

Casting in the Longhouse

The Organization of Metalworking in Late Bronze Age Settlements in South-Eastern Sweden

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Abstract

Traces of bronze casting – fragmented moulds and crucibles – frequently occur at Late Bronze Age settlements. These traces are often assumed to represent utilitarian domestic production, in contrast to more specialised workshop production at ritual or elite locations. Moreover, settlements have usually been reduced to overall production units, while actual arrangements for bronze casting within sites have remained unexplored. The aim of this paper is to provide new insight into the organization of metalworking from an empirical and ‘bottom up’ perspective by examining the spatial and social contexts of bronze casting. The analysis draws on ten excavated sites in south-eastern Sweden and addresses three spatial levels: site, setting and framing. The study shows that domestic arenas often hosted varied and complex metalworking staged at various indoor and outdoor hearths located in the core areas of settlements. Rather than being conceptualized as levels, the organization of Late Bronze Age metalworking was a multifaceted, communicative and user-oriented practice. These insights have consequences for excavation methods as well as for the interpretation of the role of metalworking in society.

Keywords: first millennium BC, bronze casting, craft organization, prestige goods, dwellings, household production, spatial organization, spatial analysis, framing, public rituals

Introduction

In the Scandinavian Late Bronze Age, with its increasing repertoire of bronze object types, bronze crafting is generally assumed to have consisted of two functional spheres of production: a mundane household sphere alongside more specialised ‘workshop’ production of politically significant weapons and ornaments (e.g. Oldeberg 1960:50; Weiler 1984:67–70, 1994; Levy 1991:66–68; Thrane 1993, 2013:750; Björhem & Säfvestad 1993:79; Jensen 2002:365; Kristiansen & Larsson 2005:225–227; Nørgaard 2014:38–39; Kristensen 2015; see also Rowlands 1971, 1976; Howard 1983; Ó Faolaín 2004 for similar arguments in a British context). Stylistic or technical differences in prestige objects are often seen as indicative of chiefly workshops at regional centres (Ottenjahn 1961, 1969; Levy 1982:93, 100; Larsson 1986; Rønne 1986; Kristiansen 1987:33–34; Herner 1989; Kristiansen & Larsson 2005:35–37; Nørgaard 2016). Specialised production has been envisaged as taking place not only in centralised workshops (Oldeberg 1960:50; Stenberger 1971:204; Jaanusson 1981:21–22; Levy 1982; Vahlne 1989; Björhem & Säfvestad 1993:79; Weiler 1994; Kristiansen 1998:67–68; Nørgaard 2015, 2016), but also at ritual or liminal sites such as cult houses or enclosures (Levy 1991:66; Kaul 1998:43–44; Prescott 2000; Goldhahn 2007; Melheim 2012), or at central places for assemblies and ceremonies (Thedéen 2004:156; Agersnap Larsen et al. 2015; Melheim 2015; Melheim et al. 2016).

Settlements and farmsteads, with their longhouses and domestic activities, are generally assumed to be associated with the production of utilitarian objects (Kaul 1987:43; Björhem & Säfvestad 1993:79; Thrane 1993:47–48; Earle 2002:311; Jensen 2002:365; Björk 2007:54; Goldhahn 2007:323; Nilsson 2011). This widespread occurrence of metalworking at a large number of Late Bronze Age settlements has often led to the question of whether or not these bronze crafting skills were widely known (e.g. Agersnap Larsen et al. 2015:66). Crafting in ‘regular’ settlements has been suggested to represent either crafting practiced by amateurs (Oldeberg 1943:145; Nilsson 2011) or production carried out by visiting specialists (Björhem & Magnusson Staaf 2006:148–151, 161; Eklund et al. 2007:396; Artursson et al. 2011a:576–577).

A few scholars have suggested that the wide variation in bronze types and the spatial distribution of casting debris in the Late Bronze Age indicates more complexity in the organization of metalworking than allowed for by the two-tiered model outlined above (Wrang 1982; Levy 1991, 1999:208). First, the widespread occurrence of casting debris for prestige goods indicates that specialised metalworking was not strictly centralised to a few regional central workshops (Levy 1991:69–70). Furthermore, Levy (1991:66)

has made the important observation that a variety of artefacts, including non-utilitarian ones, were produced at habitation sites and that ‘production of reasonably diverse metal artifacts took place at numerous communities’ (Levy 1991:68). This suggests that a division between prestige objects and utilitarian goods is a simplification that does not seem to have been defining for the organization of metalworking. As evidence of casting has been found both at settlements and in cult houses, showing at least two different arenas for production, Levy has advocated a multi-tiered model (Levy 1991:70). She has subsequently elaborated on this interpretation and suggested three different spheres or levels of production: one linked to stone moulds deposited outside settlements, one based on clay moulds in settlements; and, finally, the possibility of an exclusive, as yet unidentified sphere of crafting for the most elaborate objects (Levy 1999:208). Although these observations are both relevant and nuanced, Levy’s alternative model remains an elaboration of the same idea: that bronze crafting was spatially and socially organized in levels according to a hierarchy ranging from the domestic sphere to prestigious political spheres.

Thus, although the dichotomic model of workshop/household craft production has been challenged, it has remained a powerful and defining concept. However attractively clear, there are several problems with the empirical basis of two-tiered as well as three-tiered models of craft organization in the Late Bronze Age. First, settlements tend to be compared to each other in their entirety as single units of production. Hence when the organisation of metalworking is analyzed, sites are primarily ranked against each other as representing either small-scale/household production or large-scale/workshop production based on the *quantity* of finds related to casting *from the whole site* (e.g. Oldeberg 1960:50; Eklöf 1999:27; Nilsson 2011:88–89). Casting debris, however, is typically highly fragmented (Eriksson 2007:171) and therefore not suited to a quantitative approach. Such accounts thus tend to overlook source critical issues including the impact of formation processes, preservation conditions and chronological resolution in these complex sites. Finally and above all, little attention has been paid to the social contexts of casting-related finds when discussing crafting in settlements. *Where* and *how* the casting was carried out within settlements is rarely reconstructed (Sørensen 2015). Curiously, relationships between casting and settlements in the Late Bronze Age have been less emphasized than in the Early Bronze Age (e.g. Nilsson 1996; Ethelberg 1995; Earle 1997:130; Artursson 2005:132), despite considerable archaeological evidence (although see Levy 1991; Boddum et al. eds 2015). This may be due to the increasing complexity of the settlement evidence, where size differences between longhouses are less prominent than in earlier periods



Figure 1. Map of the sites included in the study. (1) Apalle, (2) Bredåker, (3) Nibble, (4) Pryssgården, (5) Rambodal, (6) Ryssgårdet, (7) Skuttunge kyrka, (8) Tallboda, (9) Vrå, (10) Västra Bökestad, (11) Åbrunna.

(Karlenby 1994:23; Ethelberg 2000:215; Artursson 2009), and the casting debris is more widely spread.

The central issue is therefore that the setting and spatial arrangements of crafting within settlements, and indeed during the Late Bronze Age landscape in general, are almost unknown. Instead, assumptions and misunderstandings about metalworking in settlements have been transmitted in both excavation reports and subsequent research. For example, there are persistent beliefs that the activity must have been located at the outskirts of settlements for practical reasons (e.g. Thrane 1971:161, 2015:124; Carlie 1992; Karlenby 1998:30; Aspeborg 1997:12; Paulsson Nord & Sarnäs 2001:64; Goldhahn 2007:213, 216), and that it demanded special arrangements such as furnaces (e.g. Renfrew 1976:190; Vahlne 1989; Burenhult ed. 1999:50–51; Jensen 2002:365; Goldhahn 2007). Finally, the widely proposed two-tiered organization of bronze crafting (e.g. Oldeberg 1960:50; Björhem &

Säfvestad 1993:79; Jensen 2002:365; Thrane 2013:750) raises questions about the variables used to differentiate between ‘large’ and ‘small’ settlements, as well as the functional categorisation of bronzes as either practical or prestigious/political.

Generally, Bronze Age settlement space seems to be structured according to different principles from Iron Age and later farms. Late Bronze Age settlements cover larger areas and include more diverse activity areas compared to the clearly structured and condensed farmsteads of the end of the Early Iron Age and onwards (Olausson 1998:112; Göthberg 2000:93–94; Gröhn 2004:280). The organization of Late Bronze Age settlements might therefore be less immediately comprehensible – from a modern western perspective – than, for example, a Merovingian farmstead. Reconstructing metalworking in settled spaces therefore entails a deeper inquiry into the logic of Bronze Age domestic space. A detailed, contextual study of the settings of metalworking can therefore also contribute to our more general understanding of how settlements were organized – physically and socially – in the Bronze Age.

Traditional hypotheses about the organization and spatial arrangements of bronze-crafting are here revised against a growing number of archaeologically visible production sites. Bronze casting in settlements is approached in two steps. First, by critically reviewing common assumptions about the technical and practical requirements of casting against the current evidence, making use of the considerable new information that has emerged from contract archaeological investigations in recent decades. Second, by examining how and where casting was carried out at Late Bronze Age settlements in the region corresponding to the provinces of Uppland, Södermanland and Östergötland in south-eastern Sweden.¹ The metalworking evidence in the uniquely well-preserved settlement at Apalle in Uppland (Ullén 1994; Ullén ed. 2003) features as a case study, and is then compared with nine other sites in the region (figure 1). Insights regarding the location, visibility and social settings of bronze casting are then discussed as a window onto Late Bronze Age communities, one which can inform our understandings of the internal organisation of settlements, ritual and public space, and the role and importance of metalworking in social and political strategies.

The overall aim is to demonstrate how a study focusing on detailed contextualization of bronze casting debris can provide new insights into the organization and wider role of metalworking in social and political life in the Late Bronze Age.

1 This region is also frequently referred to as mid-central Sweden, or central Sweden. Since it is located in the southern half of Sweden and not its centre, I will use the geographically more accurate and geopolitically less contested term ‘south-eastern Sweden’.

Background

Despite the absence of detailed studies, several recurring assumptions about how casting was arranged in domestic space during the Late Bronze Age are commonly seen in both fieldwork publications and wider research. Such presumptions impact our expectations and how we excavate in Bronze Age sites (e.g. Björhem & Säfvestad 1993:78; Helander & Zetterlund 1997:31–35; Strucke & Holback 2006:27). Furthermore, these assumptions often carry implications about the social and cultural conditions of crafting rooted in historical and industrial examples of working arrangements (Budd & Taylor 1995; see also Sörman 2017:55–58), and therefore continuously shape our understanding of metalworking in this period. As pointed out by Rønne (1993:72) faulty assumptions about the technical requirements of the crafting process make it unclear how to study the ties between metalworking and settlements. Three common and problematic assumptions which will be dealt with here are:

1. Bronze casting was performed outdoors because of fire hazard (e.g. Karlenby 1998:30; Aspeborg 1997:12; Paulsson Nord & Sarnäs 2001:64; Stilborg 2002:14).
2. Melting bronze required furnaces (e.g. Svensson 1940:105–106; Renfrew 1976:190; Vahlne 1989; Burenhult ed. 1999:50–51; Jensen 2002:365; Diinhof 2006:11; Goldhahn 2007; Goldhahn & Oestigaard 2008:225).
3. Bronze casting was located in the outskirts of settlements (e.g. Thrane 1971:161, 2015:124; Carlie 1992; Goldhahn 2007:213, 216; see figure 2), or in enclosures and special buildings hidden from view (Goldhahn 2007:59, 242, 324).

When we consider that, for the Early Bronze Age, casting inside longhouses has been an accepted hypothesis (Jensen 2002:109–111; Jantzen 2008:299) the first assumption, that metalworking was kept outdoors due to fire hazard, is contradictory. Experimental archaeology demonstrates that bronze melting with Bronze Age techniques can easily be carried out indoors (e.g. Burrage 2004; Paardekooper 2013:figure 8; Manning 2014). The idea that hearths used for melting are more hazardous than other indoor fireplaces is perhaps also rooted in misconceptions about the technical requirements for accomplishing higher temperatures (see discussion about ‘furnaces’ below). Casting indoors may bring benefits such as shelter from rain or wind, as well as darker spaces more favourable for distinguishing the colour and glow of the metal (Burrage 2004). It is, however, also possible to perform melting and casting in full daylight; Bronze Age crafters would have re-

lied on several senses to distinguish the readiness and quality of the alloy (Kuijpers 2013; see also Theophilus [c. 1100 AD] 1979:173).

The idea that furnaces are required for melting bronze (e.g. Svensson 1940:105–106; Jaanusson 1971; Renfrew 1976:190; Vahlne 1989; Swedberg 1995; Burenhult ed. 1999:50–51; Jensen 2002:365; Schütz 2007; Diinhof 2006:11; Goldhahn 2007; Goldhahn & Oestigaard 2008:225; Melheim 2012) is a longstanding misconception in Scandinavian Bronze Age research. The stone-lined or clay-lined pits found at the famous Late Bronze Age settlement of Hallunda in the Swedish province of Södermanland have been particularly influential in terms of shaping this misconception: interpreted as melting furnaces (Jaanusson & Vahlne 1975; Vahlne 1989), they gained much attention at their discovery in the 1970s and have since been referenced in a number of important and widespread textbooks and reports (e.g. Renfrew 1976:190; Coles & Harding 1979:497; Serning 1987; Harding 2000:233; Burenhult ed. 1999:50; Häringe 2002a:38–39; Strucke & Holback 2006:27). The presumption of furnaces for melting bronze has persisted, despite critique and technical arguments demonstrating faulty assumptions in previous analyses (Hjärthner-Holdar 1993:97; Eriksson 2003:145; Jantzen 2008:294).

There is now overwhelming evidence that Bronze Age metalworking techniques in Scandinavia relied only on melting bronze in open fire places, with the help of forced draught primarily through the use of bellows (Thrane 2006; Jantzen 2008:299; Hjärthner-Holdar ed. 2011:18; Eklöv Pettersson 2011:24, see also Sörman 2018:49–53). The two main sources of evidence for casting in open hearths are the wide and low-cut crucibles (Eklöv Pettersson 2011:24), and the L-shape of Bronze Age tuyères or blast nozzles (Thrane 2006), both indicative of direct heating through forced draught onto the crucible from above. When identified, the hearths used are no different in form from regular fireplaces (e.g. Petré 1959; Draiby 1984; Schütz 2007), making indirect finds such as casting debris and small metal droplets the keys to interpretation (Söderberg 2002; Kuijpers 2008:93; Jantzen 2008:293; Sörman 2018:53–55).

The third assumption, that bronze working was primarily carried out in the outskirts of settlements, seems to have grown from two roots. First, metalworking is often regarded as a particularly advanced activity that required specialised and complex settings. This view can be found in many archaeological publications (e.g. Burenhult ed. 1999:50–51; Jensen 2002; see figure 2). A special location is also implicit in traditional terminology such as workshops or crafting places: terms that have been shown to be misleading for the spatially flexible and diverse organization of Late Bronze Age metalworking (Sörman 2017). Second, this interpretation has been argued on the basis that settlements sometimes feature casting refuse in peripher-



Figure 2. Bronze smith at work. Traditional illustration of metalworking in north European Bronze Age settlements: (male) specialists working in designated crafting area, or in the outskirts of the settlement, at safe distance from contemporary buildings. Illustration: Miles Kelly. Published with permission from fotoLibra.

ally located waste pits (Thrane 1971:161; Carlie 1992:40, 69; Björhem & Säfvestad 1993; Goldhahn 2007:216).

However, the picture of peripheral crafting areas builds on settlement excavations from the 1970s and 1980s where dug-down features such as pits and pit systems were the only remaining find-bearing contexts to survive following excessive top-soil removal (Rudebeck 2002:42–43; Artursson 2005:22). In contrast, modern settlement excavations, where top-soil removal is more careful, often result in preserved cultural layers (e.g. Hanlon 2003; Ullén ed. 2003; Frölund & Schütz red. 2007; Seiler & Östling 2008; Sörman 2018: appendix 2). This results in different distributions of remains and finds which make it difficult to compare the results of modern projects with those of earlier excavations (Nilsson & Rudebeck 2010:26). Recent commercial excavations – in which about 5–10 percent of identified cultural layers tend to be excavated manually – indicate much wider

distribution of casting debris on settlements, including in the direct vicinity of buildings (e.g. Hanlon 2003; Ullén ed. 2003; Seiler & Östling 2008; see figure 4). The notion of special crafting areas at the outskirts of dwelling zones is also deeply rooted and visible in popularized illustrations produced throughout the last century (figure 2), but this concept now needs to be abandoned.

Casting within Late Bronze Age settlements

We will now turn from the nature of and spatial requirements for bronze casting to the organization of Bronze Age settlements. In the Scandinavian Late Bronze Age, sites of long-term habitation are characterized by one or several longhouses surrounded by areas associated with remains of intense and continuous daily life activities. The structure of settled space can provide important insight into the organization of domestic activities, gender divisions, living conditions and, ultimately, the worldviews and ideology of communities (e.g. Hillier & Hansen 1984; Samson ed. 1990; Parker Pearson & Richards eds 1994; Tringham 1994; Brück & Goodman eds 1999). As bronze crafting has mainly been discussed on a larger scale, with whole settlements treated as production units, this perspective is largely missing from craft studies. The production and consumption of metalwork has mainly been approached in large scale studies and has often been influenced by structural Marxism (e.g. Levy 1982; Larsson 1986; Kristiansen 1987). Marxist perspectives within archaeology have frequently focused on larger spatial and temporal scales (Hodder 1987:2). This is particularly notable for the Nordic Bronze Age research discourse, where a strong tradition of structural-Marxism, macro-economics and ecological processual approaches can be observed (Gröhn 2004). By contrast, when the organization of Bronze Age settlement space has been discussed it has typically been at the level of individual households, with a particular focus on the longhouse as social arena (e.g. Ullén 1994; Skoglund 1999; Gröhn 2004:chapter 4.1; Streiffert 2005; Kristiansen 2013; Oma 2018).

METHOD AND SOURCE CRITICISM

The approach taken here when reconstructing metalworking is to work beyond the concept of the individual household or building, and to look at activity areas and the dynamic between different spheres within the settlement. Since clearly identifiable casting hearths are rare, debris is the primary clue to production points (Söderberg 2002; Jantzen 2008:299), and the main focus of this analysis is mould and crucible fragments, above all their spatial relation to contemporary buildings and other activities in dwelling areas.

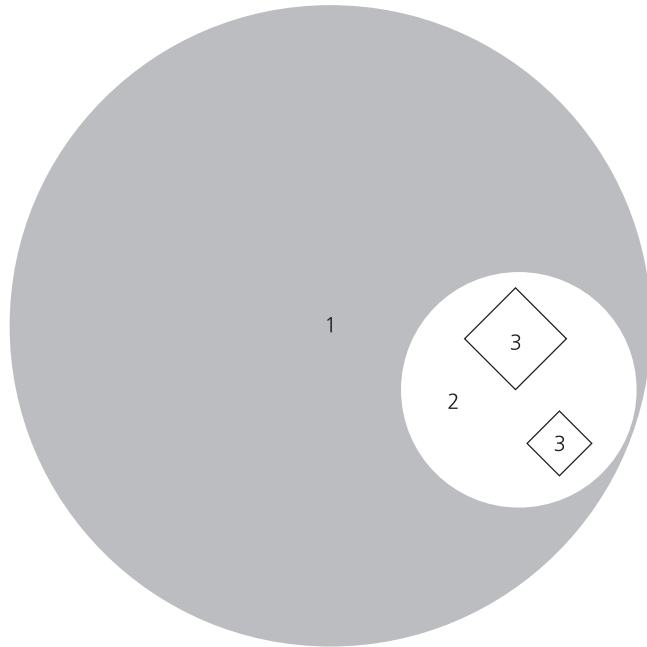


Figure 3. The proposed spatial scales of analysis in relation to the location and organization of metalworking in settlements: (1) the site, (2) the setting, and (3) the framing. Illustration by the author.

The contexts of metalworking in individual sites will be addressed at three different spatial levels (figure 3). Spatial scales and the definitions or criteria for contexts often tend to be implicit and undefined in archaeological texts (Lyman 2011:226–227). These analytical scales have therefore been designed to define some of the social and physical spaces assumed to be meaningful to the people who shaped and used them in the past. These spatial levels are defined as social spaces – given reason and meaning through human interaction with past users and today’s archaeologists (Larsson 2000:43).

The first and most general level is the *site* or *locale*. This refers to the broad category of archaeological sites – for example, a settlement complex or a cemetery. The second level is the *setting* or *milieu*, which is used to refer to a spatial and social context within a wider site. A setting may, for example, be a dwelling or activity area in a settlement, or it may be a cult-house milieu within a grave field. Third and finally, the closest spatial scale discussed here is defined as the immediate *framing* within a setting. This refers to human-scale, lived-in spaces such as a room in a particular house, the area around a fireplace in an activity area, and so on. This level is not always possible to reconstruct based on the settlement data. Although

concentrations of casting debris can sometimes hint at certain social and spatial framings, or ‘rooms’ within a space, more detailed contextual reconstruction is often hindered by the low chronological resolution and the limited base for interpretation offered by other find materials.

While interpretations of the first – and to some degree the second – level of *site/locale* and *setting/milieu* are often provided in excavation reports, the setting and framing of the casting activity itself is rarely discussed in detail. The human scale, based in bodily experience, is curiously under-used in narrating archaeological reports, and settlements are often treated as abstract, two-dimensional miniature worlds, portrayed from a bird’s-eye view (Nilsson & Rudebeck 2010:51–52). Meaningful contexts should be expected to figure prominently in site reports, as they constitute the backbone of archaeological fieldwork, but descriptions of bodily encounters with sites and materials are often insufficient for further research (Lucas 2001:16–17; Papaconstantinou 2006:13). Furthermore, observations and interpretations of metalworking activity have frequently been guided by faulty assumptions such as those discussed above. In this paper, the analysis of the spatial and social settings of casting takes into account previous observations, but is based on reassessments and re-interpretations of both field documentation and published reports.

An introduction to the settlements

Inhabited Late Bronze Age landscapes in south-eastern Sweden were concentrated along waterways corresponding today to heights around 20–30 m a.s.l., which at that time represented locations by lakes or the innermost fjords of the Baltic Sea (see figure 1; e.g. Jensen 1986; Wigren 1987; Lindström 2011). Settlement foci include widespread activity areas with clusters of houses, cultural layers, heaps of fire-cracked stones (‘burnt mounds’), stone settings, and sometimes cult houses and/or cup marks (Hyenstrand 1968, 1984:63–69; Borna-Ahlkvist 2002:169; Thedéen 2004; Artursson et al. 2011a:553; Lindström 2011). Excavations during the last decade have demonstrated that dwelling milieus were located on lower sand or clay soils, while graves and cult houses were located on adjacent, slightly higher rocky or moraine terrain as parts of joint complexes (Forsman & Victor 2007; Hjärthner-Holdar et al. eds 2008; Artursson et al. eds, 2011c; Karlenby 2011; Larsson ed. 2014; see also Sörman 2018:figure 50). Thus, ritual milieus and graves were often closely related elements of settlements.

Thirty-one sites with clear finds of Bronze Age casting debris (crucible and/or mould fragments) and thirteen sites with suspected finds of crucible and/or mould fragments have been identified in the region under study

Table 1. Late Bronze Age settlement sites included in this study.

Name of Site	County	Primary Reference (Excavation Report)	Excavated area (m ²)	Finds Related to Metalworking
Apalle	Uppland	Ullén ed. 2003	42,000	140 fragments of crucibles and 360 mould fragments.
Bredåker	Uppland	Göthberg & Schütz ed. 2006; Frölund & Schütz ed. 2007	~ 5 000	c. 40 fragments of crucibles and c. 100 fragments of ceramic moulds. c. 20 metal melts/droplets.
Nibble	Uppland	Artursson et al. ed. 2011	31,545	5 fragments of crucibles and 4 fragments of ceramic moulds.
Pryssgården	Östergötland	Borna-Ahlkvist et al. 1998	~ 72,000	1 fragment of ceramic mould, a few crucible fragments. Parts of 1 ceramic blast nozzle.
Rambodal	Östergötland	Nyberg & Nilsson 2012	~ 2100	1 fragment of a soap stone mould for socketed axe of period V–VI. 1 copper melt.
Ryssgärdet	Uppland	Eriksson & Östling 2005; Hjärthner-Holdar et al. eds 2008	17,000	2 fragments of crucibles, 20 fragments of ceramic moulds and 4 melts.
Skuttunge kyrka	Uppland	Seiler & Östling 2008	10,111	6 fragments of ceramic moulds.
Tallboda	Östergötland	Äijä et al. 1996	19,000	2 fragments of crucibles and 1 fragmented ceramic mould for a spectacle fibula.
Vrå	Uppland	Karlenby ed. 1997; Göthberg et al. eds 2002	42,000	c. 200 fragments of ceramic moulds.
Västra Bökestad	Östergötland	Helander & Zetterlund 1997	8100	c. 30 fragments of crucibles and c. 80 fragments of ceramic moulds. 1 intact gold crucible.
Åbrunna	Södermanland	Strucke & Holback 2006	47,000	7 fragments of crucibles and 1 fragment of a possible ceramic blast nozzle.

(Uppland, Södermanland and Östergötland) (appendix 1; see also Sörman 2018:59–60; Nilsson & Sörman 2015:91–92). These figures are based on a comprehensive literature survey taking advantage of Sweden's increasingly well-digitalized excavation records, and are therefore likely present a representative sample of Bronze Age settlements known today.²

2 This covers the digitalized excavation reports available online via the websites of individual archaeological actors and also the open digital archive of the Swedish National Heritage Board *Samla* (samla.raa.se). The digital catalogue of the *Vitterhetsakademien* archaeological library has also been consulted, and from this source reports with relevant titles and the keyword 'Bronze Age' have been requested and scanned for mentions of casting finds. The exact number of excavated Bronze Age settlements is impossible to estimate due to the lack of an all-encompassing, searchable register. See Sörman 2018 for more details.

Ten of the sites with clear metalworking debris have been included in this article (table 1). This selection is based on two main factors in order to provide a useful sample for comparative discussion: (1) these are sites which have been extensively excavated and are therefore suitable candidates for spatial analysis; and (2) they include the different types of crafting contexts represented in the dataset (see Sörman 2018). The richest example in terms of information, with higher chronological resolution and more contextual data than average settlement sites, is Apalle in Uppland. The metalworking at this site is therefore presented as a case study, followed by a comparison with other sites for contrasts and parallels.

Case study: the Apalle settlement

One of the most informative examples of casting in a Bronze Age settlement in southern Scandinavia is the dwelling at Apalle, 50 kilometres northwest of Stockholm in central Uppland, excavated in advance of highway construction (Ullén ed. 2003). The settlement had unusually favourable preservation of organic materials and had eluded plough damage, resulting in intact stratigraphy with cultural layers up to metre thick. These provided vast amounts of animal bones, fragmented pottery, stone-, bone- and antler tools, small bronze objects and more than a ton of burnt wattle daub (Ullén 1994:249–250, 1996:174, 2003a). In combination with the extensive manual excavation of cultural layers, these conditions provided a uniquely detailed insight into stratigraphically distinct settlement horizons (Ullén 2003b; see table 2), and even building interiors (Ullén 1994:254–257). Moreover, with trenches covering most of the central parts, the excavation provided a comprehensive and long-term picture of the site, revealing continued settlement from the Late Neolithic until the Early Iron Age (Ullén 2003b). Considering the stone-settings, cup-marks and mounds of fire-cracked stones continuing to the north of the excavated area (Ullén 2003c:13–16; Historic Environment Record *KMR*), the Apalle settlement is likely to have constituted a large complex with linked dwelling and mortuary areas (Borna-Ahlkvist 2002:169; Artursson 2011:23–24; Sörman 2018:92–93).

Each settlement phase featured several contemporary longhouses surrounded by extensive outdoor activity areas: wells, pit systems, small field plots and mounds or heaps of fire-cracked stones (Ullén 2003b). Although spatial organization within the settlement varied somewhat over time, the overall settlement structure – the placement of buildings – can be described as largely static throughout the Bronze Age (Ullén 2003b:73). With its village-like cluster of buildings, extensive size and long continuity, Apalle has been interpreted as one of the largest and most prominent complexes in the

Table 2. Finds of casting debris in different stratigraphic layer types at Apalle. The layer types each represent consecutive chronological horizons (Ullén ed. 2003:41–42).

*The chronological intervals are based on a compilation of 88 ¹⁴C-analyses: 23 from layer type 1, 12 from layer type 2, 28 from layer type 3, 17 from layer type 4, and 8 from layer type 5. For the full dataset, including lab numbers, see Ullén 2003b:figures 16–20. It should, however, be noted that this source makes no reference to the calibration curve and software edition used for correcting the dates.

	Layer type 1	Layer type 2	Layer type 3	Layer type 4–5
Crucible fragments (number of finds)	45	60	23	2
Mould fragments (number of finds)	146	117	89	8
Range of ¹⁴ C-datings per layer type, 2 sigma*	1060–350 BC	1260–790 BC	1320–790 BC	1600–830 BC
Range of ¹⁴ C-datings per layer type, 1 sigma	990–420 BC	1200–500 BC	1260–810 BC	1450–900 BC
Approx. chronological interval	c. 900–600 BC (period V–VI)	c. 900–800 BC (period IV–V)	c. 1100–900 BC (period IV)	c. 1300–1000 BC (period III)

region (Ullén 1994:250, Ullén 2003b:75; Karlenby 2007:150; Artursson 2009:147–150; Artursson et al. 2011a:573–577; Lindström 2011:517–519; Artursson et al. 2017:44–45). The *site* where metalworking took place here is thus a large settlement, and the *setting* within this site is a dwelling zone with several contemporary houses and a multitude of activities.

A detailed previous study of the casting debris from the Bronze Age phases, including 140 fragments of crucibles and 360 mould fragments (Eriksson 2003), provides a fruitful basis for assessing metalworking evidence at Apalle. A first, basic question is whether the debris represents casting on the site. Several factors illustrate that the residue does indeed represent crafting in its immediate vicinity: the debris includes broken moulds, cores and crucibles, and many crucibles show re-lining, as well as droplets of metal infused into the ceramic (Eriksson 2003:130, 132) clearly showing that they derive from production, rather than – for example – the preparation of technical ceramics intended for use somewhere else. Crucibles, which were often re-used many times (Eklöv Pettersson 2011) and thus had to be kept somewhere between production events, could potentially have been moved to the settlement for discard or storage. However, the presence of fragmented ceramic moulds and sintered cores (Eriksson 2003:132–140) – fragile materials that tend to break after each, or almost each, casting (Rønne 1993:86; Kuijpers 2008:88) – indicate that the production refuse was generated on site. Due to the fragile nature of the material, the identified fragments must be a small portion of the original amount originally used.

The casting debris is evident in the occupation deposits preserved under the topsoil, which formed stratigraphic horizons dating from period III to

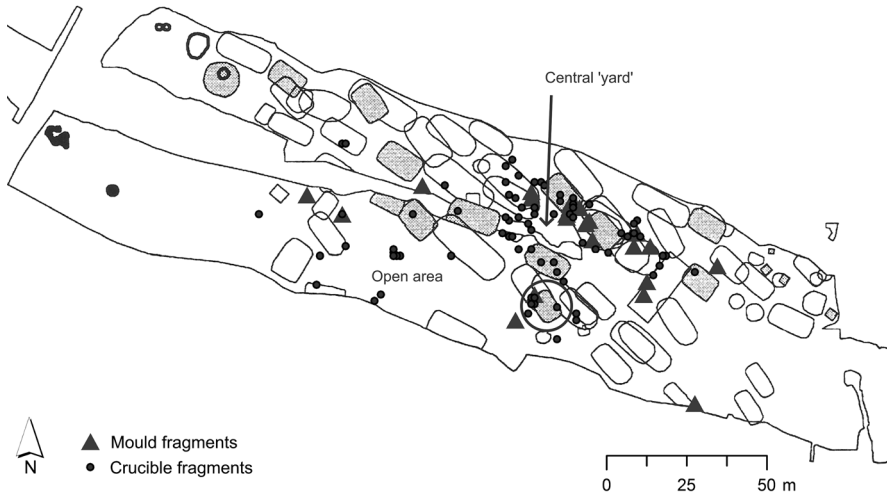


Figure 4. The Bronze Age settlement at Apalle during phase 5 of the Late Bronze Age (period V) with distribution of crucible and mould fragments from the corresponding stratigraphic layer. A longhouse (K26) where a casting mould fragment was recovered from the hearth is indicated by a circle. Illustration by the author.

period VI (c. 1300–600 BC) (see table 2; Eriksson 2003; Sörman 2018:66–80). The oldest layers, from period II–III (1500–1100 BC), contained very few traces, all centred on the middle of the settlement (appendix 2). The younger layers, representing Late Bronze Age periods IV–VI (1100–500 BC), show a successively more widespread spatial distribution across the site (appendix 2). In period IV–VI, casting refuse is evident in central courtyards, various types of buildings and at a large open area in the southern part of the settlement (figure 4). This wide distribution in occupation deposits – across several parts of the settlement – speaks strongly against metalworking being restricted to a particular crafting area or workshop within the Late Bronze Age settlement (Sörman 2018:77–79).

Although we should not rule out the possible impact of site formation processes such as mixing and midden spreads (Ullén 1994:253), there are several indicators that suggest a rather low level of stratigraphic mixing, and thus a high integrity for the layers. One such factor is the preservation of central middens (in the earlier phases) and smaller refuse accumulations by individual longhouses (in the later phases) (Ullén 1994:252–253), and refuse pits (Ullén 2003b:46–48). Another indicator is that find types from the different layers typologically match the datable organic materials that were ^{14}C -analysed from each stratigraphic horizon, again demonstrating their integrity. Apart from casting debris, the occupational layers held a vast amount of waste from the settlement: for example, 360 kg of broken

pottery, 850 kg of animal bones, broken tools made from bone, antler and stone, and about 60 fragmented bronze objects (Ullén 1996:174). A total of 98 percent of the casting debris from Apalle was found in cultural layers, and only 2 percent in fills of cut features such as hearths, pits and post-holes (Ullén ed. 2003: CD appendix, *Fyndförteckning Gjuterifynd*). However, in such unusually well-preserved stratigraphy, the distribution and spatial relations of cultural-layer finds to buildings and other features can also provide contextual insights.

The precise locations of metalworking within the settlement were considered difficult to reconstruct by the excavators as no casting furnaces or special hearths for melting bronze could be identified (Ullén 2003b:46; although see Eriksson 2003:145). The expectation of furnaces and clear crafting areas is yet another example of the influence of the Hallunda ‘furnaces’ (Jaanusson & Vahlne 1975; Vahlne 1989; see *Background*), and the common misconceptions about the techniques and practical requirements of casting as discussed in the initial parts of this article. Nevertheless, one possible crafting area was suggested based on a concentration of casting debris clustered around a circular building/enclosure (K33) in the central part of the settlement (Ullén 2003b:46, 65). This suggestion was later developed by Goldhahn (2007:212), who proposed that this feature had functioned as a secluded and even secret metalworking area. This postulated casting enclosure at Apalle was used by Goldhahn (2007) as an example in his wider argument, in which he proposed that Bronze Age casting was a highly esoteric practice, hidden from view and the mundane arenas of daily life.

There are three main problems with the interpretation of K33 as the main metalworking area at Apalle. First, the round enclosure or building was dated to period IV (1100–900 BC) and thus was in use for at most a couple of centuries during the early part of the third settlement phase, being both preceded and followed by other buildings at the same location (Ullén 2003b:65). Although casting debris clusters around K33, it is distributed throughout the stratigraphy both vertically (layer types 1–5) and horizontally (see appendix 2), indicating that it accumulated here both before and after building K33 was in place. Second, this particular area represents the most central and intensely used space throughout the history of the settlement. It features the most complex stratigraphy, the most substantial cultural layers and the highest concentrations of many find types (Ullén 2003b:63–64, figure 30). Seen in this perspective, the accumulation of casting refuse is part of a general concentration of refuse and continuous activities here. Third, the high representation of casting finds around K33 is more obvious when considering the spread of casting debris *by weight* rather than by number of finds. The concentration at the central area around K33 is dominated by crucible fragments that are far heavier than moulds

(Eriksson 2003:129, 142). Only one quarter of the mould fragments were recovered from this area, while the rest were recovered from a 7400m² area (Eriksson 2003:129). To sum up: a large part of the bronze casting at Apalle across the use phases probably occurred in association with this feature, the other centrally located buildings and the central yard-like space. However, bronze casting was not contextually or temporally restricted to the round enclosure/building K33.

Moving to the closer scale, what were the ‘framings’ in which bronze casting was carried out at Apalle? First, the accumulation of casting debris in the yard-like central area with K33 and longhouses can be seen as a focal and strategic point throughout the use of the dwelling. This area, including the location of one of the central heaps of fire-cracked stones, was described by the excavators as forming a ‘natural terrace’ (Ullén 1994:253). Low-laying parts of naked bedrock surfaced here (Ullén 2003c:figure 3; Sörman 2018:figure 27), offering the possibility to highlight, demarcate and accentuate activities played out in this space. This is the type of spatial information from bodily experience that Nilsson and Rudebeck (2010:51–52) have called for in excavation reports because, as mentioned earlier, it aids interpretations at closer spatial scales. Such close-up contextual information is not prominent in the Apalle report, which has a classic focus on general site chronology and a synthesis for each category of features and find types (Ullén ed. 2003). However, from what we can deduce from site plans and descriptions, it is possible to define the terrace as an area surrounded by buildings. This space forms a focal, open area that can be interpreted as a central courtyard throughout the settlement phases. The integration of the natural terrace in this ‘courtyard’ suggests that bronze casting was performed in a prominent, visually accessible and centric social space within the dwelling zone.

Castings may have been performed as both outdoor and indoor events in Apalle. Contextual clues in the documentation can, in a few cases, give insights into more specific settings and framings for producing bronzes in the settlement. One of these clues is the fragment of a ceramic mould, possibly for a neck ring or a dress pin, recovered from the hearth of the north-western room in a longhouse (K26) belonging to period V (layer type 1 of settlement phase 5; see figure 5 and appendix 2). This mould fragment indicates that casting could have taken place inside longhouses during the Late Bronze Age.

Another metalworking find from Apalle – from the Late Bronze Age phase of period IV–VI – was recovered from the large, open area in the southern part of the settlement (see figure 4). This 10000m² area was framed by dwelling houses in the north and by a large pit system in the south, and was not built upon throughout the millennia that the Apalle dwelling ex-

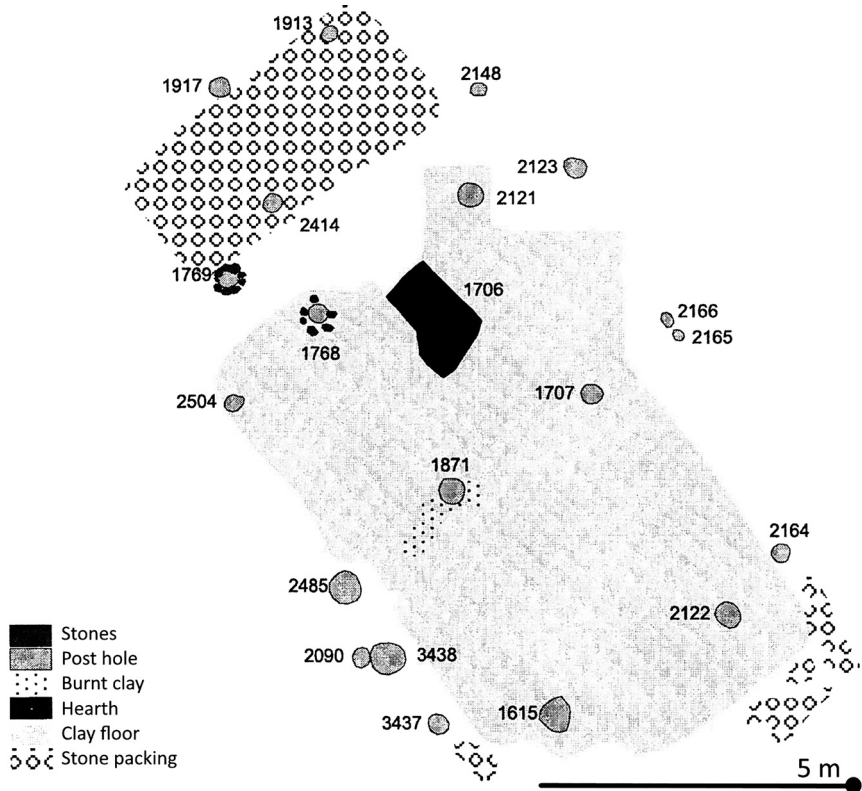


Figure 5. Detail of longhouse K26 within phase 5 (period V) of the late Bronze Age settlement at Apalle. A fragment of a casting mould possibly for a neck ring or a pin was found in the hearth (A1706) of the building. Source: Ullén ed. 2003: house catalogue.

isted (Ullén 2003b:65). The fact that it was almost encircled by buildings and pit systems and yet kept open for centuries would fit well with an interpretation of this as an assembly place for the village (Ullén 1996:173; Sörman 2018:78). Here, several crucible and mould fragments from the cultural layer types 1 – and to some degree from type 2 – indicate casting at some point(s) during the Late Bronze Age, periods IV–VI. Some of the mould fragments found here also had imprints with decoration, suggesting prestige items (Eriksson 2003:137–138).

To sum up, the distribution and find contexts of metalworking debris at Apalle show production of bronzes in a settlement setting. Initially, during period III–IV casting was mainly carried out at the central yard of the dwelling. Later, during Late Bronze Age periods IV–IV, casting seems to have occurred instead in various houses and activity areas in the dwelling zone. One particularly important space for metalworking throughout the period of the settlement seems to have been the central yard of the dwelling.

The Apalle case thus provides an illustrative example of metalworking as an integral activity that by no means required either special furnaces or hearth constructions at a peripheral location. Rather than being restricted to special or secluded places, this activity left traces on ground surfaces among other litter and refuse materials, ranging from areas between houses, an open assembly area and from within longhouses and other buildings, such as the circular building K33.

Moreover, it is not only the locations that varied through time; the relatively well-preserved moulds in the Apalle material demonstrate that the type of objects produced were also variable. Preserved imprints in the moulds testify to casting of a range of different objects, from socketed axe heads to large and exclusive dress fittings (Eriksson 2003). The material includes several fragments of moulds for neck rings, a fragment for a Late Bronze Age belt ornament (*bältekupa*), possible dress pins and several likely moulds of spectacle fibulas, a possible hanging vessel as well as one uncertain imprint for a double-edged blade of a sword or dagger (Eriksson 2003:134–142). The production of bronzes at Apalle thus included highly skilled crafting of prestige goods, and some of the most valuable and symbolically significant artefacts of this period. Items such as the conspicuous belt ornaments, previously highlighted as belonging to a category of extravagant and costly display items without known production location (Levy 1991:66), were crafted amidst the dwelling area in the Apalle settlement.

Other sites in the region

Comparison of the bronze casting evidence at Apalle with the other settlements selected for this study (table 1) reveals both similarities and differences in the settings and framing of bronze casting. Characteristic of all dwellings in this dataset is their location in ploughed fields, resulting in low levels of chronological resolution and contextual detail and poor preservation conditions. However, the examples still provide general insights, and in some cases even better preserved glimpses into the organization of bronze casting. In the following brief comparison, five sites will be considered as parallels to the Apalle case in terms of site type, milieu and spatial framing of bronze casting. Four sites will then be introduced as representing different sites or settings of casting, compared to that of Apalle. All these settlements, when taken together, shed light on the intrasite differences and various social spaces beginning to emerge within Late Bronze Age settlement complexes (e.g. Hjärthner-Holdar et al. 2008; Karlenby 2011). Locating metalworking in settlements thus also provides a window into Late Bronze Age structuration of domestic space.

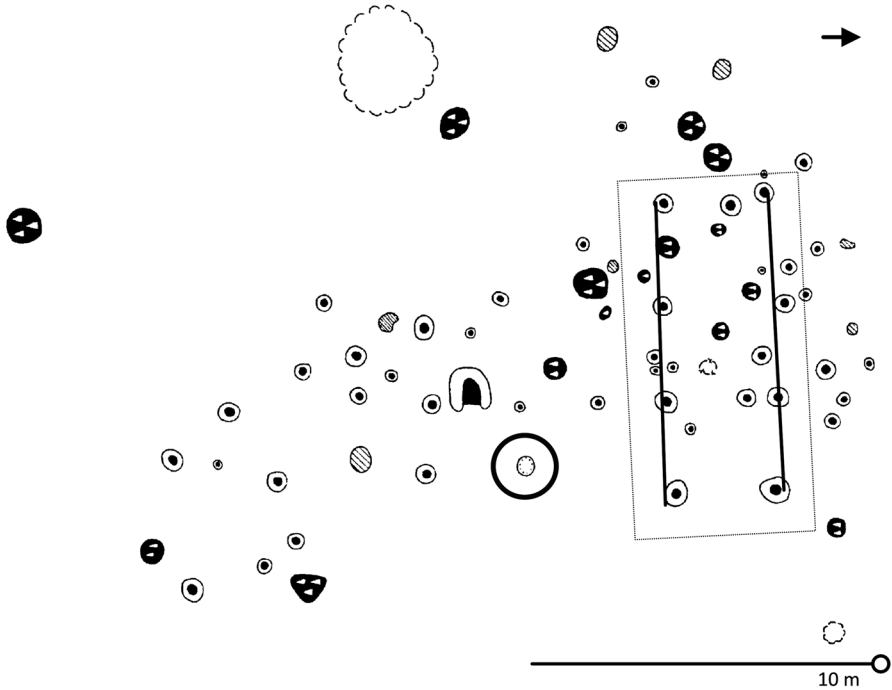


Figure 6. Plan of late Bronze Age longhouse (house 1) and activity area within the grave and settlement complex at Tallboda, Östergötland. The circle indicates the location of the pit containing fragments of a ceramic mould for a period V spectacle fibula as well as an intact crucible.

SETTLEMENT CASTING IN OR NEAR INDIVIDUAL LONGHOUSES

Tallboda

One example analogous to Apalle is the Tallboda settlement in the outskirts of Linköping, a large grave and settlement complex which was partly excavated in the 1970s. The complex included dwelling areas with longhouses, heaps of fire-cracked stones, stone settings and cup marks, with dates ranging from the Early Bronze Age to the Early Iron Age (Äijä et al. 1996). One of the few remains of bronze casting on site was an intact crucible alongside fragments of a ceramic mould recovered from a pit in a settlement area with a Late Bronze Age longhouse (Äijä et al. 1996:36, 48; see figure 6). The longhouse was accompanied by an activity area with pits and hearths, and a small mound of fire-cracked stones (Äijä et al. 1996:36–38, 41). This is likely to have been the ‘yard’, with outdoor cooking and other activities tied to the house. The pit containing the casting debris had a sooty fill, and was located immediately south of the house, in front of its probable entrance (Äijä et al. 1996:18; see figure 6). The debris included an intact cru-

cible and a mould for an ornate spectacle fibula dating to period V (Äijä et al. 1996:48; see figure 6). The casting assemblage in a dug-down feature is likely to represent a deliberate deposit as opposed to resulting from waste accumulation or strewn-around middening. This being the case, the deposition in the pit is likely to have been made in relation to the casting event. The location of the debris and its contemporaneity with the building both suggest that the fibula was manufactured in the house or within its yard.

Skuttunge kyrka

The settlement of Skuttunge kyrka in central Uppland may offer a similar case (Seiler & Östling 2008). This multi-period settlement site featured a longhouse from the Late Bronze Age (see discussion of dating in Sörman 2018:101) where the floor layer/cultural layer within the building contained fragments of a ceramic casting mould, again possibly for a spectacle fibula (Seiler & Östling 2008:39–40; Grandin & Hjärthner-Holdar 2008:7–8). The surrounding settlement was a dwelling in use throughout the Bronze Age, however this was not fully covered by the excavation and had been heavily disturbed by ploughing and later Iron Age settlement (Seiler & Östling 2008). Spectacle fibulas require highly complex casting as well as being exclusive and symbolic objects (Oldeberg 1933; Melheim 2008). The finds from Tallboda and Skuttunge kyrka thus demonstrate that longhouses were sometimes the arenas of specialised production of prestigious objects of high economic, symbolic and political value.

Pryssgården and Vrå

Two Late Bronze Age settlements of similar size and character as Apalle, but where settings and particular framings are harder to reconstruct, are the large-scale excavations of Pryssgården near Norrköping and Vrå, south of Uppsala. They are both equivalent to Apalle in terms of size and holistic excavation areas (Borna-Ahlkvist et al. 1998; Karlenby ed. 1997; Göthberg et al. ed. 2002; see table 1), which allows insights into the settlement dynamics over time. It is likely that at least Pryssgården, with its village-like structure and strategic position in the landscape (Borna-Ahlkvist 2002:173–174), is one of the more prominent settlements of this period in the region.

Waste materials in general, and casting debris in particular (Borna-Ahlkvist et al. 1998:161–162; Thrane 2006; Häringe 2002a), were much less frequent in Vrå and Pryssgården than Apalle. At both sites, top-soil removal with machine was chosen instead of careful hand digging of cultural layers. Moreover, in Pryssgården only a few patches of cultural layers remained due to ploughing (Borna-Ahlkvist 2002:21). In Vrå, approximately 2000m² or 20 percent of the cultural layers were excavated by hand; however several of these were probably former field plots fertilized with house-

hold waste rather than occupation deposits (Häringe 2002b:16, 25; Sörman 2018:288–289). This is probably the key factor behind the relatively low amounts of casting debris and other finds compared with Apalle (Eriksson 2003; Sörman 2018:77). Thus casting of bronzes was carried out within the settlement arena in Vrå and Pryssgården, but as the finds primarily derived from large pit-systems with secondary fill and single cultural layers without stratigraphic relations to houses or other structures, their relation to individual houses and phases is unclear. It is not possible to examine the settings and framings of these sites in closer detail.

Bredåker

In the Bredåker settlement north of Uppsala, it was possible to reconstruct the context of bronze casting at a more detailed spatial scale. This is the only clear case in this region where a specific hearth for melting bronze has been identified at a Late Bronze Age settlement (Frölund & Schütz ed. 2007:240–241; Schütz 2007). The casting hearth could be identified thanks to the occurrence of small metal droplets found in and by a particular fireplace (Frölund & Schütz ed. 2007:36; Schütz 2007:240–241; see also Söderberg 2002). Attention was drawn to that hearth due to a cluster of ceramic casting debris in the surrounding cultural layer. The casting activity has been dated to periods IV–VI (c. 1100–500 BC), with a more intense phase during period V (Frölund & Schütz ed. 2007:18, 27, 48–49), with evidence including the casting moulds for a typologically datable dress pin (Eriksson 2007:172).

Although one of the casting hearths could be identified, the immediate framing of the metalworking in the settlement remains somewhat unclear. The area featured several possible buildings – including one pit house – within a radius of less than 5 metres from the casting hearth. The pit house was described by the excavators as a possible ‘workshop’ (Frölund & Schütz ed. 2007:33; Schütz 2007:243; see figure 7). However, the stratigraphic and chronological relationship between the buildings and the cultural layer with the metalworking debris was unclear (Frölund & Schütz ed. 2007:246). Whether contemporary with the buildings or not, most of the casting was probably performed out in the open (see figure 8). The excavated settlement area was interpreted as a small part of a larger, diffuse settlement complex (Frölund & Schütz ed. 2007:27–28, 255) thought to extend 200 metres to the south and east, as indicated by adjacent stone-settings and mounds of fire-cracked stones. Although only one Bronze Age longhouse was identified in this primarily Iron Age part of the settlement (Frölund & Schütz ed. 2007:230), the Late Bronze Age casting at Bredåker – in the low terrain with graves and burnt mounds registered on adjacent hillocks – is likely to have taken place in a dwelling area within a larger grave and settlement site.



Figure 7. Distribution of casting debris around a cluster of features in the Bredåker settlement, including a fireplace used for bronze casting during period IV–V. The contextual and chronological relations between the casting remains and the two buildings are unclear. The area is part of a larger (as yet unexcavated) settlement complex.

Nibble, Ryssgärdet, Åbrunna and Västra Bökestad: evidence of non-longhouse casting in large settlement complexes

Turning to sites with evidence of other settings for bronze casting, the following case studies include casting associated with the cult-houses and other ritual milieus found *within* larger Late Bronze Age settlement complexes. There are primarily four large-scale excavations of such sites that have yielded metalworking evidence in the region: Nibble (Artursson et al. ed. 2011c), Ryssgärdet (Eriksson & Östling 2005; Hjärthner-Holdar et al. ed. 2008), Åbrunna (Strucke & Holback 2006) and Västra Bökestad (Heller & Zetterlund 1997).

Nibble, Ryssgärdet and Åbrunna are large complexes that all included dwelling areas in lower, ploughed terrain as well as graves or grave-like structures on rocky hillocks within or directly beside the habitation areas.

While the dwelling areas were heavily plough-damaged at all these three sites, the cult-houses and ritual settings on higher ground were better preserved (e.g. Eriksson & Östling 2005:5, 15–16; Strucke & Holback 2006:9, 14; Artursson et al. 2011b:66–67). It was in the ritual settings that most of the evidence for metalworking was found. In Åbrunna crucible finds – including one located in a particular hearth – occurred at a platform beside a cult-house (Strucke & Holback 2006:27). In Ryssgårdet, casting debris mainly occurred by two cult-houses and grave milieus located on two separate hillocks in the settlement (Eriksson & Östling 2005:42; Eriksson & Grandin 2008:359). The cult-house areas at these sites were accessible from the adjacent longhouse areas by a stone-lined passage, and were visually directed by and exposed to the dwelling (Strucke & Holback 2006:15–16, 33; Östling et al. 2008:504; Sörman 2018:136–138). The same situation – but where the excavation concerned graves and cult-house only³ – was found in Västra Bökestad. Here, ceramic casting debris was found in an activity area among a sprinkling of graves with stone-settings (Helander & Zetterlund 1997:31–33). The accumulation of casting debris was concentrated to a small house or hut between the graves, exposed at the edge of the hill. Such cult sites have been associated with the handling of human remains (e.g. Victor 2002; Eriksson 2008a; Karlenby 2011), as well as fine-ware ceramics, indicating that ritualized drinking and food consumption occurred here (e.g. Eriksson 2006, 2008b); the sites have also been associated with the handling of bronze and, in a few cases, gold (e.g. Helander & Zetterlund 1997:33; Eriksson & Grandin 2008; Sörman 2018:136–138). Such cultic or ritual milieus were thus important arenas for metalwork production, alongside the dwelling areas, within Late Bronze Age settlement complexes.

Rambodal: metalworking at a small settlement

All examples so far have shown bronze casting at dwellings or cult sites within large Late Bronze Age settlement complexes. There is one other site type represented in this dataset: a small single-farm at Rambodal close to Norrköping in Östergötland has yielded evidence of the production of bronzes (Nyberg & Nilsson 2012; Nilsson & Sörman 2015). This site is more limited spatially and chronologically than the other settlements included in this study, covering an area of just 2000m² and featuring only one longhouse, one pit house and one four-post house, all dated primarily to periods V–VI (Nyberg & Nilsson 2012:31). The dwelling was confined

3 Test-trenches revealed indications of settlement (a socketed axe and post-holes dated to the Late Bronze Age) in the surrounding field located 75 metres east of the hillock with evidence of bronze casting, but these trenches were not excavated further (Helander & Zetterlund 1997:34).

to a sandy plateau and, although located in a rich Bronze Age landscape (Nilsson & Sörman 2015:85–86), it did not form part of a larger complex.

Not only was the Rambodal settlement unusually well-delimited in size and use-period, but the metalworking waste also differed from the usual assemblages of ceramic casting debris found at the other Late Bronze Age settlement complexes described. A fragment of a broken soap-stone mould for a small socketed axe from period V–VI (Nyberg & Nilsson 2012:29) was recovered from cultural layers located less than 10 metres from the longhouse (Nilsson & Sörman 2015:figure 2). Other finds in this layer included typical Late Bronze Age ceramics, but there were no other finds related to metalworking apart from a find of melted copper which was retrieved from the interface between the cultural layer and top-soil and so was considered of unclear provenance (Nyberg & Nilsson 2012:29, 31). The deposition of a broken mould in a cultural layer close to the longhouse indicates that the casting was carried out within the farm rather than in the outskirts of the settlement or a different site. The finds metalworking debris in this context thus indicates small-scale production of one or several axes within a small dwelling area during the Late Bronze Age.

CONCLUSIONS: SITES, SETTINGS AND FRAMINGS OF LATE BRONZE AGE BRONZE CASTING

With the exception of Rambodal, all the sites discussed above qualify as dispersed settlement complexes. They were composed of several settings: areas for dwelling and longhouses, as well as graves and cultic activities. Evidence of metalworking is present in each of these types of settings. Rambodal, however, seems to represent a slightly different type of site. Its limited use-period and size indicate small-scale production at a single farm. This dwelling, with a single longhouse and two smaller buildings, possibly represents a satellite farm, collaborating with or dependent on a larger settlement nearby (Nilsson & Sörman 2015; Sörman 2018:148–149). Dependence on metalworkers from a different site is an interpretation that aligns well with the fact that the mould found at Rambodal was made of soap stone. Stone moulds are less fragile than ceramic moulds, and thus a better choice if crafters were visiting from elsewhere and bringing their own tools. The re-usability of stone tools probably meant that they were normally removed from the site after use, rarely leaving any traces behind to indicate that casting had taken place.

This observation opens up an interesting line of interpretation in relation to the organization of metalworking in Late Bronze Age settlements. Although the crafters were presumably based at larger settlement complexes, the axe was nevertheless produced at Rambodal rather than brought there

Table 3. The contexts of metalworking as seen at different spatial scales.

	Site	Setting	Framing
Apalle	Village-like settlement complex (large settlement)	Longhouse dwelling	Central 'yard' Longhouses Circular building (K33) Large assembly area
Tallboda	Grave and settlement complex (large settlement)	Longhouse dwelling	Longhouse 'yard'
Skuttunge kyrka	Unknown	Longhouse dwelling	Longhouse
Pryssgården	Village-like settlement complex (large settlement)	Longhouse dwelling	Unknown
Vrå	Grave and settlement complex (large settlement)	Longhouse dwelling	Unknown
Bredåker	Probably grave and settlement complex (large settlement)	Longhouse dwelling	Outdoor activity area
Nibble	Grave and settlement complex (large settlement)	Cult-house with graves	Unknown
Ryssgärdet	Grave and settlement complex (large settlement)	Cult-house with graves Longhouse dwelling	Cult-house 'yard'
Åbrunna	Grave and settlement complex (large settlement)	Cult-house	Cult-house 'yard'
Västra Bökestad	Probably grave and settlement complex (large settlement)	Cult-house with graves	Cult-house (small hut among graves)
Rambodal	Single farm (small settlement)	Longhouse dwelling	Unknown

as a finished product. This suggests that *the actual performance of making the object* had a social significance beyond meeting a practical need. The axe could have been more conveniently cast elsewhere, but the satellite farm – where it was presumably going to be used – was chosen as the place for making it. In other words, the process of casting the object, as opposed to just the finished object itself, was significant.

In terms of the setting and framing of bronze working, the evidence from the Rambodal settlement seems to suggest a similar picture to that observed more widely. The casting residue is not found in special or peripheral places. On the contrary, as we have seen in the examples above, it typically occurs within strategic and central spaces, close to or inside buildings (table 3). In Rambodal, the location of the mould fragment in a cultural layer just next to the house gives few clues as to the exact framing but it does, however, suggest that the mould was used within the immediate settlement (Nyberg & Nilsson 2012:31). Bronze casting in Late Bronze Age settlements of south-eastern Sweden was thus a craft performed in many of the focal spaces used daily by the inhabitants at these sites.

Discussion: casting in settled spaces

METALWORKING AND THE SPATIAL ORGANIZATION OF SETTLEMENTS

The varied and flexible metalworking shown by this study indicates that craft was performed in more dynamic ways than are usually portrayed for Bronze Age settlements (compare figure 2). Bronze crafting in Late Bronze Age settlement complexes was performed inside individual longhouses, in yards, in smaller buildings, at gathering places and activity areas or by the graves at the settlement cult sites – in fact, in a variety of focal points for the Bronze Age inhabitants of these sites. Understandings of settlements in the Late Bronze Age are still largely coloured by expectations rooted in the organizational principles of modern and historical farms (Brück & Goodman 1999:3; Gröhn 2004:280) and the ideological significance of the home in European history (Brück & Fokkens 2013:83). From a historical or modern horizon, we often expect a central residential house, surrounded by a set of outbuildings and workshops reserved for specialized tasks and functions (e.g. Borna-Ahlkvist 2002:170). The organization of bronze working demonstrates the inadequacy of these terms in the encounter with pre-historic, or at least pre-Iron Age, settlements. Late Bronze Age settlement complexes, with their cacophony of activity areas, small buildings, multi-purpose longhouses, cult places and intricate waste disposal in heaps of fire-cracked stones, are the results of another way of structuring rural settlements (see Göthberg 2000:93–94). As I have demonstrated above, places for metalworking at such ‘farms’ similarly fail to meet the expected notions of designated workshops or special crafting areas. Even though structuration of settlement space with smaller buildings for specialised activities started to emerge during the Late Bronze Age (Borna-Ahlkvist 2002:170), it is clear that metalworking did not follow this trend.

The analysis also reveals a rather different picture than that set out by traditional assumptions of marginal, hidden or specific crafting places (e.g. Thrane 1971:161, 2015:124; Carlie 1992; Karlenby 1998:30; Aspeborg 1997:12; Paulsson Nord & Sarnäs 2001:64; Goldhahn 2007:59, 213, 216, 242, 324). For example, the well-preserved casting evidence from various buildings and areas within the Apalle settlement during period V indicates several contemporary crafting loci within the central settlement area (figure 4), rather than in a particular area or at the outskirts of the site. Evidence of casting was found accumulated in various refuse pits and spread in cultural layers, as well as deposited in and around fireplaces within longhouses and other buildings. This challenges common assumptions about bronze crafting in settlements as an activity that was only conducted outdoors, in the outskirts of settlements or in special areas or enclosures due to a ta-

boo (Goldhahn 2007:213, 216) or fire hazard concerns (Karlenby 1998:30; Paulsson Nord & Sarnäs 2001; Stilborg 2002:14; Thrane 2015:124). These observations literally and figuratively shift the understanding of metalworking from a peripheral activity into a central activity performed in domestic space.

This observation also ties in to debate about settlements as arenas for public and communal events, such as collaborative cooking and ceremonial practices. Ullén (1994) has argued for a shift in spatial organization from a more ‘public’ use of space to a more ‘private’ use in the course of the Late Bronze Age. This suggestion is based on three differences observed between the Early versus the Late Bronze Age phases of the Apalle settlement: (1) a change in the internal structure of longhouses from distinct boundaries between different (usually two) rooms to a more open layout, (2) the shift from communal heaps of fire-cracked stones to smaller middens shared by fewer households, and (3) a decrease in large outdoor cooking pits from the Early to Late Bronze Age (Ullén 1994:252–258). Ullén’s interpretation of these patterns is summarised in the following section:

In the time of the earlier houses, the division between private and public was strictly emphasised indoors, whereas there was a collective spirit outwards, in the outer space, through the management of food and refuse. The later settlement, by contrast, established private spheres outside its houses, between households, but showed greater openness when inside the social sphere of the house. The later settlement put more emphasis on the individual household. (Ullén 1994:257)

However, looking at the distribution of casting debris and the settings and framings chosen for metalworking in the Late Bronze Age settlements we see an almost opposite tendency: it was being performed in the more confined rooms of longhouses in the early Bronze Age (as far as the examples known so far suggest, e.g. Nilsson 1996; Ethelberg 1995; Jensen 2002:109–117; Kristensen 2015:115). In the Late Bronze Age, however, it was performed in more diverse and sometimes visually accessible loci out in the open. As argued above using evidence from the Apalle case, Late Bronze Age casting still took place within different buildings, but the choice of casting places also became more pluralistic. This pattern could support Ullén’s (1994) suggested model, in the sense that the longhouse was a more public space in the Early Bronze Age and thus used for collective or even supra-household ceremonies, which might have included an important casting event. A different interpretation is that the ‘public’ space and communal rituals – as assumed by the framing of castings in Apalle’s central ‘yard’ and large assembly area – indicate a more varied use of strategic and communal spaces in Late Bronze Age settlements. Instead of representing a shift from a public

to a more private sense of space, it could indicate a development towards a more varied use and definition of public space. The diversity in the spatial organisation of metalworking – and of settlement space more generally – in the Late Bronze Age also correlates with more elaborate ritual arenas and cult-house areas within these settlements. As cult-house milieus became part of settlements, the complexity of social space within settlements increased. It is important to note that this was unknown at the time of Ulléns work, and that this suggests more differentiated use of communal arenas rather than a tendency towards privatisation.

The practical and spatial arrangements of casting within settlements show no signs of efforts being made to hide production from view, thus contradicting the esoteric and secret character of bronze working suggested by Goldhahn (2007). Crafters acted in the middle of their community, in arenas that were visible or at least known to all residents and possible visitors at complexes like Apalle, Åbrunna, Ryssgårdet and Tallboda. The question of which parts and stages of the production process were surrounded by taboos and restrictions needs further study, and although this avenue of research is not the main focus here, it is interesting to note that casting is the most dramatic and sensational step in the *chaîne opératoire* of production and can be exposed without risk of spreading the knowledge and skills involved (Sörman 2018:181–185). The time-limited and climactic episode from melting to casting is the part of the production process that most easily lends itself to display. In order to evaluate such factors further, and to better understand the framing of bronze casting finds, field archaeology could benefit from registering observations through bodily experiences at a more human scale when approaching these sites. Aspects of visibility and staging are particularly relevant when reconstructing how casting played out in the settlements (figure 8).

METALWORKING ORGANIZATION AND THE CLASSIFICATION OF BRONZES

The examples above also demonstrate that, rather than simple tools and trinkets for household use, production in settlement and longhouses sometimes included the creation of exclusive prestige goods; this observation has also been pointed out by Levy (1991:66). However, unlike Levy's hypothesis that 'the most elaborate, costly display items were manufactured in special locations' (Levy 1991:66), the production of such objects could evidently take place at settlements. The examples above demonstrate the making of complex belt attributes in the settlement arena at Apalle (Eriksson 2003:134–142), as well as the casting of large spectacle fibulas associated with longhouses at the Tallboda (Äijä et al. 1996:48) and Skuttunge kyrka (Seiler & Östling 2008:39) settlements. Such prestige goods, which in these

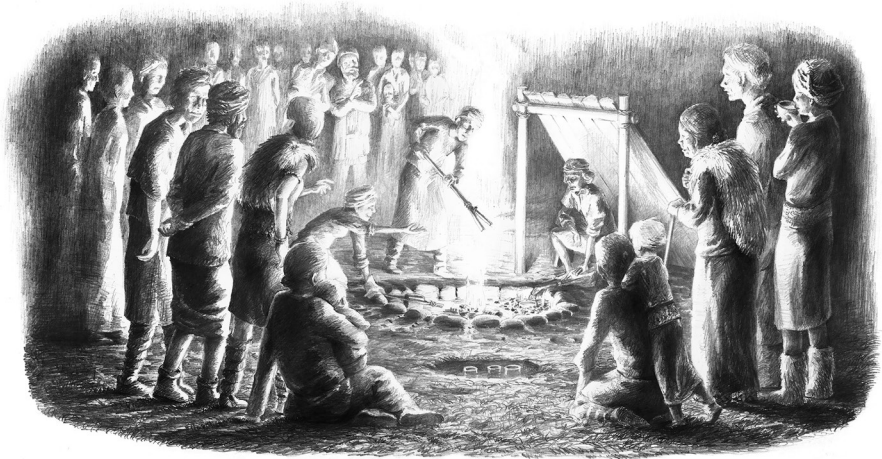


Figure 8. Reconstruction of a casting event at the Late Bronze Age settlement at Pryssgården, Östergötland, south-eastern Sweden. Interpretation by Katarina Botwid (2016). Illustration: Henning Cedemar-Brandkvist. Published with permission.

cases took the form of large, ornate costume attributes, were highly complex to make, often decorated with elements from Bronze Age iconography, and have been associated with the ceremonial costumes used by certain members of the elite (Sørensen 1997; Jensen 2002). Considering the use, role and placement on the body, objects like spectacle fibulas were probably used by performers of ceremonies and other activities that were public in scale (Sørensen 1997:107–108; Levy 1999:214). The production of such public markers urges us to envision more dynamic production, in terms of visibility, political significance and public ritualization, than that which is usually envisaged for Bronze Age ‘farmsteads’. The organization of casting practices also encourages reflection on the arrangements of settlement space in general.

Many bronzes, such as spectacle fibulas, were presumably worn as public markers by a select few, and so are likely to have been tied to special social identities within the elite collective. Such prestigious personal attributes – such as large belt and dress ornaments, weapons and personal adornments like elaborate neck rings – were then likely to have been acquired at a certain age or other social threshold (as observed from attributes combined in costumes in Early Bronze Age barrow burials, see Bergerbrant 2007). If so, the casting of new prestige objects would have been motivated by the initiations of the persons with particular, relevant attributes (and public functions) into their new roles. Interestingly, a possible spatial division has been observed between the production of weapons (at cult-houses) and large ornaments (at longhouses) within larger settlements (Sörman 2018:199–

208). This could be a reflection of a difference in the orientation and circumstances for the production – and thus the initiation rituals – for different persons/institutions who were to wear these insignia. This observation supports the idea that valuables and prestige goods must be understood as a varied and heterogeneous category of artefacts – with different meanings, functions, owners and life courses (e.g. Kopytoff 1986; Brück & Fontijn 2013; Kovacevich & Callaghan 2014). To this we can now add a further stage: that of different production contexts, that is to say, places of creation.

Thus, bronze crafting was not supplied from a special ‘crafting place’ or centralised workshop, but performed *where the object would be used*. The variety of production loci within Late Bronze Age settlements suggests that production was oriented towards a range of objects tied to various means and customers. Formulated differently, the varied spatial organization of casting seen in Late Bronze Age settlements mirrors its clients rather than its crafters and their ‘workshops’. Such loosely structured production for the multitude of artefacts circulating in the Late Bronze Age would dismiss the idea of defined spatial, technological and social spheres or levels such as a household versus workshop production. Rather than hierarchical models, other types of frames of reference are needed in order to understand this craft and its organization. The heterogeneity seen in this production challenges the functional spheres traditionally believed to have structured metalworking activities as either utility or prestigious/political (e.g. Levy 1991:66–68; Björhem & Säfvestad 1993:79; Thrane 2013:750), when considering bronze casting in settlements in particular, and Bronze Age society in general. Accordingly, new alternatives to the classic categorisations are necessary. Further elaboration on alternative categorisations such as ‘personal attributes’, ‘symbols of power’ and ‘tools’ (Sörman 2018:187–199) might be one way forward.

Conclusions

How bronze crafting was organized in society remains a relevant and vital question in Scandinavian Bronze Age research. However, as the results of this paper show, while the question is well motivated, the answer may sometimes have been sought in the wrong places – or rather, at the wrong spatial scale. Discussing settlements as overall production units has obscured the importance of crafting arrangements and spatial organization *within* these sites. The concepts of *site*, *setting* and *framing* were presented here as analytical tools to differentiate observations in these significant spatial arenas. The complexity of Late Bronze Age settlements and the way casting debris is distributed in them underlines the inadequacy of treating set-

tlements (and their craft production) as monolithic units. Apart from occasional single farms, these settlement complexes did not only contain dwelling areas, but several types of settings including grave-fields, cult-sites, and other zones for ritual activities. Bronzes were produced in all these settings.

This paper shows that the settings and framings of bronze casting *within* sites provide important clues to how Bronze Age people produced, used and categorized their metalwork. However, as these examples have demonstrated, it is also crucial to move beyond fallacious assumptions about practical requirements for bronze casting – such as the beliefs that it required special furnaces, was carried out at a distance from contemporary buildings, or was concentrated in special crafting areas or workshops – when approaching these sites. The flexible and mobile craft of melting bronze in open hearths allowed a varied and elaborate staging of production. These observations have implications for how and where metalworking debris is anticipated during excavation. Production loci are often inconspicuous and melting hearths can only be inferred from indirect evidence of small metal droplets (Söderberg 2002). Indoor hearths must also be considered as potential casting hearths. This approach has methodological consequences for both excavation and metal detecting strategies (see Söderberg 2002; Schütz 2007:243; Eriksson & Grandin 2007; Nyberg & Nilsson 2012:32). Following on from this, we must also be open to production debris in settlement contexts even when it does not stand out clearly as part of a well-defined activity area.

The picture that emerges from the settlement material is not one of assigned crafting areas and workshops – an industrial or at least historically rooted image – but more fluid and embedded production, present at different sites, staged in various rooms and, presumably, targeted towards a range of various users. Furthermore, the production of socio-political paraphernalia in the ‘domestic sphere’, amidst the arenas of daily life, points to the fact that settlements incorporated important political activities. The need to acknowledge settlements as political arenas rather than just low-key, domestic spaces for everyday activities has been repeatedly emphasised (e.g. Gröhn 2004:93; Brück & Fokkens 2013:98) but rarely linked to actual archaeological evidence of spectacular and public events. I suggest that the casting of attributes for ceremonial elite costumes, such as belt domes and spectacle fibulas, is one example of such significant public power displays in dwellings.

The setting and staging of casting objects form one empirical window through which we can begin to reconstruct how bronzes were categorized and used by Bronze Age people; this perspective differs from the conventional route of approaching this type of material culture from a preconceived (modern) division of utility versus political goods. That categoriza-

tion may be more reflective of *our* society than of the societies we try to study. Although fragmented in nature, the evidence reviewed in this paper, when considered as a whole, shows patterns that can provide new ways of addressing one of the key questions in Scandinavian Bronze Age research.

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Appendix 1. Sites with finds of casting debris in the regions of Södermanland, Uppland and Östergötland

	Name of site	ID in the Historic Environment Record [Kulturmiljöregistret]	Province	Bronze Age casting finds
1	Bornsjön	L2015:3144	Södermanland	Yes
2	Galtbacken	L1985:6339	Södermanland	Yes
3	Hallunda	L2017:2252, L2017:2770	Södermanland	Yes
4	Hästhagen, Igelsta	L2014:9132	Södermanland	Yes
5	Karleby/Gärtuna	L2014:9017	Södermanland	Yes
6	Vårberg	L2016:201	Södermanland	Possible
7	Åbrunna	L2014:3195	Södermanland	Yes
8	Åkra Grindstugan	L1984:6240	Södermanland	Yes
9	Alsta	L1942:4396	Uppland	Yes
10	Apalle	L1941:9174	Uppland	Yes
11	Bredåker	L1941:964	Uppland	Yes
12	Broby	L1944:8824	Uppland	Yes
13	Darsgårde	L2016:8971	Uppland	Possible
14	Fansta	L1944:8922	Uppland	Possible
15	Fullerö	L1941:3266	Uppland	Yes
16	Håga by	L1941:3148, L1941:2979, L1941:2643	Uppland	Yes
17	Hällby	L1942:2855	Uppland	Yes
18	Kalvshälla	L2017:9131	Uppland	Yes
19	Kyrsta	L1941:5446, L1941:4925	Uppland	Possible
20	Kälvesta	L2017:16	Uppland	Possible
21	Lilla Härnevi	L1943:8392	Uppland	Yes
22	Lunda, Lovö	L2016:5217	Uppland	Yes
23	Molnby	L2014:2730, L2014:2444	Uppland	Yes
24	Nibble	L1940:739	Uppland	Yes
25	Nyvla	L1944:9169, L1940:8752, L1940:8753	Uppland	Possible
26	Plaisiren/Vinsta	L2013:1279	Uppland	Yes
28	Ryssgårdet	L1942:5239	Uppland	Yes
29	Skeke	L1940:5093	Uppland	Yes

	Name of site	ID in the Historic Environment Record [Kulturmiljöregistret]	Province	Bronze Age casting finds
31	Skuttunge kyrka	L1942:8118	Uppland	Yes
32	Skälby	L1941:7746, L1941:7019	Uppland	Yes
33	Skämsta	L1942:5366	Uppland	Possible
34	Skölsta	L1940:5542	Uppland	Possible
35	Sommaränge skog	L1941:6658	Uppland	Possible
36	Stenvreten	L1943:3134?	Uppland	Possible
37	Trekanten	L1941:2504	Uppland	Possible
38	Trollbo	L1939:176	Uppland	Yes
39	Vrå	L1943:9161	Uppland	Yes
40	Årby	L1942:2138, L1942:2268	Uppland	Possible
41	Kallerstad	L2011:3660,	Östergötland	Yes
42	Pryssgården	L2009:6074	Östergötland	Yes
43	Rambodal	L2009:9697	Östergötland	Yes
44	Stora Sjögestad	L2008:434	Östergötland	Possible
45	Tallboda	L2011:8945, L2011:8341, L2011:9381 etc.	Östergötland	Yes
46	Västra Bökestad	L2011:4147	Östergötland	Yes

Appendix 2. Distribution of casting debris in Apalle

Distribution of casting debris from different stratigraphic horizons (layer types 1–5) corresponding to occupation phases at the Apalle settlement (Ullén ed. 2003). Stratigraphic information regarding casting finds was extracted from the find lists available in the CD Appendix of the excavation report. The find coordinates provided were digitalised, processed and plotted in GIS software onto slightly modified versions of the phase plans published in the report (Ullén 2003a:figures 34–38).

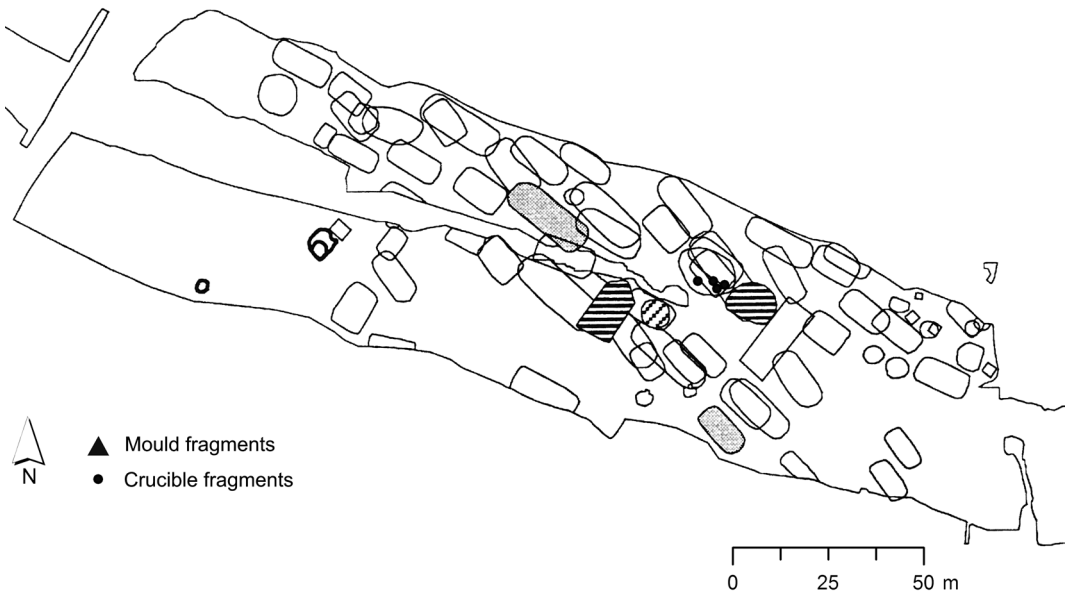


Figure A2.1 Settlement phase 1 (layer types 5 and 6), roughly dated to Early Bronze Age periods II–III. Grey-marked structures indicate the houses in use during this phase. Horizontally striped areas indicate field plots and the vertically striped circular feature is a mound of fire-cracked stones.

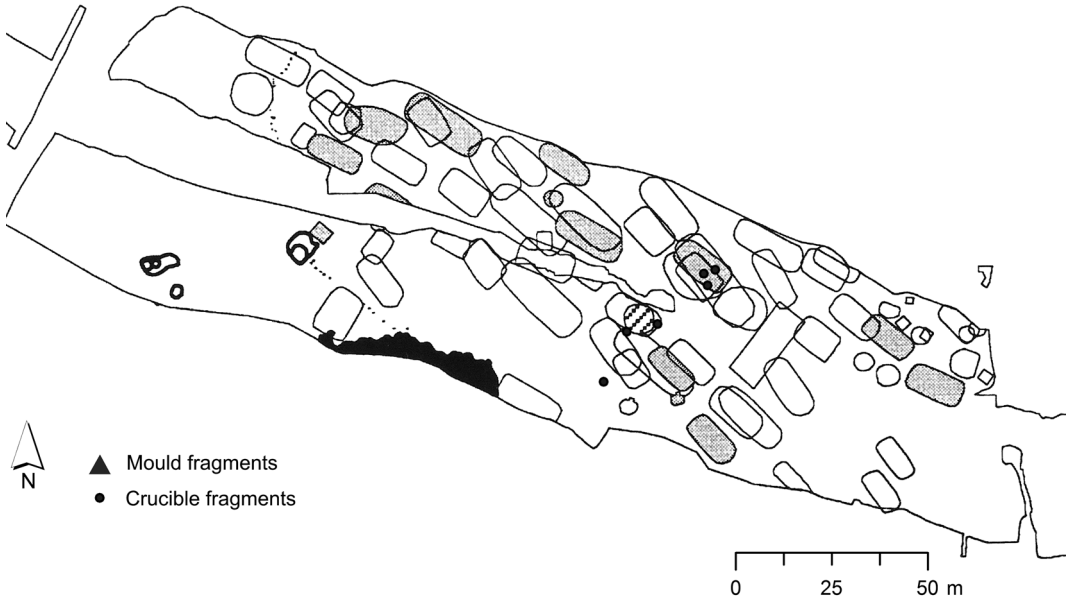


Figure A2.2. Settlement phase 2 (layer type 4), roughly dated to the transition between Early to Late Bronze Age periods III–IV. Grey-marked structures indicate the houses in use during this phase. The vertically striped circular feature is a mound of fire-cracked stones.

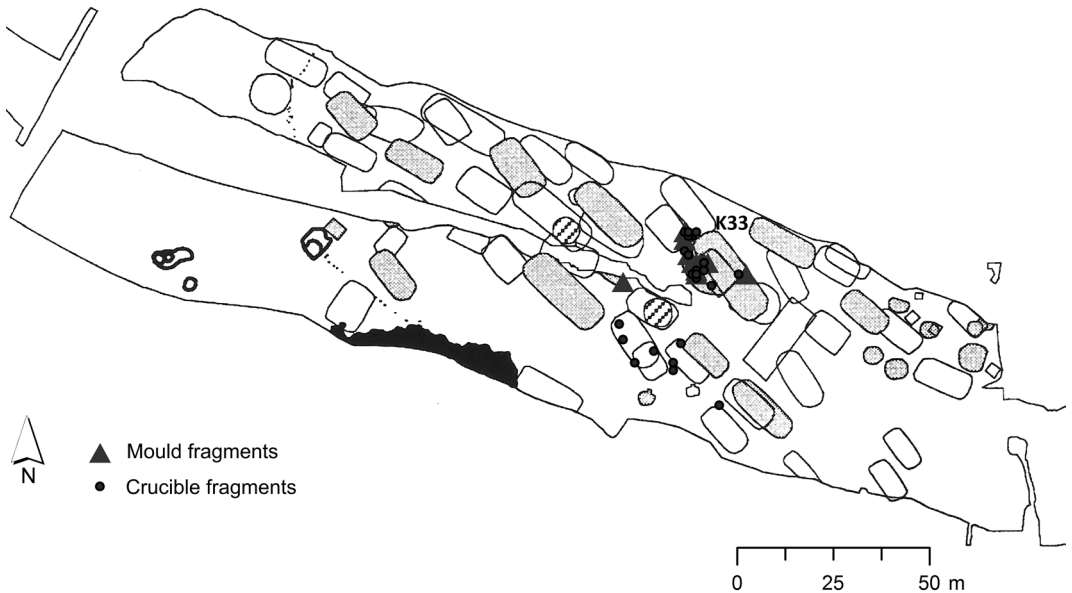


Figure A2.3. Settlement phase 3 (layer type 3), roughly dated to Late Bronze Age period IV. Grey-marked structures indicate the houses in use during this phase. The vertically striped circular features are two mound of fire-cracked stones. Areas marked in black to the south are large back-filled pit systems. The circular building K33 is indicated at the top centre. It is superimposed by another longhouse from the same phase.

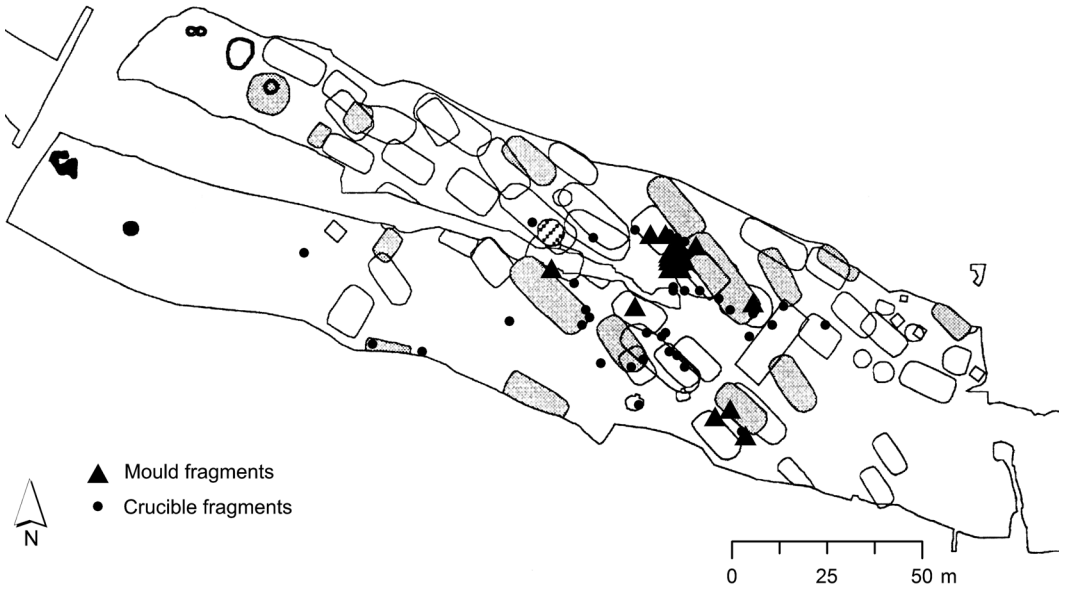


Figure A2.4. Settlement phase 4 (layer type 2), roughly dated to Late Bronze Age period IV–V. Grey-marked structures indicate the houses in use during this phase. The vertically striped circular feature is a mound of fire-cracked stones.

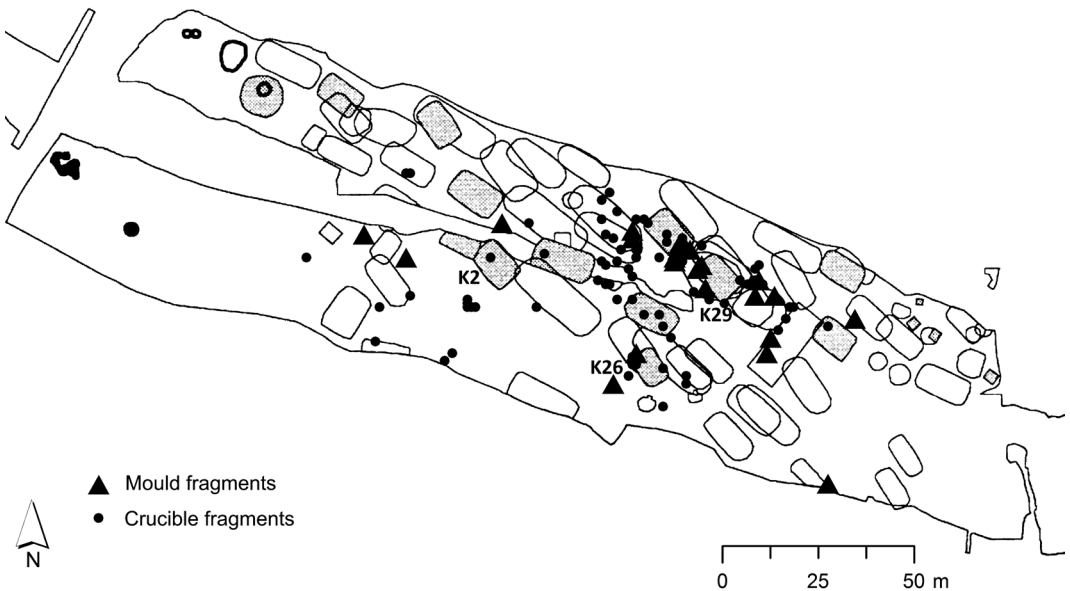


Figure A2.5. Settlement phase 5 (layer type 1), roughly dated to Late Bronze Age period V–VI. Grey-marked structures indicate the houses in use during this phase. The vertically striped circular feature is a mound of fire-cracked stones. The buildings indicated with numbers are longhouses with casting debris in the hearths (K2 and K26) and floor layer (K29).