses of the other specimens examined only semi-quantitively), confirming the fuel used was not coal.

Chemistry

Sample i: context 1225 (IA gully below roundhouse)

The composition of a sample of the slag from context 1225 was determined by XRF (for major elements) and by ICP-MS (for minor and trace elements).

Table 4 XRF major element analysis of iron-working slag sample (sample I) from context 1225.

The composition is entirely consistent with these slags being iron-working slags. The low take-up of elements present in the fuel is typical of the dense smithing slag cakes on other sites, in which the composition is determined by partial melting of the hearth wall, and the reaction of that melt with iron and iron oxides from the workpiece.

Discussion

The material studied was typical of early smithing residues. The analytical work undertaken confirmed this interpretation and revealed no evidence that any of these slags was associated with non-ferrous metalworking. The sample size was very small, but the studied slags were extremely varied, suggesting a range of iron-working tasks was being carried out on site. None of the iron slags is likely to have been associated with smelting, and none of the smithing slags need be associated with bloomsmithing. The material from context 1225 did not contain significant hammerscale, but is more likely to be associated with welding, than with any stage of the primary production process.

Archaeomagnetic Results

based on reports (Tarling 1998a, 1998b) by Professor Don Tarling, Department of Geological Sciences, University of Plymouth, Devon

All locations sampled (Solva 1-3) show more scatter than is desirable for accurate dating. This was almost certainly due to minor differential settlement within the site,

amounting to only a few degrees, but sufficient to cause enough scatter to inhibit precise archaeomagnetic dating. All three locations had directions that were statistically the same, at 95% confidence limit, as each other and also consistent with all sites in the range between about 200 B.C. and 100 A.D., although inconsistent with the 800-400 B.C. radiocarbon determination. However, the mean directions are somewhat more consistent with directions corresponding to the first century A.D. It must be emphasised, however, that such an evaluation ignores the errors in the determination and should not be considered to be indicated but NOT established.

Radiocarbon Dating

This site was clearly occupied for a considerable period. There were charcoal flecks in a large number of deposits and it is possible that some of the samples may have been composed of, or included, re-deposited material.

Unfortunately the date range for the Iron Age is necessarily large. However three samples probably associated with the inner bank construction (SWA-101, Beta-124341 and Beta-12432), and two samples from post holes towards the southern end of the remaining interior (SWA-287 and SWA-288), indicate activity within the range of *c.*800-400 B.C. with a suggestion by the intercept dates towards the later part of this range.

One sample(Beta-124344), although indicating a late Iron Age date is likely to be from residual due to associated wheel thrown pottery sherd. The results from another sample (Beta-124343) are however confirmed as probably mid to later Roman period by the associated Black Burnished Ware.

Table 5. Calibration of radiocarbon dates

Environmental Evidence

Astrid E. Caseldine and Kate Barrow

Very little is known about the environment and agricultural economy during the Iron Age and Romano-British period in this part of west Wales (see Caseldine 1990). Samples were therefore taken both for pollen analysis and the identification of charred plant remains to provide information about the landscape and agricultural activity at this time.

Pollen evidence

Two pollen columns and three spot samples have been examined for pollen. One pollen column (563) was from the buried soil beneath the bank and the other (582) was from gully XI outside of roundhouse VIII. The three spot samples were from the capped drain fill of roundhouse VIII (sample 584), the later gully fill from roundhouse III (sample 587), and the 'occupation layer' from roundhouse II (sample 589).

Methods

Sub-samples were taken in the laboratory and prepared using standard procedures (Moore *et al* 1991), including disaggregation in sodium hydroxide, micro-sieving and treatment with hydrofluoric acid because of the highly minerogenic nature of the samples, and acetolysis. *Lycopodium* tablets were added to enable pollen concentrations to be calculated (unpublished). The pollen was mounted in silicone oil and counted using a Leitz Laborlux microscope. A magnification of x400 was used for general counting with x630 or x1000 used when necessary. The pollen sum was based on a count of 300 total land pollens (TLP) but when concentrations were low the count ceased after a count of 500 *Lycopodium* spores had been achieved.

Identification was by reference to modern type material and identification keys, including Moore *et al* (1991), Andrew (1984) and Faegri and Iversen (1989). Diagrams (Illus. 20-22) have been prepared using TILIA and TILIAGRAPH (Grimm 1991). Nomenclature is based on Bennett (1994) and Bennett *et al* (1994).

Pollen zonation

Pollen column 563

The pollen record from the buried soil and overlying bank is very similar and only one pollen zone has been recognised:

PYRS.1 - *Plantago*-Lactuceae-Poaceae.

Pollen column 582

One pollen zone has been identified in the diagram from gully IX but has been subdivided, primarily on the frequency of Lactuceae pollen:

PYRG.1a - Lactuceae-*Plantago*.

PYRG1.b - Poaceae-Lactuceae-*Plantago*.

Discussion

Interpretation of pollen from soil samples must be treated with a degree of caution because of taphonomic problems, including the movement of pollen down the profile and differential preservation. However, certain observations can be made from the pollen evidence. All the diagrams indicate a largely open environment but some differences are evident.

The record from the pollen column from the base of the bank and the buried soil (Illus. 20) is dominated by herbaceous pollen, notably *Plantago* spp., Lactuceae and

Poaceae, suggesting a predominantly grassland environment with weeds such as plantains and dandelion type. Arboreal pollen is sparse apart from *Corylus avellana* type, which suggests some hazel woodland in the area. A decline in *Corylus* towards the top of the buried soil suggests some clearance in the area around the time the fort was constructed. A decline in *Polypodium* and increase in *Pteridium* may also be associated with clearance of woodland and invasion by bracken. Although values are low, a slight decline in *Alnus* occurs earlier in the record and may suggest some clearance of alder carr, perhaps growing close to the stream in the valley to the north-west of the site. An increase in *Calluna* pollen indicates some acidification of the soil and the establishment of heathland vegetation communities in the area which could be related to agricultural activity. *Calluna* values are marginally lower in the upper levels of the buried soil whilst herbaceous pollen is more frequent, perhaps reflecting activity at the site as heather is susceptible to trampling. Similarly, a reduction in *Pteridium* may represent clearance of bracken locally. Cereal type pollen is also recorded from the top of the soil but weeds associated with cultivation are scarce, suggesting that any cultivation was taking place away from the immediate environs of the fort. The presence of Chenopodiaceae pollen in the profile could reflect either cultivation, disturbed ground, or salt-marsh environments. The coastal environment is also reflected by the occurrence of *Armeria* and *Plantago maritima*. An increase in *Corylus* and *Polypodium* in the upper levels, which were from the bank, mirrors the record from lower down the profile, suggesting upcast from the ditch. Pollen concentration values (unpublished) are highest around the buried soil/bank boundary.

All the samples from within the fort indicate a largely open environment and have lower arboreal pollen values than from the soil under the bank, which may reflect their

location and their slightly later date. The assemblage from gully XI outside of roundhouse VIII is dominated by Lactuceae pollen which has particularly high values in the levels from the 're-deposited natural' of the lower fill, zone PYRG.1a, suggesting there may be some differential pollen preservation. Although *Quercus* and *Corylus avellana* type values are slightly higher in the basal level and then decline it is difficult to be certain whether these changes represent contemporary small scale clearance of oak and hazel woodland in the area because of the nature of the lower fill. Small amounts of *Alnus* occur throughout the diagram and suggest carr woodland in the area. A return to slightly higher *Corylus* values in the lower levels of the upper gully fill, zone PYRG.1b, might either reflect older pollen washed in with the sediment, some minor regeneration of hazel scrubland, or possibly pollen from hazel wood brought onto site. *Calluna* pollen is poorly represented which may reflect the different environmental conditions and different pollen source areas within the fort compared with the buried soil beneath the bank. This is further demonstrated by a greater incidence of Cerealia type pollen in the upper sediments of the gully. This probably reflects cereal brought onto the site rather than local cultivation, although this may have occurred on the area of flat ground behind the fort. However, high Poaceae, *Plantago* and Lactuceae values again suggest a predominantly grassland environment.

The pollen spectrum from sample 587 from the later gully fill from roundhouse III is similar to that from gully XI, including the presence of Cerealia type pollen. The pollen from the occupation layer from roundhouse II, sample 589, is also similar, apart from the absence of Cerealia type. In contrast, pollen sample 584 from the capped

drain from roundhouse VIII contains large amounts of Lactuceae pollen, possibly reflecting the context and less favourable conditions for preservation.

Comparison with other sites

The nearest pollen evidence from other sites in west Wales covering this period is from buried soils from enclosures at Merryborough Camp (Webley 1964) and Knock Rath (Bartley and Webley 1964). However, the information is very limited, although from the presence of cereal pollens at Merryborough it is suggested there was some arable farming prior to the construction of the bank and at Knock Rath a large increase in *Plantago* pollen on the old ground surface is interpreted as indicative of grazing. At Merryborough a large part of the pollen is said to be oak but the date of this is unclear. The pollen sequence from the raised bog at Esgyrn Bottom (Slater and Seymour 1977), near Fishguard, is, unfortunately, undated, making direct comparison difficult, although changes in the pollen zone attributed to this period are interpreted as woodland clearance and grazing. Later changes, interpreted as evidence of arable farming, are assigned to the Norman period. In contrast, the pollen record from Whitland Roman Road (Caseldine *et al* forthcoming) is more accurately dated and suggests increased clearance during the Iron Age and a largely pastoral economy, although occasional grains of cereal type pollen are recorded indicating some cultivation. Further east, the pollen record (Walker 1985) from the enclosure at Penycoed also suggests a mainly pastoral landscape with only limited cereal cultivation. Woodland is scarce but, as at Porth y Rhaw, alder and hazel are most strongly represented. In the diagram from Llanllwch (Thomas 1965) a sharp decline in Coryloid frequencies is interpreted as being associated with Roman activity and a Celtic monastic community at Carmarthen, but the diagram is inadequately dated.

Charred plant remains

Charred plant remains were recovered in order to gain information about crop husbandry practices in the area and crop processing activity at the site. Samples were taken from a range of contexts including a burnt layer above a hearth, possible cooking pits, an occupation layer, a layer above a floor, and capped and uncapped drain fills (Table 6).

Methods

Samples were processed using a simple wash-over technique. Hydrogen peroxide was added to the samples prior to processing to aid disaggregation of the clays. The floats and residues were collected in a stack of sieves with 2mm, 1mm, 500um, and 250um meshes. Identification was by comparison with modern reference material and identification texts (eg Jacomet 1987). Nomenclature for non-cereals follows Stace (1991). The results are presented in Table 6.

Discussion

Charred plant remains are sparse but provide some information about crop husbandry during the Iron Age and Romano-British period. One sample (590) from above the floor of roundhouse VIII failed to produce any remains. Wheat (*Triticum*) is the most frequent cereal recorded from the site and glume bases indicate the presence of both emmer (*T. dicoccum*) and spelt wheat (*T.spelta*), although a number of glume bases could only be assigned to an emmer/spelt category. Spelt dominates and it is possible that emmer was present only as a contaminant. Hulled barley (*Hordeum sativum*) is also present and may be under-represented as it is more likely to be destroyed than the glume wheats when exposed to heating (Boardman and Jones 1990). Weed seeds are

scarce but include *Persicaria* spp.(knotweeds), Chenopodiaceae (goosefoots) and Poaceae (grasses). Other remains include stems of *Calluna vulgaris* (heather), *Pteridium aquilinum* (bracken) leaf fragments and a fruit-stone of *Prunus spinosa* (blackthorn).

The assemblages largely represent waste from crop processing, mainly glumes bases as a by-product of sieving. Charred cereal remains from the cooking pits are marginally more frequent than in the other samples, probably reflecting the use of waste as fuel although the few cereal grains could represent accidental charring during cooking activity. However, generally, none of the samples yielded large quantities of material, the amounts present probably representing charred material that was blown about or trampled in, suggesting waste material was being deposited outside the immediate environs of the fort.

Although chaff might have been deliberately burnt it might also have been used as animal fodder at the site. Similarly, the charred bracken fragments could represent animal bedding as well as fuel and the charred heather could derive from flooring material or fuel. The few weed seeds provide only limited ecological information. Poaceae indicate grassland, *Persicaria* spp., *Polygonum aviculare*, Chenopodiaceae could reflect cultivation or waste ground. The presence of *Calluna* remains indicates heath communities and the thorns and fruit-stone of *Prunus spinosa* (blackthorn) suggest scrubland.

There is no evidence for a change in the crops being grown between the Iron Age and Romano-British period with spelt dominating throughout, but the total assemblage is small. There is also insufficient evidence to assess the status of the site from the plant macrofossil remains. The glume wheats, emmer and spelt, are frequently stored and

traded in spikelet form, particularly in areas with wet climates, so that in an area like west Wales the presence of glume bases may or may not indicate local production. The extent to which crops were being grown in the immediate area, ie the area of flat land behind the fort, is therefore unclear, if probable.

Comparison with other sites

The results are similar to those from Llawhaden (Caseldine and Holden 1998) where wheat, largely spelt, predominated, but barley was also present. In addition, oat (*Avena* sp.) was recorded at Llawhaden, but it was uncertain whether it was wild or cultivated, and there was some evidence for bread/club wheat (*T. aestivo-compactum*) The absence of these species at Porth y Rhaw may be a reflection of the small size of the assemblage rather than their absence at the site. Wheat grains were also recovered from Penycoed as well as oat and rye (*Secale cereale*) (Nye 1984).

Conclusions: Environment and Economy

The pollen evidence suggests a mainly open landscape, perhaps with some carr woodland in the valleys and some hazel scrub. It also suggests a largely pastoral economy with only limited cereal cultivation. The scarce plant macrofossil evidence from the site appears to confirm this, but it is probable that waste material was disposed of outside of the fort and therefore cereal remains are under-represented. The charred plant remains indicate that spelt wheat was the main cereal crop but that barley was also being grown, although it could also have been a contaminant like emmer. The pollen evidence indicates the development of heather communities, confirmed by the presence of charred heather remains, suggesting some soil acidification, perhaps as a result of agricultural activity. The evidence appears to be in

keeping with that from other sites in west Wales at this time which suggest a mainly pastoral economy.

Table 6 Charred plant remains from Porth y Rhaw

Discussion

Porth y Rhaw represents the first excavation of any size to be undertaken recently in west Wales on a coastal promontory fort. The work has demonstrated that this fort was densely occupied over a considerable length of time, and has shown similarities to many of the inland defended sites in the region. This site does not appear to fit Hogg's assessment of a "fortified village... random scatters of roundhouses separated by ample space where animals could graze" (Hogg 1972, 14). Evidence of manufacture of metalwork, the presence of items of personal adornment, and the scale of the defences, combining strength with an element of display, suggests that the settlement was of high status, probably able to draw on resources beyond its level of occupation.

The Defences

This site is one of the most massively defended promontory forts in west Wales, taking advantage of the natural slope of ground. The eastern defences are closely spaced; however the western part of the third ditch and fourth bank appear to be deliberately enclosing a large annexe. The creation of the fourth bank is almost inevitable while digging the western end of the third ditch, as it would be impossible to place the soil on the third bank; the ramparts should therefore be seen as a triple rather than a quadruple defence. This enclosure of an outer area is a feature seen at some other west Wales coastal forts, such as Flimston and Greenala in south

Pembrokeshire and Castell Bach, near Newquay in Cardiganshire (Rees 1992). This area was possibly used for impounding cattle, but the southern end of the annexe is relatively flat and may contain structures.

The entrance appears to have been along a metalled trackway along the cliff edge before passing through the inner defence where there was probably a towered gateway with expanded bank terminals. The flat area behind the eastern half of the third bank could have formed a fighting platform, as was suggested by Wainwright (1971) for the terminal of the internal bank at Tower Point, Pembrokeshire. Furthermore, at Porth y Rhaw there is a pronounced mound at the western end of the third bank overlooking the entrance; its purpose is unknown, but it could have formed the base of a tower, or even part of a bridge over an outer gateway. However, as any evidence of the outer defences on the eastern side of the entrance has, presumably, been lost, and the western side is eroded, no further conclusions can be drawn.

Both the surface evidence and that obtained from Trench 2 show that the outer defences have been remodelled to some degree and, given the long occupation of the site, it would seem unlikely that the inner defence was never rebuilt. The form of construction of the inner bank could not be conclusively determined. While it may have been built as a dump rampart with rear revetment, radiocarbon determinations indicated a date of construction of fifth century B.C or earlier, which is probably too early for this type of structure. Furthermore, the layer of large stones in the ditch strongly suggests that the outer face was, at least partially, stone clad; the nearest coastal fort, the Gribin, still retains stone facing on part of its bank, and the fort at St David's Head appears to have stone walled defences, although both sites are undated. The double slot at the rear of the bank may suggest some rebuilding; excavated sites at

Tower Point (Wainwright 1971) and Dale (Benson and Williams 1987) have rebuilt revetted ramparts of *murus duplex* form, which are attributed to the later Iron Age.

A number of west Wales sites have produced evidence for occupation in the late Bronze Age, including Broadway (Williams and Mytum 1998) and Dale (Benson and Williams 1987), both in Pembrokeshire, and possibly also at Caer Bayvil, Pembrokeshire and Llanstephan, Carmarthenshire (Williams and Mytum 1998). As such a small section of the bank at Porth y Rhaw was excavated, evidence for pre-rampart occupation could not be expected; nor was there any indication of earlier occupation within the interior, other than a spread of struck flints from the Mesolithic period. However, given the natural defensive slope and the close proximity of the spring at Porth y Rhaw, the site may have been settled before the ramparts were constructed.

The Interior

Roundhouses I-VII are in the Iron Age tradition, which continued into the Romano-British period, and are not dissimilar from those found on other sites in Pembrokeshire, such as the Llawhaden enclosures and Castell Henllys (Williams and Mytum 1998). At Porth y Rhaw there appear to be two distinct forms of roundhouse gullies: narrow and steep sided for roundhouses I, II, IV, V and VI, whereas the later phases, at least, of roundhouse III and all builds of VII were larger, being wider, more rounded and deeper. Recent analysis of the roundhouse gullies on the defended enclosures of Llawhaden, Pembrokeshire (ibid., 122) indicated that later gullies tended to be more substantial. The larger gullies of roundhouse III are demonstrably later than those of IV and V; the other larger gullied roundhouse VII was thought to be later in date but insufficient area was excavated to substantiate this opinion.

Roundhouse III was the only house demonstrated to have a post-ring; of the remaining houses (except for V), none of the central areas were excavated and therefore no conclusions could be drawn concerning the existence of internal central supports. The hearth appeared to occupy the centre of roundhouse V, arguing against a central post, and there were a number of post holes nearby which may have related to the structure of the house. Roundhouse III showed evidence of more rebuilds than any of the others It did not appear to overlie earlier features and seemed to have had a very long duration. It may be significant that the three shallow pits and a large number of stake holes were located between roundhouse III and the roundhouse II to the south, possibly indicating contemporaneity.

Roundhouse VIII appears, in structural terms, to be an example of a developed roundhouse, firmly in the Romano-British tradition rather than Iron Age, an analysis which is supported by both the pottery and the radiocarbon determinations. There are no exact local parallels for this roundhouse in Pembrokeshire: the roundhouse excavated at Tower Point, 13 km to the south, had spread stone footings, but could not be firmly dated (Wainwright 1971), although it appeared to be in the later Iron Age tradition. There are seven stone footed roundhouses, possibly similar in form, at St David's Head, Pembrokeshire (Murphy forthcoming), 7.5km to the north west, which may date to the Romano-British period. Three roundhouses (probably stone footed) were recorded on the Gribin 1.5km to the east, and apparently destroyed around 1900 (Laws and Owen 1908).

The only known examples of internal drains in Pembrokeshire roundhouses are at Walesland Rath (Wainwright 1971a), although these are within timber structures. There are a number of drains in roundhouses in Anglesey, north Wales including

Holyhead Mountain and three sites currently being excavated on the A55. There are also parallels at some sites in Cornwall, where a number of stone-footed roundhouses from the Iron Age have internal drains; they are also found at the Romano-British defended site at Trethurgy (Miles and Miles 1973), where a number of the houses have these features.

Only two roundhouses had clearly identified entrances, one possibly Iron Age (roundhouse II) and the other Romano-British (roundhouse VIII); both faced south-west into the prevailing wind. However this orientation would capture the evening sunlight, which may have been of practical or social significance. Another south-western entrance may have existed on roundhouse IV, and roundhouse III appeared to have an entrance in an earlier phase, orientated to the north.

The hearth located near the centre of roundhouse V was the only such feature to be located on the interior. Its small size, large amount of fire reddening of the surrounding subsoil and in particular its keyhole shape, suggest it may have been a furnace or small oven. Unfortunately only the lower part of this structure survived and there was no indication of a tuyere hole. As this feature appeared to have been cleared out after its last use its function remains uncertain; iron slag, the crucible fragments and a glass bead were all found very close by. Some or all of the adjacent fire reddening could be the scattered remains of the top of this structure. As there were no indications of vitrification either in this patch or the hearth, suggesting a relatively low temperature, it is probable that the process being undertaken was not iron working. Two patches of fire reddening or burning were seen in the section edge within roundhouse II, which could be the remains of cooking hearths. The probable reason for the lack of hearths on the site is that the centres of all the roundhouses, except for

V, lie outside the excavated area.

Economy

The artefacts from Porth y Rhaw, other than the amber bead and jet counter, are similar to assemblages from other Pembrokeshire coastal forts and defended inland sites. Spindle whorls are a fairly common artefact on Iron Age sites and those from Porth y Rhaw would not appear to be particularly diagnostic or distinctive. However, the small spindle whorl (438), while not complete, is very light and must have been used to spin a very slender thread, implying the weaving of fine cloth. The glass beads, together with the amber bead, the jet counter and the Roman pottery, must have been transported over some distance; however they are not proof of direct contact with their areas of origin.

A Roman road running west from Carmarthen has now been traced as far as Llawhaden in Pembrokeshire (Illus. 23), some 23km from Porth y Rhaw. Excavation on a section of this road near Whitland, Carmarthenshire (Nigel Page forthcoming) indicated that the road was in use for some time. However the distribution of Roman finds appears to have a coastal bias and coastal trading was almost certainly a major activity. West Wales should now be seen to lie more within the Roman sphere than previously considered, quite possibly on, rather than at the end of, the trade routes.

The investigations of 1808 by Fenton reported a large amount of limpet shells; however the recent excavations found no ancient deposits of organic material and the chemistry of the site appears to be unfavourable to organics: the only such material recovered was calcified bone. It is possible, therefore, that the limpet shells were a more recent deposit, possibly associated with quarrying activities. Although no organic material survives, the sea would have been exploited for both fish and

shellfish, and also possibly for salt for preservation or trade. The beaches below would be ideal for fishtraps, while the flat ground immediately behind the fort, with relatively good well drained soil, few frosts and a long growing season, would have benefited both crops and cattle. Trees now grow readily in the sheltered valley to the north-west and would probably have been more plentiful except right on the coastal edge. However, location is probably one of the overriding aspects of this fort's long life: the sea access in the cove to the west and the springs immediately outside the entrance must have played a part, and few of the Pembrokeshire coastal forts are as well situated.

Dating and comparisons

Promontories, whether coastal or inland, lend themselves to defence without the necessity for building complete enclosures (Harding 1974, 55). In West Wales there is little dating evidence for the coastal promontory forts, but what there is indicates that such sites have been utilised for defence over a long period of time, from the Bronze Age, with the major earthworks constructed during the Iron Age, and occupation continuing well into the Roman period. There is a scatter of evidence for post-Roman occupation, such as the imported wares from Coygan Camp, Carmarthenshire (Wainwright 1967). A few sites have been defensively reoccupied in the medieval and modern periods (e.g. Llanstephan Castle, Carmarthenshire (Guilbert 1974), Dale Fort, Pembrokeshire).

There are distinct parallels between Porth y Rhaw and the more complete excavations of defended inland sites: the Llawhaden, Pembrokeshire defended enclosure project (Williams and Mytum 1998), the continuing work on the small promontory fort at Castell Henllys, Pembrokeshire, and especially the fully excavated defended enclosure

at Walesland (Wainwright 1971a), 15km to the south-east. All these excavations have produced evidence of closely built structures; Porth y Rhaw appears to have been at least as densely occupied as these sites, and the similarity with the rebuilding of roundhouses at Walesland, followed by an apparently lighter occupation in the Roman period, is particularly striking. The radiocarbon determinations indicate that the inner rampart at Porth y Rhaw is most likely to date around the fifth century B.C. while those at Walesland appear to start in the third century B.C. The late Iron Age-early Roman period at Walesland also produced crucibles for bronze, while the pottery continued through into the fourth century (although no features associated with the later Roman period were found). The pottery at Porth y Rhaw dates throughout the Roman period, albeit all in association with roundhouse VIII, and these two sites would appear to be contemporaneous. Porth y Rhaw is however far more heavily defended and probably had a larger number of dwellings for most of its occupation.

Recent work at the promontory fort at Brawdy camp, 7.5 km to the east of Porth y Rhaw, on the coastal fringe, suggested that the site was re-occupied in the Romano-British period after a phase of abandonment (Williams and Mytum 1998), although the level of reoccupation is uncertain due to the limited area excavated. Further away in north Pembrokeshire, Castell Henllys (Mytum 1989) also appears to be lightly occupied where a Romano-British farmstead was established in an annex, while the main part of the fort was unoccupied. Although examples are few it appears probable that, by the later Romano-British period, some small hillforts and other defended sites have reduced to, or re-occupied as, farmsteads.

It would seem unlikely that *all* of the coastal promontory forts of Pembrokeshire were occupied at the same time, or were of similar status or function. Some are positioned

quite close together; Porth y Rhaw, for example, has three near neighbours less than 2km away to east and west, all substantial fortified structures. Even allowing for erosion, forts vary greatly in the area of their interiors, from 10ha at Wooltack Point, Pembroke-shire to 1ha at Dinas Fach, Pembrokeshire, and in the size and form of their defences. The size of interiors may, however, have more to do with where defences could be placed to make the best use of natural defensive features and this would appear to be the case at Porth y Rhaw and Wooltack Point.

The comparison of coastal promontory forts in the west of Britain is dependent on only a limited amount of excavation and where this has occurred, has frequently been restricted to narrow sections through the defences with occasional limited internal areas, often on known hut sites. Where there is dating evidence for the rampart or occupation it is inclined to be poor due to the calibration of radiocarbon data for this period.

The date for the construction of Porth y Rhaw is uncertain but is probably between the eighth to fifth centuries B.C., inclining towards the latter. During this period hillfort construction in Britain was increasing (Cunliffe 1991) and a number of small hillforts in Pembrokeshire appear to date from this period, including Brawdy camp, Broadway camp and Castell Henllys (Williams and Mytum 1998). Continuous occupation, or re-occupation without a long intervening abandonment, is difficult to prove, particularly with only limited excavation, and the general paucity of artefactual evidence in west Wales exacerbates this situation. However a pattern may be starting to emerge in west Wales, where the smaller, more lightly defended sites appear to have a shorter overall life-span than the more heavily defended forts.

The Pembrokeshire coastal forts are not generally paralleled in north Wales, where

there are fewer suitable coastal promontories. There is also a much greater use of stone in the north, both for the defences and structures, as at Tre'r Ceiri, Gwynedd, a feature which continues at the late Roman site at Carreg y Llam, Gwynedd (Hogg 1957).

There appears to be a greater similarity with the promontory sites in south-west England, particularly Cornwall, for example the Rumps (Brooks 1974), Penhale Point (Smith 1988) and Gurnard's Head (Gordon 1940), where there are apparent similarities in style of defences. These similarities however, are probably largely a result of a defensive response on comparable topography. As in Pembrokeshire, there has been little excavation work on the interiors of these sites. To date there is no evidence of cultural contact with Cornwall during the Iron Age: Wales does not have the distinctive pottery of south-west England in this period, nor are structures such as souterains present. However it has been suggested that four-posters, found in Wales but not in Cornwall, may have fulfilled the same function as souterains (Williams and Mytum 1998, 143).

The evidence from Porth y Rhaw, and other Pembrokeshire coastal forts, presents a number of parallels to inland defended sites in west Wales. The longevity of these sites is increasingly apparent, extending through into the Romano-British period, and possibly, at least on some sites, beyond into the post-Roman period. There appears to be a high density of occupation during the Iron Age, with a reduced level of activity in the Romano-British period. The increasing number and range of artefacts from excavations show that this area was not as isolated as might have been supposed, either in the pre-Roman or in the Roman periods, with objects arriving at both coastal and inland sites from England and beyond. It is probable that other Pembrokeshire coastal

forts, some of which are also under threat of erosion, would produce equivalent results to those from Porth y Rhaw. It is hoped that this programme of work will continue in order to obtain detailed comparisons, before the remaining information is lost.

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Archive Deposition

Final deposition of the report and finds will be at Scolton Manor Museum,

Haverfordwest. A copy of the archive report and archive list will be lodged with the Royal Commission on Ancient and Historic Monuments (Wales), Aberystwyth.

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Maps and Photographs

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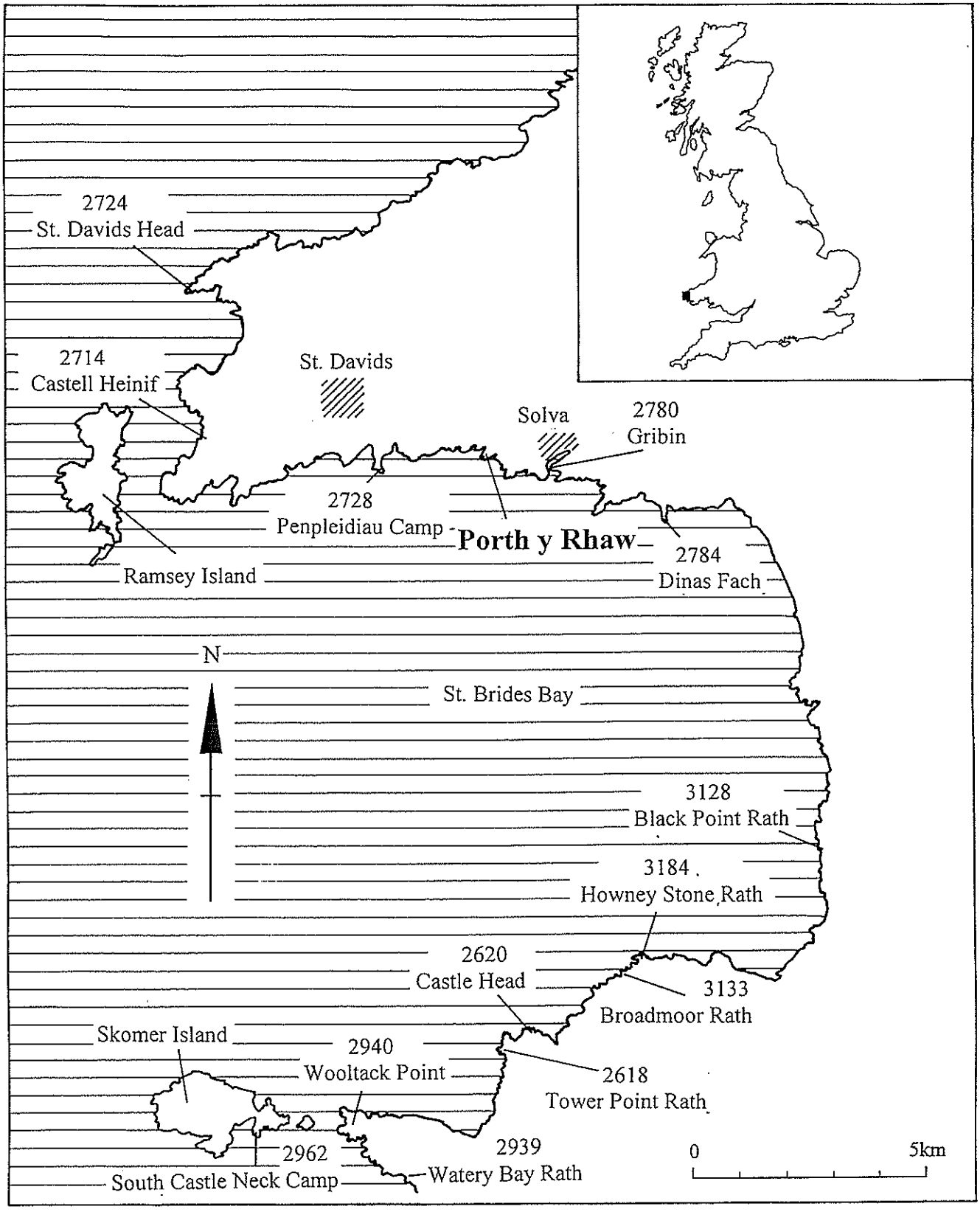
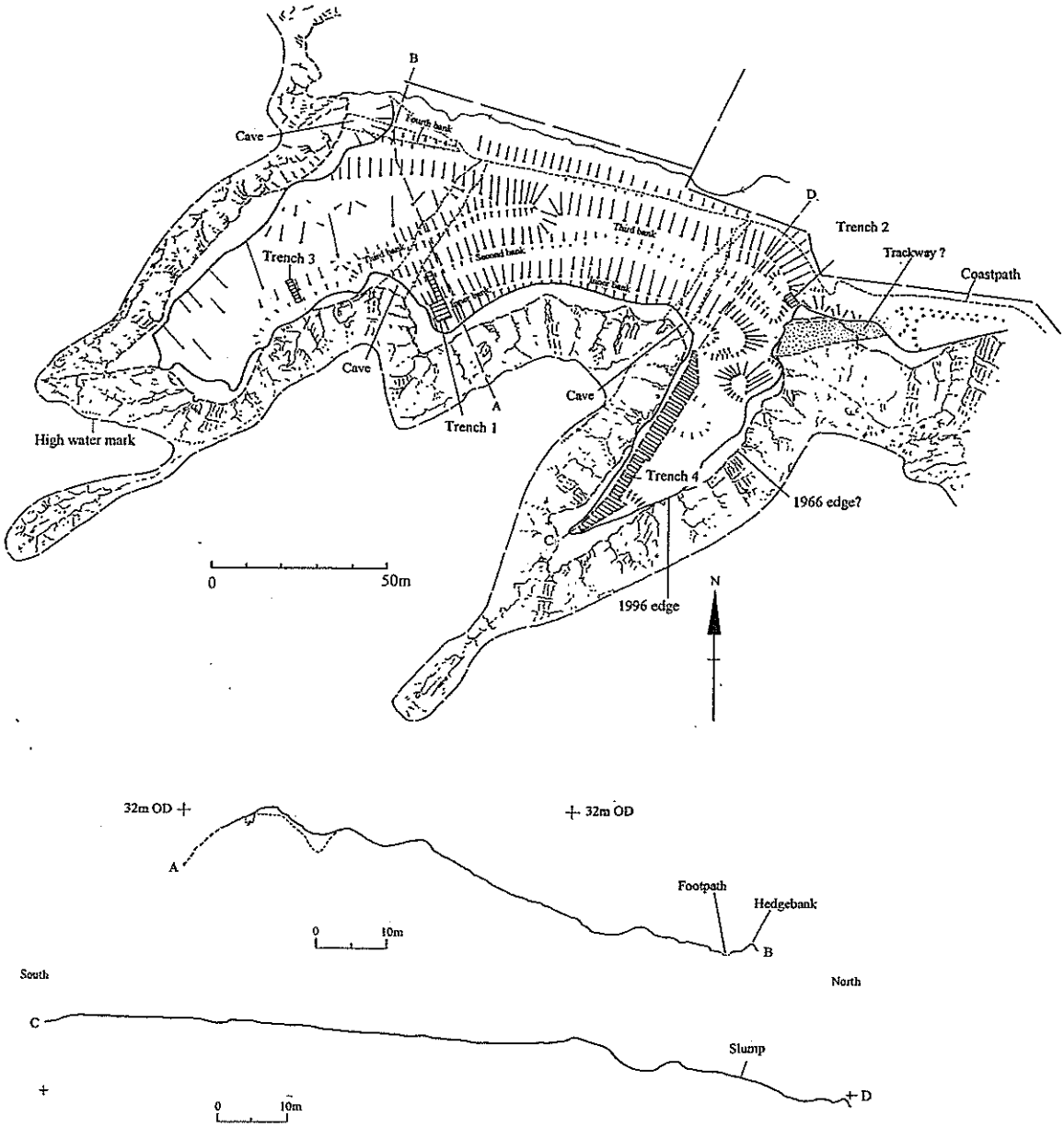
Tithe map and schedule 1838 Parish of Whitchurch in Dewisland



Illus. 1. **Porth y Rhaw and other promontory forts on St Brides Bay**

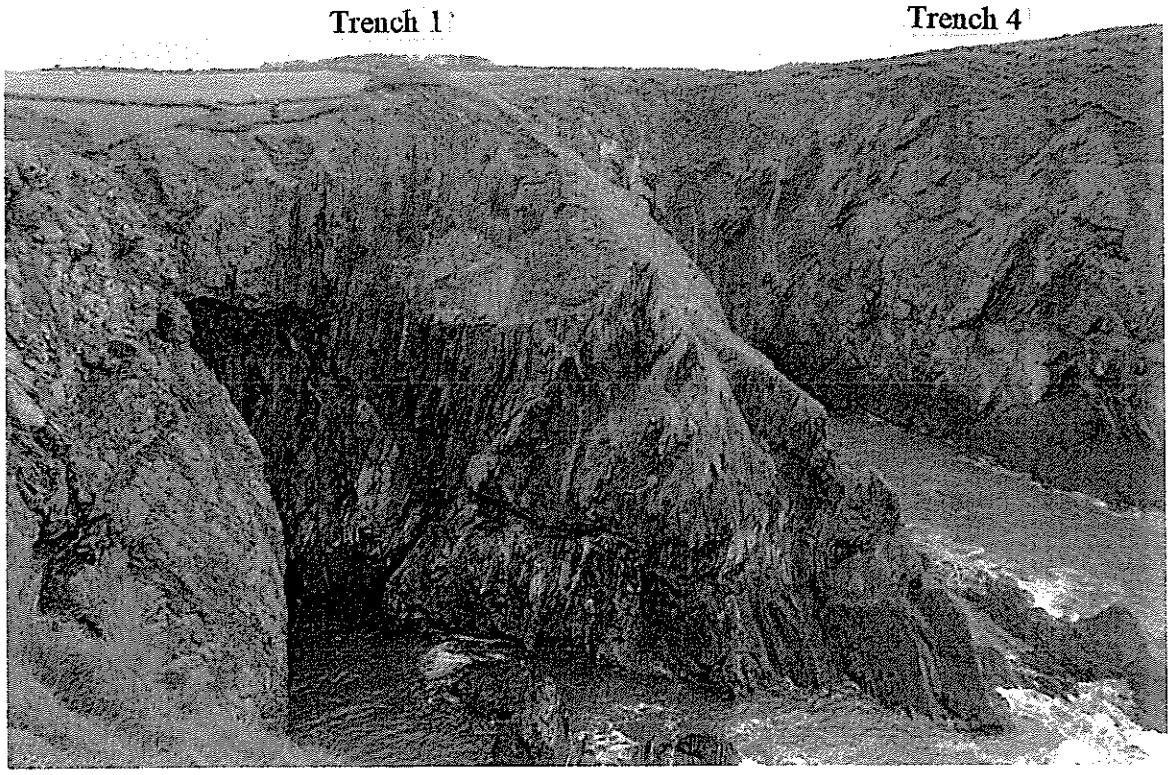


Illus. 2. 1966 Ordnance Survey plan, overlain by line showing the 1995 edge, trenches 1-4 and defence profiles

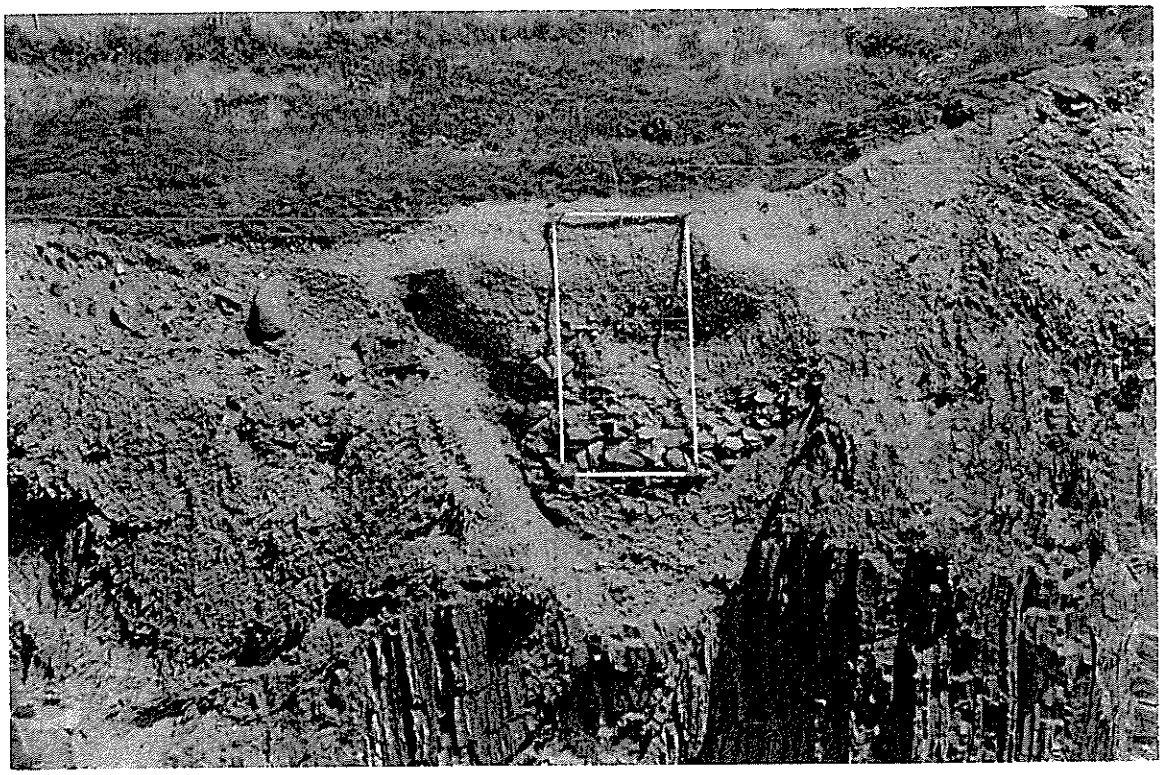
Illus. 3. Porth y Rhaw fort. View SE

Illus. 4. Aerial photograph © DAT. View NW

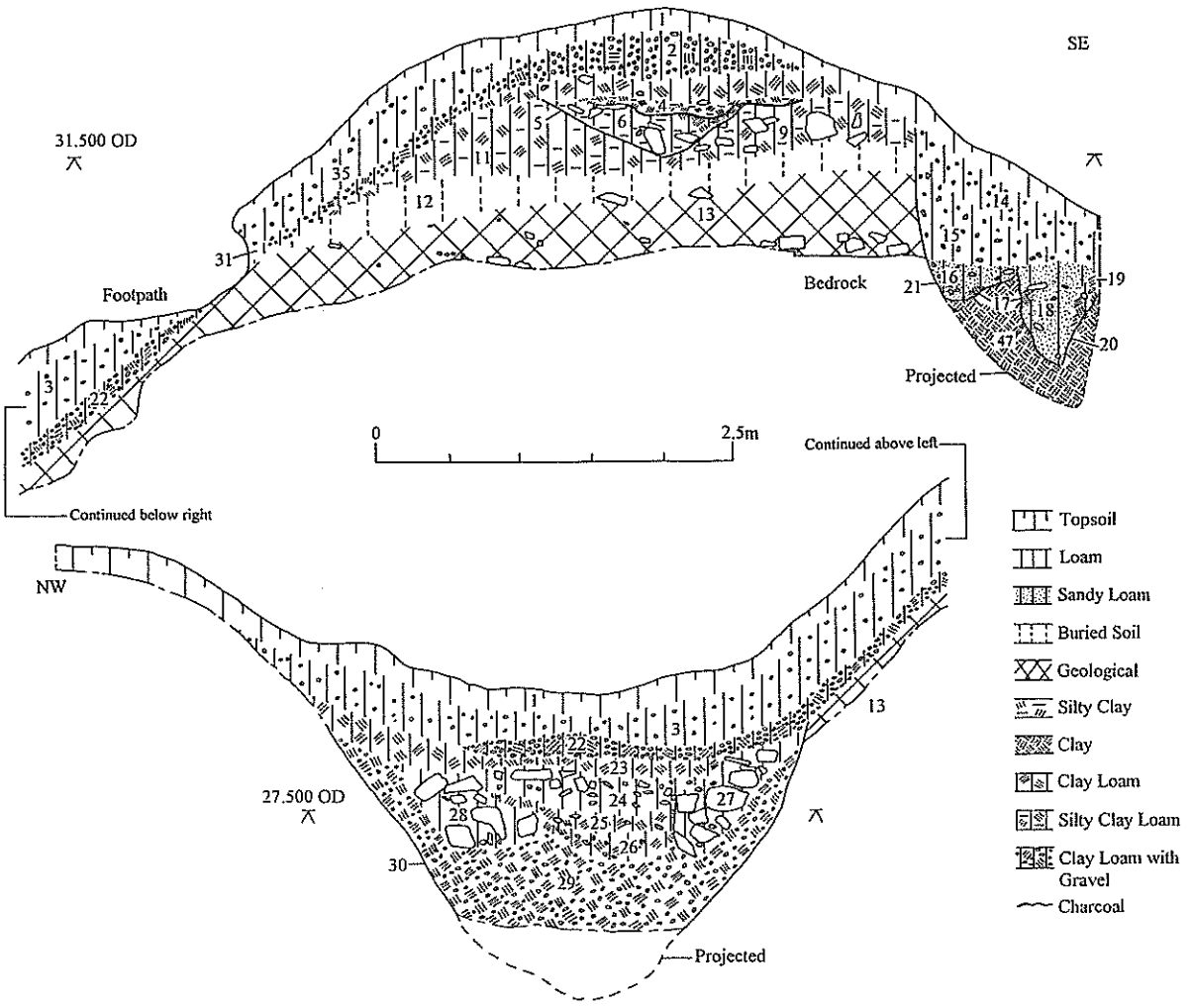
Illus. 5. Western Promontory. View NE



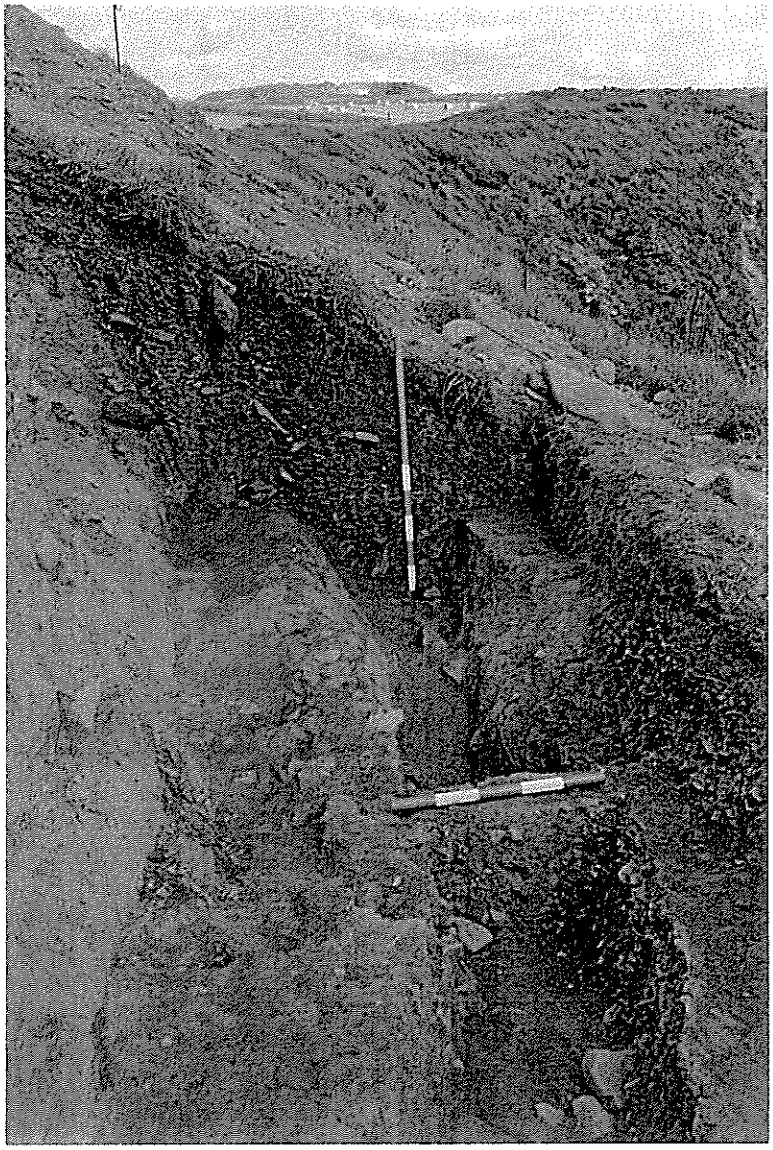
Illus. 6. Western Promontory, Trench 1. View NW



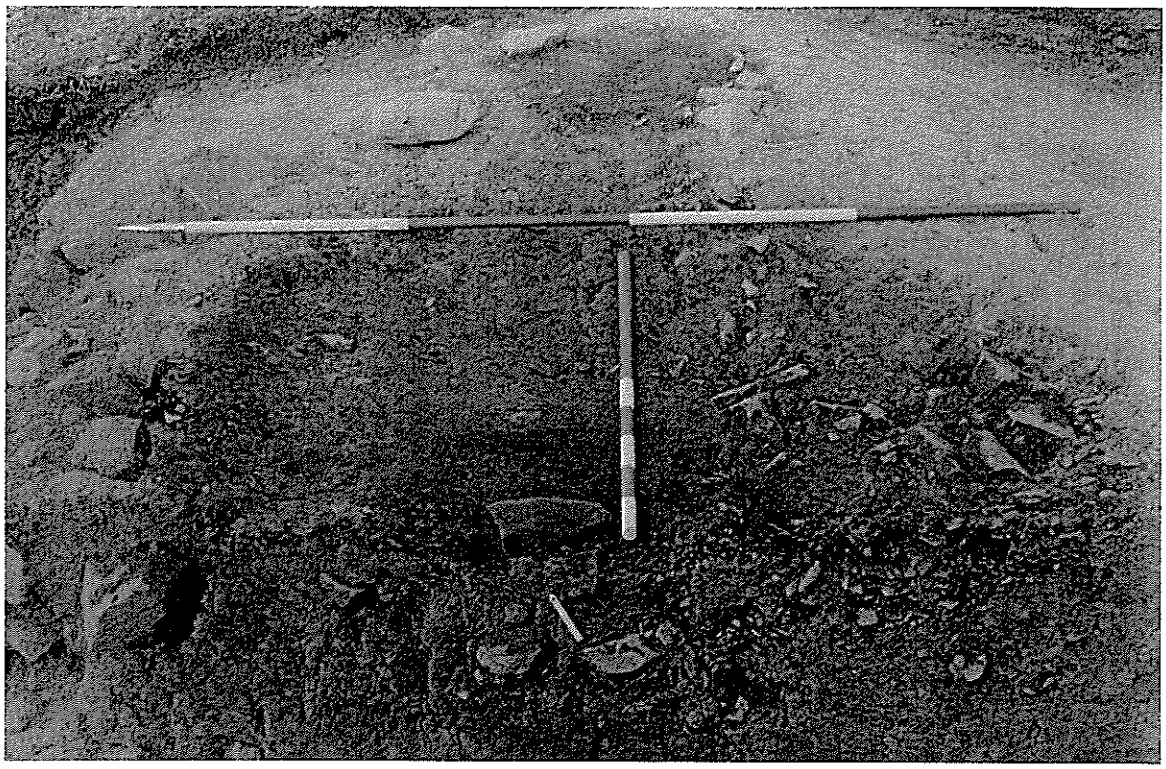
Illus. 7. Western Promontory, exposed inner ditch section. View NE. Frame 2m x 1m



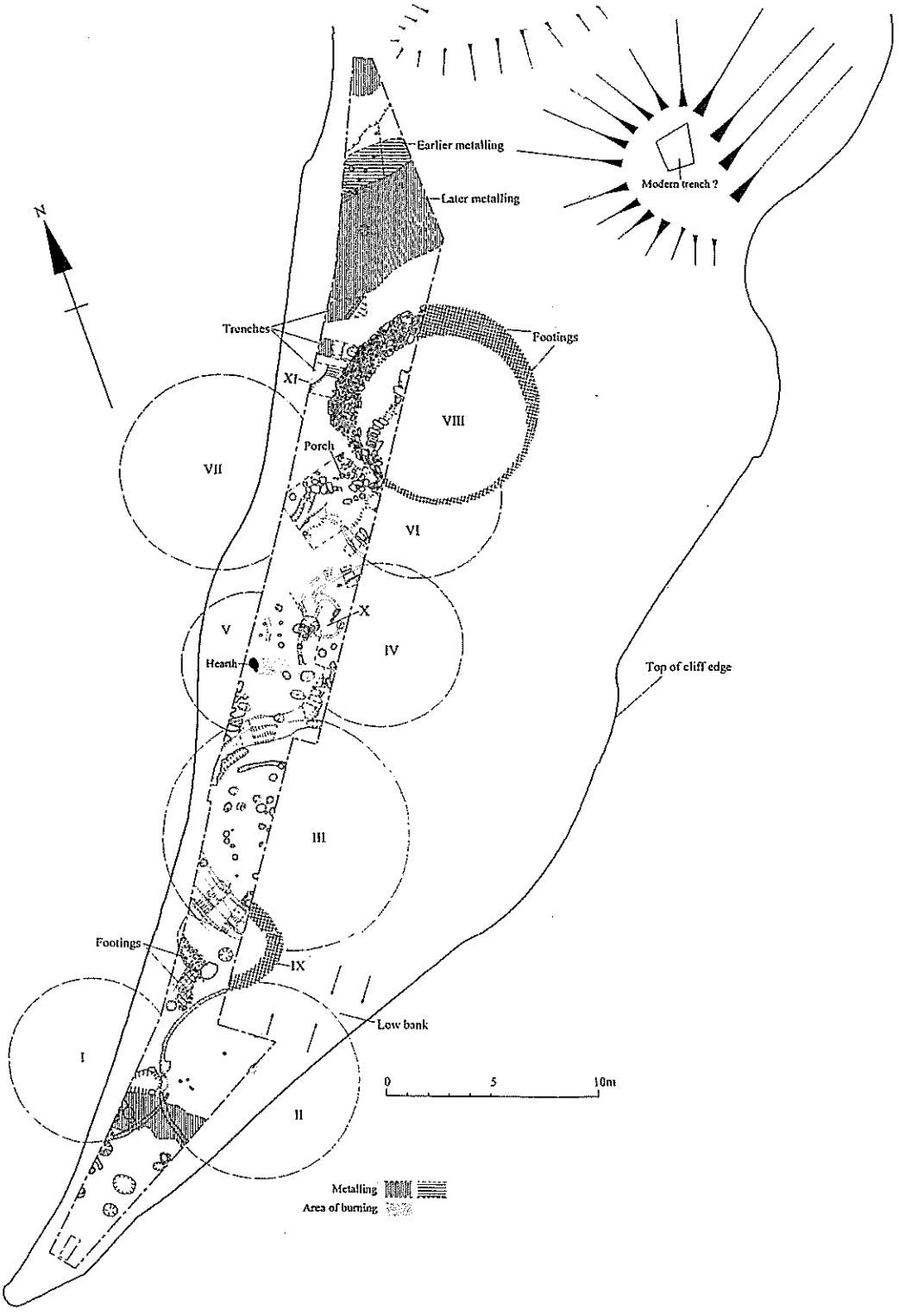
Illus. 8. Trench 1 Main section of inner bank and ditch



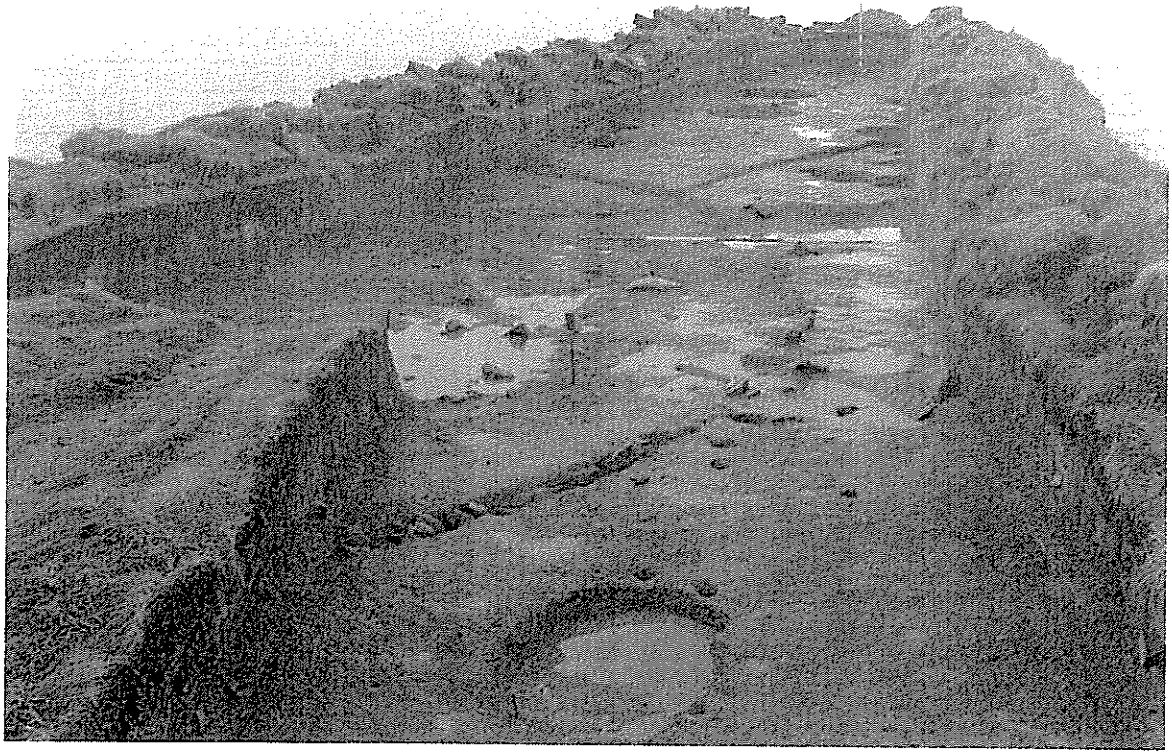
Illus. 9. Trench 1 Rear revetment trenches. View NE. Scales 0.5m and 1m



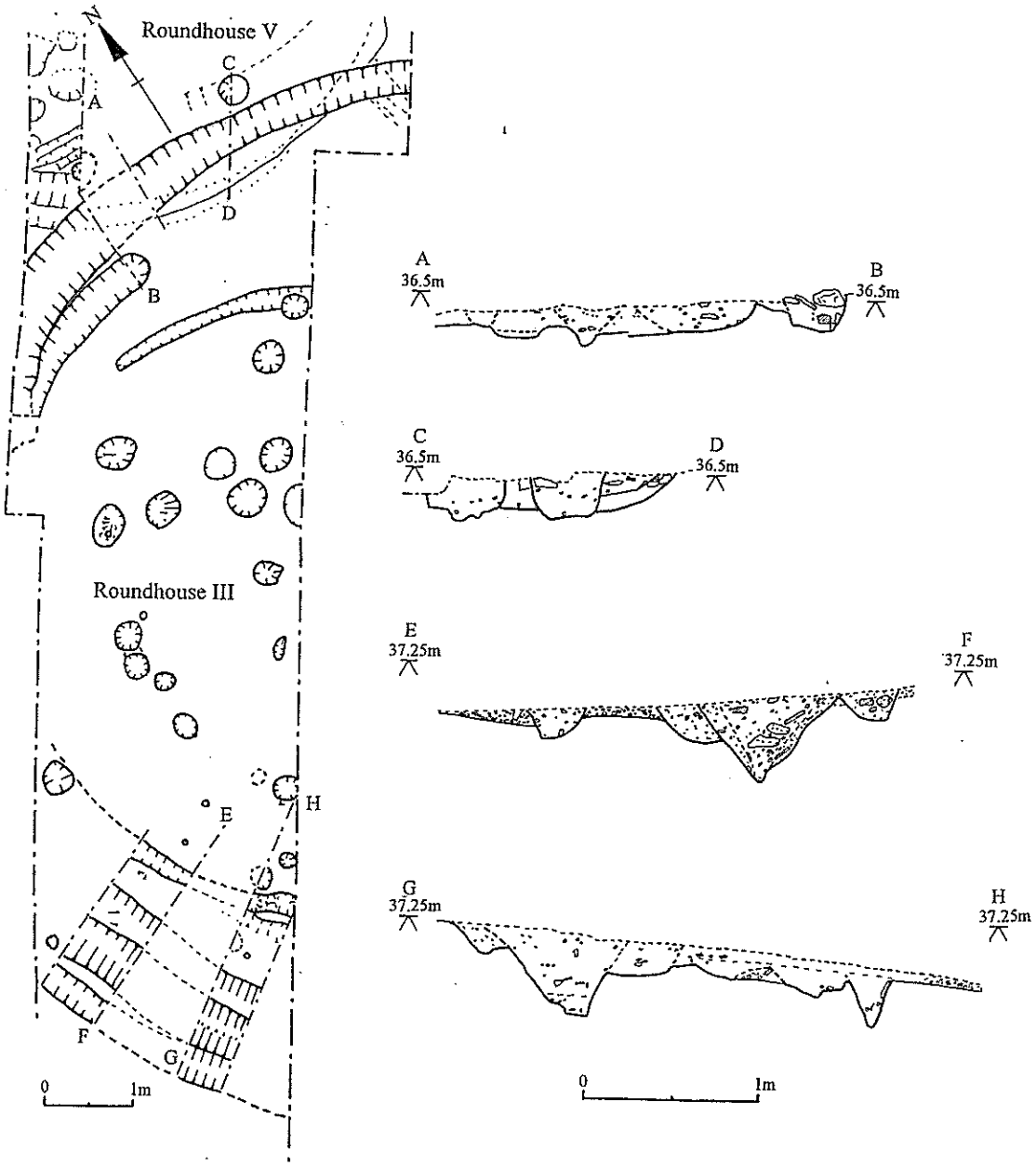
Illus. 10. Trench 1 Hearth (9), part excavated. View SW. Scales 1m and 2m



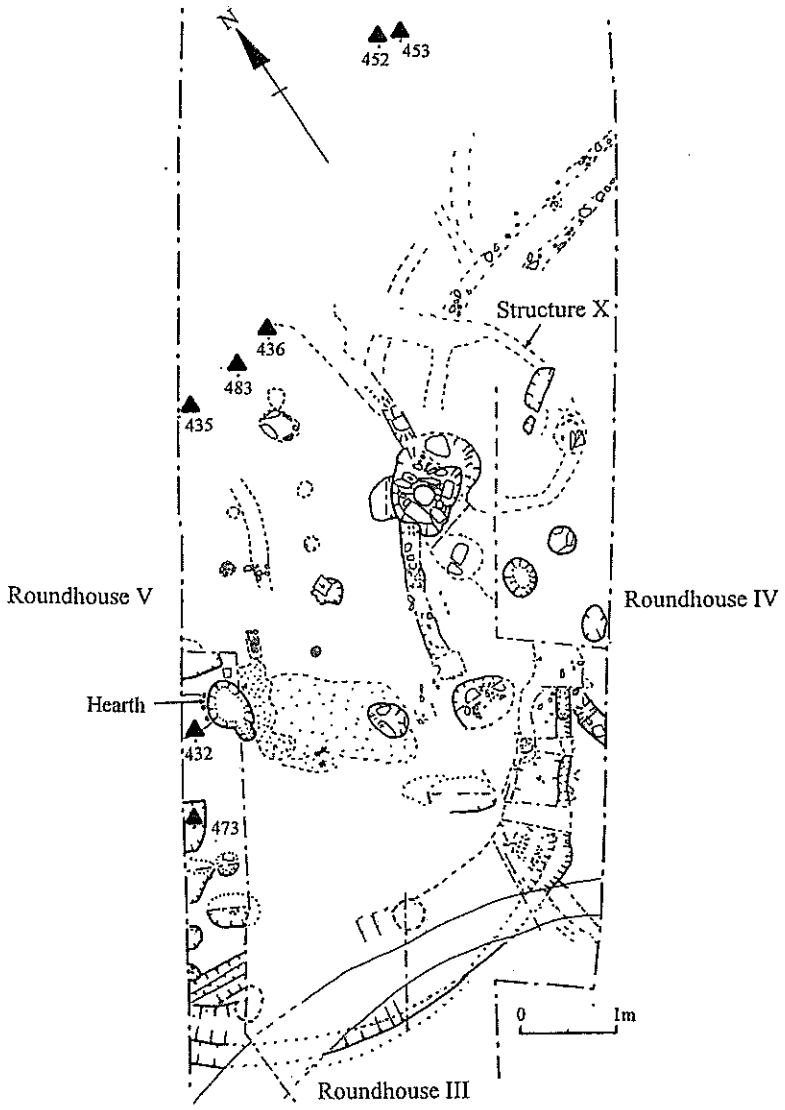
Illus. 11. Trench 4



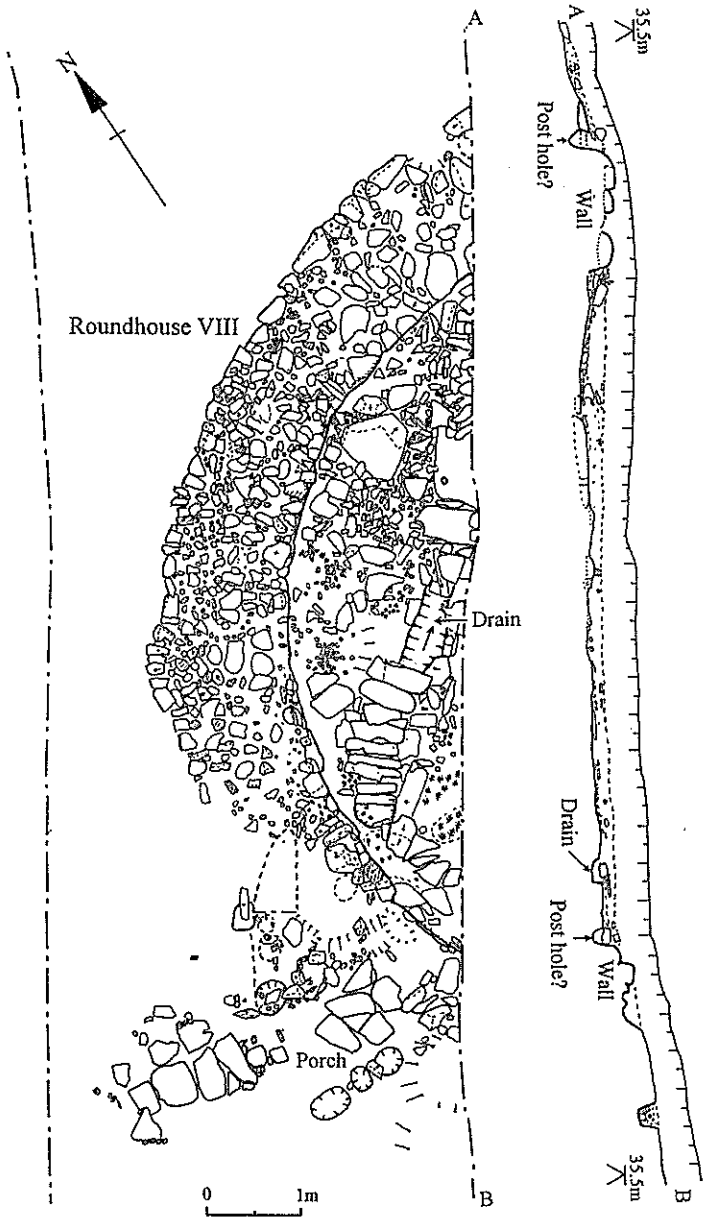
Illus. 12. Trench 4 Headland. View SW. Scales 1m and 2m



Illus. 13. Trench 4 Roundhouse III

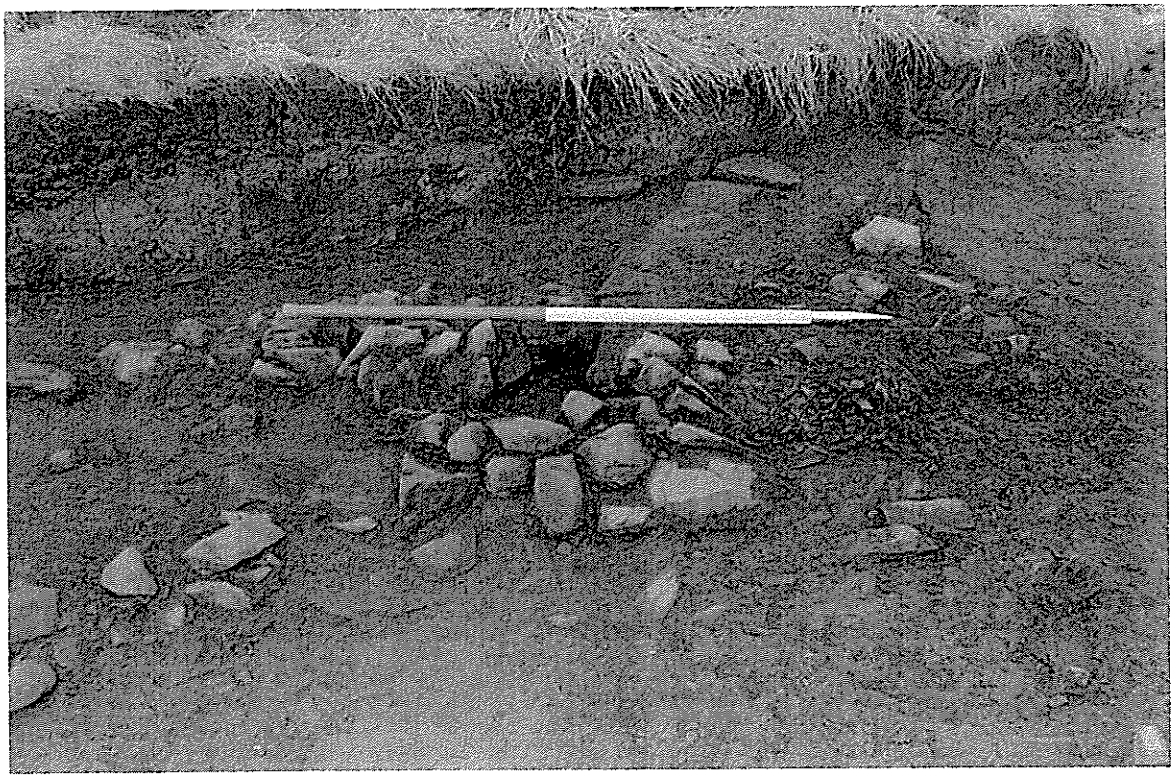


Illus. 14. Trench 4 Roundhouses IV and V

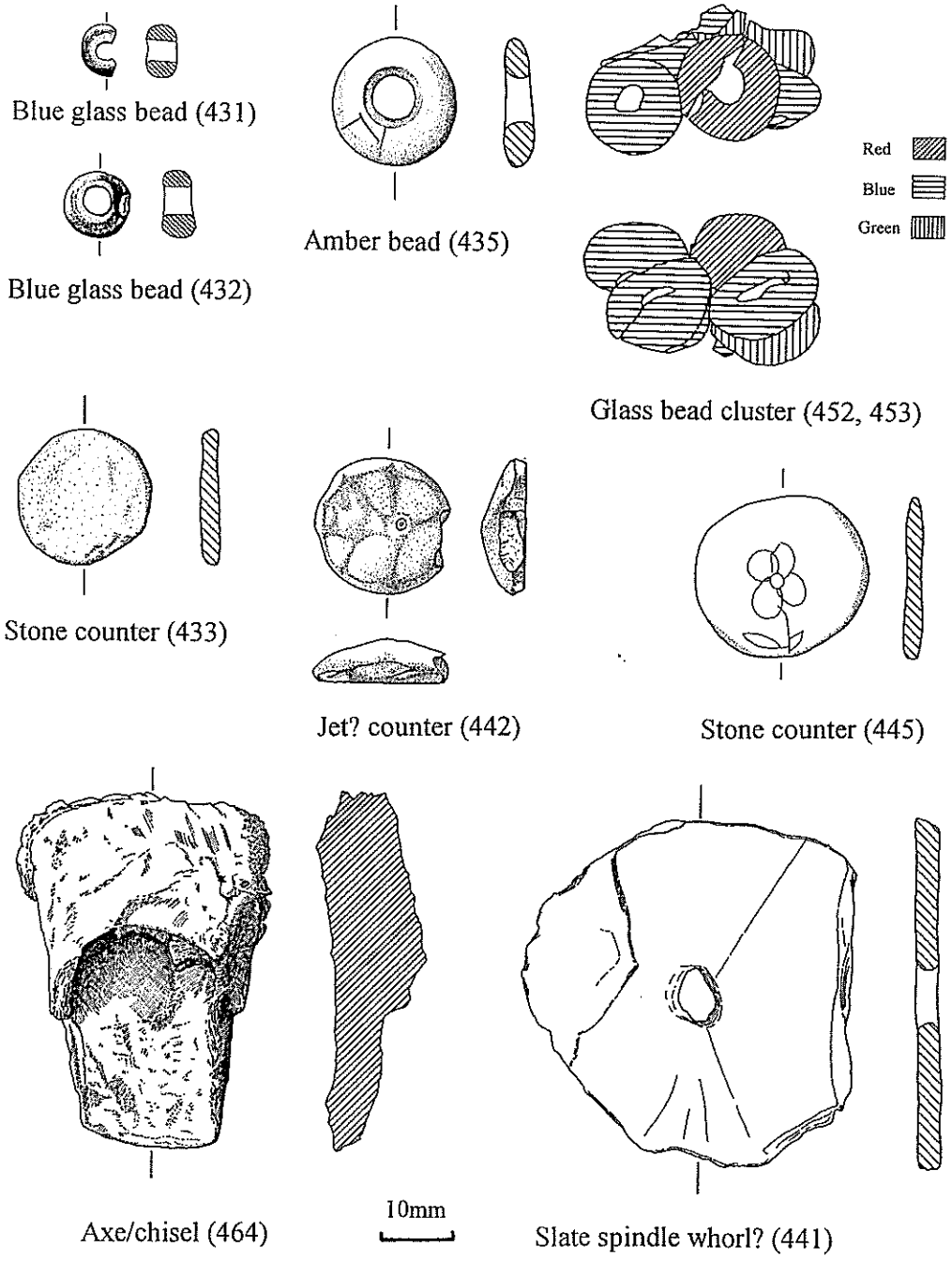


Illus. 15. Trench 4 Roundhouse VIII

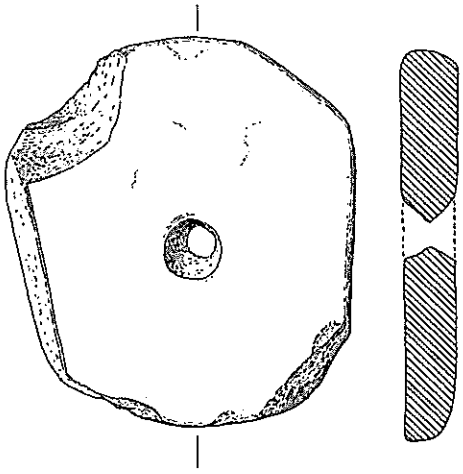
Illus. 16. Trench 4 Roundhouse VIII. View S. Scale 1m



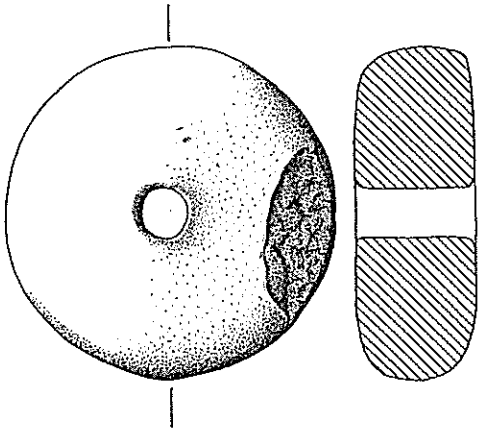
Illus. 17. Trench 4 Structure IX. View NW. Scale 1m



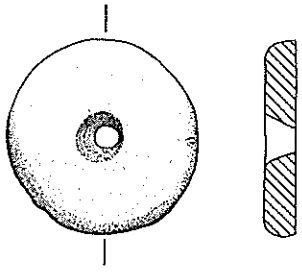
Illus. 18. All objects 1:1



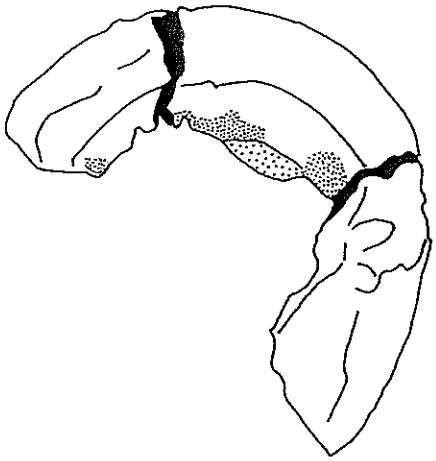
Stone spindle whorl (462)

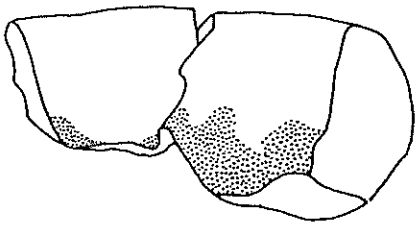


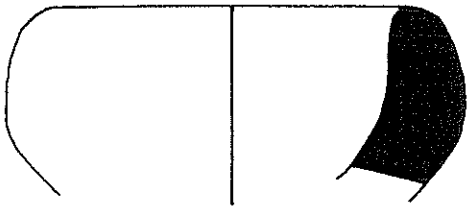
Stone spindle whorl (444)



Stone spindle whorl (438)



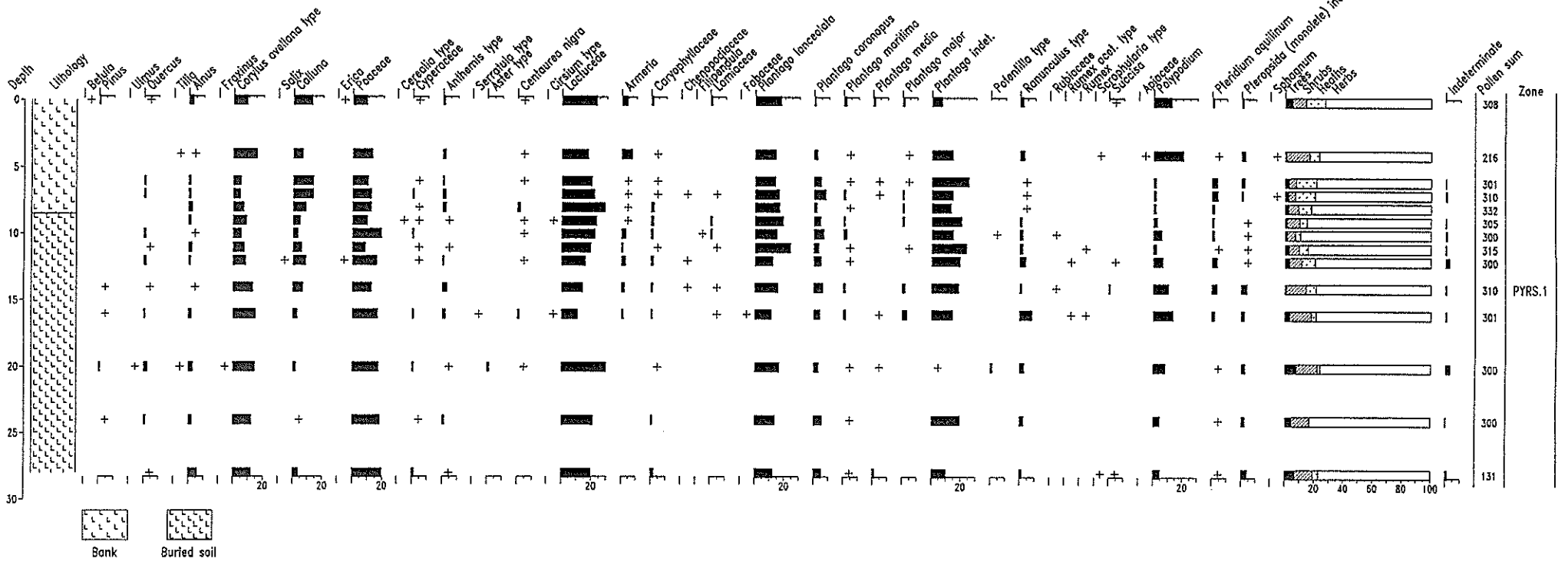




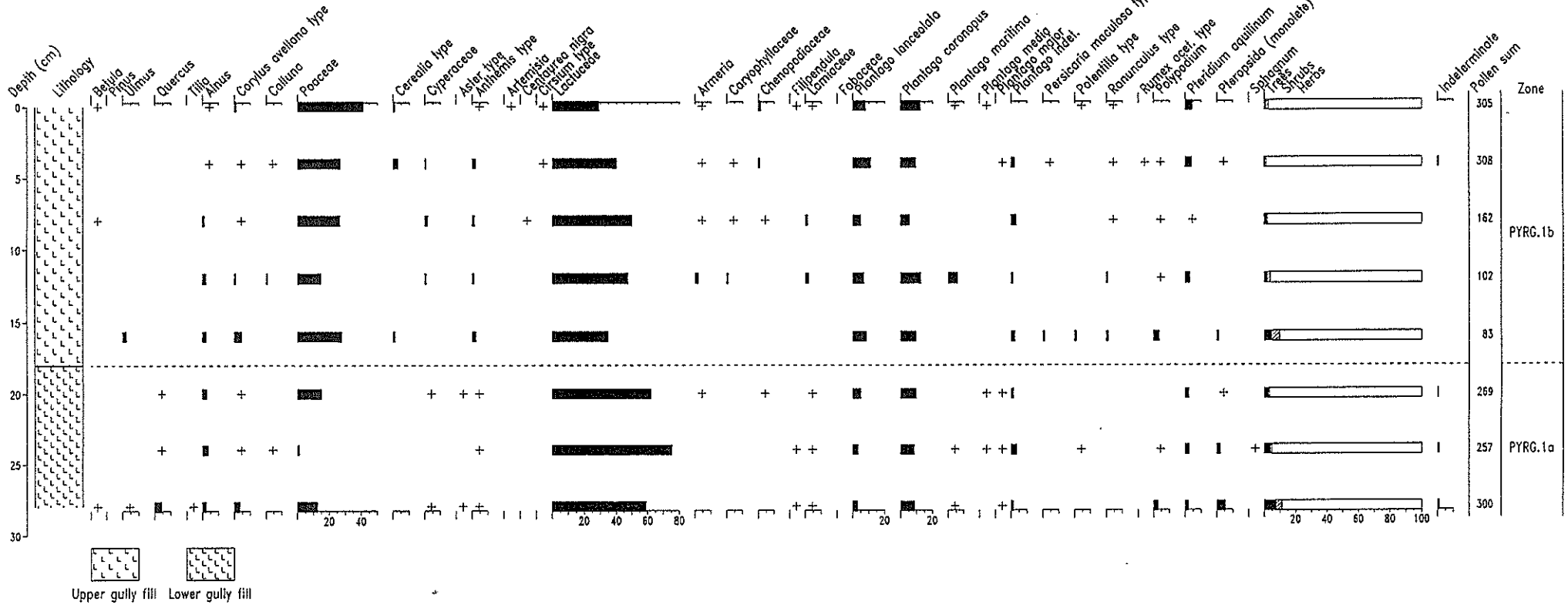
Crucible (473)

10mm

Illus. 19. All objects 1:1

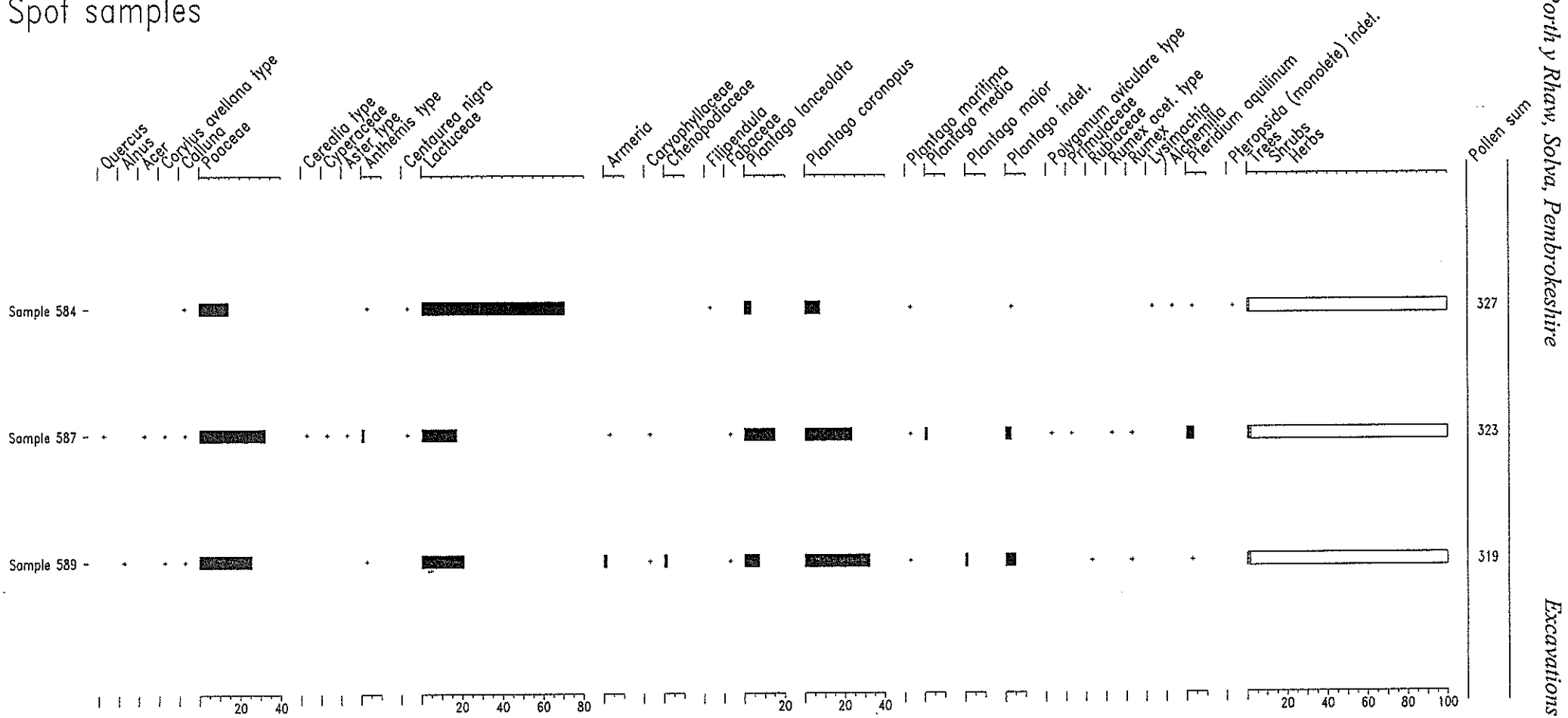


Illus. 20. Percentage pollen diagram from the buried soil beneath the inner bank

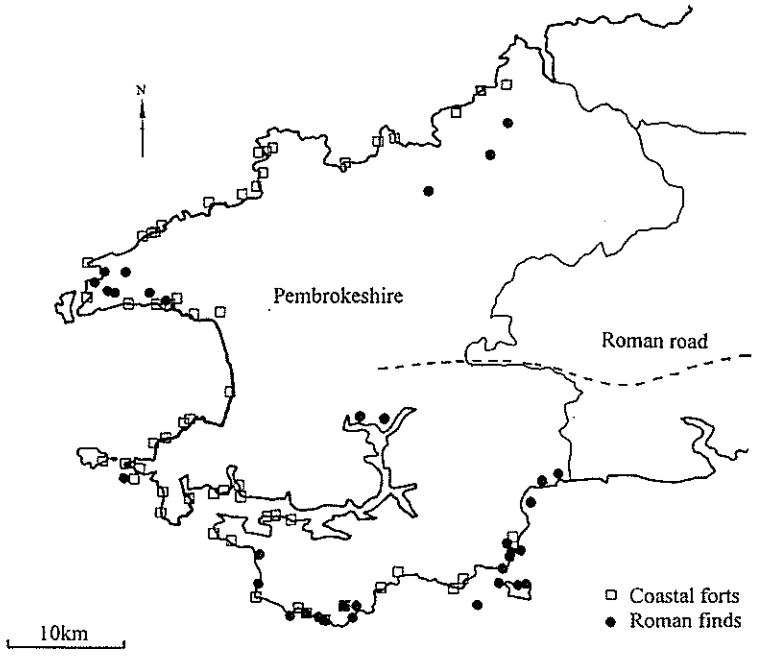


Illus. 21. Percentage pollen diagram from gully XI

PORTH Y RHAW
Spot samples



Illus. 22. Percentage pollen values from spot samples taken from the capped drain fill of roundhouse VIII (sample 584), the later gully fill from roundhouse III (sample 587), and the 'occupation layer' from roundhouse II (sample 589)



Illus. 23. Pembrokeshire coastal forts, Roman finds and road

Context	Sample	Weight	Age	Setting	Residue	Analyses
Group 1						
1225		50	IA		Dense grey slag	SEM amd w/r
1339			IA		Dense grey slag cf 1225	
Group 2						
1251				Occupation near furnace	Broken dense slag	SEM
1285		40		P/h near furnace	Fired clay?	
1286				Fill of cut near furnace	Small pieces pale slag. Crucible 473	Rock frags?
1760				Adjacent to furnace	? crucible lid	
Group 3						
1763				Upper fill of p/h near ent.	Smithing cake and cinder	SEM + w/r
1795				Upper fill of p/h near ent.	Large amount of furnace debris from near blowhole, some denser flaps and poor cake	
1298		335		? 1795	Smithing slags	
Group 4						
1217	576	800 bs	C2	Roundhouse floor		
1217			C2	Roundhouse floor	Light frothy clinker	
1234			C2	Over roundhouse porch	Light frothy clinker	
1235?			C2		Light frothy clinker - large pieces	
1235			C2		Light frothy clinker - large pieces	
1236?			C2			
1236			C2		Light frothy clinker - large pieces	
1770				Stake hole	Light frothy clinker	
650			C C2	Wall tumble	Light frothy clinker	
Group 5						
604			General	Occupation	Mainly light frothy clinker, 1 piece dense grey slag cf. IA material. crucible	Glass + stone
1761				Unstrat.	Light frothy clinker	

Table 1. Summary of the residue archive

	Na	Mg	Al	Si	P	Sn	K	Ca	S	Ti	Mn	Fe	Cu	Cl	total	total *
Tin oxide on ext.	<	<	0.5	0.8	0.3	67.4	0.3	<	<	<	<	0.4	<	<	70	78
Tin oxide in slag	<	<	1.1	3.4	1.2	75.3	<	<	<	<	<	1.3	2.9	<	85	94
Bleb in slag	<	0.7	2.0	1.4	1.8	64.7	0.6	<	0.2	<	<	2.0	4.3	<	78	85
Altered slag matrix	5.5	5.6	9.7	32.7	9.2	15.3	2.9	5.1	0.2	0.6	0.3	12.2	0.4	0.1	100	102

Table 2. EDS analyses from crucible material quoted as wt% of oxide. The totals of material analysed on rough surfaces is very low, so those analyses should only be used as a semi-quantitive guide to composition. Total is given as a hypothetical value were the tin present as a hydrated oxide. < indicates element below detection. The samples did not contain lead, zinc or arsenic in detectable quantities.*

	Tetrahedral	Octahedral					End Member composition		
	Si	Ca	Fe2	Mn	Mg	total	Fa	Fo	"Ca2SiO4"
olivine edge	1.022	0.017	1.755	0.000	0.183	1.96	90	9	1
olivine core	1.014	0.012	1.685	0.000	0.276	1.97	85	14	1

Table 3a. Mineral formulae for EDS analyses of olivines, based on a structure with 4 oxygens (context 1225: sample h)

	Tetrahedral				Octahedral					
	Fe3	Si	Al	total	Fe2	Mn	Ca	Ti	Mg	total
magnetite	13.59	0.15	2.26	16.00	7.38	0.00	0.00	0.13	0.00	7.51

Table 3b. Mineral formula for EDS analysis of magnetite, based on a structure with 32 oxygens and 16 filled tetrahedral sites. (context 1225: sample h)

	Tetrahedral		Octahedral							Interlayer				Other	
	Si	Al	Al	Fe2	Fe3	Mn	Mg	Ti	total	Ca	Na	K	total	S	P
glass	10.047	4.011	0.000	2.742	0.000	0.000	0.000	0.000	2.74	1.289	1.42	2.30	5.01	0.04	0.22

Table 3c. Model mineral formula for EDS analysis of glass, calculated as if it were a feldspar with 32 oxygens. (context 1225: sample h)

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
12.46	3.94	42.59	37.41	0.04	0.54	0.73	0.00	0.94	0.27	0.27

Table 4 XRF major element analysis of iron-working slag sample (sample I) from context 1225.

Lab No	Result BP	Intercept date	Calibrated range at 1 sigma	Calibrated range at 2 sigma	Sample No / Context No
SWA-101	2470 ± 70 BP	520 BC	759-412 BC	792-394 BC	551/4
SWA-286	2350 ± 80 BP	400 BC	479-470 BC and 412-361 BC and 268-268 BC	762-625 BC and 623-610 BC and 593-338 BC and 324-202 BC	570/665
SWA-287	2430 ± 70 BP	480 BC and 470 BC and 410 BC	759-630 BC and 591-576 BC and 571-455 BC and 454-398 BC	787-379 BC	571/667
SWA-288	2550 ± 80 BP	770 BC	798-752 BC and 727-686 BC and 658-520 BC and 463-434 BC	829-404BC	572/679
Beta-124341	2420 ± 80 BP	415 BC	760-635 BC 560-395 BC	790-370 BC	561/16
Beta-124342	2430 ± 60 BP	485 BC and 465 BC and 425 BC	760-670 BC and 550-400 BC	780-385 BC	564/4
Beta-124343	1720 ± 70 BP	350 AD	AD 245-415	AD 145-465 and AD 475-515	576/1217
Beta-124344	2320 ± 90 BP	390 BC	415-355 BC and 290-230 BC	760-635 BC and 560-175 BC	577/1248
Beta-124345	2170 ± 70 BP	190 BC	360-280 BC and 250-100 BC	385-20 BC	592/1209

Table 5. Calibration of radiocarbon dates