The excavation of a Mid Anglo-Saxon malthouse at Sedgeford, Norfolk: An interim report

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Abstract

Excavations in Sedgeford, Norfolk, have revealed the well-preserved remains of an entire grain-processing complex sealed beneath Mid Anglo-Saxon ploughsoil and Late Anglo-Saxon and later colluvium. Though the excavations, which began in 2013, are still ongoing, the remains of one complete malthouse have now been exposed, comprising cistern (for steeping), floor (for germination), and kiln (for drying), all contained within a tripartite building defined by postholes. Not only is what we are calling Malthouse 1 unique in Anglo-Saxon archaeology, its discovery has implications for the understanding of grain-dryers in general. We stress the provisional character of our conclusions. Excavation, analysis, and interpretation are ongoing. The paper is divided into four sections. First, to contextualize Malthouse 1, we provide a brief overview of the Mid Anglo-Saxon archaeology at Sedgeford. Second, we present in some detail the archaeological evidence for Malthouse 1. Third, we offer a summary of the comparative evidence for Mid Anglo-Saxon grain-dryers. Finally, we draw upon historical sources to describe the traditional malting process, and then interpret the Sedgeford evidence in the light of this.

Mid Anglo-Saxon Sedgeford

Since 1996, the Mid Anglo-Saxon site at Sedgeford in north-west Norfolk (Fig. 1) has been the focus of summer research and training excavations organized by the professionally led, but independent and volunteer-based Sedgeford Historical and Archaeological Research Project (SHARP). Here we provide a brief overview of the settlement and cemetery which were the focus of earlier SHARP excavations.[1]

Between 1996 and 2007, we investigated a Mid Anglo-Saxon cemetery on the Boneyard-Reeddam site, excavating a sample of 291 inhumations, in the course of which we observed several phases of boundary ditches and various structures. Some of the features undoubtedly related to the cemetery, but others probably represented phases of settlement activity interleaved with successive use of different areas for burials, including one major structure within a substantial palisaded enclosure (Figs. 2 and& 3). A combination of stratigraphic, artefactual, and radiocarbon evidence suggests an approximate dating for the cemetery of *c.* AD 650/725–850/875.

Between 2007 and 2016, our attention shifted a short distance to the south – higher up the southern slope of the little valley of the River Heacham – where geophysical survey had revealed evidence for a settlement, confirmed by fieldwalking finds to be Mid to Late Anglo-Saxon in date, in the neighbouring Chalkpit Field. Here, well beyond the limits of the cemetery, which was confined to the lower slope closer to the river, we uncovered evidence for several phases of settlement activity. In the earliest Anglo-Saxon phases (Phases 3 and 4: *c.* AD 650/700–?775/825), the settlement was bounded by curvilinear ditches, and the evidence for associated structures was minimal. A major reorganization occurred in the late eighth or early ninth century AD, with a new layout of rectangular plots defined by ditches, and a sequence of post-hole and post-in-beam 'hall'-type buildings (Phases 5 and 6: *c.* AD ?775/825–?900/950). All of the latter were aligned north-south, except for the most substantial, which was aligned east-west, implying some special status. Not all buildings were contemporary – there was clear stratigraphic evidence for replacement in places – and many of the boundary ditches had been frequently recut and sometimes realigned. Finally, probably in the early tenth century, post-dating the cemetery but contemporary with the later phases of the settlement, a massive D-shaped enclosure was established immediately to the south, inside which, despite heavy plough truncation, we identified a number of substantial features (Phase 7: *c.* AD ?900/950–?975/1025). We have provisionally interpreted the D-shaped enclosure as a thegnly residence.[2]

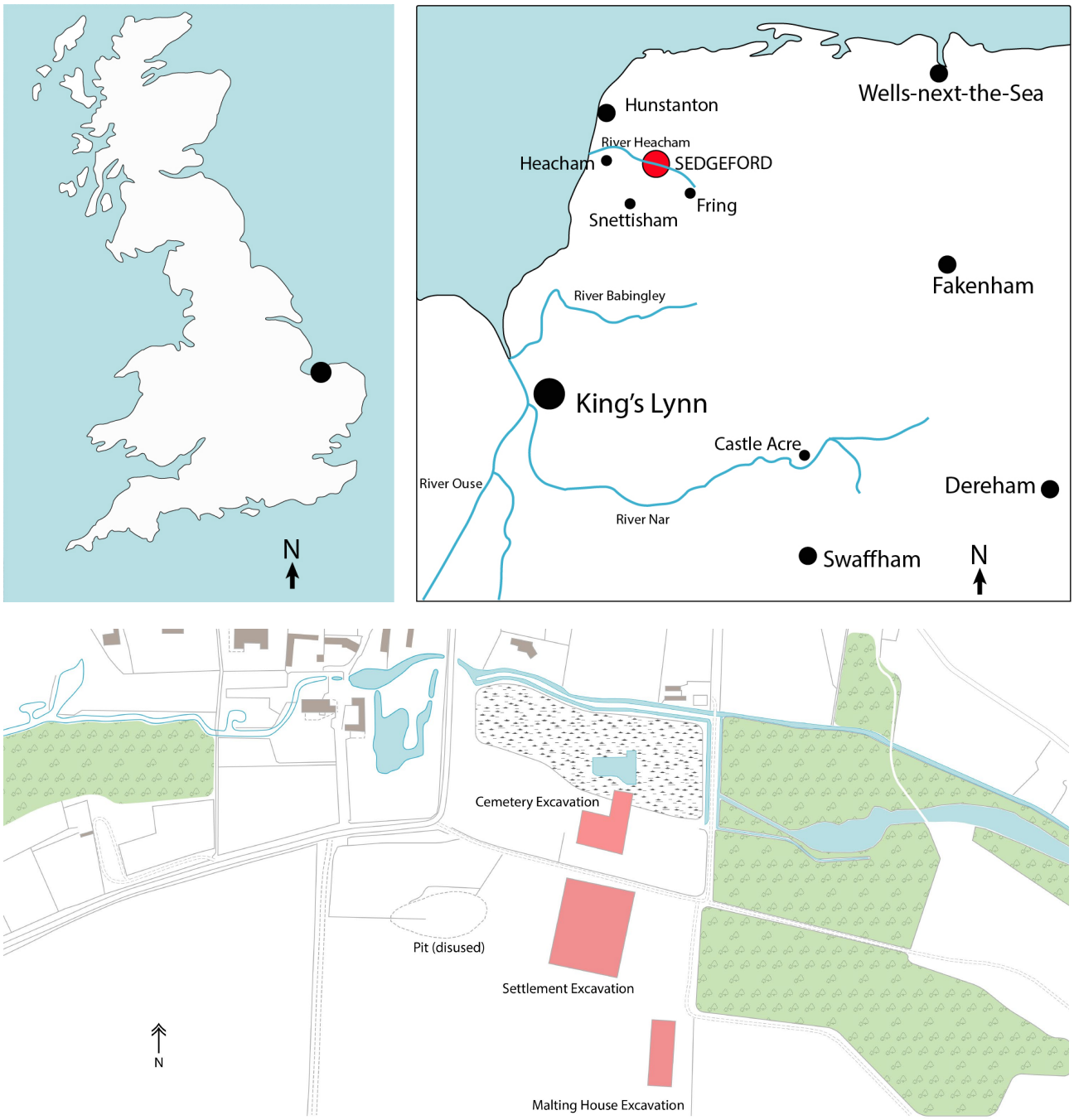

Figure 1a, 1b, 1c. The location of Sedgeford and the Boneyard and Lower Chalkpit Field excavations. Image: Gary Rossin/SHARP.

Since 2014, we have been exploring a third zone, a cereal-processing plant located a short distance south-east of the settlement in a shallow gully towards the eastern side of Chalkpit Field (Trench 23). First indicated in the form of some extreme geophysical anomalies, our excavated discoveries so far include three definite and one or more possible kilns, at least two and maybe three or four burnt structures, several clay floors, and an elaborate system of water-management ditches. Both the cereal-processing plant and an overlying layer of what is almost certainly ploughsoil can be dated ceramically to the Mid Anglo-Saxon period, making the cereal-processing activity contemporary with the earlier phases of the settlement but not the later ones. The location of the site towards the bottom of a chalk hill, combined with its relatively steep sides and the loose sandy-gravelly subsoil, caused the gully to fill up rapidly with colluvial inwash after the Mid Anglo-Saxon phases of activity. The effect has been both to preserve the working surfaces of the cereal-processing plant and to maintain the temporal integrity of the ploughsoil (both dated by Ipswich Ware): the entire Mid Anglo-

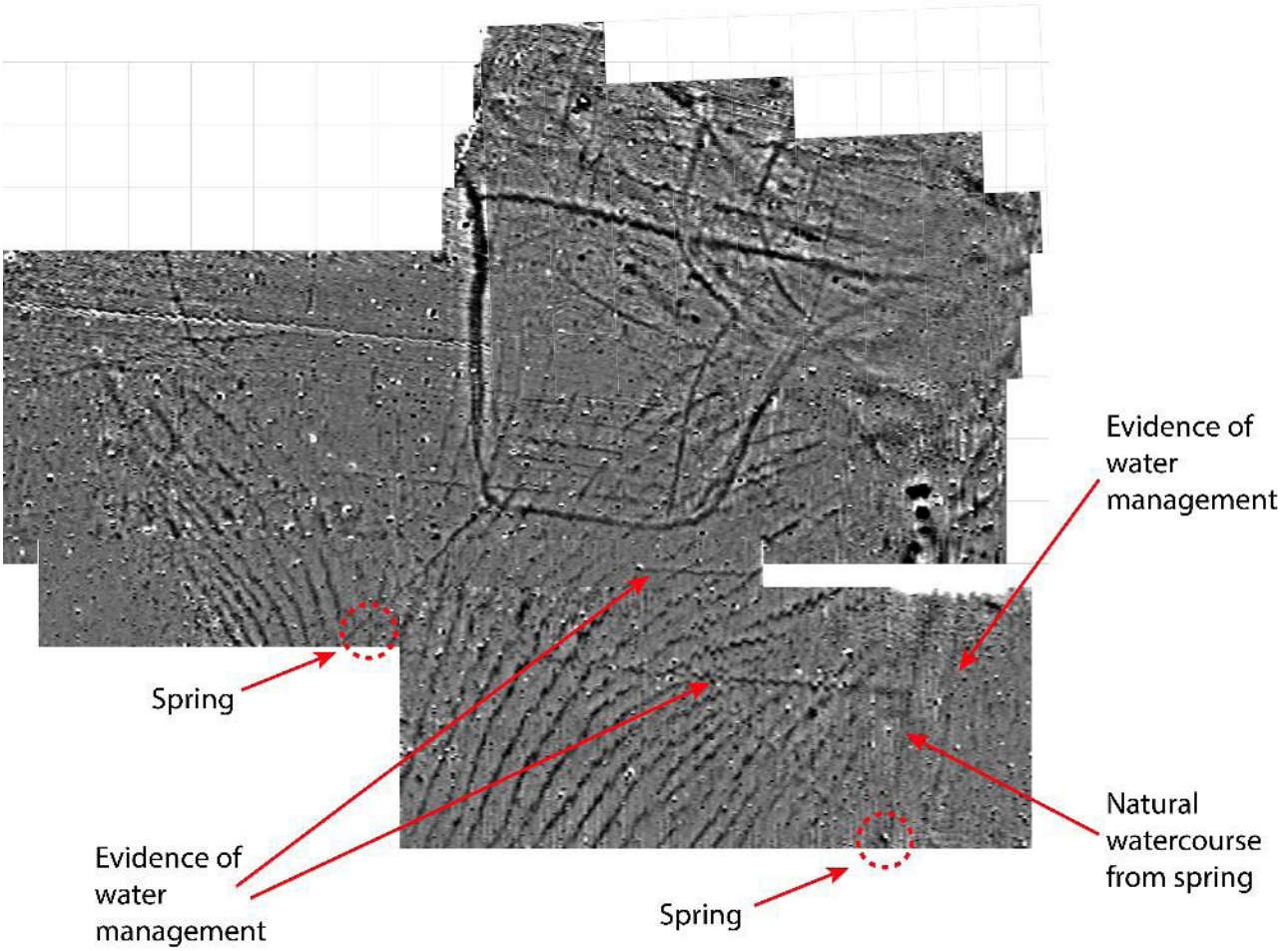

Figure 2. Geophysical survey plot of Lower Chalkpit Field.
Image: Melinda Barham, David Hibbitt, and David Wood/SHARP.

Saxon sequence, in short, has been sealed by deep deposits of later medieval colluvium.

So across the site as a whole, we have evidence for three distinct periods of activity:

Phases 3 and 4 (c. AD 650/700–?775/825)

Clear settlement evidence for this period so far eludes us, and the possibility is growing that the original Mid Anglo-Saxon settlement may have lain to the north of the cemetery, beneath the Reeddam, which we increasingly suspect was created in the late eighth or early ninth century. A series of evaluations has revealed Mid Anglo-Saxon remains in this now-waterlogged area, and we are beginning to suspect a major landscape reorganization around AD 800, with the purpose of managing water to power mills, feed a canal, and develop a wetland. On the other hand, some sort of settlement focus may be represented by a substantial curvilinear ditch excavated on Chalkpit Field, though we have little evidence for buildings within, and none at all for plot boundaries. What is certain, however, is that we have a large, ordered, probably Christian cemetery with up to 1,000 east-west aligned inhumation burials on the Boneyard-Reeddam site.

Phases 5 and 6 (c. AD ?775/825–?900/950)

Around a century or so later, the settlement seems to have been laid out anew on Chalkpit Field on a grid pattern, with hall-type buildings sitting inside rectilinear plots bounded by ditches. The cemetery on Boneyard-Reeddam remained in use for much of this period, and at some point a substantial palisaded enclosure, probably containing at least one major structure, was established west of the cemetery. In the early part of this period (Phase 5), a cereal-processing plant was established on Chalkpit Field in a north-south gully to the south-east of the settlement site.

Phase 7 (c. AD ?900/950–?975/1025)

About a century later again, a large D-shaped enclosure, most probably a higher status complex),[3] was established on the southern edge of the settlement. The latter was little changed, but the cemetery seems by now to have gone out of use, as had the cereal-processing plant.

Figure 3. Composite image showing Boneyard and Lower Chalkpit Field excavation trenches in relation to geophysical survey data. Image: Melinda Barham, David Hibbitt, and David Wood/SHARP.

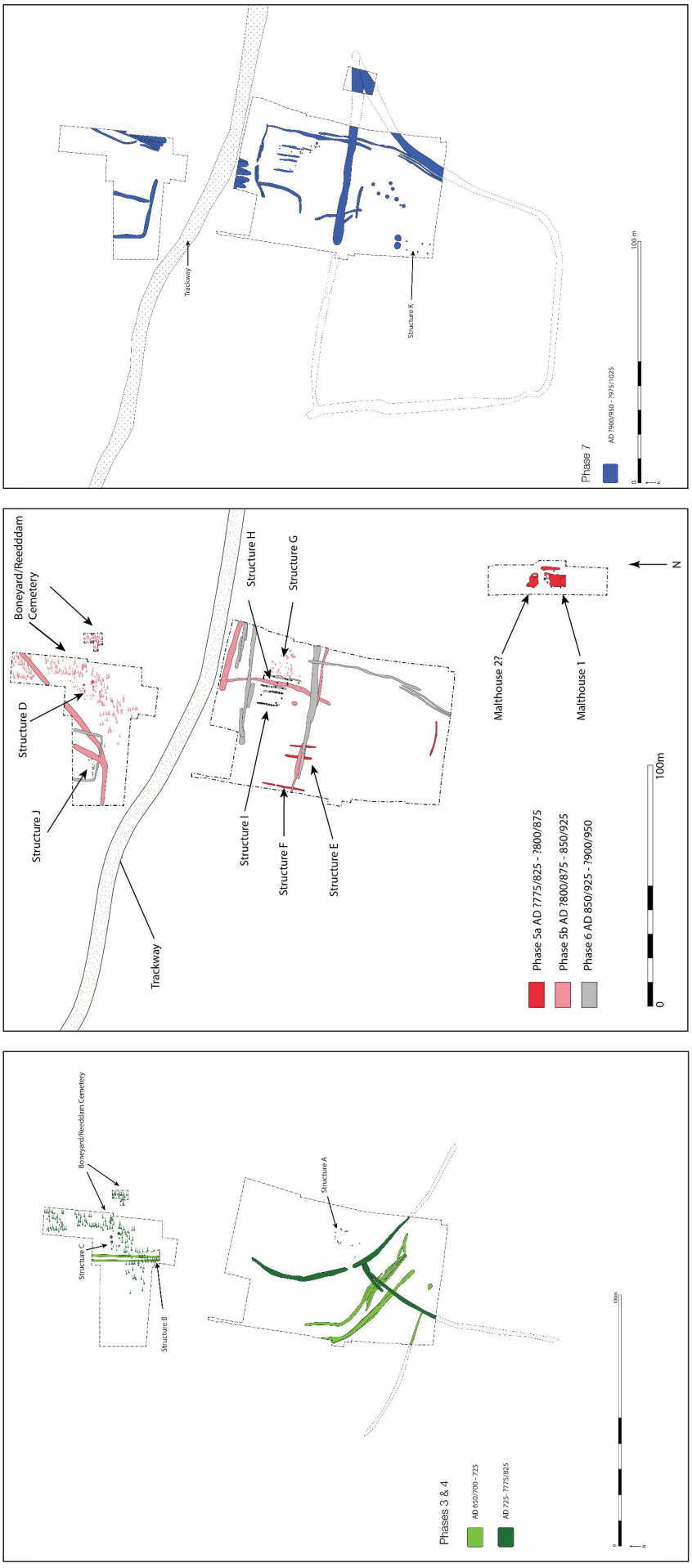

Figure 4a, 4b, 4c. General plans to show the three main phases of Mid/Late Anglo-Saxon archaeology on Boneyard and Chalkpit Field: a) Phases 3 and 4 (c. AD 650/700–?775/825); b) Phases 5 and 6 (c. AD ?775/825–?900/950); and c) Phase 7 (c. AD ?900/950–?975/1025). Image: Jon Cousins and Gary Rossin/SHARP.

One caveat is in order. Our investigations represent only a sample of the archaeological deposits. Our 291 burials, even when coupled with a further 126 excavated in 1957, 1958, and 1960, probably amount to less than half, perhaps less than a quarter, of the total; we are left guessing, because we have been unable to establish the full extent of the cemetery, especially on the northern side, and because the density of burials was found to be variable during excavation, so no easy extrapolation from sample to whole is possible. The settlement is known to have extended beyond the limits of our trenches in all directions, and there is some evidence – from geophysics, fieldwalking, chance finds, and antiquarian records – that it may in fact have been many times larger than the area uncovered in our excavations. As for the cereal-processing plant (our Trench 23), it is already clear that this extends beneath our current western baulk, and, quite possibly, also beyond the southern and northern limits of the trench.

The Archaeology of Malthouse 1 (Figs. 5, & 6)

Introduction

Although only part of a more extensive malting complex, still under investigation, the excavation of what we are calling Malthouse 1 is now sufficiently complete to warrant interim publication. Some uncertainties remain; these are clearly indicated in the report below, and we hope to resolve them during the next phase of excavation. None is such as to cast any real doubt on our main conclusion: that we have a late eighth- or early ninth-century malthouse of traditional tripartite character defined by three dominant features – steeping tank, germination floor, and drying kiln.

Malthouse 1 extends approximately north-south along the base of the gully on the eastern side of the northern part of Chalkpit Field, and occupies a fairly central location within Trench 23. Begun as a small

Figure 5. General view (drone shot), north to south, along the length of Malthouse 1, showing kiln/drying area, germination floor, and cistern/steeping area. Image: Ian Drummond/SHARP.

Figure 6. General view (drone shot), overhead (north to the right), showing Malthouse 1, with kiln/drying area (centre), germination floor (left centre), and cistern/steeping area (left). Note that Kiln 2, part of a second malting complex, is clearly visible on the right. Image: Ian Drummond/SHARP.

evaluation trench in 2013 (Trench 17), subsequently enlarged and renamed in 2014 and 2015 (Trenches 17 and 19), we have been excavating this site since 2016 as a single open-area excavation (Trench 23). Similar features, likely to represent other malthouses, have now been observed to the north and the south of Malthouse 1; these will be investigated over the next few years. Though there is some evidence for both earlier and later Mid Anglo-Saxon phases in the central part of Trench 23, the stratigraphy is dominated by the remains of Malthouse 1. Our focus in this paper is exclusively on this building, although we indicate below where features have been observed which may relate to other phases.

The remains of Malthouse 1 are exceptionally well-preserved for a rural Anglo-Saxon site, allowing us to see, for the first time, the form of an entire malthouse of this period, to divine the technology implicit in its operation, and to throw grave doubt on traditional interpretations of grain-dryers. This is so for three reasons. First, the Mid Anglo-Saxon layers have been sealed by rapid colluvial infilling of the gully where they lie. Second, the malthouse burnt down, and the remains of carbonized timbers, wattle-and-daub wall panels, baked clay surfaces, and general spreads of fire debris characterize the site. Third, a clay-lined semicircular depression that we take to be a cistern/steeping tank was infilled with much of this burnt material, perhaps deliberately, to reclaim the land for agriculture. Because of the quality of the evidence, combined with the importance of the observations and interpretations based upon it, interim publication seems justified, since the excavation still has several more years to run.

We deal with the technology of the malting process in detail below, but we provide a brief summary here to assist readers unfamiliar with it before proceeding to our description of the stratigraphic evidence.

Malting and brewing go back thousands of years.[4] The basis of malting is that germinating grain initially feeds off itself by converting stores of starch into sugar, up to the point where a sprout is produced which penetrates the soil and absorbs external nutrients to feed further growth. The maltster's

job is to trigger, control, and then terminate this natural process, thereby converting starch-rich grain into sugar-rich malt, the latter being, of course, the raw material of brewing, which is essentially the fermentation of malt. The aim is to arrest the germination process – by drying – *without* destroying the enzymes necessary for fermentation by scorching and thereby killing the grain. A traditional malthouse therefore comprises three essential parts: a steeping tank to soak the grain for a couple of days and trigger the germination process; a moist germination floor on which the grain can lie for up to two weeks; and a drying area with moderate heat to terminate the germination process.

The dating evidence

Malthouse 1 – and, indeed, the malting complex as a whole – is securely dated to the Mid Anglo-Saxon period. Moreover, we suspect, though with less confidence, that it belongs more precisely to the late eighth and early ninth centuries AD. The reasoning is as follows.

As explained above, the gully on the eastern side of the northern part of Chalkpit Field has been subject to rapid colluvial infilling from the west, the north, and especially the east (as is evident in our ditch sequences, where we have multiple recuts). The effect of this, coupled with the fact that the field appears not to have been ploughed between the Mid Anglo-Saxon period and the twentieth century, has been to seal the Mid Anglo-Saxon deposits beneath protective layers of overburden. At the base of the gully, beneath modern ploughsoil of up to 0.5 m depth, these layers – formed of orange-brown sandy colluvium with numerous chalk lumps and some flint – reach a maximum depth of 1.2 m.

The colluvium overlies a dark-brown humic layer 0.4 m in maximum thickness. Except for occasional fragments of residual Iron Age or Romano-British pottery, this layer contains only Ipswich Ware (*c.* AD 720–850), nothing later. The Ipswich Ware is present in moderate quantity, with a good number of large, unabraded sherds. There is also a fair amount of animal bone and shell. This layer directly overlies the features of the malting complex, which, in many places, are scarred by north-south plough-lines. The humic deposit seems poorly sorted, with marked grey/brown contrasts in places, and perhaps even a suggestion of diagonal layering of clods of earth. The impression of a sealed Mid Anglo-Saxon ploughsoil containing midden debris seems compelling.

The implication, of course, is that abandonment of the malting complex must have predated the end of the Mid Anglo-Saxon period (as defined by Ipswich Ware) by a sufficient period to allow time for the accumulation and working of an overlying ploughsoil. This period need not have been very long, however, since our own experience confirms that the gully fills up very rapidly, such that a few years of accumulation might well have been quite sufficient to create a workable soil. We therefore propose the following hypothesis: that the establishment of the cereal-processing plant was broadly contemporary with the establishment of the grid-planned settlement – i.e. both events belong to Phase 5 (see above). We argue this on the basis that both archaeological imprints – the sophisticated plant and the ordered community – could be thought of as complementary and as requiring the intervention of some guiding hand from above. Moreover, as already indicated, we suspect that these two developments were in turn linked with a third: a major reorganizsation of the landscape in the valley bottom to manage water in order to power mills, facilitate transport, and create wetland resources (although we are not yet in a position to report on this in any detail).

Water management, access routes, and associated structures

This paper does not constitute an interim report on the ongoing excavations in Trench 23 as a whole; it is an interim report on the set of associated features constituting Malthouse 1. What follows is a brief summary of some of the other features observed on or close to the site – either seen on geophysical plots or wholly or partially excavated within the trench – which may have had a functional relationship with Malthouse 1.

North-south ditches run to either side of Malthouse 1. The eastern ditch varies between 0.6 m and 0.8 m in width and between 0.25 m and 0.4 m in depth. It lies only 0.4 m from the eastern wall of the drying area and 1.8 m from the eastern wall of the germination floor. The western ditch lies at a greater distance from the malthouse, is cut into the western side of the gully, and therefore runs at a considerably higher elevation. It varies between 0.6 m and 1.0 m in width and between 0.3 m and 0.8 m in depth. Frequent recuts have been observed in section. It lies 6.5 m from the western wall of the germination floor.

The ditches were probably multi-purpose, channelling water either side of the base of the gully where the malting facilities were located, providing a water supply for the steeping process and perhaps providing drainage for the disposal of waste water from the same. However, a further possibility has

been raised by David Wood and Melinda Barham, SHARP's geophysical survey team. Having now completed a magnetometry survey of the whole of Chalkpit Field, they are confident that they have identified the upslope spring-line source and stream gully supplying water to the malting complex. They have further suggested deliberate manipulation of this resource to concentrate flow and perhaps generate the power necessary to drive one or more small, hillside watermill. All this remains, at this stage, highly speculative: work is ongoing, and no full report of relevant observations can be given at this stage.

Geophysical survey has also revealed evidence for a trackway running south-east to north-west over the brow of the lower slope of Chalkpit Field, passing from the location of the malting complex into and through the settlement site discussed briefly above. Excavations on the settlement site revealed ditches bounding a presumed trackway of roughly 5 m in width. The trackway may have extended as far as the river, which lies approximately 300 m due north of Malthouse 1, perhaps following an indirect north-westerly route over higher ground to avoid boggy terrain in the lower reaches of the gully where the malting complex lies – perhaps especially necessary if the speculation about water management to maximize flow down the slope is correct. However, the section of the trackway investigated during the settlement excavation turned out to belong to Phase 3 (*c.* AD 650/700–725) – it was dated by grass-tempered pottery rather than Ipswich Ware – and thus predates the malting complex, perhaps by as much as a century.

In Trench 23 itself, in addition to Malthouse 1, we have fully excavated one other kiln and associated clay surface, which may represent a second malthouse south of and adjacent to Malthouse 1, though on an east-west alignment. Less well defined at this stage is a third kiln and associated clay surface to the north of the trench, and, almost certainly, a fourth at the southern extent, represented at this stage of the excavation by heavy concentrations of burnt daub. The lack of much vertical sequencing is a notable feature of the site. This gives rise to three possible interpretations: that only one malthouse was operational at any one time; that several malthouses were constructed sequentially to increase capacity, such that two or more were eventually operational at the same time; or that the entire complex was originally constructed as a multi-unit facility.

Figure 7. Interpretive detail view (drone shot) of Malthouse 1, showing assumed tripartite building form (north to the right). Image: Ian Drummond and Gary Rossin/SHARP.

Finally, the geophysical surveys have revealed evidence for possible 'helms' or 'hay barracks' in the form of rings of post-holes several metres wide, notably a group of three immediately north of Trench 23, precisely where we might anticipate large-scale grain storage. As Mark McKerracher has observed, a feature of this kind was seen at Yarnton, and many contemporary examples are known from Germany and the Netherlands.[5] Our work on these features is at a very preliminary stage, however, thus we can do no more here than draw readers' attention to the potential for placing Malthouse 1 in a much fuller landscape context as research proceeds.

The steeping area

Our provisional interpretation of Malthouse 1 is that it comprises a single building divided into three parts (Figs. 7, & 8). We deal with each of these in turn, starting with the steeping area.

Major uncertainties, which may be clarified by further excavation, remain in relation to the steeping area. The evidence can be broadly divided into four elements. From north to south, these are: 1) a clay-lined, semicircular depression [23050]; 2) a possible rectangular structure within the depression defined by carbonized timbers and collapsed wattle-and-daub (23051); 3) a ground-level clay surface (23625) at the presumed southern extremity of the malthouse, one that extends west of the line of the western wall of the germination floor; and 4) a clay 'ramp' (23386) extending up the western side of the gully from close to the presumed southern extremity of the malthouse. In this section, we first describe the evidence for each of these elements, then, combining the evidence, offer several hypothetical reconstructions, none of which is, in our present state of knowledge, entirely satisfactory.

1. The semicircular depression

The clay-lined semicircular depression is 4.0 m in width east-west, 2.2 m long north-south, 0.41 m in depth at the deepest point, and has sloping sides of

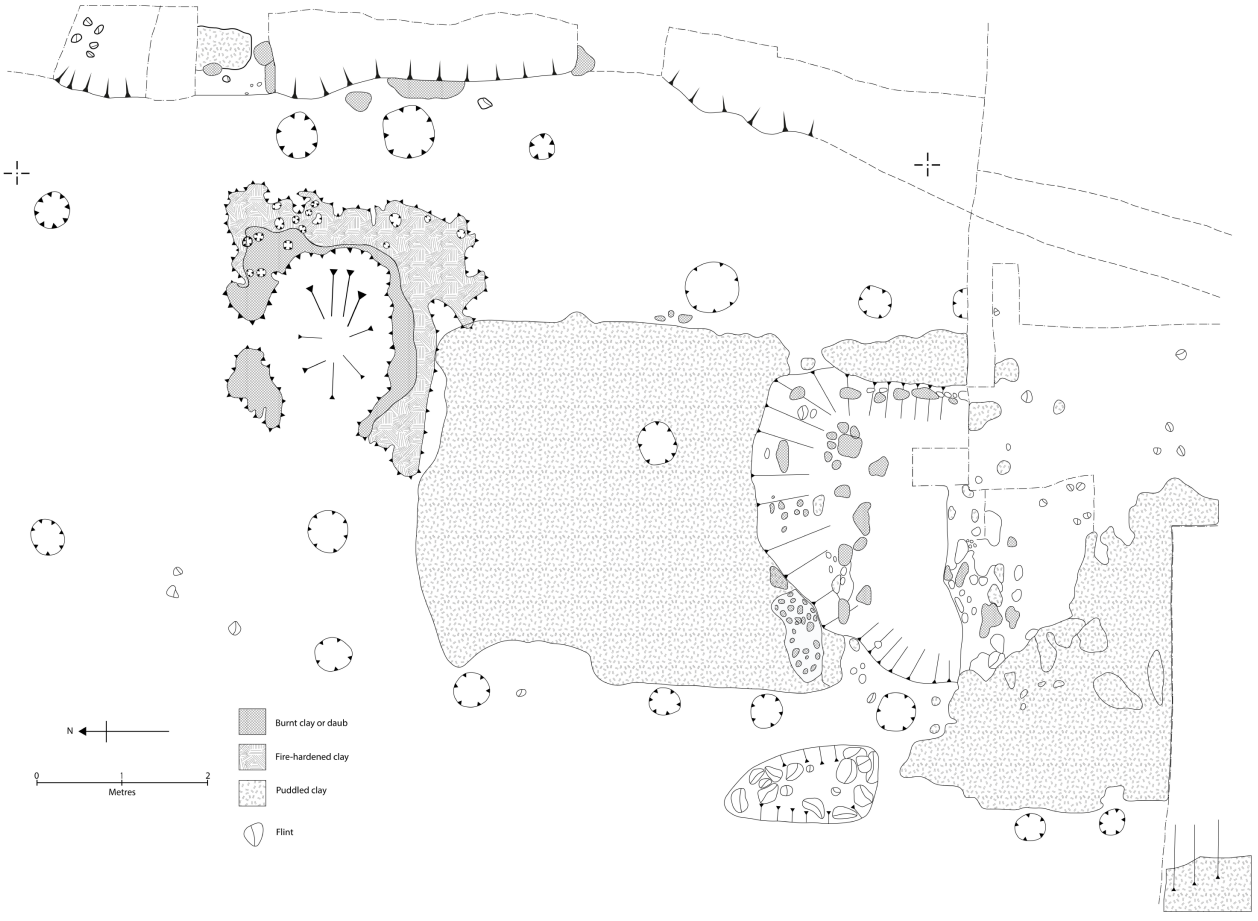

Figure 8. Interpretive plan of Malthouse 1 (north to the left).
Image: Stuart Calow, Ian Drummond, and Neil Faulkner/SHARP.

Figure 9a, 9b. General and detail views of in situ wattle-and-daub wall forming southern side of the presumed cistern/steeping area of Malthouse 1. Image: SHARP.

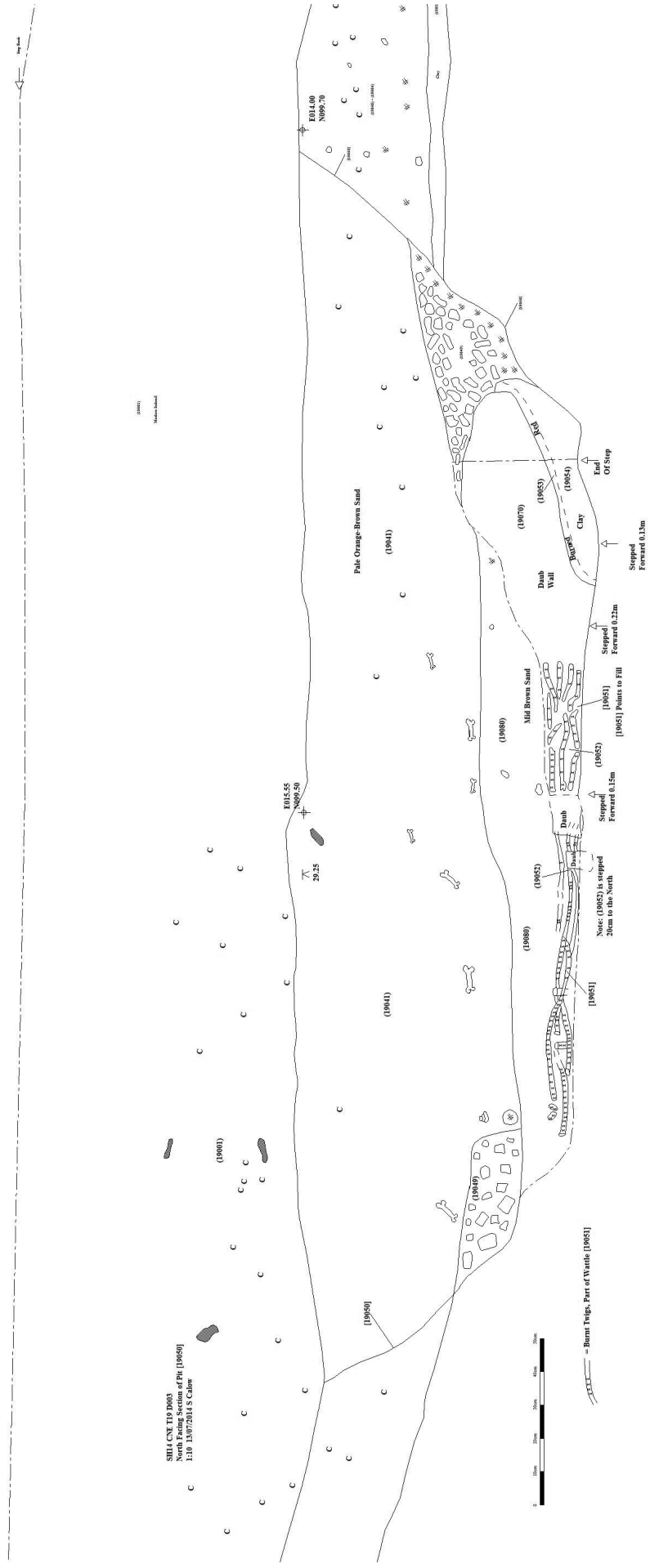

Figure 10. Section showing the wattle-and-daub wall and building collapse in the cistern of Malthouse 1. Image: Stuart Calow/SHARP.

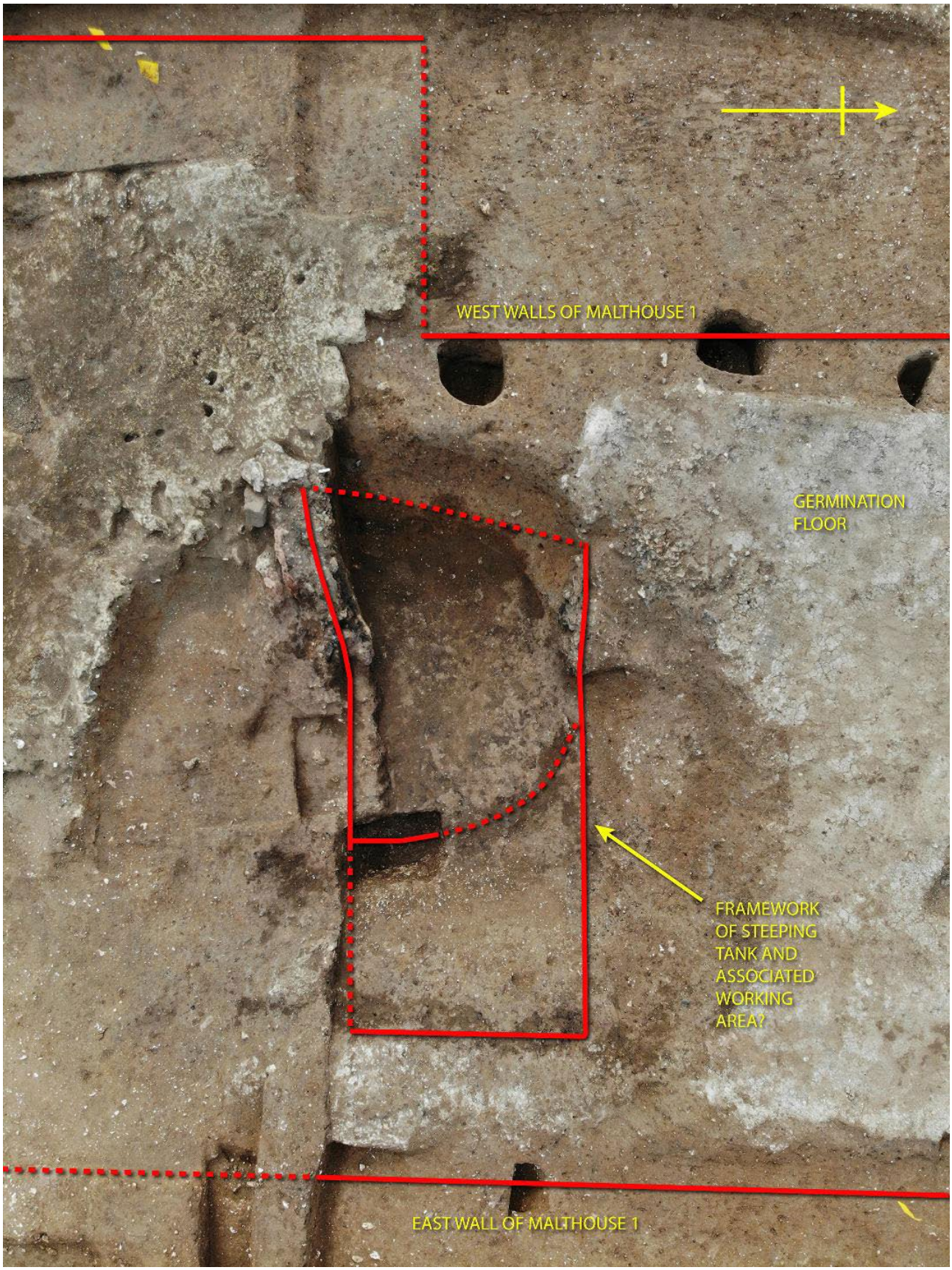

Figure 11. Interpretive detail view (drone shot) of cistern/steeping tank, showing evidence for timber framework within pit. Image: Gary Rossin/SHARP.

variable gradient. The southern, straight side of the depression is defined by the intact wattle-and-daub wall discussed below as part of element (2). The depression appears to have been clay-lined across the entire surface. It was infilled with three distinct deposits. The lowest (19060) comprised a loose, mixed, general infill deposit. The second (23351) comprised a layer of collapsed daub debris 0.25 m thick at its deepest point. The distribution of this material was uneven, with the greatest concentration, and a higher proportion of larger pieces, close to the wattle-and-daub wall (23051) at the southern limit of the depression; we interpret this as representing the collapse of the upper portion of this wall. The uppermost deposit comprised a very dark, grey-brown, charcoal-rich, sandy soil (19059), 0.12 m thick; we take this to represent natural infilling of the hollow after the building had burnt down. One potentially significant find, from within the collapsed daub debris, was a large iron hook (see below).

2. The possible rectangular timber and wattle-and-daub structure (Figs. 9, 10, 11)

Within the semicircular depression, we have evidence for the possible former existence of a rectangular framework of squared timbers and wattle-and-daub walling, measuring 2.4 m east-west and 1.0 m north-south. Further investigation is pending; in particular, we have yet to explore the foundations of the structure represented. One significant preliminary observation is that of a squared timber laid horizontally, seen in a small sondage in the base of the depression; this appears to run east-west beneath the wattle-and-daub wall defining the southern side of the depression. This, measuring 0.1 m by 0.12 m, may be representative of the timber framework as a whole. This supposition is supported in places by impressions on the clay base of the depression of what appear to be parts of carbonized horizontal timbers represented by dark lines, sometimes associated with ephemeral lines of burnt daub (Figs. 12a, & 12b).

Two substantial extents of carbonized and burnt wattle-and-daub wall have been revealed. The smaller section (23072), on the north-western extent of the putative structure, measures 0.85 m in length. A far larger section (23051), forming the southern, straight edge of the depression, measures 2.0 m in length, approximately 0.3 m in thickness, and stands up to 0.4 m in height. Clearly visible in this deposit are the carbonized remains of a weave of withies coated in layers of burnt daub.

A caveat must be noted here. We have seen very little of the material underlying the hard clay base of the depression, yet we know from observations in a small square-shaped sondage, that rich carbonized deposits lie beneath. The possibility arises, therefore, that more than one phase may be represented; perhaps the facility was repaired/rebuilt on one or more occasion.

3. The clay surface at the south end

This surface (23625), formed of a considerable thickness of puddled yellow clay (notably different in composition from that forming both the germination floor and the lining of the depression), extends across the southern end of Malthouse 1. Although excavation is incomplete, it appears to extend 4.5 m north-south and 3.5 m east-west. The surface does not extend as far as the line of the eastern wall of the germination floor; however, it is highly likely that this is due to truncation by a later south-west to north-east running ditch. Possible postholes associated with this edge of the clay surface have yet to be explored. On the other hand, the surface clearly extends approximately 0.9 m west of the line of the western wall, where its western limit is defined by a straight edge to the clay and two postholes, [23684] and [23687], respectively 0.38 m in width by 0.34 m in depth, and 0.37 m in width and 0.46m in depth, making them comparable in size with the postholes forming the western wall of the germination floor. In other words, the western wall of the germination floor and the western wall of the steeping area form a dog-leg – similar (as described below) to that of the eastern wall of the germination floor and the eastern wall of the drying area – giving the unmistakable impression of a tripartite building.

It may be worth adding the following comment. Tight control over environmental conditions on the germination floor is an essential feature of the malting process. To achieve this in traditional malthouses, the walls butt up against the germination floor and the ceiling tends to be low. It is even advisable to limit the overall size of germination floors – such that expansion of capacity is liable to take the form of multiplication of units rather than enlargement of units – because regulation of temperature, light, moisture, and air-flow is easier in smaller spaces. Because of this, traditional malthouses tend to have a multi-partite design – instead of, for example, everything being enclosed within a symmetrical rectangular building. (See below on the technology of Mid Anglo-Saxon malting, especially Table 2.)

4. The possible clay ramp

A further clay surface (23386) – whose relationship with (23625) is yet to be established – appears to be represented by two areas of well-preserved puddled

Figure 12a, 12b. General and detail views of carbonised timbers within cistern/steeping tank. Image: SHARP.

grey clay, separated by an area of poor preservation, probably due to plough damage, extending up the side of the gully beyond the presumed south-western limit of Malthouse 1. If we are correct in believing this to represent a single spread of material, it would have extended 5.2 m north-south and 4.0 m east-west, and rises on a gentle gradient, potentially to a terrace cut into the side of the gully, where large quantities of burnt material were recovered from a ditch fill. This fill may be from the same source as an extensive deposit of grey, ashy material rich in charcoal, daub, clay, and burnt grain (23365) overlying the clay ramp. The implication could be that a large building standing on a terrace-platform on the side of the gully burnt down, and that the clay ramp was related to both this building and to the malthouse below. Also worth noting is the presence of a sub-oval spread of large flints measuring 1.85 m north-south and 1.0 m east-west, lying adjacent to the southern end of the western wall of the germination floor. We mention this here because of a possible relationship with the burnt structure to the west (discussed below).

The hypotheses

Our understanding of the steeping area remains in flux. Not only have we yet to make full sense of the structural remains represented in and around the cistern, we have to explore further the way in which grain might have been delivered to the southern end of Malthouse 1, and this will involve addressing uncertainties about the nature of the buildings on the western side of the gully, the relationship between these and the possible ramp connecting them with the malthouse, and the character and extent of storage facilities incorporated into the malthouse itself. Here, therefore, we list and comment upon a series of possibilities.

1. The semi-circular, clay-lined depression functioned as a steeping tank

This was, for a long time, our working assumption, but it now seems inconceivable for two reasons. First, the grain and the clay of the lining would have turned into a soup. Second, in working the grain, the maltsters would have been churning the steep into a quagmire. On the other hand, the clay-lined depression works well enough as a water-container in the context of (2) and (3) below.

2. A structure of timber and sacking or canvas formed the steeping tank

There is strong evidence for some such structure – supported by the discovery of two large iron hooks, one in the building collapse, one in the overlying ploughsoil (see below) – and this would have allowed grain to have been saturated/steeped, but kept suspended above the clay-lining of the cistern.

3. A timber working platform was suspended over the clay-lined depression

Again, there is strong evidence for some such structure, and this would have allowed the maltsters to work the steeping tank, in particular to move grain in and out of it, without the obvious impracticalities of standing inside the clay-lined depression.

4. Water may have been moved by channels, soakaways, and/or buckets/shadoufs

Each steeping required fresh water – and, ideally, changes of water during each steep – so elaborate arrangements would have been necessary for moving water into and out of the steeping tank/cistern on a continual basis.

5. There may have been a single integrated complex, conjoined buildings, or separate buildings

The distinctive elements comprising the southern end of Malthouse 1 – the cistern, the timber structure, the clay floor, the clay ramp, the associated postholes – cannot yet be fully interpreted, so we must leave open the question about precise building form.

6. There may have been more than one phase

The evidence for more than one phase at Malthouse 1 is modest, yet some intercutting features have been observed, including two large post-holes which do not correspond to the building plan (one in the drying area, one on the germination floor), a water channel which appears to cut through the south-eastern extent of the building, the possibility of more than one phase of clay surfaces in the southern area, and the possibility of more than one phase of timber construction in the steeping area.

The germination floor

The germination floor is the best defined of the three distinct areas constituting Malthouse 1. Since it is joined to the drying area at its northern end and the steeping area at its southern end, it has only two external walls. These enclose a sub-rectangular clay surface (23044) measuring between 4.0 m and 5.0 m north-south (the difference being due to the edge of the pit associated with the steeping tank at the southern end), and between 3.3 m and 3.8 m east-west (with relative splaying at the southern

end). The deposit comprises a levelled surface of fine, grey, puddled clay up to 0.1 m in depth. The straight edges along the eastern and western extents, combined with the marked upward lipping of the clay at these points, clearly imply that the clay rested against former wall-lines. The only aspect of the clay surface which appears somewhat anomalous is a posthole [23679] cut into the middle of it, which we assume to represent a later phase.

The germination floor is contained by two external walls defined by postholes and, in places, possible traces of carbonized wattle-and-daub wall plates; but these walls extend beyond the southern limit of the floor also to enclose the steeping tank. Running north to south, the postholes of the western wall comprise [23066], [23611], [23068], and [23600], varying in size between 0.36 m and 0.45 m in width, and 0.27 m and 0.35 m in depth. Post-pipes were observed in all four postholes, varying from 0.15 m to 0.30 m in width. The eastern wall is less well defined. One posthole [23615] seems to be on the same alignment as the two large postholes forming the eastern wall of the drying area, though three others [23693], [23613], and [23623] are closely aligned with the eastern edge of the clay surface. Three of these postholes are somewhat smaller than those forming the western wall, being 0.30 m, 0.31 m, and 0.32 m wide, but [23623] is 0.38 m wide. Two of the former revealed evidence for post-pipes, and two contained limited evidence for stone packing.

The northern limit of the clay surface is also notable for its exceptional regularity. As well as having a straight edge, the corners, especially that to the north-west, describe neat curves. The strong implication is that the edges of the clay retain the form of a lost partition wall of some kind, presumably necessary to contain the heaped up grain on the floor and prevent it spilling into the stoking-area to the north, and perhaps also to facilitate regulation of environmental conditions in different parts of the complex.

The southern limit of the clay surface is more problematic, in that its semicircular form can hardly have been convenient. Aspects of this are discussed above. To be noted here, however, is the fact that there is evidence that the rim of the clay was lined with some sort of wattle-and-daub partition, again, one assumes, to contain the grain heaped up on the floor and prevent it spilling back into the steeping area to the south. We might think of the germination floor, then, as a large grain-bin, with full-height walls east and west and low partition-walls north and south.

The drying area

The last part of the building is defined by large postholes and a kiln. Two significant certainties exist in relation to the building enclosing the drying area. First, we have identified one posthole [23064] that does not appear to respect any known alignments, would obstruct access to the kiln if contemporary with it, and which we must therefore assume relates to an earlier or later phase of construction. Second, and of greater significance, we have two postholes [23652] [17019] which may, on present evidence, represent either the northern wall of Malthouse 1 or the southern wall of a building enclosing Kiln 2 (or both).

The general picture seems sufficiently clear, however, and we provisionally envisage the drying-area building as a structure measuring 4.1 m north-south by up to 7 m east-west, defined by up to six postholes. This building extends 1.8 m further east than the germination-floor building. We want to suggest two connected reasons for this tripartite building form. As explained above, tight control of temperature, moisture, light, and ventilation on the germination floor is an essential of malting. This is most easily achieved in a confined space. The germination floors of traditional malthouses typically extend across the width of the building and have low ceilings above. Malthouse 1 seems to follow this pattern. The kiln, on the other hand, could not have been accommodated in a similarly restricted space, partly because of its own bulk, partly because of the requirement for a raised drying floor above, and partly because of the requirement for adequate working/stoking space in front of it.

The two postholes which almost certainly represent the eastern wall of the drying area of Malthouse 1 [23607] [23603] are larger than any others, measuring, respectively, 0.51 m in width by 0.40 m in depth, and 0.56 m in width by 0.43 m in depth. The two postholes which may represent the northern wall [23652] and [17019] measure, respectively, 0.42 m in width by at least 0.18 m in depth, and 0.24 m in width by 0.50m in depth. The possibility of a (burnt-down) wall is supported by an overlying linear deposit of carbonized wattle-and-daub debris (23609). Our evidence for the western wall is currently limited to posthole [23605], which measures 0.35 m in width by 0.29 m in depth. In some cases, possible evidence for the post-pipe was apparent, in the form of a somewhat darker sandy deposit with few inclusions, in contrast to the orange-brown sandy deposit with some chalk and flint forming the surrounding fill. In the case of posthole [23605], for example, the post-pipe seems to have been 0.25 m in width.

The eastern-wall postholes are of exceptional size, and the clear implication is that the drying-area building was more substantial than the rest of the malthouse. This is what we might expect, since the grain-drying process requires a raised floor above the kiln, and ideally also a conical or pyramidal roof to create an efficient updraft.

The central feature of the drying area was, of course, Kiln 1 (23012), constructed of clay daub applied to a framework of woven withies of approximately 10-15 mm in diameter. The base of this wattle-and-daub structure survived to a height of approximately 0.1 m. The curvature on many of the daub fragments representing the collapse of the kiln strongly implies that a domed superstructure rested on this sub-rectangular base.

We were originally misled by the apparent existence of inner and outer walls, but further excavation has since established that the 'inner wall' represents collapse of part of the domed roof of the kiln. A section cut through the entire feature has shown the outer wall to rest upon the underlying orange-brown colluvium, whereas the supposed 'inner wall' lies at an angle of about 45º sloping inwards, and overlies a deposit of ash, charcoal, and burnt grain.

We can therefore now describe the kiln as follows. It lies on an east-west axis, with outer dimensions of 3 m in length and 2.1 m in width, and a central, oval fire-chamber 2.1 m in length, 1.9 m in width, and at least 0.46 m in depth (with the possibility that we have not yet fully excavated the fill). The kiln appears to have been worked – fed with fuel and raked of ash – from a 1.0 m-wide opening on the western side. This may be confirmed by our impression of a subtle interior/exterior deposit distinction either side of the western wall. The 'interior' surface, across the putative 2.4 m-wide 'raking area' between the kiln and the western wall, appears somewhat darker and to have a somewhat greater density of what might be interpreted as 'trample' material (where multiple and diverse small inclusions are present in the matrix); whereas the 'exterior' beyond the western wall seems to comprise the clean orange-brown colluvium characteristic of the site in general.

Regarding the kiln itself, we must assume that the opening on the western side was sealed with a door of some kind, and we have no reason for assuming that the result was anything other than a fully enclosed chamber; an apparent opening on the northern side which could have been some sort of vent, we prefer at this stage to interpret as accidental damage. Nor have we any reason for assuming any kind of internal subdivision of the fire-chamber, in particular an internal shelf, as commonly assumed in reconstructions of grain-dryers. This has major implications for the interpretation of the functioning of all grain-dryers in the archaeological record, but we reserve discussion of this to the interpretive section of the paper. Amber Patrick[6] has suggested vents around the sides of the kiln dome – to facilitate heat dispersal/transmission and to act as an exhaust – but we lack any evidence for this.

Before concluding discussion of Kiln 1, we must make mention of our colleague Ian Drummond's work on the burnt-daub assemblage recovered from the remains of Kiln 2. Meticulous analysis of fragments, including some experimental reconstruction, not only confirmed a domed superstructure, but also yielded evidence for a stoking arch and a kiln door. One especially significant door fragment revealed the imprint of a wooden frame arranged at a 135º angle, which would have permitted a high vertical opening, facilitating easy access to the interior of the kiln. Though this material does not relate directly to Kiln 1, there is no good reason for believing that the design of Kiln 1 would have been substantially different. The daub analysis has also underlined the technical sophistication implicit in the kilns, with clear evidence for the use of a saw, likely to have been a relatively expensive, highly crafted tool used by a specialist woodworker. Mark McKerracher has proposed the involvement of itinerant specialists in the construction of grain-drying kilns.[7] We would concur, given the sudden appearance of such technologically advanced, industrial-scale plant.

Ironwork

A number of small finds from Trench 23 may be related to industrial activities on the site. These include an iron loop (65 mm in diameter) found embedded in a clay surface next to Kiln 2, and a substantial iron handle or attachment (89 mm in length) found in the Mid Anglo-Saxon ploughsoil.

Two other finds are even more suggestive. Both are hooks. One (SF3815) comprises a straight, square-sectioned shaft approximately 90 mm in length (the upper end of which may have been broken off) and an angular U-shaped hook with a flipped-over terminal measuring approximately 80 mm across. The top of the shaft, moreover, displays clear evidence, in the form of carbonized remains and corroded wood products, that it was originally embedded in wood. Though found in the overlying Mid Anglo-Saxon ploughsoil, its location was close to the underlying semicircular depression.

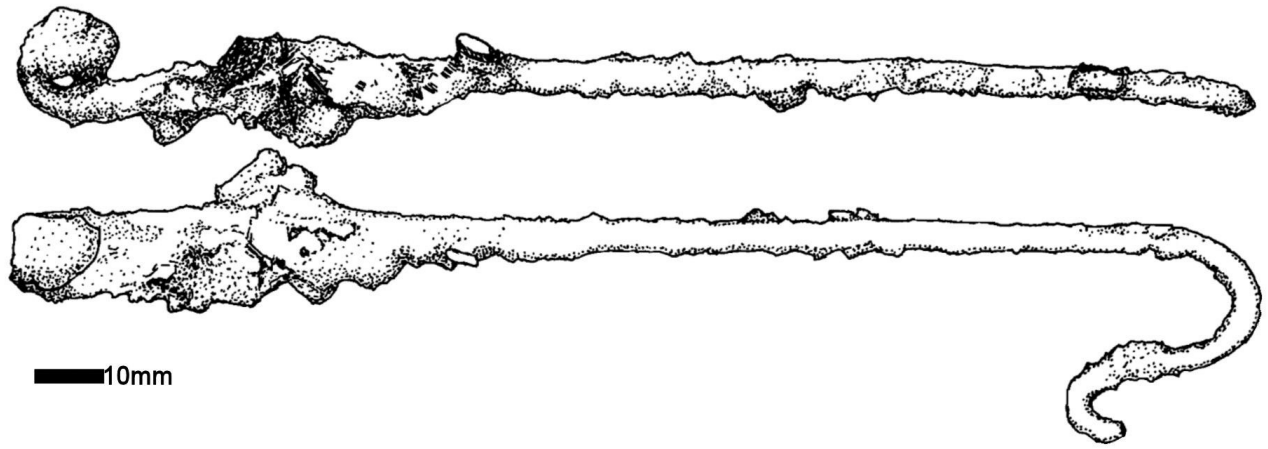

Figure 13. Iron hook found in Trench 23 which may have been used to support sacking or canvas containing grain within the steeping cistern. Image: Ann Smith/SHARP.

More compelling still was a similar but larger artefact (SF3579), measuring 179 mm in length, again comprising shaft, U-shaped hook, and flipped-over terminal, with hook and terminal measuring 35 mm across (Fig. 13). This, moreover, was found *within* the destruction fills of the semicircular depression.

The possibility arises that these were suspension hooks embedded in the timber framework of the steeping tank to support the canvas or sacking used to contain the grain within the clay-lined cistern (see our discussion on the steeping area above).

Burnt grain

Large quantities of burnt grain were recovered from both Kiln 1 and Kiln 2 during excavation, as well as from other carbon-rich deposits elsewhere on the site. Work on the grain samples is ongoing, but the provisional conclusions are clear: that all four major grains (barley, rye, oats, and free-threshing bread wheat) are represented, and that a large proportion, especially of the rye, was malted.

The main work to date has been done by Alice Wolff, who worked as SHARP's archaeo-environmental supervisor until 2017, with post-excavation analysis carried out as part of an MA dissertation at the George Pitt-Rivers Laboratory of the Department of Archaeology at the University of Cambridge.[8] Full publication of this work is pending. What follows is a summary of the key conclusions of Wolff's work.

Overall, the samples contained a mixture of free-threshing bread wheat with some barley, rye, and oats. Anglo-Saxon farmers are believed to have sown a mix of different species, known as 'maslin'.[9] The shorter, stronger varieties supported the longer staples against storm damage.

Kiln 1 contained a mixture of cereals, primarily wheat with rye and small quantities of barley and oats. This material was closely examined for evidence of germination. Though preservation was often poor and classification difficult – more than 70% of the wheat in any given sample had to be labelled 'indeterminate' – where grains were sufficiently complete for identification to be made, more than 70% of wheat and rye grains in the Kiln 1 samples turned out to be germinated.

The results were yet more emphatic in relation to Kiln 2. The predominant cereal here was rye, but with quantities of wheat, barley, and oats, along with a greater admixture of non-cereal seeds. Preservation was better, allowing a far higher proportion of the grains to be classified as germinated or ungerminated. In this case, almost 90% of the 'determinate' rye was germinated, and 40% of the entire rye assemblage, both 'determinate' and 'indeterminate'. These results were supported by the observation of a number of sprouts in the most finely sieved samples.

Far lower proportions of germinated grain in assemblages have been taken as clear evidence of malting. At Higham Ferrers, a figure of 25% to 50% was seen as definitive of a malting oven.[10] We are therefore beyond doubt in relation to the primary purpose of the Sedgeford grain-dryers. And while we accept that grain-dryers may often have been multi-purpose, we see no reason to embrace such looseness of interpretation when our kilns are not only associated with large quantities of malted grain, but also with various other features characteristic of traditional malthouses. This does not, of course, preclude the possibility that the facilities at Malthouse 1 were occasionally used for other purposes when convenient.

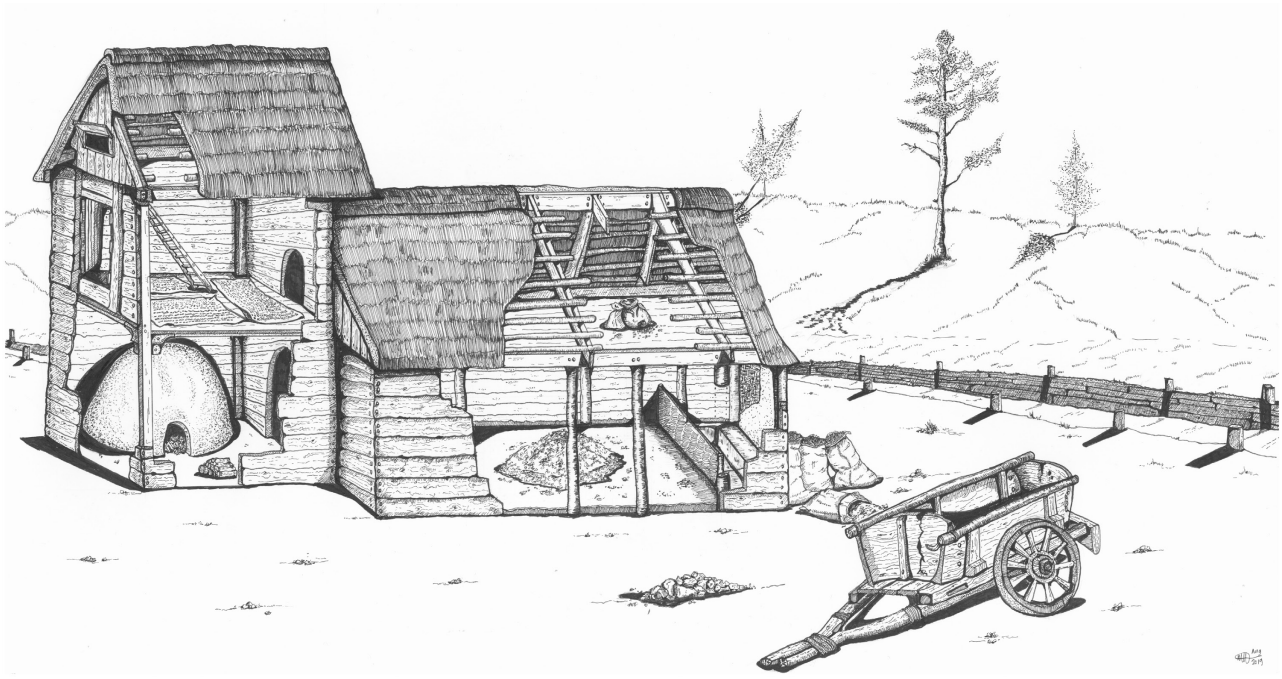

Figure 14. Provisional reconstruction of Malthouse 1. The reconstruction has been deliberately truncated at the southern (right-hand) end, because of continuing uncertainties about the limits of the building and its possible relationship with other buildings. However, we are reasonably confident that what has been depicted – steeping tank, germination floor, and kiln/drying room – offers a useful working hypothesis. Image: Adrian Donaghey/SHARP.

One further comment should be made. Malted rye is exceptionally rare in archaeological deposits, but, like any other grain, rye may be malted and fermented, and there appears to be a long tradition of brewing rye beer in Germany (*Roggenbier*) and some other parts of northern Europe.

Mid Anglo-Saxon grain-dryers: a summary of the comparative evidence

In an earlier draft of this paper, we used this section to summarize the interpretive conclusions of colleagues who had worked on other Anglo-Saxon grain-drying sites. Since then, however, three strands of work have combined to bring about a paradigm shift in our understanding of ancient and medieval grain-drying technology: the growing corpus of excavation data at Sedgeford; a review of the anthropological and historical evidence for traditional malting; and our assessment of what is now a fairly substantial body of evidence for grain-drying during 'the long eighth century'. In this section, therefore, we restrict ourselves to a summary of the comparative evidence in the form of a table, followed by a few general interpretive comments.

Dating

The great majority of known examples of Anglo-Saxon grain-dryers belong firmly to 'the long eighth century'. The earliest known example may be that at Feltham (in Middlesex), and that may be significant, in that nearby Kent was often the first recipient of new cultural influences coming into the island from the Merovingian/Carolingian world.[11] An Irish influence is also possible, since grain-dryers appear to have been in use in Ireland from an early date.[12] The seemingly remote ecclesiastical site at Hoddom in Dumfriesshire also turns out to have been an early powerhouse of the new grain-processing technology, from at least the later seventh century AD; and this implies a mechanism of transmission. Not only was the Kingdom of Kent the first to welcome a Christian mission from the Continent (that of Augustine in AD 597), but shortly afterwards it forged a strong link with distant Northumbria, when King Aethelberht's daughter Aethelburh travelled 300 miles north, accompanied by the Christian missionary Paulinus, to be married to King Eadwine, probably in the early AD 620s. John Blair, Stephen Rippon, and Christopher Smart have recently reported on the singular fact that the monumental palace complex at Yeavering reveals unmistakable evidence of having been laid out on a regular grid of short perches like that employed – apparently for the first time in Britain – in the layout of two Augustinian churches at Canterbury.[13] They have drawn the obvious conclusion: that the Church was the primary mechanism for the reintroduction

Table 1: Anglo-Saxon grain-dryers

Site	Feature	Form	Approximate Size (outer dimensions)	Date	Comments
Chalton, Hampshire	Corn-drier 1 (northern)	L-shaped	3m+	?C10/11th	Associated timber structures.
	Corn-drier 2 (southern)	L-shaped	?2m+	?C10/11th	Associated timber structures.
Chantry Fields, Gillingham, Dorset	Oven 280 Phase 1a	T-shaped, stone-lined pit	6m x 2.5m chamber, 6m arm	late C7th-early C8th	Associated postholes 'between ovens'.
	Oven 416 Phase 1a	T-shaped, stone-lined pit	6m x 2m chamber, 2m+ arm	late C7th-early C8th	Associated postholes 'between ovens'.
	Oven 280 Phase 1b	Stone-lined and fired-clay pit	5m x 2.5m chamber	late C7th-early C8th	Associated postholes 'between ovens'.
	Oven 416 Phase 1b	T-shaped, stone-lined pit	6m x 2m chamber, 2m+ arm	late C7th-early C8th	Associated post-holes 'between ovens'.
	Oven 280 Phase 1c	Stone-lined and fired-clay pit, with ?stoking-area	4m x 2m chamber	late C7th-early C8th	
	Oven 416 Phase 1c	Stone-lined and fired-clay pit, with stoking-area	5m x 2m chamber and stoking-area	late C7th-early C8th	
	Oven 280 Phase 1d	Fired-clay pit	3.5m x 2.5m chamber	late C7th-early C8th	
	Oven 416 Phase 1d	Fired-clay pit	4m x 2m chamber	late C7th-early C8th	
	Structure 459	L-shaped, stone-lined and fired-clay pit	4m x 2m chamber, 10m arm	late C7th-early C8th	Associated structural remains.
Cottam, East Yorkshire	Feature 3023/4	8-shaped, chalk-cut pit	2.5m x 1m	C9th	Associated postholes.
Feltham, Greater London	Corn-drier	L-shaped, wattle and fire-clay lined	2.9 x 2.5m chamber, 7.4m long x 1.7m wide arm	C7th	Associated drainage gullies, hearth, pits, and post-hole structure.
Higham Ferrers, Northants	Malting oven	Square, stone-walled chamber, with tapering stone-walled flue, and stoking-area	3m x 2.5m chamber, 4m long x max 2m wide flue, and 2m long stoking-area	late C8th-early C9th	Associated with malted grain.
Hoddom, Dumfriesshire	Structure 2	Type 1 (pit kiln with wattle-and-daub superstructure)	2.3m x 1.1m chamber	AD 750-800	Enclosed within timber building.
	Structure 6.1	Type 1	1m x 0.8m chamber	later C7th	Enclosed within bipartite sub-rectangular timber building.
	?Structure 8	?Type 1	?	later C7th	Kiln presumed but not seen. Enclosed within sub-rectangular bipartite timber building.
	Structure 9	Type 1	1.6m x 1.45m chamber	late C7th-early C8th	Enclosed within sub-rectangular bipartite timber building.
	Structure 10a	Type 1	1.2m x 1.2m chamber	early-mid C8th	Enclosed within sub-rectangular bipartite timber building.

Site	Feature	Form	Approximate Size (outer dimensions)	Date	Comments
Hoddom, Dumfriesshire	Structure 10b	Type 1	1.6m x 1.4m chamber	early-mid C8th	Enclosed within sub-rectangular bipartite timber building.
	Structure 6.2	Type 2 (freestanding kiln with stone footings)	5.2m x 4m paved area around kiln bowl	AD 750-800	Enclosed within sub-rectangular bipartite timber building.
	Structure 7.1	Type 2	3.2m x 3m paved kiln base	AD 750-800	Enclosed within sub-rectangular timber building.
	Structure 7.2	Type 2	3.2m x 3m paved kiln base	C9th	Enclosed within sub-rectangular stone and timber building.
	Structure 11.1	Type 3 (freestanding stone-built kiln)	?	AD 750-800	Enclosed within bipartite stone and timber building.
	Structure 11.2	Type 3	4m dia circular stone chamber	C9th	Enclosed within bipartite stone and timber building.
	Structure 11.3	Type 3	4m x 3m oval chamber	C10/11th	Enclosed within bipartite stone and timber building.
Springhead, Ebbsfleet Valley, Kent	Feature 3227	Oval pit	4.2m x 3.4m chamber	?later C9th	Identification as grain-dryer uncertain.
	Feature 3475	Flint-lined oval pit infilled with collapsed daub	3m x 1.5m chamber	C9th	
Sedgeford, Norfolk	Kiln 1	Oval shaped, wattle and fired-clay lined	3m x 2.1m chamber	AD ?775/825	Enclosed within tripartite timber malthouse.
	Kiln 2	Oval shaped fire-pit within sub-rectangular structure, wattle and fired-clay lined	3.25m x 2.25m chamber	AD ?775/825	Associated with germination floor and postholes.
Stafford, Staffordshire	Clay oven 1 (214)	Keyhole-shaped, wattle and clay-lined, with stoking-area	2m x 2m chamber, 2m x 1.5m stoking-area	?early-mid C9th	Associated cobbled surface.
	Clay oven 2	Keyhole-shaped, wattle and clay-lined, with stoking-area	?	?early-mid C9th	Associated cobbled surface.
	?Robbed oven 1 (130)	Keyhole-shaped, wattle-lined, with stoking- area	3m x 2m chamber	?early-mid C9th	Associated cobbled surface.
	?Robbed oven 2	Keyhold-shaped, wattle-lined, with stoking-area	?	?early-mid C9th	Associated cobbled surface.

Sources for this table are: Hughes 1984 (Chalton); Heaton 1993 (Chantry Fields); Richards 1999 (Cottam); Howell 2007 (Feltham); Hardy et al 2007 (Higham Ferrers); Lowe 2006 (Hoddom); Andrews et al 2011 (Springhead); SHARP archive (Sedgeford); Moffett 1994 (Stafford).

to Britain of Roman surveying techniques and grid-planning of settlements during the seventh century AD.[14]

The same might be assumed to apply to advanced grain-processing technology; an assumption supported by the fact that Hoddom, an early example, was both an ecclesiastical site and part of the Kingdom of Northumbria at the time. Very soon, in any case, we have a wide spread of Mid Anglo-Saxon sites, with the Kingdoms of Kent, East Anglia, Wessex, Mercia, and Northumbria all represented in Table 1. If anything in the archaeological record for the period suggests some sort of 'industrial revolution', the spread of grain-drying technology does.

A final comment here: Sedgeford is listed in the gazetteer of Anglo-Saxon grid-planned sites by Blair

et al.[15] Further work has since amplified the initial impression, in relation to both the settlement site and now the malting complex. The germination floor and associated walls of Malthouse 1 appear to form a 'short-perch' square in layout, and at least two of the other germination floors identified so far in Trench 23 appear to be of the same dimensions. The impression grows that grid-planning and malting technology were part of the same 'package', perhaps alongside a range of other innovations – including nucleated villages, open fields, heavy ploughs, crop specialization, and large-scale water management – that would have amounted to an 'agricultural revolution'.

Form

Grain-dryers – for the obvious reason that their basic form is that of a pit with burning – give rise to exceptionally strong archaeological imprints. They therefore tend to be highly visible in both survey (especially magnetometry) and excavation. The same cannot be said for possible associated features, which may be surfaces sheared away by the plough, or hard to distinguish from natural accumulation, or the ephemeral soil-stain evidence of post-hole structures. Despite this, in a surprising number of cases, close reading of excavation reports does in fact reveal the presence of associated features suggestive of buildings which may have enclosed the grain-dryers. And in the exceptional case of Hoddom, the evidence is unequivocally of 'kiln-barns': grain-dryers inside timber and/or stone structures.

The absence of observed/recorded evidence elsewhere – at Higham Ferrers, for example – is neither here nor there. Absence of evidence is not evidence of absence. The character of the site, and the circumstances of excavation, especially in a commercial context, will often preclude survival or recovery of more ephemeral evidence for associated buildings. What we are now prepared to say – let us present this as a clearly stated hypothesis – is that *all medieval grain-dyers were enclosed within buildings*. In the case of Higham Ferrers – the only other site (apart from Sedgeford) which has been securely identified as that of an Anglo-Saxon *malting* kiln – no other alternative is conceivable. Large-scale malt production in the temperate zone requires an enclosed malthouse, because the key variables of temperature, light, moisture, and air-flow could not otherwise have been adequately controlled, to say nothing of the sheer impracticality of trying to prevent loss and contamination during the two-week malting process in the open air of the temperate zone.

Form and size vary considerably, although it is notable that some of the largest and most solidly constructed dryers – those Mark McKerracher[16] describes as 'monumental' – are early in the sequence, so there is no implication of growing technological sophistication and scale. The technology arrives on the island fully developed, and is probably first deployed by those with both connections and resources, so presumably on the great estates of secular or ecclesiastical lords. As the technology spread to lesser domains, a smaller facility may have been adequate. The evidence is also that scaling up, when it occurred, took the form not of larger single units, but of multiple units ranged side-by-side. Hoddom is the obvious example: in Phase 4 (AD 750–800), there may have been as many as six kiln-barns in simultaneous operation.[17] But we also wonder about Sedgeford, where we seem to have a similar pattern of adjacent units potentially in simultaneous use.

Following this survey of the comparative archaeological evidence, and before considering the technological processes represented, we must make mention of one highly salient historical source: the famous St Gall Plan, a technical drawing of a paradigmatic Carolingian monastery, copied between AD 820 and 830 from a lost original. Though no malthouse is shown, a drying kiln associated with grain milling is depicted (Fig. 15). We suspect that the authors of the primary study of the St Gall Plan have misinterpreted the illustration in suggesting a kiln surrounded by racks enclosed within an open-sided structure. In fact, the cross-hatching shown around the kiln almost certainly represents a raised drying-floor, and the building was almost certainly enclosed so as to control temperature. The St Gall drying kiln appears to constitute a contemporary manuscript illustration of the type of facility represented by Kiln 1 at Sedgeford.[18]

The technology of Mid Anglo-Saxon malting: a possible reconstruction (Fig. 14)

The basics of malting are so simple that countless examples of 'backyard' maltings are to be found in the historical and ethnographic records. A Latvian immigrant to the United States in the 1890s recorded this simple family malt recipe: 'Wet some good barley and keep it warm and moist. After it grows feet, form it into a rough loaf and place it in a warm oven until dry'.[19]. This might be contrasted with the scientific and technological sophistication of modern industrialized malting. The history of malting displays an extraordinary range of practice. The challenge we face at SHARP is to attempt a

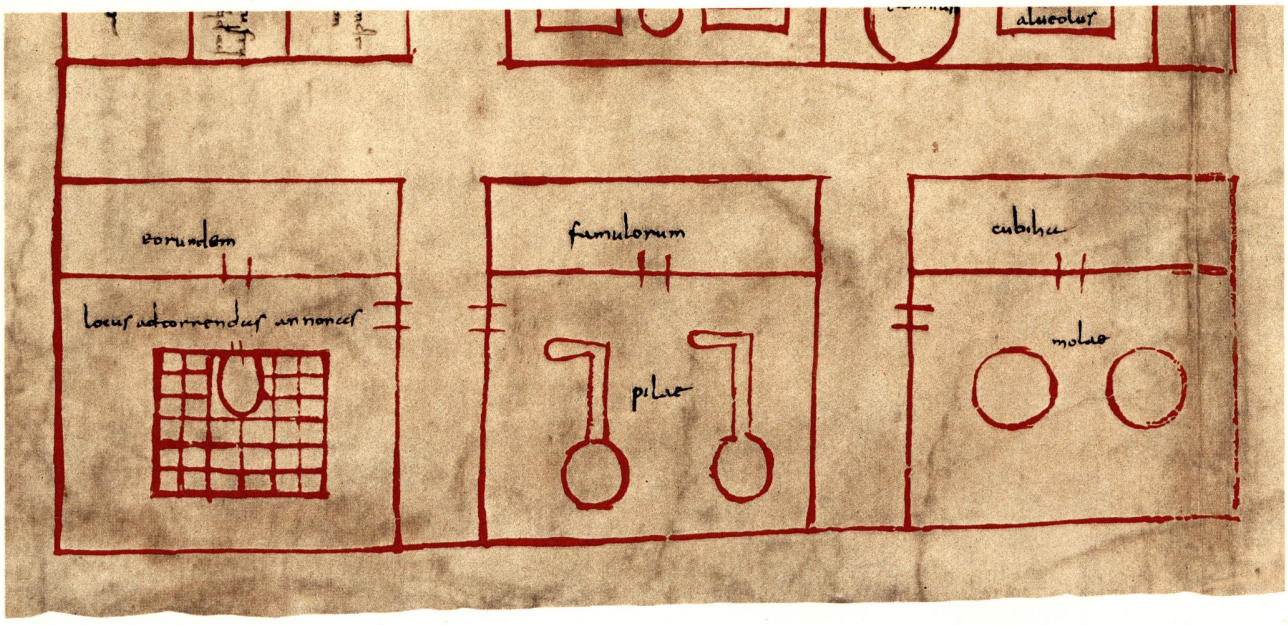

Figure 15. An early ninth-century drying kiln, as depicted on the St Gall Plan. Image: Stiftsbibliothek, St Gall.

reconstruction of the methods used at Sedgeford in the years around AD 800 on the basis of three strands of evidence: the ovens and associated features in Trench 23; other ovens and associated features from elsewhere, especially the small number of known Mid Anglo-Saxon examples discussed above; and the wider historical and ethnographic sources for traditional malting techniques.

It will be useful to begin with a summary of the malting process. We have broken this down into two categories, main processes and subsidiary processes or sub-processes, since basic malting, as the recipe above indicates, consists of only three essential processes, while in practice, of course, large-scale traditional malting involves much greater complexity, designed to achieve a consistently high-quality product. For clarity, the information is presented in the form of a table. Table 2 is a composite hypothetical reconstruction based on traditional sources – *not* a description of any particular malting process, and certainly *not* a description of what was necessarily happening at Sedgeford's Mid Anglo-Saxon maltings. It is a composite of specifications drawn from several manuals of traditional malting dating from the early seventeenth to the early twentieth century, supported by personal visits to two traditional malthouses (Warminster Maltings in Wiltshire and Crisp Maltings in Norfolk), and discussions with working maltsters.

How does this schema match up with the Sedgeford evidence? We can, of course, assume a more simplified process than that implied in Table 2, which brings together a range of practices recorded in several different historical and ethnographic case-studies. But the essentials, in terms of plant, seem to be storage facilities, a cistern and its associated channels, a couching or germination floor, and a kiln with raised drying-floor. All should be relatively close together to minimize labour and loss, and the last three – --steeping cistern, germination floor, and drying kiln –-- being part of a single production process requiring tight control over temperature, moisture, light, and air-flow, should be contained within a single substantial structure – a malthouse. The kiln, it should be noted, has a role in maintaining temperature at *all three main stages* of the process, and quite possibly during storage before and after; the kiln is multi-functional within the malthouse.

The evidence of Malthouse 1 at Sedgeford clearly fits the model of a traditional malthouse. Our tripartite structure, each part with its distinctive features and forms, mirrors the three linked processes – steeping, germination, and drying – that comprise the basics of malting. More precisely, Malthouse 1 comprised: a cistern for steeping the grain, a floor for germinating the grain, and a multi-purpose kiln for parching the malted grain on a raised drying-floor (using radiant heat) and for maintaining an even temperature across the germination floor (using ambient heat) and, quite possibly, in storage areas at either end of the complex. Our kilns seem to have been of an appropriate form and size to do this work.

At this point, two observations relevant to the interpretation of grain-dryers in general should be made. It is, in our view, inconceivable: a) that grain-dryers would have stood in the open air; and b) that

Table 2: A composite hypothetical reconstruction of a traditional malting process.

Main Processes	Subsidiary Processes	Associated Plant	Capacities	Requirements	Additional Comments
	Post-harvest storage	Ricks/stacks or barns/granaries, probably with raised floors.			
	Threshing	Threshing-floor.			Threshing could take place before or after transport to maltings.
	Transport (in)	Routeways. Access-points.			
	Post-threshing storage	Kiln-warmed malthouse?		Delay of one month between harvesting and malting ideal.	Ideally storage would be within building where heat can be regulated.
	Sweating/ Drying	Kiln.	(see below)	10ºC.	Not essential.
	Screening/ Cleaning	Malthouse. Sieve			Not essential. To remove dust, chaff, etc before steeping.
Steeping		Cistern. Water channels. Drainage channels. Facility for changing water. Kiln. Malthouse.	Deep (e.g. 100cm) rather than wide.	Grain to be soaked for between 40 and 90 hours at 10/12.5ºC. Necessary to control moisture and temperature.	Grain should gain about 50% in weight by absorbing water.
Germination	Couching	Couch-frame. Kiln. Malthouse.	Similar size/ capacity to cistern (max 30in deep).	Grain to be couched for 20+ hours to generate heat and start germination.	
	Flooring	Germination floor. Kiln. Malthouse.	Ideally space for three batches being worked simultaneously at different stages.	Grain spread 12-15cm deep. Regularly turned/ ploughed. Occasionally sprinkled. For 10-14 (max 16) days at 10-15ºC.	Malthouse essential to control temperature, moisture, light, and air-flow. This process creates wet or 'green' malt.
	Withering	Germination floor. (Kiln.) Malthouse.			This is preliminary superficial 'free' drying. Not essential.
Kilning	Drying and Curing	Kiln: firebox, raised drying-floor, perforated floor, hair-cloth, ducts/ vents. Malthouse.		Grain spread 10-40cm (usually 20-25cm) deep. Dried for 1-4 (usually 2) days at 25-100ºC (usually 65-80ºC).	Raised drying floor will be 6x area of firebox. Malthouse floor will be roughly 6x capacity of cistern, couch-frame, and kiln.
	Screening/ Cleaning	Sieve			The terms dressing, rubbing, winnowing, and sieving may be applied.
	Storage	Barns. Sacks?			
	Transport (out)	Routeways. Exit points.			

Sources: Markham 1613; Anonymous 1736; Loftus 1876; Lancaster 1908; Mallett 2014.

grain would have been placed inside the kilns. We have to assume that all grain-dryers would have been enclosed in some sort of structure, the minimal form of which must have included some sheltered area for the working of the kiln, and a raised-drying floor on which the grain rested. Only on this basis would it have been possible to process large quantities, maintain an even temperature, periodically turn the grain, prevent

scorching and spoiling, protect against damp and rot, and avoid waste of fuel and heat. Reconstructions that show operatives tending an open-air kiln in the mud and rain of the British Isles are ludicrous. These comments, it should be said, apply to grain-dryers of all periods, including the much larger number known in the Romano-British archaeological record. In this regard, we note in passing the evidence at Orton Hall Farm, where the Late Roman dryers were unquestionably located inside a large barn.[20]

In developing the interpretation further, a number of points must be stressed. Two of these have been mentioned already: malting requires tight control over temperature, moisture, light, and ventilation; and close association of cistern, germination floor, and kiln is desirable to avoid waste of labour and loss of grain. A further consideration is the importance of continuous flow, since interruption and delay would be liable to result in spoiling. Once grain has been steeped, it must immediately be laid in the couching frame or on the germination floor; and once sufficiently germinated, it must immediately be transferred to the drying floor of the kiln. The implication is that the separate elements of plant must be in due proportion, and our historical and ethnographic parallels suggest what these should be: the germination floor needs to be approximately six times the size of both the steeping tank and the kiln drying-floor. This seems entirely plausible in relation to Malthouse 1. And although it would be premature to do so here, we hold out the prospect that we may, in due course, be able to undertake serious estimates of the capacity and potential output of Sedgeford's Mid Anglo-Saxon malting complex.

This brings us to a final point. Brewing tended to be done on a domestic scale, often by women, until relatively recent times, whereas malting, a more complex process, has a much longer history as a specialized industrial activity. Traditional malting tends to be a male-dominated craft, carried out in purpose-built facilities, for up to eight months of the year (October to May).[21] We keep an open mind as to the identity of the maltsters in Mid Anglo-Saxon Sedgeford, but we are confident that the technology was sophisticated, the craft highly specialized, and the likely output prodigious. It is clear that new designs and new techniques of malting (and industrial-scale grain-drying more generally) were becoming established at the beginning of 'the long eighth century'. And it is safe to assume that unless plant was heavily used, the investment in it would have been largely wasted, and the output of the drying ovens would never have repaid the effort of constructing them. All the signs are that Malthouse 1 at Sedgeford represents a new kind of economy based on great estates and regional connections involving specialized production and elite appropriation, distribution, and consumption of surpluses.

So where does this leave the beer being produced by Mid Anglo-Saxon Sedgeford's malthouse and (perhaps) brewery? It makes it highly likely that it represents a food render. Some, no doubt, would have been consumed by the villagers. Much, no doubt, would have been consumed by the elite, either at another location, or at Sedgeford itself in the course of a peripatetic progression around a succession of estates. And some might have found its way to market, maybe to an inland fair, or perhaps around the coast to the emporium at Ipswich, to be traded for North Sea fish, Baltic amber, or Carolingian trinkets.

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Notes

1 Interim reports have appeared in *Norfolk Archaeology*, and occasional popular articles in *Current Archaeology*, but the main publication of results so far has taken the form of an overview monograph, *Digging Sedgeford: a people's archaeology*, in 2014. Full and final publication of both cemetery and settlement is in progress.
2 Hamerow 2012, 111–5; Hardy *et al.* 2007, 201–6.
3 Reynolds 1999, 123–34.
4 Mallett 2014, 27–9.
5 McKerracher 2018, 75.
6 Pers. comm.
7 McKerracher 2014, 84.
8 Wolff 2017.
9 Banham and Faith 2014, 21–2, 36.
10 Moffett 2007, 163.
11 Blair *et al.* 2020, 115–7.
12 McCormick *et al.* 2014, 24–50.
13 Blair *et al.* 2020, 118–23.
14 See also Blair 2005 on the role of minster churches.
15 Blair *et al.* 2020, 54–5, 286.
16 McKerracher 2014.
17 Lowe 2006, 169.
18 Price 1982, 62–4.
19 Mallet 2014, 51.
20 Mackreth 1996, 64, 75–80, 229–30.
21 Robin Appel and Chris Garratt, Warminster Maltings, pers. comm.