9 The Production Area

The plateau south of the Kjellerhaug grave mound has seen varied use from the very beginning of SP I all the way into modern times. With the notable addition of the construction of the Kjellerhaug grave mound in the middle of SP I, Area 6 in SP I and II was dominated by agricultural activities. A wider range of production was initiated in SP III and IV. The data includes tangible evidence in the form of refuse from iron smithing, whereas copper alloy work, glass bead production and possible pottery production are merely suggested by geochemical measurements or clustering of finds.

The processes that took place in SP III are characterised by waste from ferrous metalworking, as well as ovens used likely for curing meat and possibly for glass-bead production. A clustering of pottery sherds in Area 6 may relate to local pottery production in SP III, although this is more likely explained as patterns of waste disposal. In SP IV–V production activities are mainly associated with food processing and storage. Large concentrations of grain were found in drying kilns as well as postholes and ditches that may have belonged to storage constructions. Macrofossil and geochemical measurements also indicate the use of seaweed ash to preserve animal commodities, dating mainly to SP IV–V. Geochemical analyses indicate copper-alloy work of rather limited volume; although these chemical signatures cannot be dated by stratigraphy, the likely use of brass may indicate a late SP IV or early SP V date.

Iron smithing and other SP III production activities seem to have a wider spatial distribution within Area 6, whereas the grain-related activities in SP IV are concentrated in its central and western parts. This variance in distribution is probably due to the construction shortly after AD 600 of a fortification on the plateau's eastern rim, thereby sequestering that part of the plateau. This created a vertical and horizontal stratigraphy for the various remains: processes from SP III are found across the plateau whereas the processes from SP IV–V were focused west of the fortification (Østmo, Ch. 11). This chronology of activities and use of space is supported by radiocarbon dates from a number of features.

The land underneath the Kjellerhaug grave mound and the area to the south of it were cleared for pasture in the late Neolithic. Analysis of layers sealed under the mound indicates that the area had been used for livestock early in SP I. South of the mound an arable colluvium was detected. The soil derives from cultivation deposits, presumably firstly redeposited as mound fill in Kjellerhaug. It remains uncertain whether the colluvial formations were tilled again after the build-up or only prior to it. Features such as postholes and hearths were discovered at different levels within the colluvium, but as the stratigraphy and radiocarbon dates not always coincide, this indicates both a gradual build-up of the layers and the varying impact of later trampling or other farmyard activities obscuring the upper part of features. A few cooking pits, one of which is dated to late SP I, predate a major change taking place at the transition to SP III, when the area became the site for a range of production processes (Fig. 9.1). Due to the coarse chronology provided by radiocarbon dates, it remains unknown whether all processes were contemporaneous.

Fig. 9.1: Overview of Area 6: the production area with dated features other than postholes. For the latter, see figure 9.8. The stone-built fortification A20 and underlying deposits were not removed, except in the two trenches across A20. These trenches were excavated to expose underlying layers and features, uncover stratigraphic relations, and establish good sampling contexts. Except for the trenches and some areas where stones were exposed to reveal extent and construction details, the fortification A20 and Kjellerhaug grave mound were preserved for future excavation; thus, additional production traces likely remain *in situ*. See details in Østmo, Ch. 11 and Østmo and Bauer Ch. 12. Illustration: I. T. Bøckman, MCH.

The activities of SP III occurred across the entire plateau south of Kjellerhaug. Some of these have left definite and tangible remains, while others can be inferred indirectly. Among the processes with tangible remains is ferrous metalwork, manifest in slag fragments and spheroidal slag dispersed in various features across Area 6. Some hearths are also believed to be associated with this production. Based on microstratigraphic observation, one oven located south in Area 6 has been interpreted as a low-temperature installation used for food preparation, possibly for the curing or boiling of meat.

Analyses of burnt clay showed no chemical signatures reflecting ferrous or non-ferrous metalwork and may relate to other types of ovens and productions processes. Among the processes suggested as taking place in this period are pottery production and glass bead manufacture. As many as 434 sherds or 66 % of the total prehistoric pottery material from the 2011–12 excavations comes from Area 6. This seemingly structured spatial pattern has two possible explanations: pottery production or waste disposal. Supporting evidence for pottery production is meager, whereas pXRF and other soil chemical readings indicate waste disposal as the more likely explanation; both suggestions, however, will be addressed in this chapter. Glassy slag with high contents of phosphate and calcium observed in micromorphology analyses (hearth 37770, Fig. 9.1) implies a form of artisan work that may have included the use of ashly fluxes. The kind of artisan activity this represents remains speculative. Glass bead manufacture is a possibility based on the chemical signatures, though this lacks supporting evidence in terms of waste remains.

The transition from SP III to IV is characterised by a restructuring of space and the introduction of new types of production. The A20 stone construction is believed to form a base of a defensive rampart or wall, functioning as a fortification. This construction sealed off the eastern edge of the activity surface from SP III, reducing the size of the flat surface area available for production activities, while simultaneously affording a measure of protection to the remaining production area. Activities here focused on food processing, preservation, and storage. High concentrations of grain were found in a corn-drying kiln, postholes, and ditches, likely reflecting both the drying and the storage of grain (Fig. 9.8). Fragments of charred seaweed, combined with chemical signatures indicative of a wider and denser distribution of charred seaweed or seaweed ash, are interpreted as indications of the preservation of commodities such as meat or cheese through the use of seaweed ash or black salt (Balantyne et al., Ch. 19:490, 499–501; Cannell et al., Ch. 18:436–9). The charred seaweed could be related to the actual preservation process as well as storage of preserved products. While pXRF-analyses of soil sampled in a horizontal grid cannot be related to certain features or phases, they do indicate a form of low-volume copper-alloy work, likely with brass. Cannell et al. (Ch. 18:439–43, 451–2) argue that this copper-alloy work has Viking Age parallels across Scandinavia, raising the possibility that these geochemical signatures may date to SP IV or early SP V.

The spatial restructuring and the construction of A20 implies that activities from SP IV onwards have been protected behind a fortification. The end date of the fortification remains uncertain; however, the area of the A20 saw no later activity until the modern period (Østmo, Ch. 11). The features west of the fortification were a mix of remains from SP III to early SP IV with no clear internal stratigraphy, due to the prehistoric colluvial formation, possible cultivation, stocking of animals, and muddy trampling by humans in this area, as well as disturbances from activities related to the modern farmyard (Bauer and Østmo, Ch. 8:154–5). Consequently, only radiocarbon-dated features provide chronological information on the activi-

ties there. Waste from metalwork and charred grain were occasionally found mixed together in the same contexts, probably as a result of truncations and re-deposition of older waste in younger features. In some cases there is also a lack of diagnostic waste. Thus, it is not always evident what processes had taken place in individual ovens or hearths. In addition, the waste from the various processes was not only found in the ovens or hearths, but also in postholes, deposits, and cooking pits. Because the occurrence of the production waste there is likely due to re-deposition, such contexts form *terminus ante quem* dates of the production that produced that specific debris; nevertheless, similar types of production may have taken place in Area 6 at a later date.

In this chapter, the archaeological features will be presented first, followed by a discussion of the indications of metalwork, treatment of cereal, and other processes, drawing on artefacts, ecofacts, and analyses of micromorphology and soil chemistry.

9.1 Ovens, hearths, and kilns

The features associated with production and processing included six ovens, hearths or kilns. The features portray an internal variation and could reflect a range of processes, from metalworking to grain drying and processing of other foodstuffs. Stratigraphic information and radiocarbon dates from the features show that the variation is also chronological: beginning in early SP III and continuing through SP IV and into SP V. The features will be presented here in chronological order.

Oven A401438 (Figs. 9.2.a–b) was located in the south-eastern part of Area 6, underneath A20. The oven was only partially exposed within a trench and consisted of a bowl, a fire pit, and a flue (A45470, A39340, and A37190, respectively). The feature was cut partly into subsoil and partly into greenstone schist bedrock. The flue was lined and covered by flat stones, which, assuming they originally followed the cut into the bedrock, may have been slightly displaced towards the south-east during the later construction of A20. The bowl was the deepest part of the oven, lined with very compact, greyish sandy clay and filled with a humic soil with inclusions of dung, presumably originating from a later period when the area was used for animal stocking (Macphail and Linderholm, Ch. 17:404–5; Bauer and Østmo, Ch. 8:141). The construction bears superficial similarities with L-shaped corn-drying kilns with regard to the placement of the flue in respect to the oven (Monk and Kelleher 2005:302; Monk and Power 2012). However, in A401438 it seems the flue was designed to lead air into the fire pit rather than to lead heated air from the fire pit into the chamber. The elevated fire pit may have presented a challenge with circulating hot air and smoke into the chamber, but depending on the chamber's architecture this may have been compensated by a chimney effect that would have secured the circulation of hot air, as seen

Fig. 9.2.a: The oven A401438. Illustration: I. T. Bøckman, MCH.

Fig. 9.2.b: Photos from different stages of excavation of oven A401438 with main features delineated: (i) flue before excavation, facing northwest; (ii) flue and fire pit after removal of upper part of stone lining, facing northwest; (iii) emptied flue and fire pit, cut in the bedrock visible, facing northwest; (iv) emptied flue, fire pit, and bowl, cuts in the bedrock visible, facing southeast. Photo: MCH. Illustration: I. T. Bøckman, MCH.

Fig. 9.3: Profile 41719: section through the possible hearths A37744 and A37770, facing north.
Illustration: I. T. Bøckman, MCH.

for example in the reconstruction of the Hyrdehøi pottery oven from the late Bronze Age (Ingvarðson 2005:50; Monk and Kelleher 2005:95).

Micromorphology and soil chemistry analyses from the bowl indicate a low-temperature oven most likely used for preparing meat or drying cereals (Macphail and Linderholm, Ch. 17:410–11). The signatures of decaying meat found in the fill of the bowl (Macphail and Linderholm, Ch. 17:410) may indicate that it was used for smoking and drying meat. A charcoal layer dated to AD 265–406 (Ua-45337) covered the bottom of the fire pit and dates the oven to early SP III.

Further north, also covered by the fortification A20, *two possible hearths*, A37770 and A37744, were partially exposed in a trench dug through this fortification. Both continued into the northern trench wall. Judging from its exposed part, A37770 was a simple round or oblong pit placed at the edge of the plateau where the terrain falls towards the sea in the east (Figs. 9.3–4). It measured approximately 1.5 metres in cross-section and was 30 cm deep, cutting partly into bedrock, partly into subsoil, with a few stones placed towards the bottom of the cut. The fill comprised three layers with varying content of charcoal fragments and red burnt clay; the subsoil bore signs of in situ burning. An unidentifiable piece of corroded iron, sintered clay, and a helical blue glass bead found in the backfill may be related to the production in the pit; alternatively, they were coincidentally redeposited there.

Fig. 9.4: Hearth A37770 (centre) prior to excavation, facing north. The bedrock forming the edge of the plateau is visible to the right. Photo: MCH.

Somewhat similar pits, but with larger inclusions of slags and metallurgic ceramics, have been examined at other Norwegian sites – for example, a group of hearths at Rødbøl in Vestfold (Rønne 2008) and Hurdal in Akershus (Bergstøl 2005). A37770 did not seem interconnected with other features, as seen at the late Roman Iron Age smithy at Fossdalen, where a separate pit for the bellows lay in direct continuation of the hearth (Kristoffersen 1988). However, it is possible that such associated elements were obscured by the overlying fortification in the unexcavated part of the feature. The placement on the edge of the plateau, precisely at the point where the terrain begins to slope downward, could also permit placement of a bellows. Soil micromorphology has shown the presence of spheroidal slag and indications of temperatures of around 1000 °C, fitting well with an oven or hearth used for metalworking (Macphail and Linderholm, Ch. 17:407). The hearth was radiocarbon dated to early SP III, that is, AD 237–333 (Ua-45336).

Hearth, A37744 (Figs. 9.3 and 9.5), only 1.15 metres further west, was of a different character. It measured 53 cm in diameter, 15 cm deep, and was lined with flat stones. A thin deposit containing charcoal and some red burnt patches of subsoil was discovered underneath and partly between the stones and included a few fragments of

Fig. 9.5: Plan (above) and section (below) of the possible hearth A37744. Photo: MCH.

sintered clay and slag. No finds or waste inside the pit could otherwise illuminate its use; relying on its similarities with younger hearths from Sigtuna, it is assumed to be related to metalworking (Söderberg 2002:258, fig. 3). It was radiocarbon dated to AD 535–601 (Ua-45334).

Two ovens, A10438/52326 and A12142/52220, both consisting of two parts – a hearth interlocked with a shallow pit partly filled with stones forming a figure-of-eight-shaped type of oven – lay further north-west on the plateau (Fig. 9.6). Both were poorly preserved, consisting of deposits no more than 8–14 cm thick, presumably representing the bottommost section of the oven constructions. A10438/52326 was recognised primarily on the basis of its resemblance in terms of layout and composition to the slightly better preserved A12142/52220. A similar, better-preserved oven dated to the late Iron Age excavated at Toten, Oppland, has been interpreted as part of a smithy (Loktu and Hovd 2014). The lack of slag and inclusion of no more than four fragments of sintered clay in the Avaldsnes ovens means that an association with iron smithing is unlikely; however, it is possible that they were used as grain-drying kilns, as more than 30 charred grains were found in each of the thin deposits. Grain-drying kilns of a similar construction are known on the British Isles (Monk and Kelleher 2005; Ballantyne et al., Fig. 19.8). The Avaldsnes specimens are closer to the oven from Toten in size terms and are smaller than the parallels from the British Isles, where the bowl alone measures about 1 m in diameter. The small size could be due in part to their fragmented state of preservation. Only one of the ovens was dated by radiocarbon, giving a date range of AD 882–971 (Ua-45377).

Oven A44031, a *keyhole-shaped kiln*, was discovered in the northern part of Area 6 (Fig. 9.7). The chamber was shallow and contained charcoal lenses and concentrations of red burnt clay presumably from the collapsed oven lining. The clay found in the chamber was not preserved in solid form – possibly, indication that it had not been exposed to very high temperatures, as clay burnt at temperatures below 450°C may be less resilient to water and more likely to dissolve (Brorsson 2005:80). Still, it should be noted that it remains unknown whether the clay is representative for the oven as a whole, as other parts of the oven lining may have been removed or truncated. The bulk samples from the bowl fill contained large amounts of grain and some spheroidal slag. The relatively low MS readings around the oven (Fig. 9.9; Macphail and Linderholm, Fig. 17.17.b) in tandem with the indication of lower temperatures provided by the dissolved clay means that this was more likely a grain-drying kiln than an oven associated with metalwork. If this is the case, the spheroidal slag likely is the result of re-deposition. A long flue containing charcoal led into the chamber; it is expected that a fire pit lay at the mouth of the flue, which would have been intended to keep sparks from entering the drying chamber and setting fire to the grain. The large amount of charcoal found in the flue is puzzling; one possibility is that it was intended to create an oxygen-reduced atmosphere inside the oven. A radiocarbon date from one of the oat grains shows that the oven was in use in the period AD 1033–1152 (Ua-45360).

Fig. 9.6: Figure-of-eight-shaped oven A12142/52220 prior to excavation (above) and cross-section (below). Photo: MCH.

Fig. 9.7: Oven 44031 with flue. Photo prior to excavation.
Photo: MCH. Illustration: I. T. Bøckman, MCH.

In addition to the described features there were a few cooking pits or pits that in light of artefacts, ecofacts, and soil chemical analyses could either be associated with ironworking or contain redeposited materials.

9.2 Buildings, fences, and other constructions

Seventy-five postholes and seven stakeholes were excavated in Area 6. The postholes were generally round and small with cross-sections measuring below 40 cm and with no preserved post imprints. It was not possible to identify buildings on the basis of these postholes, though some formed rows that may have been sections of walls or fences. These findings make it unlikely that larger buildings such as long-houses would have been standing here. Rather, this has been an area of varied use with fences relating to husbandry, sheds, lean-tos, or buildings of relatively simple construction related to production processes or storage.

Most of the postholes contained cereal, and radiocarbon dates on carbonised grain from a selection of 11 postholes show that ten of these were from SP IV–V and only one from SP III: A50424 (Ua-45375) (Figs. 9.8–9). Charred grain is normally preferred over charcoal as dating material; firstly because grain is an annual plant whereas the life period of the trees from which the charcoal derives may produce dates significantly older, and secondly, at multi-phase sites, the circulation and redepositing of charcoal may result in radiocarbon dates that reflect earlier activities (Løken et al. 1996:57; Diinhoff 2005b:110; Gustafson 2005g:50–5; 2016:111). While the same may be the case for grain, the latter is generally believed to be less susceptible to such reworking within deposits. As a rule, larger volumes of either charcoal or grain are more likely to bear relation to their context as compared with single fragments or grains. Most postholes here were grain rich; of those few postholes that did not contain cereals, two were selected for carbon dating on the basis of charcoal to clarify whether they represented activity or a time period different from the grain-containing postholes. Consequently, one posthole was dated to early SP III and the other to early SP IV (Fig. 9.8). Given that 11 out of 13 dated postholes were dated to SP IV–V, it seems likely that the dated and undated postholes mainly represent activity in this period, and that most of them have been part of lighter constructions related to the processing and storage of grain. In Ireland, postholes have been found close to grain-drying kilns; these finds have been interpreted as roofs, kilns attached to storage sheds, and screens or windbreaks (Monk and Kelleher 2005:84). In fact, experiments with corn-drying kilns show that the results may be greatly affected by wind and weather; thus, roofs and screens serve as important control mechanisms in the drying process (Monk and Kelleher 2005:102–4). One of the two postholes dated to SP III (A50424) contained a larger concentration of spheroidal slag and vitrified or sintered clay and is likely related to metalwork on the plateau.

Fig. 9.8: Overview of postholes in Area 6 with datings. Illustration: I. T. Bøckman, MCH.

Fig. 9.9: Overview of MS readings and relevant features for metalwork; see Macphail and Linderholm (Fig. 17.17.b) for further detail. Darker colours signify higher MS readings. Please note that the cooking pits included in this map have only a low volume of slag; however, their locations make them relevant. Illustration: I. T. Bøckman, MCH.

9.3 Metalwork

Remains of hearths or ovens, one piece of plano-convex slag, and spheroidal slags, as well as soil chemical signatures, bear witness to the metalwork that has taken place in Area 6. The presence of iron slag and the lack of moulds, crucibles and pieces of copper alloys, silver, or gold indicated that metalwork primarily consisted of iron-smithing. In Fig. 9.9 the most relevant features in respect to metalwork is combined with Macphail and Linderholm (Fig. 17.17.b) analyses of MS readings.

The apparently equal distributions of burnt and sintered clay and of slags (Figs. 9.10 and 9.12) led to an initial assumption that the clay represented the remains

BURNT CLAY IN LAYERS AND STRUCTURES

Grams per feature

- 0,01–1 g
- 1,01–5 g
- 5,01–15 g
- 15,01–30 g
- 30,01–62,6 g

▭ Trench ▭ Excavated area

SINTERED CLAY IN LAYERS AND STRUCTURES

Grams per feature

- 0,01–5 g
- 5,01–50 g
- 50,01–150 g
- 150,01–250 g
- 250,01–458 g

Fig. 9.10: Overview of the spatial distribution of burnt and sintered clay. With a few possible exceptions, the analysed clay does not indicate metalwork, but rather other activities. However, the distribution shows some correspondence with the distribution of slags; see Figure 9.12. The distributions in Figs. 9.10 and 9.12 show amount per context, not density of finds in each context. Since much of the waste may be the result of re-deposition, the associated processes did not necessarily take place where the waste was found, but probably in the near vicinity. Illustration: I. T. Bøckman, MCH.

Fig. 9.11: Plano-convex slag (above right), spheroidal slag from different contexts (left), and a mix of slag from bloom refining and forging found in the same context (centre) (Scale 1:2). Photo: Terje Tveit, AM.

of ovens or metallurgic ceramics, as found at several sites with traces of Iron Age metalworking (e. g., Bergstøl 2005; Rønne 2008; Reitan 2010). A selection of clay and slags was subjected to thorough analysis by Bernt Rundberget and Unn Pedersen (2015) with the intention of identifying non-ferrous metalwork or specialised processes such as brazing or carburisation (Gustafsson and Söderberg 2005; Söderberg 2014). The analysis consisted of visual characterisation and measurements by a pXRF (model Niton XL3t GOLDD+), with the result that only four sintered fragments and none of the burnt clay had high Fe readings indicative of ironwork. No indications of non-ferrous metalwork were found (Rundberget and Pedersen 2015). Thus, with a few possible exceptions, the clay does generally not reflect metalwork and should rather be interpreted as waste from other types of ovens or processes.

From Area 6, 564.7g slag was collected, of which 3.26 g were spheroids and 308.4 g was a single lump of plano-convex slag (Fig. 9.11). The slag underwent similar analyses as the clay in order to identify visual and chemical signatures representing various processes (Rundberget and Pedersen 2015). A small fraction of the fragments bear the characteristics of smelting slag, but considering their low volume, they likely originate from a primary process of bloom refining (Rundberget and Pedersen 2015). Most of the slag is waste from iron forging and as such a byproduct of secondary processes. One single piece of plano-convex slag formed in the bottom of a hearth was found in the make-up of the Kjellerhaug grave mound in the northern end of Area 6 (Rundberget and Pedersen 2015). Although found out of context, it is reasonable to assume it originates from a hearth in Area 6. Fifty-two pieces of spheroidal slag were found in postholes, ovens, ditches, and layers. Spheroids form during processes of

bloom refining and forge welding; while their scarcity indicates that they originate from secondary processes, the analyses could not provide firm conclusions regarding their origin (Jouttijärvi and Andersen 2005:328–9; Jouttijärvi, et al. 2005:301–2; Jouttijärvi 2009:975; Dorling 2011:35; Rundberget and Pedersen 2015).

The distribution of different types of slags does not correspond to any spatial pattern reflecting different areas for primary or secondary processes (Rundberget and Pedersen 2015). In fact, slags of both kinds could be found within the same contexts, for example in postholes directly next to each other, such as A50414 and A50424. Similarly, the fragments seem to be mixed due to cultivation, trampling, or truncations, such as in the redeposited fill A25526 in fortification A20 (Figs. 9.9 and 9.12). Figure 9.12 rather indicates that the distribution reflects separate processes occurring at separate times within the same concentrated areas as well as post-depositional activities. Consequently, the ironworking in Area 6 encompasses at least two and likely several different processes and techniques.

The spatial distribution of slag coincides quite closely with that of spheroidal slag, although spheroids appear in fewer features (Fig. 9.12). The significance of this combined spatial pattern is confirmed by the soil chemical analyses. Macphail and Linderholm (Ch. 17:406) interpret the generally high MS readings as the results of pre-historic metalworking. The readings also show two areas of especially high MS values measuring approximately 4x4 m², which Macphail and Linderholm (Ch. 17:406, Fig. 17.17.a) identify as two smithies or forges. The south-eastern area of high MS levels overlaps with a concentration of slag, spheroidal slag, and sintered clay. Whereas the analysed clay does not show direct contact with iron or other metals, it does indicate high temperatures. Furthermore, although no hearth or forge was identified there, one 16 cm deep feature, categorised as a cooking pit (A45593), with a few fire-cracked stones, 17 fragments of sintered clay, and one spheroidal slag could be related to metalworking activity.

At the Roman Iron Age ironworking site at Rødbøl, Vestfold, small charcoal-rich hollows were interpreted as hearths. While bearing a noted morphological similarity to cooking pits, their function as ironworking hearths is clearly indicated by the smithing debris they were found to contain (Rønne 2008:93–109). A few well-preserved workshops, such as one of Migration Period date in Skeke in Sweden and one from the Viking Age at Viborg-Søndersø in Denmark, may serve as models for lesser-preserved sites. These workshops featured installations including a large post to hold the anvil, support for bellows, charcoal storage, and a casting box in the form of a flat stone covered in sand (Thomsen 2005:280–2; Hjærtner-Holder 2012). Similar functionalities could be expected in other sites; these examples provide an interesting perspective on the high amount of spheroids found in posthole A50424. As at Rødbøl, where the distribution of spheroids and hammerscales led to identification of three or four forges (Jouttijärvi 2009:977–8), the concentration of spheroids in A50424 (22 pieces, almost half of the total amount from Area 6) may be indicative of a proximity to a forge and anvil. The radiocarbon date from the posthole A50424 is AD 214–326 (Ua-45375).

SLAG IN LAYERS AND STRUCTURES

Grams per feature

- 0,01–5 g
- 5,01–20 g
- 20,01–50 g
- 50,01–100 g
- 100,01–458,7 g

▭ Trench ▭ Excavated area

SPHERIODAL SLAG IN LAYERS AND STRUCTURES

Pieces per feature

- 1 piece
- 2
- 3
- 4
- 22

Fig. 9.12: The spatial distribution of slag and spheroidal slag in Area 6.

Illustration: I. T. Bøckman, MCH.

Fig. 9.13: A20032: possible working surface within a smithy. Left: plan and section drawing of the feature. Right: photos during excavation. Photo: MCH. Illustration: I. T. Bøckman, MCH.

The north-western peak of MS values (Fig. 9.9) does not correspond directly with concentrations of slag, spheroids, and sintered clay, although some of the adjacent features may bear some association with these elevated measurements. One of these features is A20032, which contained two spheroids, a tiny piece of slag, and burnt clay, as well as a glass bead. A20032 is of unclear function and consisted of central, flat, semi-rectangular stones as well as smaller stones placed along the sides of the cut (Fig. 9.13). It is possible that the flat stones were so placed for the purpose of forming a well-kept, flat and clean working surface for the various processes taking place within the smithy, though an alternative interpretation is suggested in the following. A compact hearth or charcoal lens containing burnt clay, which lay directly north-east, may be associated with assumed metalworking in this area. In the same area Cannell et al. (Ch. 18:439–43, Fig. 18.3.a) have found indications of copper-alloy work, likely in brass based on the combined elevated levels of copper and zinc. Though

there is spatial overlap, it is not likely that this assumed low-scale copper work is the origin of the elevated MS readings; such a low volume of copper-alloy work, according to Cannel et al. (Ch. 18:453), would not necessarily imply formal structures and a significant amount of waste. This also explains the absence of tangible remains, leaving the chemical signatures as the sole indication of such activity.

The indications of metalworking in Area 6 are both direct in terms of slags and features interpreted as hearths or ovens and indirect in terms of the MS values and pXRF measurements. The spatial distribution of smithing debris partially corresponds to the higher MS values measured in the western part of the plateau, indicating the possible location of two smithies. Some of the contexts interpreted as related to metalworking were concealed by the fortification on the geological edge of the scarp. The dated features related to metalworking seem to be a part of an activity phase initiated at the very beginning of SP III and ending around AD 600; as such, these features contribute to defining SP III. Metalworking waste found in younger dated features may represent re-deposition, although later instances of metalworking cannot be excluded.

9.4 Processing of agricultural products

Farming consisting of cultivation and grazing seems to have been established at Avaldsnes early in SP I, although grazing may have slightly predated cultivation (Macphail and Linderholm, Ch. 17:405; Bauer and Østmo, Ch. 8:140). Overall, archaeological features contained only a few macrofossils, highlighting the high concentrations of grain in various contexts in Area 6. The charred grain from Area 6 makes up 72% of all grains from the excavation. The grain-rich features were dated to SP IV and V with smaller clusters of consistent radiocarbon dates providing support for contemporaneity (Ballantyne et al., Ch. 19, particularly Tabs. 19.7–8, Fig. 19.8).

Some kilns or ovens contained concentrations of both grain and spheroidal slag, suggesting the possibility of multifunctional ovens. The keyhole-shaped kiln A44031 is an example of this, containing more than a hundred carbonised grains as well as 3 spheroids and an iron nail (Ballantyne et al., Tab. 19.8). However, it is probable that metalworking waste from earlier phases was redeposited in younger contexts, as supported by the fact that all ovens containing fewer than 3 grains are of an SP III date, with the youngest dated to AD 535–601 (Ua-45334) (Fig. 9.1; Ballantyne et al., Fig. 19.8). By contrast, the earliest of the grain-rich features is dated to AD 689–775 (Ua-45369).

The two figure-of-eight-shaped ovens A12142/52220 and A10438/52326 (Figs. 9.1 and 9.6) both contained burnt bone and sintered clay, with no direct indication of metalworking. Both were found to contain more than 30 grains of various types and may have served as grain-drying kilns, although some degree of multi-functionality is pos-

sible. A barley grain from A10438 was dated to AD 882–971 (Ua-45377), corresponding well to the adjacent grain-rich features, especially ditch A12178, but also postholes A53576, A49724, A12060, and A12036 (Figs. 9.1, 9.8). A construction (A20032; Fig. 9.13) with a previously suggested relation to a smithy may offer an alternative interpretation. Measuring approximately 100 by 70 cm and consisting of two flat stone slabs resting on or lined by smaller slabs, A20032 resembles constructions found in buildings from the 6–7th centuries in Rogaland. Such constructions have been interpreted as *tusser*, an installation for drying grain on a slab heated from below (Petersen 1933:7–8, 24–6, 87; Talve 1960:437–9, fig. 136). It has been suggested that similar constructions from Swedish sites were used for the baking of bread (Bergström 2007:160–1). The interpretation of A20032 remains inconclusive; the fill beneath the stone contained only 16 grains and a small amount charcoal, as well as two pieces of spheroidal slag.

These features, in combination with undated postholes of similar shape, size, and archaeobotanical content are likely remains of contemporary granaries, small storage buildings, lean-tos, or screens designed for fencing off and sheltering workspaces.

Apparent lack of charred chaff and straw from the excavation in general and from grain-rich Area 6 in particular led to a working hypothesis that grain was either threshed and cleaned outside the excavated areas or brought to Avaldsnes already cleaned as part of a taxation system. Analyses of phytoliths as well as stable isotopes were conducted with the aim of shedding light on these matters (Ballantyne et al., Ch. 19:490–7). However, the analyses showed that chaff and straw were indeed present, but likely designated to a use other than kindling, such as thatching or fodder, as they were not subjected to charring. The stable isotopes showed continuity in growing conditions, and a shift towards large amounts of imported grains from SP IV onwards seems unlikely. Rather, the origins of grain from SP I–V seem to be the same, although import from areas with similar $\delta^{13}\text{C}$ plant values cannot be completely ruled out.

Nevertheless, the high concentrations of grain as well as the presence of ovens or kilns do show a shift in the organisation of the treatment and storage of agricultural produce. A large volume of grain-drying kilns from Ireland have been dated to the 4th–13th centuries with a peak in the 6th century. Monk and Power (2012) have suggested that this increase may have been a response either to a wetter and colder climate or to a higher demand for grain to feed a segment of the population that was not self-sufficient, such as craftspeople, warriors, or an élite. The high concentrations of cereals and kilns may represent an intensification of the crop-growing area or simply a new spatial organisation of the area. Unfortunately, the analysed pollen sequence from Area 2 (Macphail and Linderholm, Ch. 17:385–8) does not cover SP IV–V and cannot answer these questions.

From SP IV, Area 6 seems to have been designated for treatment and storage of various foodstuffs. Based on dated grain-rich postholes and ditches as well as dated grain-drying kilns/ovens, this designation of the area was likely begun in the 7th century and continued through the Viking Age with the youngest grain-rich feature,

the kiln A44031 dated to SP V. The social and mythological significance of bread and its association with high-status fortified settlements may shed light on this concentration of grain and area for food storage (regarding the palisade A20: Østmo, Ch. 11).

9.5 Other production processes

Charred seaweed was found in 16 of the excavated contexts at Avaldsnes. Six of these lay in Area 6, amongst which oven A37770 was dated to SP III and a posthole was dated to AD 781–894 (Beta-319018). The implications of these findings are treated in further detail by Ballantyne et al. (Ch. 19:499–501), who argue that the most plausible explanation for the routine charring of seaweed is the production of seaweed ash known as ‘black salt’, which can be used for preservation of foodstuffs. By the Hallstatt period, the extraction of salt from mines in north-eastern France, central Germany, and the Austrian Alps was a well-established practice, while production of sea salt dominated in England and the Mediterranean area (Gräslund 1973:284–5). Geological sources of salt are absent on the Scandinavian Peninsula, whereas the processing of sea salt by natural evaporation or boiling of saltwater is known from historical periods; the apparently well-established production and taxation of salt in Scandinavia during the Middle Ages suggests that the technology likely had long been available in the region, although archaeological traces for the prehistoric and early medieval periods are scarce (Gräslund 1973:287–8; Øye 2002:362–4; Larsen 2013:44–9). Archaeological excavations on Læsø, Denmark, have however shown that the practice of boiling saline groundwater have roots at least back to the Middle Ages (Vellev 1996:40–81).

The alternative use of black salt as a means of preserving meat, fish, seal, whale, and cheese has been documented by several ethnographic sources from the North Atlantic region and has support in archaeological remains in the Norse settlement on Greenland. Charred seaweed has been documented at a wide range of North Atlantic sites dating from the Neolithic onwards, mainly in the latter part of the first millennium AD (Ballantyne, Ch. 19:500–1). Geochemical analyses of some of these sites has shown that the use or production of seaweed ash for food preservative leaves geochemical traces, though the findings in analyses conducted on material from Area 6 is not sufficient for drawing firm conclusions (Cannell et al., Ch. 18:439, 450). However, Cannell et al. argue that the combined indications of archaeobotanical and soil-chemical analyses do suggest that seaweed was used either as fuel or as food preservative in the form of ash.

While seemingly a component of a regional traditional technique for conserving foods with black salt during the medieval and historic periods (Clément 1914; Vellev 1996:8–15), charred seaweed has scarcely been documented at Norwegian prehistoric sites. Charred seaweed in contexts dating back to SP III in Area 6 provide indications both of the knowledge and use of black salt during the Iron Age in general,

and that Area 6 was used specifically for the processing and possibly also storage of commodities other than grain. The food-oriented use of the plateau could therefore have predated the grain-rich contexts, as indicated by the traces of decaying meat in the low-temperature oven A401438, which was possibly used for smoking and curing. Char that might originate from cooking by roasting was also documented in the micromorphology analyses through the colluvial formation immediately south of the Kjellerhaug grave mound, providing further support to the food-oriented use of the area (Macphail and Linderholm, Ch. 17:408; Bauer and Østmo, Ch. 8:154–5). A radiocarbon-dated charcoal inclusion (Ua-45354) as well as stratigraphic relations indicate that this was a colluvial build-up that formed gradually, probably during SP II–V.

In addition to metalworking and food processing, calcium- and phosphate-rich silicate slags observed in micromorphology samples indicate craftworking involving use of ashey fluxes, such as glass bead manufacturing (Macphail and Linderholm, Ch. 17:407–8). There is however no further evidence of such a production process, though five glass beads were found across the plateau, one of these in the same context as the studied micromorphology sample.

The collection of 434 pottery sherds found at Area 6 comprises both tableware and cruder pots. This relative intra-site clustering of pottery may be explained as either traces of a local pottery production or as a pattern of waste disposal. Kristoffersen and Hauken (Ch. 21) have analysed and compared the sherds of bucket-shaped pots to regional corpus. They argue that the material can be seen as part of an innovative, although not particularly high-quality local craft tradition that might be rooted in a late Roman Period elite milieu situated along the Karmsund Strait. With the concentration of pottery sherds in Area 6 it is worthwhile considering Avaldsnes or its immediate surroundings as a possible place for such production. Based on an assumed connection between goldsmith workshops and production of bucket-shaped pots, the clustering of gold artefacts at Avaldsnes could provide an indication of a production site, especially as suitable clay for pottery production is to be found at Bøvågen (Kristoffersen and Hauken, Ch. 21:556). These are, however, only circumstantial indications. At Augland, Vest Agder, the remains from a massive pottery production was excavated in the 1970s. In addition to approximately 55,000 sherds and wasters, the site contained pits for processing of clay, several ovens, and a possible storage area for drying pots (Rølsen 1980). The indications of pottery production at Avaldsnes seem meagre and tentative by comparison; furthermore, Augland may be unique as sites with remains of a production of this magnitude are otherwise not known. In addition to the clustering of pottery and the circumstantial indications, there is little evidence to support the presence of pottery production. However, most of the fragments of clay spread across Area 6 (Fig. 9.10) are not related to metalworking and could potentially be associated with other types of ovens or waste from activities such as pottery production. The lack of wasters, ovens associated with pottery production, and clay reservoirs speaks against pottery production and necessitates considera-

Fig. 9.14: Distribution of bucket-shaped pottery in Area 6. Illustration: I. T. Bøckman, MCH.

tion of other explanations for the relative clustering of pottery in Area 6. Much of the material is disturbed and redeposited in trampled or possibly cultivated layers or in the waste layers preserved under A20 (Fig. 9.14). The waste layers also contain inclusions that have been interpreted as episodic dumping of latrine waste in addition to waste from metalworking and burnt and sintered clay. It is therefore likely that the eastern part of Area 6 was used for waste disposal, leading to farmyard middening in some places (Macphail and Linderholm, Ch. 17:406). According to Kristoffersen and Hauken (Ch. 21:528–40), the layers contained both early and late bucket-shaped pottery, which also could indicate waste disposal as the cause for this clustering. Both the youngest pottery and dated charcoal from these waste deposits (for example Ua-45332 from a lens in A32050; Fig. 9.3) slightly predate or just barely overlap with the very youngest suggested date range for underlying hearth A37744. This could imply that the area was subjected to the dumping of waste simultaneously with the working of hearths, or that at least some of the deposits containing waste had been at least partially relocated or levelled out prior to the building of A20. It should be noted that the pXFR measurements and other soil-chemical measurements of soil sampled from a horizontal grid in the central part of Area 6 do show high levels of phosphate, sulphur, and loss-on-ignition, likely reflecting patterns of the disposal of organic and general waste (Cannell et al., Ch. 18; Macphail and Linderholm, Ch. 17).

9.6 Summary

The production processes occurring in Area 6 during SP III–V exhibit several main tendencies. The production during SP III occurred across the plateau and includes activities ranging from food preservation to various forms of iron-smithing. There are chemical indications of other artisan work that would be compatible with glass bead manufacture, but this remains speculative in the absence of documented physical waste. The clusters of pottery sherds in Area 6 could be explained by pottery production or patterns of waste disposal. While the latter might have more direct support in the soil-chemical analysis, firm conclusions are not possible. During SP IV a fortification was built on the eastern edge of the plateau, delimiting the area available for production processes. Besides possible copper-alloy work of limited volume, the area seems specialised and designated for food processing and storage. As this area lay protected behind a fortification, it may have been deemed important to secure and defend these subsistence goods in the southern farmyard area.

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