Beyond Wayland – thoughts on early medieval metal workshops in Scandinavia

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ABSTRACT: This paper reflects on and summarises the current state of research on early medieval (750-1100 AD) metal workshops in Scandinavia by way of examples from workshops and metalworking sites recovered via archaeological excavations and surveys over the last 30 years. A critique is presented of a number of features which occur perennially in Scandinavian archaeometallurgical presentations, such as the tendency to overemphasise the importance of written accounts and the common habit of over-interpreting archaeometallurgical finds.

Introduction

The use of metals in past ages is a subject of seemingly endless possibilities in terms of research and publications – Scandinavia is no exception. It is explicitly or implicitly included in most academic works within the fields of Iron Age and early medieval studies, but as with so many other important and fundamental cultural features, it is more or less taken for granted – as if the extraction and working of metals took place almost on its own. The situation was of course much more complex than that, and this paper aims to highlight some aspects of one of the fundamental prerequisites for metalworking – the workshop. The workshops and production sites listed below have mainly been found within the boundaries of modern day Sweden, but some important sites in Denmark, Norway, Finland and Estonia have been included (Fig 1). The timeframe is that of *c*750-1100 AD, often referred to as the Viking Period.

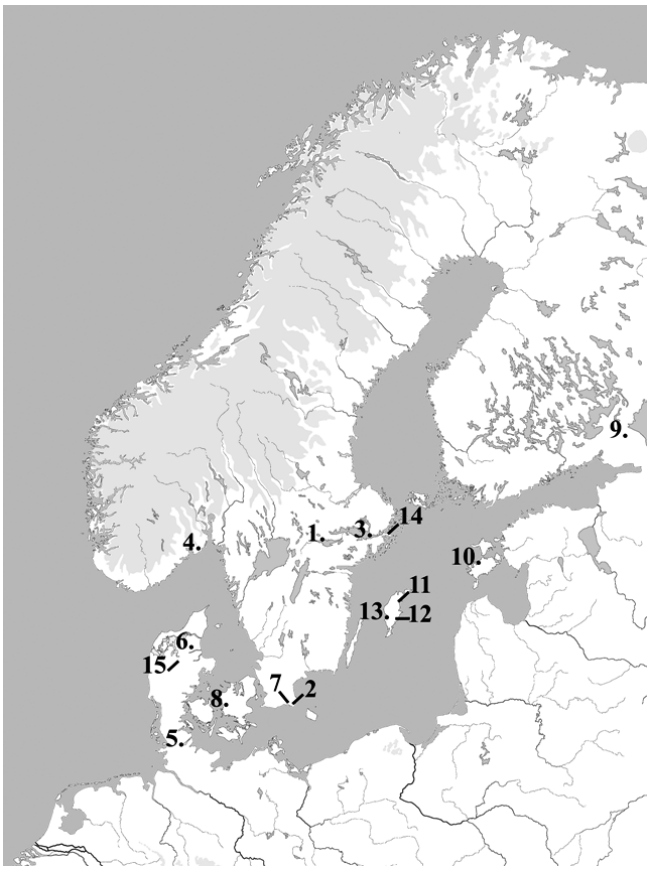

Figure 1: Sites mentioned in the text, in order of appearance. 1: Husby in Glanshammar, 2: Hagestad, 3: Birka, 4: Kaupang, 5: Haithabu, 6: Fyrkat, 7: Köpingebro, 8: Trelleborg, 9: Tontinmäki, 10: Paatsa, 11: Klints in Othem, 12: Lyrungs, 13: Bottarve in Fröjel, 14: Farsta gärde, 15: Viborg Søndersø.

The ever-productive forge of myth and legend

In many studies of early medieval Scandinavia, the working of metals is mainly presented as taking place under the ever-watchful eyes of masterful smiths. These are often depicted as somewhat outside the norms and regulations of their contemporary societies, and their domain, the smithy, is just as often described as a symbolic border zone where the unknown lurks in the

shadows (*cf* Burström 1990; Lindeblad 1996, 71-2; Hed Jakobsson 2003, 143-175). This view, mainly built on written sources and ethnographic analogies, does have some merit for the interpretation of social interaction and behaviour, but it also tends to present the metalworkers in such a metaphysical fashion that it is sometimes hard to connect them to the debris found in archaeological contexts. Recently, the basis for some of this idealisation was challenged by Unn Pedersen (2009) in a paper which illustrates the evident research gap between ideal and real smiths. Pedersen makes some excellent points by highlighting how ideal smiths are constructed from ethnographic analogies and literary sources. This approach is common, especially in Scandinavian early medieval archaeology; a few written sources often seem to take precedence over contemporary, and definitely more abundant, archaeological remains. These are instead, at best, brought in as secondary sources to confirm the written account's descriptions of the dwarves, demigods and wizards said to master metalworking.

One of the reasons for this scholarly dislocation can be traced back to a previous lack of secure, contextualised archaeological remains of metalworking. Metallurgical debris, like slags, fragments of technical ceramics and scrap metal, have been a crucial part of the archaeological record since the dawn of antiquarianism but due to methodical deficiencies and lack of documentation the original contexts of these finds are often enigmatic. This might have been an explanation that held true 50 years ago, but thanks to increased development, as well as improvements in archaeological methodology, the number of recorded metalworking sites and workshops has seen a steady increase over recent decades. This trend can be seen throughout Scandinavia (*eg* Jensen 1991; Brorsson 1998; Hjärtner-Holdar *et al* 1999; Gustafsson *et al* 2000; Dahlström and Eriksson 2002; Peets 2003; Kirpichnikov 2004; Andersson *et al* 2006; Pedersen 2010). These new sites give invaluable insights into the work of real Norse smiths, as opposed to that of the idealised smiths of myth and legend. The last decade has also seen a return to finds- and technology-orientated archaeology in Scandinavia and hence the empirical basis for theories and assumptions has increased considerably.

A basic understanding of pre-industrial metalworking and its prerequisites, from both practical and theoretical points of view, is a good starting point for the interpretation of early medieval metalworking. Archaeometallurgical analyses of slags and technical ceramics can tell a great deal about the raw materials and techniques used at a site. Other research questions are better answered through more experimental approaches – provided they are executed in a way that replicates the physical conditions experienced by the early medieval metalworkers (*eg* Söderberg 2002; Åberg *et al* 2006). In addition to these technical aspects, it is also important to account for contemporary lore and other cultural traits in connection with the craft. This is of course the biggest problem, especially when dealing with metalworking in societies with as few contemporary sources as early medieval Scandinavia. It can thus, as Pedersen (2009 133) put it, be tempting to fly away with Wayland and the other ideal smiths described in the Sagas. Many archaeologists also tend to retreat into ethnographic analogues in the hope that they will fill in gaps in their interpretations. However, this approach must be handled with care; curiosity and eagerness to understand can easily slip into what might be described as 'spotlight ethnography', *ie* when researchers, in their eagerness to find parallels for various cultural features or techniques in the past, pick and choose within the culture-specific 'how it was done' reports written by ethnographers over the last two centuries. Matching traits and techniques are then highlighted while contradictory or more problematic examples are ignored (*cf* Callmer 2002, 338-9; Wellinder 2005, 219). This risk should, however, not stop all use of ethnographical parallels in archaeological interpretation, rather it should act as a warning to the researcher. Even if one society in parts of Mali made moulds and crucibles according to their beliefs in a particular fashion in the 1950s, this is not necessarily relevant when considering how people in, say, 9th-century Jutland made theirs, and how they perceived the concept of metalworking within their contemporary society.

Scandinavian metalworking remains: a rough outline

As stated above, the number of documented remains of metal workshops and other metalworking sites has increased considerably over recent decades. This means that older assumptions and general references can and should be updated, but does not, however, necessarily mean a paradigmatic rejection of everything achieved by research prior to 1985.

One aspect of past practice which seems to have stood the test of time is the notion that the Scandinavian Iron Age and early medieval metalworkers performed their crafts in a manner which was physically quite different from that of later periods: they worked closer to the ground – the smithing and casting hearths were dug down into it and preserved anvil stones are often rather low (*eg* Strömberg 1981, 31) and hence suited to

a smith working in a crouched position. More upright forging, for example as on the 13th-century portal from Hylestad stave church (Hauglid 1969, pl 135), is said to have reached Scandinavia via the continent in the late Viking Period. However, in the 12th-century German metalworking treatise, De Diversis Artibus, the workshop is described as more or less floor-level, even though more ergonomic working positions were created by board-lined trenches in the workshop floor (Hawthorne and Smith 1979, 81), a feature not so far identified in Scandinavian workshops.

In 1997 and 1998 the contract archaeology service of the Swedish National Heritage Board excavated a site at Husby, in Glanshammar parish (Fig 1:1). It was soon established that extensive metalworking had taken place within the area and the expertise of the Board's Geoarchaeological Laboratory was brought in to assist with field documentation, sampling and post-excavation analyses. Within the boundaries of the excavation, several areas with well-preserved remains of metalworking were found and recorded. Among these were at least two buildings interpreted as smithies, and also heaths and furnaces; they were radiocarbon dated to the later Iron Age to early medieval periods. In addition, traces of bronze casting were recovered which could be firmly dated to the early Vendel period (6th-7th centuries AD) by the remains of crucibles and clay moulds for casting jewellery typical of the period (Hjärtner-Holdar *et al* 1999). Of special interest is one of the smithies (A 19152), roughly dated to the early 12th century, where a stone foundation in the NW corner of the building was interpreted as the remains of an elevated smithing hearth. In another nearby but slightly older building, also interpreted as a smithy (A 15087), no remains of a forge could be identified, despite rich finds of metalworking debris and an anvil stone. This could indicate that an elevated forge had also been present in that smithy, but it might have been destroyed by ploughing (Hjärtner-Holdar *et al* 1999, 8-9). The elevated hearths at Husby are interesting as they highlight an obvious weakness in the general interpretative model for metal workshops and similar metalworking sites. For obvious reasons elevated structures will be much harder to recognise, even at sites where they were brought into use in an early stage; they would be the first thing to be altered or removed if an area was cleared and utilised for new purposes, and they would certainly be destroyed well before the floor levels if they were in farmland subject to regular ploughing. The hearth remains would then end up as stray pieces of fire-affected stones, slag and hearth lining in the plough soil.

In southern Scandinavia several settlements almost entirely consisting of pit-houses have been excavated. Pit-houses also occur in mid-Scandinavia, though not as abundantly as in the south. They have traditionally been interpreted as temporary, low-status living quarters and specialised workshops; many appear to have been used for textile production, others for antler and bone working and some for metalworking (*eg* Björhem and Säfvestad 1993; Fallgren 1994; Gotfredsen and Gebauer Thomsen 2011). In recent years, some doubts have been cast on the uniformity of the use of pit-houses; finds from Denmark, Germany and southern Sweden seem to indicate that sites with larger clusters of pit-houses actually served as assembly sites in connection with seasonal festivals and market trade (Nørgård Jørgensen *et al* 2011). Despite this, it has been demonstrated that some pit-houses were definitely used as workshops, for instance at Hagestad in Lödderup parish, eastern Scania (Fig 1:2), where two pit-houses clearly used as smithies have been excavated (Strömberg 1981, 25-7). The general view of pit-houses is that they were very basic structures, quick and easy to build and rather short-lived. The lack of clear floor levels in many excavated house pits tends to obscure precise attributions of use; instead the finds tend to reflect the overall settlement since most finds and debris are usually recovered from backfills of abandoned house pits, *ie* in soil originating in their surroundings (Callmer 2002, 353).

Nørgård Jørgensen *et al* (2011, 105) additionally make an important point: that it is crucial to keep in mind that traces of an *activity* in a house does *not* necessarily reflect its overall *function*. Here it might be appropriate to remember that high temperature crafts such as glass- and metal-working leave highly resilient traces, even if they occurred only once in the life of a building. If metalworking under such conditions takes place in a pit-hearth, sunk in the floor, which is backfilled and covered after use, there is a high potential for the hearth to survive and be found in recognizable condition if the remains of the building are archaeologically excavated. This survival has caused a problem: a habit of over-interpreting traces of metalworking that have been found in buildings. It is as if the metallurgy overrides all other finds; buildings without traces of metalworking are just buildings, but buildings *with* traces of metalworking *are* smithies or foundries (*eg* Sarauw and Alin 1923, 343-4; Graham-Campbell and Kidd 1980, 125; Gustafsson *et al* 2000, 21). The presence of a backfilled hearth-pit, with or without slag and clay walling, does not necessarily make the building into a forge, though it does show that the building was used for metalworking at some stage.

From an early medieval Scandinavian perspective any hamlet of more than five contemporary buildings is usually seen as atypical when compared with the general settlement pattern (*cf* Clarke and Ambrosiani 1993, 46-55; Skree 2008), but there is some need for further distinction even for hamlets and larger building clusters. In some respects, it is hard to draw a line between clustered settlements and emporia like Birka, Kaupang or Haithabu (Fig 1:3-5). Regardless of their size these sites often seem to have been developed to concentrate and control trade.

The workshops in the emporia will not be discussed thoroughly here, mainly because of the complexity of their cultural deposits which comprise many layers often deposited over very short chronological periods. But all the emporia mentioned above have yielded large amounts of finds and debris from both ferrous and non-ferrous metalworking as well as from other crafts (*eg* Jakobsson 1996; Gustafsson 2009; Pedersen 2010; Hilberg 2008, 94–95). Despite their often ambiguous find-contexts, these remains provide vital clues to both basic know-how and individual approaches and solutions to craft-related problems. They carry the technological fingerprints of the craftsmen, who despite being unknown still speak through the objects they left behind. Hence these remains can and ought to be used to strengthen the empirical basis on which better preserved and more easily understood workshop remains are interpreted.

Temporary use and superimposed structures

Finds of metalworking are not confined to obvious workshops and production sites; three longhouses (2N, 1V and 4Ø) within the ring fortress at Fyrkat in Jutland (Fig 1:6), serve as an example. Hearth-pits had been constructed in the floors of these otherwise rather standard longhouses (Roesdahl 1977, 41-4) which have sometimes been referred to as more or less permanent smithies (*eg* Graham-Campbell and Kidd 1980, 125). A more modest and plausible interpretation is that the hearth-pits were temporary features in the houses during the construction of the ring fortress and its dwellings (Olsen 1977, 98). Construction work demands a steady supply of nails, rivets and fittings so the use of a forge for their production would have been essential. When the construction work finished, any temporary forge would simply have been backfilled and covered by the floor where it would stay virtually invisible until rediscovered through archaeological excavation. Another example of forging probably associated with construction was recovered in Köpingebro, Scania (Fig 1:7) in the 1980s where remains of iron forging were found in a Fyrkat-style longhouse (Grandin *et al* 2000). At Fyrkat there is another building with clear remains of metalworking, a smaller house in courtyard 2. In and around this house, measuring *c*9m by 3.6m, finds of copper alloy, gold, iron smithing slag, hammerscale, sherds of scorifiers, crucibles and moulds were recovered (Roesdahl 1977, figs 239, 241-2). Compared to the longhouses this smaller building stands out as a definite, purpose-built smithy. Interestingly, a relatively large quantity of broken scorifiers, crucibles and moulds were recovered from yet another longhouse (4V) despite the fact that no traces of non-ferrous metals were found in the house (Roesdahl 1977, figs 239 and 242). The finds seem to indicate that metalworking was also carried out in this house, but no clear metalworking hearth was identified during the excavation (Schmidt 1977, 187-90). A potential interpretation might be that house 4V was at some point temporarily used by a gold- or silver-smith whose small, shallow hearth has been obscured by later activities. At Trelleborg, a similar ring fortress on Zealand (Fig 1:8), traces of both ferrous and non-ferrous metalworking as well as various other crafts were recovered during excavations. Among the finds are a pair of smithing tongs, a couple of anvils, augers, a file, a steatite ingot mould, a press die for filigree jewellery and a scorifier (Nørlund 1948, 140; Roesdahl 1977, 166). Alas, no details of the craft activities were presented in Poul Nørlund's report on the excavation (Roesdahl 1977, 166-7).

Another possibility is that several buildings may have been erected on top of each other. Under very favourable circumstances, remains of these sequences are preserved in defined layers which allow a correct interpretation; however, this is not normally the case. At some sites this superimposition could explain the apparent occurrence of several different crafts within the same workshop; it is possible they did not actually take place in the same building but in several short-lived structures which, in the archaeological record, give the impression of being only one. Jüri Peets (2003, 190-91) has illustrated an example from Tontinmäki in Karelia. Several hearth pits were found in the remains of a building which was excavated in 1888. By comparison with a number of superimposed workshop buildings at Paatsa in Estonia, Peets showed that the Tontinmäki workshop was the remains of several chronologically and physically overlapping workshops, a fact not identified by its excavator (Schvindt 1893, 69-71).

The complex stratigraphy of Birka's settlement, the

Black Earth, has so far resisted interpretation in terms of the physical location of craft production, though the excavations between 1990 and 1995 are currently being prepared for publication and might change that. Within the 350m^2 excavated the remains of at least one bronze casters' workshop was discovered along with a large quantity of artefacts and metalworking debris. As yet, only a few papers about these finds have been published (*eg* Ambrosiani and Eriksson 1992, 34-41; 1994, 7-25; Jakobsson Holback 1999; Gustafsson 2009). Only a few hundred metres to the south the situation is entirely different. There, on a terraced slope known as the Garrison, the stratigraphy is still complex but the deposits are reasonably shallow in comparison to those of the main settlement. On the uppermost terrace (Terrace 2) a complex and overlapping cluster of buildings were excavated between 2001 and 2004. Initially there was some confusion, most notably in the treatment of the fragmentary clay loom weights which were found in rather large numbers. In a paper from 2002, they were all interpreted as tuyères and connected to the abundant metalworking debris (Bjerstaf 2002). A thorough on-going analysis of the site has shown that several houses stood on the terrace; the loom weights and metalworking debris can be linked to different phases and thus most probably to different buildings despite their overlapping spatial distributions (Bergström *in prep*). The possibility of closely overlapping buildings, in both a chronological and a spatial sense therefore needs to be considered when less well-documented workshop sites are interpreted archaeologically, especially as it is common practice to refurbish an existing building if possible (*eg* Schietzel 1981, 61-4) rather than erect a new building on a different alignment.

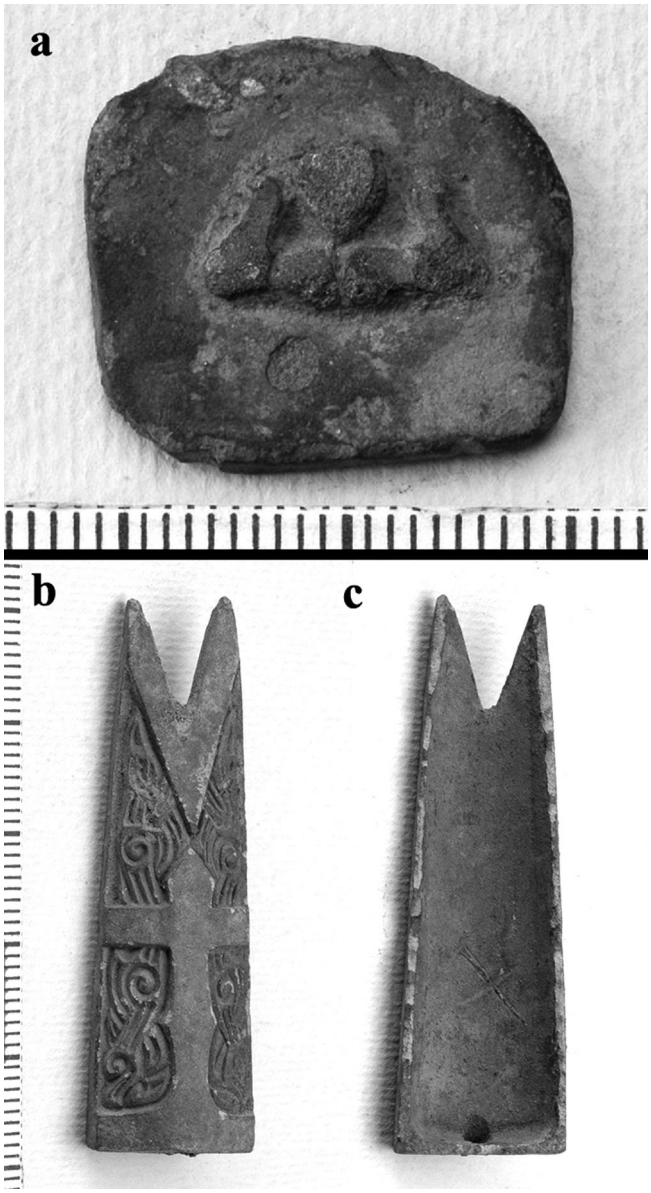

Figure 2: Finds from Klints in Othem parish, Gotland. A) Press die for gold sheet; b) Front of copper alloy master for fish-head pendants; c) Back of the master. Scales in mm. Photos © the author.

Gotlandic workshops and metalworking remains

In 2002, the possible remains of a Gotlandic metal workshop were located at Klints farm in Othem parish on the island's NE coast (Fig 1:11). The finds were not in situ but were recovered from a big spoil heap left by bulldozers extending a local golf course. Despite this, archaeologists from Gotland Museum were able to retrieve around 700 silver coins, 70 pieces of hack-silver and many other artefacts dating from the Vendel to medieval periods by meticulous metal detecting of the spoil heap (Pettersson 2005). In 2007 the probable context of the silver artefacts was excavated by a field school led by Dan Carlsson and Tove Eriksson (Carlsson and Jonsson 2008). Even though the construction work had caused irreparable damage, parts of the building had escaped the bulldozers. One of the most striking finds was a corner post still in its hole. It was later dated to around 1046 AD by dendrochronology (D Carlsson, pers comm). The building measured roughly 6m by 4m and most of the interior had been dug away, but enough finds were recovered to allow its tentative interpretation as a metal workshop. Much of the non-monetary silver from the spoil heap was either fragmented or coiled up, possibly to fit it into crucibles. The metal had also been thoroughly tested by pecking to test its purity.

The silver is, however, overshadowed by two other artefacts found in the heap. One (SHM 34663:167; Fig 2a) is a copper-alloy press die for D-shaped gold foils of a

type normally found on prestigious Gotlandic jewellery such as button-on-bow brooches and box brooches. So far, only one other die of this type is known; it has no known findspot and was probably, probably sold to the Historical Museum in the 19th century. The second artefact from Klints is also directly connected to the production of local Gotlandic jewellery: it is a copper alloy master for casting beeswax models of so-called fish-head pendants (SHM 34663:61; Figs 2b and 2c). As such pendants are hollow the wax model had to be made in two halves joined around a porous core of mould loam. This master is the ornamented front, one part in a set of two. The 2007 excavation led to the recovery of more evidence of metalworking, notably sherds of crucibles and clay moulds. A pierced piece of limestone with signs of severe exposure to heat could possibly have been used as a bellows shield next to a casting hearth. Most traces of metalworking at Klints have been displaced and re-deposited but they still provide a valuable addition to overall knowledge of Gotlandic non-ferrous metalworking.

Even without the Klints finds Gotland holds a special place within Swedish archaeology. One reason for this is the seemingly endless supply of Iron Age and early medieval hoards discovered on the island over the centuries – and hoards are still being discovered in a rate unrivalled in Scandinavia. The majority of these hoards date to the Viking Period (*c*750-1150 AD on Gotland). Since the advent of metal detectors for private use, plunderers have looted both known and unknown hoard sites. To combat this the local antiquarian authorities used legal metal detection from as early as 1977: the so-called Hoard Project. Its main goal was to beat the plunderers to their loot by recovering as much valuable metal as possible from the find sites. The original project, headed by the local branch of the National Heritage Board, ended in 1989 but similar campaigns have occurred intermittently since then (Hellqvist and Östergren 2011). This means that a wealth of finds have been collected over the years, and thus saved for science. Most of the hoard sites are located on farmland that is regularly ploughed. This means the original find contexts are usually disturbed, which is generally a requirement for the use of metal detection on any site of archaeological significance. From early on in the Hoard Project, it became clear that the hoards were often found at settlements, and in many cases *within* early medieval buildings. This became evident through the 'by-products' of metal-detecting: non-precious metal finds which derive from everyday activities in and around the settlement. Beside metal objects or objects with metal inclusions, non-detectable finds like potsherds, burnt clay and antler or bone fragments were often collected at the hoard sites. The overall picture of the sites and their spatial spread of finds thus led Majvor Östergren, the archaeologist in charge of the project, to the conclusion that silver generally followed buildings, at least in Viking-period Gotland. This became the subject of her doctoral thesis which is still considered as the standard work on the subject (Östergren 1989).

The Hoard Project meant a big leap forward for Gotlandic archaeological research and it also triggered several spin-offs. One was the Eke Settlement Project, which lasted from the 1980s until the death of the project leader Torgny O Andersson in 2008. Andersson, a part-time archaeologist and noted local historian, managed to survey some 85% of the farmland within Eke parish on the SE coast of Gotland (Andersson 1999, 24), though many of the finds and the scientific data he collected remain unpublished. At many sites, both in Eke parish and on Gotland in general, debris from various crafts were collected. The majority of these finds were generated by metalworking – not unexpected given the method of surveying. On closer examination the sites seem to fall into a number of sub-groups, depending on the finds. At a large number of sites iron slag has been recovered, mainly from secondary smithing. At many sites the slag was also accompanied by pieces of more or less vitrified hearth lining. Together these finds undoubtedly point to the occurrence of iron smithing on the sites where they have been collected. They mainly derive from forges which were either deliberately broken up and dumped, or were unintentionally ploughed-out when the settlement areas were brought into cultivation. These traces of ironworking are hard to interpret and date: they could just as well be late medieval as Iron Age as local iron smithing changed very little until the modern era.

Because of this problem with dating iron smithing, it is more rewarding to look at the non-ferrous metalworking. Even though some copper-alloy and silver casting did occur in the Gotlandic countryside during the late medieval period it was mainly a craft controlled and regulated by the guild system in the island's capital, Visby. Thus most debris from non-ferrous metalworking found in the Gotlandic countryside derives from early medieval or Iron Age production; at some sites it might even date to the Bronze Age, but that is usually hard to prove. The approach to non-ferrous metalworking on Gotland appears rather different from that in mainland Scandinavia where it seems to have been concentrated on a few, specialised sites (generally the clustered settlements and emporia mentioned above). The number of properly excavated settlements in the rest of Scandinavia vastly exceeds those on Gotland though few areas on the

mainland have seen as many thorough metal detector surveys as the Gotlandic hoard sites. A compilation of finds recovered during some 685 metal detector surveys of 390 sites all over Gotland showed that objects and debris directly connected with non-ferrous metalworking were found on at least 85 of these sites (Gustafsson in prep). At most sites only a few finds were recovered, but on a number the abundance of finds indicates that some kind of specialised workshop must have been present, as is also the norm on the mainland. It is the many indications of small-scale casting that distinguishes the Gotlandic settlements. In previous research this has been interpreted as a locally-based production of jewellery on certain farms (Carlsson 1983, 85). In the light of the finds accumulated over recent decades, this interpretation probably needs to be adjusted to include the presence of travelling specialists. Fine smiths or jewellers might have been based at settlements with more abundant traces of casting and then travelled around to the nearby farms producing jewellery on-site in temporary hearths, possibly with raw metal provided by the customers. It is currently hard to tell whether or not this was the case as only one undisturbed early medieval Gotlandic workshop has so far been excavated with sufficient care: that at Bottarve, Fröjel parish (Figs 1:13 and 4; see below).

Workshops

Many recognisable early medieval workshops appear to have been of a type where the building itself seems to have been erected especially, but not exclusively, to be used for a specific craft. Four examples are discussed below.

The Stånga workshop

In 1975, an excavation was launched at Stånga annex, now Lyrungs, in Stånga parish (Fig 1:12). In the area were remains of several early Iron Age houses with massive stone foundations, a type commonly found on the island, as well as a rather well-preserved field system. A narrow trench (19m by 1m) was laid out over what is referred to as House 1 by the excavator, Dan Carlsson (Fig 3). The house overlay ard marks and an iron furnace dated to the 2nd century BC (Carlsson 1976; Huttu 1996, 7-9). House 1 measured *c*35m by 10m and like most houses with stone foundations it was probably constructed during the Scandinavian late Roman (200-400 AD) or Migration period (400-550 AD), a date supported by two radiocarbon samples (535±125 AD and 375±100 AD). House 1 was overlain by a smaller building, *c*5m by 3m, constructed inside the stone foundations that

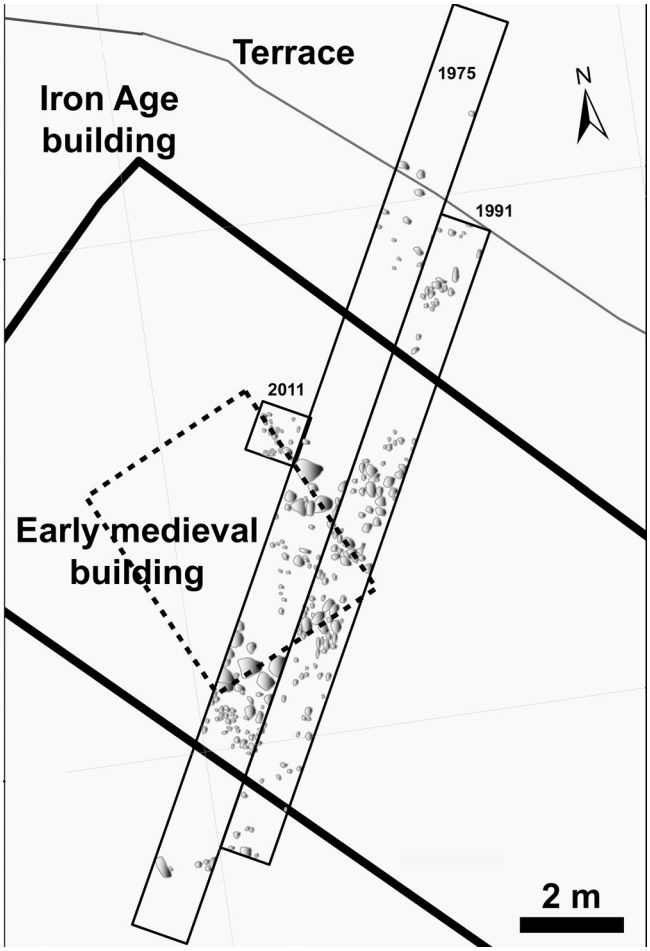

Figure 3: The Stånga workshop. The majority of both glass tesserae and loom weight fragments were recovered in the north-eastern part of the early medieval workshop building. After Gustafsson and Viberg forthcoming.

had been somewhat disturbed by shallow ploughing. Only some 3m^2 of this house was excavated but a large number of finds were recovered from it which brought about a second excavation in 1991 when a 13m by 1m trench was laid out beside the area excavated in 1975, extending the total excavated area to 32m^2 and that of the smaller house to 6m^2. Among the finds from the latter are 95 glass tesserae and a large number of fragments of ceramic loom weights as well as a bronze plated iron weight and a fragment of an Islamic silver coin dated to between 749 and 833 AD (Hovén 1991). Carlsson interpreted the smaller building as a utility workshop for glass bead making and weaving (Carlsson 1976 87). So far no traces of metalworking have been recovered from the Lyrungs workshop, but if glass working took place there it ought to have left traces in the form of a hearth or furnace of some kind (*cf* Söderberg 2008, 124-8). The clay walling of such a structure would have been subjected to substantial heat and would normally be expected to survive well in the ground, but during Carlsson's limited excavations of the building no finds

which could have come from a furnace were recovered. In the autumn of 2011, the Archaeological Research Laboratory undertook a magnetic survey of the area in an attempt to delimit the workshop and its inner features. Guided by the results, a test square of 1m^2 was opened up. In the uppermost plough soil an additional 7 white and green opaque glass tesserae were found and further down a concentration of fire cracked stones and fragmented loom weights. Among the finds were also one piece of vitrified clay and two partially melted stones (Gustafsson and Viberg forthcoming). The melted and vitrified clay is of a type commonly found in or around hearths and furnaces for glass and metalworking but since it appeared in the plough soil it currently cannot be connected with any specific archaeological feature.

The Fröjel workshop

In the summer of 2000, a small portion of a pasture called Irmas hage at Bottarve in Fröjel parish on the Gotlandic west coast (Fig 1:13) was excavated as a part of the Fröjel Discovery Program. The area had never been ploughed and several possible stone foundations of small buildings could be seen on the surface. An area of 42m^2 in and around one of these foundations were excavated and it was soon established that it formed part of a building *c*5.5m by 4m which lacked most of the eastern long side (Fig 4). Judging from several postholes found in the eastern part of the trench, another older building, possibly on a different alignment, had been present on the site. The later building had a large hearth in its southern end and two pit hearths to the north. These proved to be of special metallurgical interest since they gave direct evidence for extensive silver working in the building. One of the pit hearths had clearly been used for cupellation of considerable amounts of silver (Söderberg 2011), while the other one had been used for casting, and its backfill held the largest collection of clay mould fragments found so far on Gotland – *c*960g – as well as two intact crucibles and fragments of several others (Gustafsson and Söderberg 2007). Additionally, finds of various antler objects, raw antler, smithing slag and glass beads clearly showed that the building had also been utilised for antler working, iron forging and possibly glass bead making (Dahlström and Eriksson 2002, 152-3).

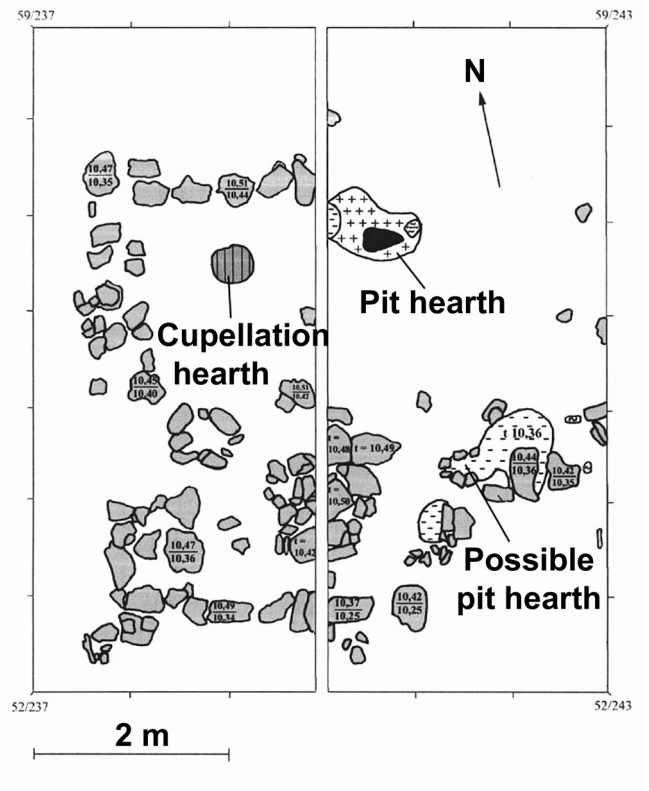

Figure 4: The Fröjel workshop. The mould fragments were mainly recovered in the northernmost pit hearth. After Dahlström and Eriksson 2002.

The Farsta gärde workshop

During trial excavations at Farsta gärde in Gustavsberg parish east of Stockholm (Fig 1:14), traces of metalworking were found in 1992 and 1993. The site saw total excavation in 1998 during which it was established that the metalworking had taken place in a building roughly dated to the latter part of the 11th century (Andersson 2004, 7). The building, probably some kind of timber post-and-plank construction on a stone foundation, measured *c*13.5m by 6.5m (Fig 5). A slightly raised

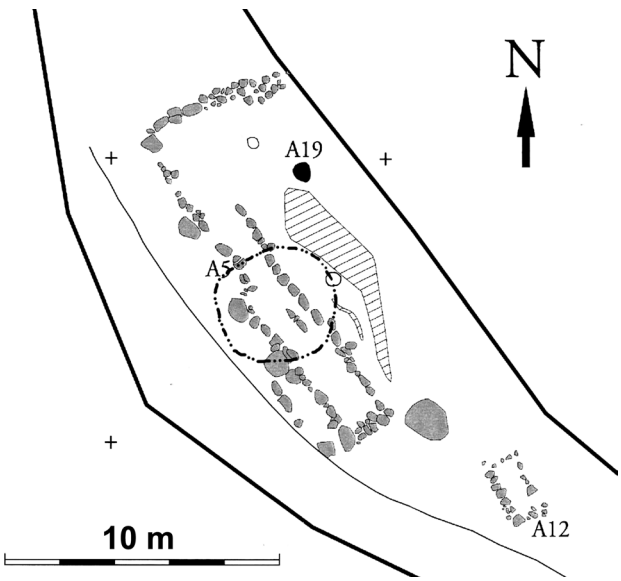

Figure 5: The Farsta gärde workshop. The central circular area marks the smithing hearth. A5: Stone foundation. A12: Storage. A19: pit-hearth. After Andersson 2004.

area within the building, *c*3m in diameter, made up of fire-cracked and fire-affected stones was interpreted as the remains of a smithing hearth. Several iron blanks, smithing slag and vitrified clay were found within this presumed hearth area along with copper-alloy smelts and a number of lead and copper-alloy droplets. A stone-lined pit, 0.6m in diameter, in the northern part of the building was interpreted as a possible but not definite pit-hearth (Andersson 2004, 33-4). Along with the debris from the metal working, a large number of fragmented ceramic loom weights were found, 108 fragments on the site as a whole, of which 62 were found within the building (Andersson 2004, 21). In an adjacent smaller building, *c*2.7 by 1.5m, several finds of scrap metal – both iron and copper-alloy – were recovered. It was interpreted as a storage area for the larger workshop building (Andersson 2004, 30). The finds from Farsta gärde led the excavators to interpret the building as a workshop for ferrous and possibly non-ferrous metal-working and textile production.

The Viborg Søndersø workshop

In 2001, excavations started at a site at Brænderigården by Viborg Søndersø in Jutland (Fig 1:15). Thanks to previous excavations in the area it was known to be waterlogged, so local conditions for preservation of organic material were good. This knowledge was used to plan and execute an archaeological pilot project based on meticulous single-context recording and an interdisciplinary approach. Several interesting features were found in the 70m^2 excavated (Fig 6a). Among these were the remains of a building which must be regarded as the best example of an early medieval workshop excavated, documented and published in Scandinavia; it measured *c*5m by 3m with undaubed wattle walls (Fig 6b). The wet conditions on the site meant that organic remains were preserved to an extent unseen in the other workshop sites presented here. This allowed for exact dating of the phases in the building. Based on the large number of dendrochronology samples, the building seems to have been erected in 1019 or 1020 and rebuilt around 1025 (Thomsen 2005, 271-4). Along its northern side the building was fitted with a 1m square elevated forge whose oak frame was partly preserved and was dated to after 1020 (Thomsen 2005, 281). A concentration of vitrified clay and slag in the southern part of the building could, however, be the remains of an earlier hearth which was replaced by the raised hearth (Jouttijärvi *et al* 2005, 301). The floor of the workshop had apparently been rather damp from the start and it was improved by a layer of sand around 1020, followed by an additional layer in the southern part, probably later in the same year (Jouttijärvi *et al* 2005, 300). By analysing these layers

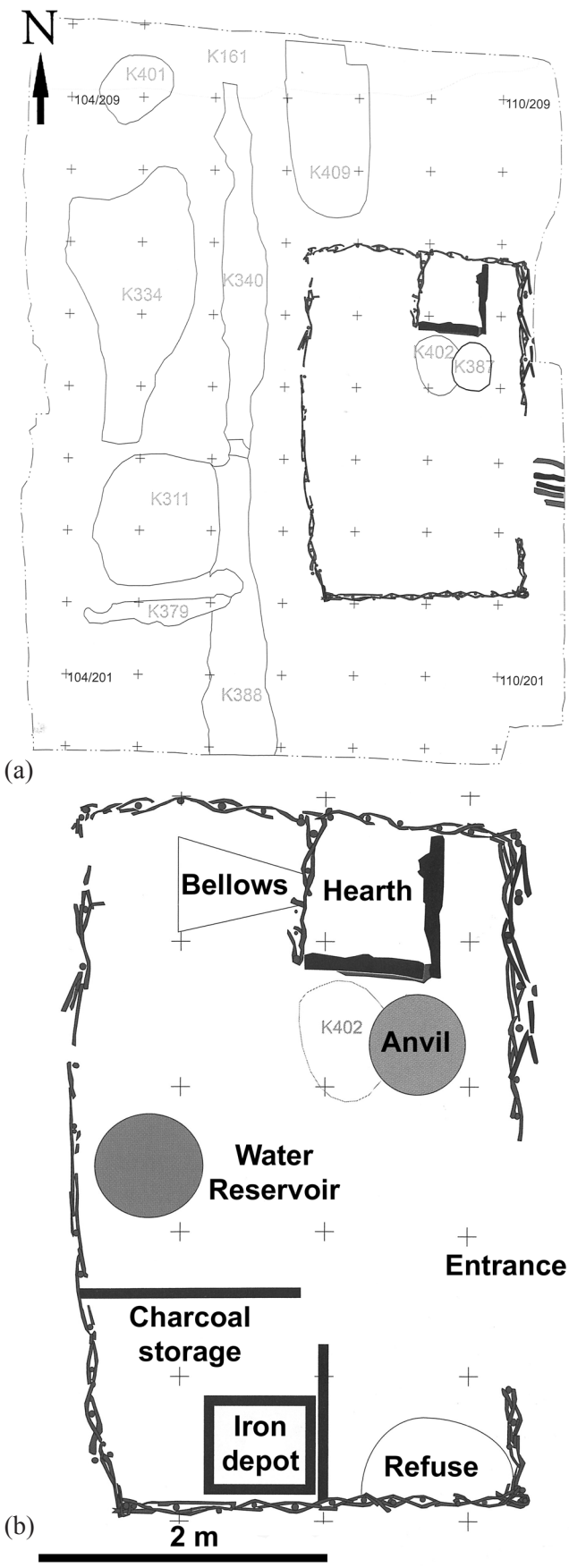

Figure 6: The Viborg Søndersø workshop. a) Overview of the trench; b) Basic furnishing of the workshop reconstructed from documented archaeological features. After Jouttijärvi et al 2005.

of sand and the spread of charcoal, soot and dirt it was possible to determine not only that metalworking had occurred in the building, but also when it occurred. In front of the forge a pit for the base of the anvil stump had been dug into the floor. The wedges that had secured the stump were still in the pit and had been made from wood felled in 1018 and 1020 (Thomsen 2005, 282). The workshop seems mainly to have focused on ferrous and non-ferrous metalworking but in 1021 or 1022 the workshop was used by a comb maker leaving behind traces of antler working (Jouttijärvi *et al* 2005, 310-11). Thanks to the well-recorded stratigraphy, it is possible to follow the activities in the building with an almost monthly precision until around 1025 when the building was dismantled, the ground levelled and a new building was erected on the site (Jouttijärvi *et al* 2005, 318). The rich documentation from the Viborg Søndersø workshop place it in a league of its own, but it also enables its use as a template when interpreting other, less well-preserved and less well-excavated workshops.

These four sites illustrate a possible trend in early medieval Scandinavian workshops. They are all rather small and were apparently used for more than one craft. Furthermore, when the micro-stratigraphy is preserved and documented, as at Viborg Søndersø, it becomes evident that there were seasonal variations in use; this variation was probably more common than we realise. Based on this, admittedly limited, selection of excavated sites some workshops seems to have been more of utility buildings which were brought into use for metalworking when needed, rather than the enigmatic and symbolic border-zone smithies mentioned initially.

Conclusion

The workshop evidence leads back to the earlier discussion concerning activities in, compared to the intended function of a building. When does a building stop being one thing and become another? Of course a definitive answer cannot be given, but this dichotomy should be kept in mind when attributing a particular function or purpose to a building. The sheltered and confined space offered by a small house, with or without a hearth, could have been used in a multitude of ways: as spare housing, for storage or as a byre – or as a workshop for shorter or longer periods of time.

One aspect of metalworking which is often overlooked is cold working, or rather all the work which does not demand high temperatures. One of the more obvious examples is filing and polishing objects. To that, various types of applied decoration can be added. In non-ferrous metalworking melting metal and pouring the melt into moulds represent just two stages of many in a long sequence. They are preceded and followed by a number of equally crucial stages, some of which need raised temperatures, but far below those required for metal melting. Some, like modelling and mould-making, need no heating at all and could well have been carried out in a building without leaving any archaeologically-visible traces of metalworking. It could have been convenient but not necessary to keep the entire production under one roof; we will never know what was done.

One of many 'holy grails' within archaeometallurgy is the goldsmith's workshop. The products of Scandinavian goldsmiths are well represented in museum collections around the world but their precise place of origin is elusive. It is possible to work out the techniques used in the production of certain pieces, and hence establish which tools, alloys and temperatures were used, but no fully equipped goldsmith's workshop has yet been identified despite all attempts (*eg* Armbruster 2010).

A compilation of some early medieval metal workshops and metalworking sites such as the one presented here illustrates a number of things. First and foremost is that our knowledge is far from complete. Even at sites like Viborg Søndersø where excavations were executed with delicate precision, it is hard to identify more than the basic outline – that a building once stood on the site and seems to have been used mainly for metalworking. Secondly, no fully equipped workshop in its prime has been identified – but could it be that the ideal workshop is just as fanciful as the idealized smiths of previous research?

The best way forward probably lies in an improved understanding of the metallurgical processes and techniques which left the finds we recover during excavations. One day a perfectly-preserved frozen-in-time Norse workshop might be found, fully equipped with crucibles still in the long-extinguished hearth and rows of tools in position along the walls – but until then we must make the most of the large number of actual finds of raw metal, miscasts, tools, debris and buildings left by the metalworkers. When these are analysed, interpreted and the data extrapolated, they have a lot to tell about the metalwork, the craftsmen and the societies which produced them. It might then be appropriate to consider the written accounts about metalworking to gain some insights into more complex social features – and maybe even to stretch one's wings in a flight with Weyland, reassured by the knowledge that a safety net of factual

information is there to soften the fall, should the wings be less trustworthy than expected.

References

Ambrosiani B and Eriksson B G 1992, *Birka vikingastaden volym 2* (Stockholm).

Ambrosiani B and Eriksson B G 1994, *Birka vikingastaden volym 4* (Stockholm).

Andersson D, Willim A, Grandin L and Hjärtner-Holdar E 2006, *Arkeometallurgiska analyser av material från ett mässingsgjuteri. Skänninge stad, Mjölby kommun, Östergötland*. Geoarkeologiskt Laboratorium, Analysrapport nummer 16-2006, Avdelningen för arkeologiska undersökningar. UV GAL (Uppsala).

Andersson K 2004, *Tidigmedeltida verkstadsbebyggelse vid Farsta gärde. Arkeologisk delundersökning av boplats RAÄ 40, Farsta, Gustavsbergs socken, Värmdö kommun, Uppland*. Stockholms läns museum rapport 2004:9 (Stockholm).

Andersson T O 1999, Boplats Eke – Ett försök att lokalisera och datera förhistoriska boplatser i Eke socken, Gotland. Uppsats Fördjupningskurs i arkeologi. Unpublished MA thesis, Gotland University College

Armbruster B 2010, 'Remains of the Viking-age goldsmith's craft and workshop', in B Hirschel and B Ludowici (eds), *Trade and communication-network of the first millennium AD in the northern part of central Europe* (Stuttgart: Neue Studien zur Sachsenforschung 1), 191–213.

Bergström L in preparation, *Hus och hantverk – arkeologisk undersökning av de övre terrasserna i Birkas Garnison, RAÄ 35, Björkö, Adelsö sn, Uppland 2001–2004* (Stockholm: Rapporter från Arkeologiska forskningslaboratoriet).

Bjerstaf Å 2002, Krigarsmedjan – Analys och fyndpreparering av järnföremål från smedjan vid Birkas Garnison. Unpublished MA thesis, Stockholm University.

Björhem N and Säfvestad U 1993, *Fosie IV. Bebyggelsen under brons och järnålder* (Malmö: Malmöfynd 6).

Brorsson T 1998, 'In the workshop – Gold- and silverwork at Borgeby in Scania, southern Sweden', *Fornvännen* 93, 225–239.

Burström M 1990, 'Järnframställning och gravritual. En strukturalistisk tolkning av järnslagg i vikingatida gravar i Gästrikland', *Fornvännen* 85, 261–271.

Callmer J 2002, 'Wayland – An Essay on Craft Production in the Early and High Middle Ages in Scandinavia', in L Larsson and B Hårdh (eds), *Centrality – Regionality. The Social Structure of Southern Sweden during the Iron Age* (Lund: Uppåkrastudier 7), 337–361.

Carlsson A 1983, *Djurhuvudformiga spännen och gotländsk vikingatid – text och katalog* (Stockholm: Stockholm Studies in Archaeology 5).

Carlsson D 1976, 'Ett vendel-vikingatida verkstadshus på Gotland', *Fornvännen* 71, 82–88.

Carlsson D and Jonsson K 2008, 'Utgrävningen av en skattfyndplats i Klints, Othem sn, Gotland', in K Jonsson (ed), *Myntstudier nr 2008:1 maj. Mynttidskriften på Interne*t www.archaeology.su.se/numismatiska (Stockholm), 1–7.

Clarke H and Ambrosiani B 1993, *Vikingastäder* (Höganäs).

Dahlström C and Eriksson T 2002, Rapport från utgrävningen av den vikingatida hamn- och handelsplatsen Fröjel, Gotland 2000. Fröjel Discovery Programme, Dnr 220-1955-00. Unpublished report.

Fallgren J-H 1994, 'En vendel- och vikingatida grophusbebyggelse i Övra Wannborga på Öland', *TOR* 26, 107–144.

Gotfredsen A B and Gebauer Thomsen L 2011, 'Three pit-houses of the magnate's residence at Lake Tissø', in L Boye (ed), *The Iron Age on Zealand – Status and perspectives* (Copenhagen: Royal Society of Northern Antiquaries), 213–222.

Graham-Campbell J and Kidd D 1980, *The Vikings* (London).

Grandin L, Enlund L-E and Hjärtner-Holdar E 2000, *Smidesavfall från ett Fyrkathus i Köpingebro, RAÄ 50a-b, Stora Köpinge sn*. Geoarkeologiskt Laboratorium, Analysrapport nummer 2000:6, Avdelningen för arkeologiska undersökningar. UV GAL (Uppsala).

Gustafsson N B 2009, 'Vikingatida blästerskydd av sten och lera från Mälardalen', *Fornvännen* 104, 153–161.

Gustafsson N B in preparation, In the Wake of the Hoards – glimpses of Gotlandic non-ferrous metalworking through the finds of the Hoard Projects.

Gustafsson N B and Söderberg A 2007, 'En senvikingatida metallverkstad i Fröjel', *Gotländskt arkiv* 2007, 99–110.

Gustafsson, N B and Viberg A forthcoming, 'Tracing high temperature crafts. Magnetometry on the island of Gotland, Sweden', paper submitted.

Gustafsson M, Hallgren A-L, Having E, Olsson R, Stark K and Sundström J 2000, *Binga och Hossmo - Hantverk och gravar från yngre järnålder. Fornlämning 134 och 161, Hossmo socken, Småland*. E22-projektet, rapport 2000:8. (Kalmar).

Hauglid R 1969, *Norske stavkirker* (Oslo).

Hawthorne J G and Smith C S 1979, *Theophilus. On Divers Arts* (New York).

Hed Jakobsson A 2003, *Smältdeglars härskare och Jerusalems tillskyndare – berättelser om vikingatid och tidig medeltid* (Stockholm: Stockholm studies in Archaeology 25).

Hellqvist M-L and Östergren M 2011, *Ett plundrat kulturarv - Att motverka och förebygga plundring av fornlämningar* (Visby).

Hilberg F 2008, 'Hedeby in Wulfstan's days: a Danish emporium of the Viking age between east and west', in A Englert and A Trakadas (eds), *Wulfstan's voyage – The Baltic Sea region in the early Viking age as seen from shipboard* (Roskilde: Maritime Culture of the North 2), 79–113.

Hjärtner-Holdar E, Larsson L, Englund L-E, Lamm K and Stilborg O 1999, *Järn- och metallhantering vid en stormannagård under yngre järnålder och tidig medeltid, Husby, Glanshammar sn, Närke*. Geoarkeologiskt laboratorium, Analysrapport nummer 2-1999, Avdelningen för arkeologiska undersökningar. UV GAL (Uppsala).

Hovén C 1991, Numismatisk analysrapport, KMK 322/91. Unpublished report.

Huttu J 1996, Järn och korn. Undersökning med målsättning att förklara bakgrunden till järnåldersboplatsen Stånga annex etablering, samt göra ett rekonstruktionsförsök av denna forntidsmiljö. Uppsats för påbyggnadskurs i arkeologi.Unpublished MA thesis, Stockholm University/Gotland University College.

Jakobsson T 1996, 'Bronsgjutarverkstäderna på Birka – en kort presentation', in H Forshell (ed), *Icke-järnmetaller, malmfyndigheter och metallurgi* (Stockholm), 71–75.

Jakobsson Holback T 1999, 'Svårtolkade spår efter en metallurgisk process – ett danskt exempel och dess paralleller i omvärlden', *By, marsk og geest* 11, 5–12.

Jensen S 1991, 'Metalfund fra vikingetidsgårdene ved Gl. Hviding og Vilslev', *By, Marsk og Geest* 3, 27–40.

Jouttijärvi A, Thomsen T and Moltsen A S A 2005, 'Værkstedets funktion', in M Iversen, D Robinson, J Hjermind and C Christensen (eds), *Viborg Søndersø 1018-1030. Arkæologi og naturvidenskab i et værkstedsområde fra vikingetid* (Århus: Jysk Arkæologisk Selskabs Skrifter 52), 297–320.

Kirpichnikov A N 2004, 'A Viking Period workshop in Staraya Ladoga, excavated in 1997', *Fornvännen* 99, 183–196.

Lindeblad K 1996, 'Borgs socken – förändring i tid och rum 200 – 1200 e.Kr', in K Lindeblad, L Lundqvist, A-L Lielsen and L Ersgård (eds), *Slöinge och Borg – stormannagårdar i öst och väst* (Linköping: Riksantikvarieämbetet arkeologiska undersökningar Skrifter 18), 53–77.

Nørgård Jørgensen A, Jørgensen L and Gebauer Thomsen L 2011, 'Assembly sites for cult, markets, jurisdiction and social relations historic-ethnological analogy between north Scandinavian church towns, Old Norse assembly sites and pit house sites of the late Iron Age and Viking period', in L Boye, L Heidemann Lutz, S Kleingärtner, P Kruse, L Matthes and A B Sørensen (eds), *Arkæologi i Slesvig / Archäologie in Schleswig Sonderband - Det 61. Internationale Sachsensymposion 2010, Haderslev, Danmark* (Neumünster), 95–112.

Nørlund P 1948, *Trelleborg* (Copenhagen: Nordiske fortidsminder 4).

Olsen O 1977, 'Borgen', in O Olsen and H Schmidt, *Fyrkat – en jysk vikingeborg, I. Borgen og bebyggelsen* (Copenhagen: Nordiske fortidsminder Serie B, Bind 3), 9–104.

Pedersen U 2009, 'Den ideelle og den reelle smed', in J Lund and L Melheim (eds), *Håndverk og produksjon. Et møte mellom ulike perspektiver* (Oslo: Oslo Archaeological Series 12), 129–146.

Pedersen U 2010, I smeltedigelen. Finsmedene i vikingtidsbyen Kaupang. Unpublished PhD thesis, Oslo University.

Peets J 2003, *The power of iron. Iron production and blacksmithy in Estonia and neighbouring areas in prehistoric period and the middle ages* (Tallinn: Research into Ancient Times 12).

Pettersson A-M 2005, *Arkeologisk efterundersökning: Fyndplats för vikingatida silverskatt och boplatslämning, Klints 1:16, Othem socken, Gotlands kommun* (Visby).

Roesdahl E 1977, *Fyrkat – En jysk vikingeborg. II. Oldsagerne og gravpladsen* (Copenhagen: Nordiske fortidsminder Serie B, Bind 4).

Sarauw G and Alin A 1923, *Götaälvsområdets fornlämningar* (Göteborg).

Schietzel K 1981, *Stand der siedlungsarchäologischen Forschung in Haithabu — Ergebnisse und Probleme* (Neumünster: Berichte über die Ausgrabungen in Haithabu 16).

Schmidt H 1977, 'Bebyggelsen', in O Olsen and H Schmidt, *Fyrkat – en jysk vikingeborg, I. Borgen og bebyggelsen* (Copenhagen: Nordiske fortidsminder Serie B, Bind 3), 105–241.

Schvindt T 1893, 'Tiedoja Karjalan rauatakaudesta jasitä seuraavilta ajoilta Käkisalmen kihlakunnan alalta saatujen löytöjen mukaan', *Suomen Muinaismuistoyhdistyksen Aikakauskirja* 13.

Skree D 2008, 'The development of urbanism in Scandinavia', in S Brink and N Price (eds), *The Viking World* (Abingdon), 83–93.

Strömberg M 1981, *Järn i österlenska forntidsfynd* (Simrishamn).

Söderberg A 2011, 'Eyvind Skáldaspillir's silver – refining and standards in pre-monetary economies in the light of finds from Sigtuna and Gotland', *Situne Dei* 2011, 5–34.

Söderberg A 2002, 'Metalliska spår efter gjuteriverksamhet- en skiss till en arkeologisk fältmetod', *Fornvännen* 97, 255–264.

Söderberg A 2008, 'Metall- och glashantverk', in A Wikström (ed), *På väg mot paradiset – arkeologisk undersökning i kvarteret Humlegården 3 i Sigtuna 2006* (Sigtuna: Meddelanden och Rapporter från Sigtuna Museum 33), 97–130.

Thomsen T 2005, 'Værkstedet – en bygningsarkæologisk redegørelse', in M Iversen, D Robinson, J Hjermind and C Christensen (eds), *Viborg Søndersø 1018-1030. Arkæologi og naturvidenskab i et værkstedsområde fra vikingetid,* (Århus: Jysk Arkæologisk Selskabs Skrifter 52), 271-296.

Wellinder S 2005, 'Review of S Thedéen 2004, Gränser I livet – gränser i landskapet. Generationsrelationer och rituell praktik i södermanländska bronsålderslandskap', *Fornvännen* 100, 218–220.

Åberg E, Söderberg A and Gustafsson N B 2006, Överfångsgjutning på silver och järn - experimentell metodstudie. Rapport projekt HAF 13/06, Lejre Research Centre. Unpublished report.

Östergren M 1989, *Mellan stengrund och stenhus : Gotlands vikingatida silverskatter som boplatsindikation* (Stockholm: Theses and papers in archeology 2. New series, A).

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