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The Flintknapper and the Bronzesmith

Deborah Olausson

Abstract:The labels 'stone' and 'bronze' in Stone Age and Bronze Age reflect what archaeologists perceive as trends in material culture, but our perspective is skewed by a number of factors such as formation processes and our need for dividing the temporal continuum into discrete units. The focus of the paper is on examining this transition from the perspective of the craftspeople who were making the objects which archaeologists perceive as central for defining a Stone Age and a Bronze Age. Southern Scandinavia is the region in focus. Conditions and constraints on the flintknapper and on the bronzesmith, respectively, are compared and contrasted. No specialists can be discerned in the realm of flintknapping. Regarding metals, domestic copper/bronze casting begins somewhat hesitantly, as would be expected of a new technology. The number of forms is limited and metal alloys are heterogeneous. By Period IB of the Bronze Age, however, we see a bifurcation whereby we can distinguish between elaborate and complicated bronzeworking using a standardized raw material on the one hand, and simpler, less complicated crafting, on the other. This confirms Kristian Kristiansen's conclusion from 1987 (p. 46) that bronze specialists had emerged by Period II.

Keywords:Flintknapper, bronzesmith, specialists, bronze, copper

Introduction

The period between 2350 BC and 1500 BC, encompassing in southern Scandinavian archaeological terminology the Late Neolithic up to and including Bronze Age Period IB (Table 1), was surely a time of turbulence in southern Scandinavia. In the retrospective view that archaeology affords us these 850 years, equivalent to about 35 generations, embrace the end of the Stone Age and the beginning of the Bronze Age. The labels 'stone' and 'bronze' reflect what we archaeologists perceive as trends in material culture, but our perspective is skewed by a number of factors such as formation processes and our wish to divide the temporal continuum into discrete units. It is worthwhile to question the validity of our temporal classification systems now and then to ask if the prehistoric agents would agree that significant changes marked the beginning of a new 'age', and to explore the mechanisms involved in the change. I propose to examine a particular aspect of this transition from the perspective of the craftspeople who were making the objects archaeologists see as central for defining a Stone Age and a Bronze Age, respectively.

In spite of what our terminology implies, copper-based metals were being worked in southern Scandinavia during the entire late Neolithic, just as stone crafting (including flintknapping) was practiced during Bronze Age Period I and thereafter. Daggers, sickles, axes and pressure-flaked points of flint, for instance, occur in both late Neolithic and early Bronze Age contexts. By the same token, individuals were casting naturally alloyed copper into flanged axes from at least the outset of the late Neolithic period (Vandkilde 1996; Magnusson Staaf 2002; Melheim 2012).

Table 1 Calibrated BC dates for the relevant archaeological periods. Based on Vandkilde 1996:305-6.

Period	*Date cal BC*
Late Neolithic I	2350 - 1950
Late Neolithic II	1950 - 1700
Bronze Age Period IA	1700 – 1600
Bronze Age Period IB	1600 - 1500

On a scale visible in the archaeological record we might conclude that individuals versed in flintknapping and individuals versed in shaping metal were performing these activities during the same time-span and in the same geographical area. Were the flintknapper and the bronzesmith the same person?

One major obstacle to answering this question is a virtually complete absence of information regarding where these crafts were being carried out during this transitional phase. As an alternative avenue of approach I propose to examine the conditions involved in knapping flint[1] and casting copper/bronze[2] during the period, in order to explore similarities and differences between them from the crafter's point of view. Following that I will investigate what we can learn from the products of these respective crafts. Denmark and southern Sweden are my focus.

Conditions and constraints on the flintknapper and on the bronzesmith

Raw material availability

Besides flint, the flintknapper's raw material requirements include stone, bone, wood or antler for making hammers and punches plus stone suitable for grinding. These needs could easily have been met by locally available raw materials. As for flint, it is widely accessible on beaches and streambeds and in the moraine soils of southern Sweden and Denmark today, as it probably was in the past (Högberg & Olausson 2007). The flintknapper in southern Scandinavia would most likely not have experienced any constraints on raw material supplies for plying his/her craft.

The bronzesmith's raw material requirements, aside from metal, include: fuel; clay suitable for making moulds (only two stone moulds dating to this period are known, see below), *tuyères* and/or crucibles; quartz for tempering these; grinding stones; stone, bone, wood or antler for making hammers or clubs; and perhaps

[1] I use 'flintknapper' as a term to describe both the expert flintknapper, capable of elaborate knapping such as is required for making type IV flint daggers, and the everyday knapper.

[2] I use 'bronzesmith' to describe the person responsible for casting copper and/or bronze.

Fig. 1a Flanged axe LUHM 6485 is placed in soft clay.
b. Making the clay fit tightly around the axe.
c. The impression left by axe LUHM 6485.
d. Flanged axe LUHM 6540 fits perfectly into the impression left by LUHM 6485, although its butt end is shorter, probably due to damage. This indicates that both axes were cast in the same mould or from the same prototype.

beeswax. We can assume that all these raw materials were locally available in the surrounding landscape. What is the situation in regard to metal raw material?

For the bronzesmith, potential sources of copper, tin or copper alloy are: a) smelting of naturally occurring ores, b) ingots, or c) recycled metal objects. Only options b and c would have been available in southern Scandinavia, however, as neither copper nor tin is local to this area.

Regarding option b, Helle Vandkilde (1996:205) lists 22 examples of objects dating to Late Neolithic II from Denmark which might be ingots; for instance, the heavy rings in the Late Neolithic Pile hoard (Weiler 1994:48). Bronze ingots from the Early Bronze Age are absent, however, at least in the Danish material (Vandkilde 1992:125; cf. Buchwald & Leisner 1992:96).

This leaves us with option c. There is general agreement that remelting alloyed metal was the main source of raw material for Scandinavian smiths, at least until Period I (Levy 1991:59; Liversage 2000:17). Interestingly, the earliest Bronze Age objects are not made from late Neolithic metal, however (Liversage & Liversage 1989:74). In fact Liversage and Liversage see this as one of the most important markers for a discontinuity between the Stone and the Bronze Ages (Liversage & Liversage 1989:67). By Period IB of the Bronze Age we see a compositionally standardized full tin bronze completely dominating Denmark and much of Europe, according to Vandkilde (1996:246). David Liversage (2000:74) does not fully concur, however. He concludes on the basis of impurity patterns in copper that there were two main types and some minor types of copper in use in Denmark during Period I. When he added the information about tin content, which tells us about alloying practices, he found that these two metal types may have been the products of different workshop traditions (Liversage 2000:17).

Consequences of raw material availability for gaining access to a craft

While the flintknapper's raw material was widely available in southern Scandinavia, it is safe to assume that the bronzesmith was faced with limitations regarding access to the raw material for his/her product. This factor has a particularly significant impact on how a craft is learned. A ubiquitous raw material permits trial and error and allows practice. It seems reasonable to assume that most Stone Age people were flintknappers and all Stone Age individuals were most likely taught flintknapping by their parents as an essential life skill (Olausson 2012). The ubiquity of flint and flintknappers meant that some particularly talented knappers emerged. The combination of natural ability and a plentiful raw material allowing practice are prerequisites. These knappers are visible in the archaeological record through their exceptional products, such as well-made type IV flint daggers (Olausson in press).

During the late Neolithic the technology involved in casting copper or bronze represented an innovation quite different from any technology already existing in Stone Age society, according to Ben Roberts (2008:362). Given raw material limitations, the introduction of metallurgy in southern Scandinavia required building up a stockpile of bronze. Eventually a balance between production and consumption was reached and supplies could thereafter have been maintained by modest annual accruement (Kristiansen 1981:258). Even after that stage, however, access to

Fig. 2 The two bronze scimitars from Rørby, probably deposited together. Length c. 50 cm. Photo: The National Museum of Denmark.

copper/tin or bronze was not unlimited. Failures during the casting process can be rectified by remelting, which means that some trial and error is possible. Nonetheless, oxidation in connection with each melt (Vandkilde 1992:125) is a limiting factor. Further, with the lost wax method each casting episode is unique as the mould is broken to release the cast object. This reasoning means that bronzesmiths were never as common as flintknappers. The south Scandinavian bronzesmith was probably taught by someone who already had theoretical knowledge of and/or practical experience with the process, rather than each individual learning by trial and error (cf. Melheim 2012:40). Next I wish to explore the knowledge (theoretical) and the know-how (practical) required for each type of craft.

Knowledge is theoretical and can be communicated by words; it is a recipe for action. Know-how is practical and embodied; it can be learned only by doing. The greater the know-how needed for carrying out a craft, the longer time is required for practice (Apel 2001:27-29; Pelegrin 1990:118).

Knowledge: the recipe for action

I would argue that we can see differences in the amount of knowledge required of the bronzesmith as opposed to the flintknapper. Flintknapper knowledge would include for instance where to find flint and the *chaîne opératoire* for making a particular object. While the *theoretical* basis for flintknapping (knowledge) can be explained in five minutes, becoming a proficient knapper (know-how) takes a great deal of practice (Olausson 2008).

In contrast, casting bronze requires access to several recipes for action. To enumerate these we need to know something about how casting was done in southern Scandinavia during the Late Neolithic and Early Bronze Age. Unfortunately, however, the archaeological record suffers from an almost complete lack of direct evidence dating to this period (Bodin 1998; Melheim 2012:46; Oldeberg 1976; Stilborg n.d.; Vandkilde 1996; Weiler 1994). Only two stone moulds with a possible date to Bronze Age Period I are known from the Scandinavian area: one half of a bivalve mould for a Bagterp point found at Österby in Östergötland (LUHM [Lund University Historical Museum] 21014; Oldeberg 1943:140) and a bivalve mould from Blia, Värmland (Oldeberg 1938). Therefore, we can only assume that casting was usually carried out in moulds of clay or sand which have not survived. Direct evidence for crucibles is also weak. Only one example of a crucible possibly dating to this period, from Ordrup, Denmark, is known (Rønne 1989:107). Assuming this crucible is typical we might say that knowledge of suitable clay as well as a recipe for the amount and type of temper are necessary for making clay moulds and crucibles (Pettersson 2011; Weiler 1994:49). And if the lost wax method was employed the bronzesmith would need knowledge of how to gather and prepare wax (Rønne & Bredsdorff 2011; Weiler 1994:49).

The most complicated part of the process, requiring a large measure of theoretical knowledge, involves achieving the optimal composition of the metal. B. Ottoway (2001:99) maintains that alloying, i.e. mixing copper and tin, requires specialist knowledge. However, as noted above, there is no evidence that Scandinavian smiths were alloying at this time. Rather, they relied on remelting alloyed metal, at least until Period I (Levy 1991:59; Liversage 2000:17).

Examining the question from a chronological perspective we see some significant changes occurring during the transitional period with which we are dealing. An analysis of 77 late Neolithic low flanged axes showed that 51% were of mixed metal composition (Liversage & Liversage 1989:64). Vandkilde (2000:16-17) characterized the earliest flanged axes as completely lacking standardization in technological procedures and material forms. This picture changes as time passes, however, and during Bronze Age Period I greater homogeneity emerges (Melheim

Fig. 3 The flint scimitar from Favrskov. Length c. 35 cm. Photo: The National Museum of Denmark.

2012:112; Vandkilde 1992:121). However, standardization was not total, according to Liversage (2000). His examination of impurity patterns for Period I objects in Denmark showed that two major types of copper were in use. He found a correlation between tin content and ore type, where one bronze type carried definite amounts of tin, meaning it was carefully alloyed, while the other type was much less standardized (Liversage 2000:17-18). Two things seem to be happening here: a general increase in standardization of ores and metal composition in the Bronze Age as opposed to the late Neolithic, and an emergence of two levels of knowledge in regard to metal composition during Bronze Age Period I. We will return to these observations in the conclusion.

Know-how: practical and embodied

Know-how means practical knowledge or embodied expertise. I propose that whereas more knowledge was necessary for the bronzesmith than for the flintknapper, the opposite is true of know-how. Becoming a good flintknapper requires practice and for those who achieved the highest levels of expertise, such as the knappers who made the type IV flint daggers or the scimitar from Favrskov (Rønne 1986; Fig. 3), a great deal of practice must have been necessary (Olausson in press, 2008). Knapping requires skills such as hand-eye coordination and control of bodily movements during blows (Olausson 2008). I can see few elements in bronzecasting which require comparable bodily control. What can we say about the know-how required of the bronzesmith?

Let us examine the various steps involved in bronzecasting in order to evaluate the minimum amount of know-how which might be involved. Melheim provides an illustrative description of know-how involved in casting:

When bronze is melted in an open crucible, a metamorphosis from solid to liquid form and a subsequent change of colour is easily observed. Close observation of the structure and colour of the metal, to assess the right moment for pouring the liquified metal into the mould, is essential for a successful cast….This involved visual observation, hearing, smelling and feeling. Arguably, this know-how was integrated in the motions and body-techniques of a skilled craftsman; embodied and non-discursive, a competence that rested on sensory impulses and muscular memory, as opposed to verbalized or symbolic explanatory models used to rationalize and predict physical change in industrial times. (Melheim 2012:9)

This description seems to imply a high level of know-how as a requisite for casting. However, experimental evidence paints a more variable picture. Simon Timberlake carried out experiments with students in Great Britain. Under instruction, they were able to smelt copper ore in crucibles and co-smelt copper and tin to make bronze. They succeeded in casting the metal in ingot or axe moulds, even when this was their first attempt at metallurgy. The whole process, including making moulds and casting flat axes and small daggers, was carried out in less than a week (Timberlake 2007, 2009). Sara Bodin (1998:110) relates the experience of Torbjörn Sjögren, who has worked with schoolchildren and the general public for ten years. Sjögren is cited as saying that two days are required for learning to make a bronze razor. Andreas Nilsson (2008) performed experiments to determine the difficulty involved in casting in a soapstone mould as opposed to lost wax casting. When he began his experiments he had no previous experience with bronzecasting, although he had gained (theoretical) knowledge by talking to people with such experience. On his first day of casting bronze in a soapstone mould he experienced five failures and two successes; by days three to five he had 12 failures and 13 successes. Based on his own experiments, Preben Rønne says that making a bivalve mould of clay was easily within the reach of any member of the society (Rønne 1993:89). Thus, these accounts indicate that know-how requirements, at least for simple casting, were low.

However, Sue Bridgford points out that the level of difficulty rises when casting thin blades on objects such as daggers, rapiers and swords (Bridgford 2002:123). In southern Scandinavia, domestic casting of such objects appears first towards the end of Bronze Age Period I. Two more technological innovations which appear at this time are the socketed spearhead, requiring core casting, and axes with high-cast flanges (Liversage & Liversage 1989:66). Demands on practical know-how increase substantially with these elaborations.

Metallurgical analyses of flanged axes from Bronze Age Period I show that intensive hammering and annealing was required for shaping many of the alloys in use (Buchwald & Leisner 1990:82). Bridgford claims that hammering the metal in order to thin and harden it is a highly skilled task. She writes further that annealing at too high a temperature can cause the metal to crack (Bridgford 2002:124). Here we see facets of bronze crafting requiring a high degree of know-how. These emerge after metalworking has been practiced for some time in southern Scandinavia, however. In its early stages the degree of know-how was low and it does not appear as though bronzecasting required extensive practice.

Up to this point I have ignored the question of decoration on the bronze objects. Elisabeth Herner argued that Early Bronze Age spiral ornamentation was applied by punch after the object was cast (Herner 1987). Indeed, examples of clumsy ornamentation can be seen in Andreas Oldeberg's catalogue (e.g. Oldeberg 1976 no. 3305). Herner's attempts to use this technique resulted in obvious mistakes, but a professional craftsman was able to copy the design with 'a minimum of effort' (Herner 1987:144). However, Rønne's experiments demonstrated that ornamentation could also be cast (Rønne 1991; Rønne & Bredsdorff 2011). Helle Vandkilde argues that cast ornamentation on flanged axes was present in the Late Neolithic II (Vandkilde 1996:263). Convincing arguments have also been presented in favour of the idea that the ornamentation on three of the bronze scimitars dated to Period IB (Fig. 2) was cast (Jensen 2002:74). My point here is that achieving a high quality result in regard to decoration is easier (i.e. requires less physical expertise/know-how) when it is cast.

While some of the processes involved in making the metal objects from the late Neolithic and Period IA of the Bronze Age required manual dexterity (know-how), in general the level of technology in evidence did not require special skills or expertise. By Period IB we see some objects requiring intensified know-how, however. If we accept this scenario then we find a not insignificant difference between flintknapping and bronzecasting. I have argued elsewhere (Olausson in press) that even the most highly crafted flint daggers were not made by professional specialists but rather by especially talented individuals with the time and the inclination to polish their skills. However, we know from studies of modern knappers that reaching this level of know-how requires practice over many years. Data on the degree of know-how required for casting the Late Neoltihic and Period IA objects are scarce, but I believe they indicate that the level of expertise required could have been attainable by practically everyone. This is not true from Period IB, however (see below). Next we will explore what information can be gleaned from the products themselves.

Evidence for differences in expertise on objects of flint and metal

It is not far-fetched to argue that the amount of skill or expertise held by the crafter may be visible in the products, although there are practical considerations which may hamper our efforts to study this. Flintknapping is a subtractive technique; once the flake is removed it cannot be replaced and knapping mistakes have a good chance of being preserved in the archaeological record. An example of this approach can be found in Olausson (2008). Here I set up criteria for classifying Scandinavian flint daggers in regard to how skillfully they were made and applied these in an examination of *c.* 500 flint daggers belonging to types I-VI. I found substantial variations within each type, from daggers made with low skill to daggers made with a high degree of skill. I argued that the most reasonable explanation for these differences is the different levels of knapping ability among the knappers (Olausson 2008).

Studying the quality of workmanship on metal objects is fraught with source-critical pitfalls, however. The most serious of these is the fact that, due to remelting, casting mistakes will not necessarily be preserved for the archaeologist to observe. Faulty casting has a theoretical chance to turn up in a founder's hoard but we lack such hoards from the period in question. Therefore, it is possible that any evidence for unskilled work, if it existed, is not preserved. Nevertheless, I have made a modest attempt.

A team consisting of archaeologist Andreas Nilsson, conservators Bernd Gerlach and Lovisa Dal, and myself examined 37 metal copper/bronze artefacts dating to Late Neolithic I, Late Neolithic II, Bronze Age IA and Bronze Age IB from the collections of the Historical Museum in Lund (Table 2). The objects belong to types which Vandkilde (1996) identifies as domestically cast and all were found in southern Sweden. We noted features such as symmetry, complexity of form, and surface regularity. We examined holes in the metal in order to determine if they were due to casting mistakes (blistering) (Bridgford 2002:125; cf. Nilsson 2008) and recorded observations regarding grinding, hammering or damage.

We observed no major differences during any of the four periods regarding the quality of workmanship. We saw little evidence for clumsy workmanship or beginner's work. The differences between what we judged to be the poorest and the best workmanship were slight. Furthermore, there did not seem to be any obvious chronological development; both poorly-made and well-made objects were present from the early Late Neolithic and continued to be present during Bronze Age Period IA and IB (cf. Bridgford 2002:128), although the appearance of Bagterp and Valsømagle Points in Period IB, as they possess both sockets and thin blades, does represent a step up in complexity at this time.

One unexpected result of this study was the discovery of two flanged axes which appear to have been cast in the same mould or from the same prototype (Fig. 1a-d). Both axes were turned in as stray finds; axe LUHM 6485 is listed as coming from a mound while LUHM 6540 lacks further contextual data.

Conclusions

During the early Neolithic, members of the Funnel Necked Beaker Culture were circulating copper flat axes in Northern Europe. There is even evidence that such axes were being cast here (Klassen 2000:308; Magnusson Staaf 2001:23). However, this activity did not give rise to a metal age. One thousand years later, metallurgy was reintroduced to Scandinavia (Klassen 2000:310). This time the idea caught on and stayed for good, eventually resulting in an age of bronze.

During the period between 2350 and 1500 BC people were knapping flint and casting objects of copper and then bronze in southern Scandinavia. As would be expected of a new technology, domestic casting begins somewhat cautiously. Smiths were making only flat axes in Late Neolithic I, progressing to somewhat more complicated low-flanged axes by Late Neolithic II. Vandkilde (2000:16-17) notes that the earliest flanged axes lacked standardization regarding technological qualities and forms. As time passes and we enter Bronze Age Period IA, we find an increase in variation of forms produced but the number of forms in domestic production is still quite limited. However, this development is accompanied by greater homogeneity in metal content (Melheim 2012:112; Vandkilde 1992:121), suggesting increased knowledge. As we move into Bronze Age Period IB we find a significant increase in the number of product types, with the addition of for instance several types of points requiring high casting know-how. Vandkilde (2000:27) remarks that the amount of metal in circulation increases markedly at this time. She also notes that flanged axes differentiate into two groups at this stage: a larger group containing small, inconspicuous axes which are

Table 2 Metal objects examined to determine workmanship. Types are classified according to Vandkilde 1996. Tin percentages are taken from Cullberg 1968. n.d. = no data available. LUHM = Lund University Historical Museum. LN I = Late Neolithic I, LN II = Late Neolithic II, BA IA = Bronze Age Period IA, BA IB = Bronze Age Period IB.

Date	***Type***	***% Sn***	***Parish***	***Findspot***	***LUHM Number***	***Observations***
LN I	5	0.2	Lilla Bedinge	Lilla Bedinge, bog	5130	Surface appearance may be due to heating prior to breaking
LN I	5	trace	Tygelsjö	Tygelsjö, east of church	12597	Good workmanship
LN I	5	trace	Borgeby		12634	Heavily damaged
LN I	8	n.d.	Vellinge	Vellinge nr 22 + 30	27860	Average workmanship
LN II	A2	0.6	Hörby		3507	Slight edge damage
LN II	A2	7.4	Simris	Simris village	6485	Fault near edge on one face; slightly twisted; heavily used
LN II	A5	8.5	Simris	Simris village	6540	Some potlidding
LN II	A1	trace	Vallby	Vallby	11051	Asymmetric; heavily corroded
LN II	A1	2.3	Ringsjö	near Ringsjön	12390	Poor workmanship
LN II	A1	trace	Malmö	Oxie, Fredriksberg	19336	Asymmetric edge; heavily corroded
LN II	A1	0.1	Kvistofta	Gantofta	20024	Evenly spaced nicks on flange; result of metal testing?
LN II	A1	10	Lilla Bedinge	LillaBedinge nr 2, Ängarna	28676:34	Edge is poorly cast
LN II	A2	trace	Löderup	Löderup village	12581	Surface appearance may be due to heating prior to breaking
LN II	A2	trace	Gislöv	Gislöv	18560	Symmetric edge; heavily corroded
LN II	A2	trace	Lilla Bedinge	Lilla Bedinge nr 1	20937	Asymmetric edge, potlidding
LN II	A2	9.1	Hammarlöv		25038	Good workmanship
LN II	A5	8.2	Malmö	Bunkeflo Vintrie nr 1	25775	Uneven flanges; heavily corroded
LN II	A5	10	Köpinge	Gärds Köpinge	28117	Good workmanship but asymmetric edge
LN II	A6	1.2	Burlöv	Arlöv	28678	Good workmanship
BA IA	Torsted point	n.d.	Södra Vram	Bökeberg	20548	Good workmanship except for 1 hole
BA IA	B2	7.6	Svedala	Marktflecken	22245	Left and right flanges do not resemble each other
BA IA	B2	10	Skytt		4410	Good workmanship but some potlidding
BA IB	Bagterp point	n.d.	Vallby		11112	Good casting quality, decoration clumsily done
BA IB	Bagterp point	n.d.	Lund	east	12718	One shoulder imperfectly cast
BA IB	Valsömagle point	n.d.	Helsingborg	Raus	16129	Good workmanship; corroded
BA IB	Valsömagle point	n.d.	Burlöv	Stora Bernstorp	27042:25	Good workmanship; but 5 pinholes are evident
BA IB	C3	3.8	Stora Råby		2818	Good workmanship
BA IB	C3	10	Sankt Ibb	Ven	2825	Good workmanship but some edge asymmetry
BA IB	C3	9.3	Simrishamn		8662	Rough and uneven surface; heavily used
BA IB	C3	9.1	Vittskövle	Vittskövle	10504	Good workmanship; heavily used
BA IB	C3	8.7	Hemmesdynge	Villen	17146	Poor workmanship
BA IB	C3	10	Kävlinge		19594	Some potlidding; heavily used
BA IB	C3	6.1	Ivetofta	Grödby	25600	Good workmanship, heavily used
BA IB	C3	7.7	Sankt Olof	Älmhult	27536	Asymmetric edge, potlidding
BA IB	C3	10	Södra Åby	Elleberga	27983	Good workmanship; heavily used
BA IB	C5	5.6	Högestad		12635	Good workmanship
BA IB	C5	n.d.	Lund	Sandby	28495	Surface appearance may be due to heating prior to breaking

coarse and often show damage from use, and a less numerous group of long, slender, delicately built axes. Domestic Period IB metalwork includes unique objects which have neither antecedents nor successors, such as the bronze scimitars, of which six are known (Vandkilde 1996:243). Given their size and complexity, I would suggest that the scimitars required a higher level of technical know-how than we have seen previously. Two of the scimitars (Fig. 2) were deposited together, and morphological similarities among four of them have led many to conclude that they were made from the same prototype (Forssander 1935:44; Mathiassen 1957:43; Vandkilde 1996:232). Kristian Kristiansen (1987:33) writes that here, at the threshold to Period II, we see an explosive development of local metallurgy in southern Scandinavia which embraces a complicated technology including modelling, casting, hammering, engraving, fitting gold and amber, etc.

During a time when some people were exploring the potentials and limitations of the new medium metal, others were pushing flintknapping to its limits. The Favrskov flint scimitar (Fig. 3) and the short dagger of flint from Næsbjerg, both dated to Bronze Age Period IB (Lomborg 1973:70f.; Vandkilde 1996:231f.), are objects of knapping *tour de force*. However, as far as we know they are unique. I maintain that the knapper who made them was not producing to meet market demand. Rather, they are the products of an especially skilled individual demonstrating his/her prowess or perhaps just pushing the limits because he/she can.[3] They mark the flintknappers' swan song as no comparable elaborate flint objects are known after this period.

By Bronze Age Period IB we have reached a bifurcation point in the bronze casting craft. Some individuals have fully mastered the craft and innovations and complex casting, as seen for example in domestically cast swords, are in evidence (Artursson et al. 2005: 504; cf. Rasmussen & Boas 2006). At the same time simpler casting for household needs continues. Artursson et al. (2005:511) maintain that by Period IB the amount of bronze in circulation had reached a point at which it could be harnessed for building social stratification. Kristiansen (1981) advocated that the 'fully developed Bronze Age' begins in Period II. He also suggested that bronze specialists had emerged by then (1987:46). Jørgen Jensen goes so far as to say that within a few hundred years after 1700 BC the bronze crafting in southern Scandinavia was of such high quality that it was among the best on the European continent (Jensen 2002:69).

Were the flintknapper and the bronzesmith the same individual? My position is that all members of the Stone Age community were flintknappers, although, as is true of any activity requiring bodily action, some were better than others. Because of interest, perhaps combined with native talent, some knappers explored the limits by making exceptional objects. But these artefacts occur in limited numbers and their makers were not specialists. In the same way as we find well-made and poorly-made flint daggers, we find well-made and poorly-made flanged axes. Characterized as it is by lack of uniformity of forms and raw materials, the early domestic metal casting was not in the hands of a few specialists with exclusive knowledge and/or know-how.[4] Melhiem points to the rapid spread of metallurgy in the late Neolithic to support the idea that metallurgical knowledge was not esoteric, at least in the beginning (Melheim 2012:18). Towards the end of Bronze Age Period I, however, we see a bifurcation whereby craft specialists capable of mastering an increasingly complex technology are emerging. Apparently this development continued, for certainly by the late Bronze Age we see clear indications for specialized workshop locations, such as Södra Kristineberg (Högberg et al. 2011), on the one hand, and small-scale casting to fill household needs (e.g. Nilsson 2008), on the other.

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References

APEL, J., 2001. *Daggers Knowledge and Power.* Uppsala: Uppsala Universitet (Acta Universitatis Uppsaliensis/Coast to coast project 3).

ARTURSSON, M., P. KARSTEN and B. STRÖMBERG, 2005. Aspekter på samhällsutveckling. In P. Lagerås and B. Strömberg (eds.), *Bronsåldersbygd 2300-500 f.Kr.*: 496-547. Lund: Riksantikvarieämbetet.

BODIN, S., 1998. *Bronshantverkets olika ansikten.* CD thesis, Lund: Department of Archaeology and Ancient History, University of Lund.

BRIDGEFORD, S.D., 2002. Bronze and the First Arms Race – Cause, Effect or Coincidence? In B.S. Ottoway and E. Wager (eds.), *Metals and Society*: 123-132. Oxford: Archaeopress (British Archaeological Reports International Series 1061).

BUCHWALD, V.G. and P. LEISNER, 1992. A Metallurgical Study of 12 Prehistoric Bronze Objects from Denmark. *Journal of Danish Archaeology* 9:64-102.

CULLBERG, C., 1968. *On Artifact Analysis.* Lund: GWK Gleerups Förlag.

FORSSANDER, J.E., 1935. Bronsålderns krumsvärd. *Meddelanden från Lunds universitets historiska museum* 1935:33-58.

HERNER, E., 1987. *Profession med tradition.* Stockholm: Almqvist & Wiksell International.

HÖGBERG, A. and D.OLAUSSON, 2007. *Scandinavian Flint – An Archaeological Perspective.* Aarhus: Aarhus University Press.

HÖGBERG, A., L. GRANDIN and A. BRUSLING, 2011. Brons, guld, silver och koppar – yngre bronsålderns metallhantverk vid Kristineberg. In A. Högberg (ed.), *Södra Kristineberg – hantverk i fokus*:19-82. Malmö: Sydsvensk Arkeologi AB.

JENSEN, J., 2002. *Danmarks Oldtid. Bronzealder 2000-500 f.Kr.* Copenhagen: Gyldendal.

KLASSEN, L., 2000. *Frühes Kupfer im Norden.* Højbjerg: Jutland Archaeological Society.

KRISTIANSEN, K., 1981. Economic Models for Bronze Age Scandinavia. In A. Sheridan and G. Bailey (eds.), *Economic Archaeology*: 239-303. Oxford: Archeopress (British Archaeological Reports International Series 96).

KRISTIANSEN, K., 1987. From stone to bronze: the evolution of social complexity in northern Europe, 2300 – 1200 B.C. In E.M. Brumfiel and T.K. Earle (eds.), *Specialization, exchange, and complex societies:*30-51. Cambridge: Cambridge University Press.

LEVY, J., 1991. Metalworking technology and craft specialization in Bronze Age Denmark. *Archeomaterials* 5(1):55-74.

LIVERSAGE, D., 2000. *Interpreting Impurity Patterns in Ancient Bronze: Denmark.* Copenhagen: Det Kongelige Nordiske Oldskriftselskab.

LIVERSAGE, D. and M. LIVERSAGE, 1989. A Method for the Study of the Composition of Early Copper and Bronze Artifacts. An Example from Denmark. *Helinium* 28(1):42-76.

[3] Walter Osika, MD specializing in psychiatry, notes that practice and refinement are fundamental to art and crafts. He suggests that our brains lead us to repeat actions in order to improve. This drive to get progressively better at something provided an evolutionary advantage (Nasr 2012:B12).

[4] Vandkilde (1996) provides distribution maps showing the find locations for metal objects from LN I, LN II, Bronze Age Period IA and Bronze Age Period IB in Denmark. With the exception of western Jutland the finds are fairly evenly distributed over the landscape. No workshops or production centres are in evidence. I carried out a similar analysis for the finds from the province of Scania in southern Sweden and found that here too the products are evenly distributed in space.

LOMBORG, E., 1973. *Die Flintdolche Dänemarks*. Copenhagen: Det Kongelige Nordiske Oldskriftselskab.

MAGNUSSON STAAF, B., 2001. Early Metallurgy in Scandinavia: Continuity or discontinuity? *Lund Archaeological Review* 7:19-28.

MAGNUSSON STAAF, B., 2002. Changes of Use: Transformations of Comprehension. In B. S. Ottoway and E. Wager (eds.), *Metals and Society*: 133-144. Oxford: Archeopress (British Archaeological Reports International Series 1061).

MATHIASSEN, T., 1957. Endnu et krumsværd. *Aarbøger for nordisk Oldkyndighed och Historie* 1957:38-55.

MELHEIM, A.L., 2012. *Recycling Ideas: Bronze Age Metal Production in Southern Norway.* Oslo: Department of Archaeology, University of Oslo.

NASR, N., 2012. Ett finger med i spelet. *Sydsvenska Dagbladet Snällposten* 10 mars 2012: B12-B15.

NILSSON, A., 2008. *Gjutfel och dålig ornamentik.* CD thesis, Department of Archaeology and Ancient History, University of Lund.

OLAUSSON, D., 2008. Does Practice Make Perfect? Craft Expertise as a Factor in Aggrandizer Strategies. *Journal of Archaeological Method and Theory* 15(1):28-50.

OLAUSSON, D., 2012. Making Daggers and Scouting for Talents: Situated Learning in Late Neolithic Scandinavia. In N. Johanssen, M. Jessen and H. Juel Jensen (eds.), *Excavating the Mind: Cross-sections through culture, cognition and materiality*: 211-232. Aarhus: Aarhus University Press.

OLAUSSON, D., (In press) Knapping skill and the question of craft specialization in Late Neolithic southern Scandinavia. In *Crafts and People* forthcoming.

OLDEBERG, A., 1938. En värmländsk gjutform från äldre bronsålder. *Fornvännen* 1938:309-310.

OLDEBERG, A., 1943. *Metallteknik under förhistorisk tid.* Leipzig: Kommissionsverlag Otto Harrossowitz.

OLDEBERG, A., 1976. *Die ältere Metallzeit in Schweden I.* Stockholm: Kungl. Vitterhets Historie och Antikvitets Akademien.

OTTOWAY, B.S., 2001. Innovation, production and specialization in early prehistoric copper metallurgy. *European Journal of Archaeology* 4(1):87-112.

PELEGRIN, J., 1990. Prehistoric Lithic Technology: Some Aspects of Research. *Archaeological Review from Cambridge* 9(1):116-125.

PETTERSSON, P.E., 2011. *En hållbar utveckling? – Hållbarheten för bronsålderns keramiska deglar.* Masters thesis, Department of Archaeology and Ancient History, University of Lund.

RASMUSSEN, L.W. and N.A. BOAS, 2006. The Dystrup swords: A hoard with eight swords from the Early Bronze Age. *Journal of Danish Archaeology* 14:87-108.

ROBERTS, B., 2008. Creating traditions and shaping technologies: understanding the earliest metal objects and metal production in Western Europe. *World Archaeology* 40(3):354-372.

RØNNE, P., 1986. Fattigmands svärd. *Skalk* 6:13-15.

RØNNE, P., 1989. Fund af ældre bronzealders keramik og smedeverktøj fra Ordrup i Nordvestsjælland. *Aarbøger for nordisk Oldkyndighed og Historie* 1989: 99-114.

RØNNE, P., 1991. Forsøgsarkæologi og bronzealderens ornamentik. *Eksperimentel Arkæologi:*31-49. Lejre: Historisk-Arkæologisk Forsøgscenter.

RØNNE, P., 1993. Problemer omkring bronzealderens metalhåndværkare. In L. Forsberg and T. B. Larsson (eds.), *Ekonomi och näringsformer i nordisk bronsålder*: 71-92. Umeå: Arkeologiska Institutionen.

RØNNE, P. and T.H. BREDSDORFF, 2011. Cire perdue støbning i bronzealderen. Hvordan laver man en voksmodel? *Aarbøger for nordisk Oldkyndighed og Historie* 2008:59-76.

STILBORG, O., n.d. Why are bronze age casting moulds made differently? Unpublished manuscript.

TIMBERLAKE, S., 2007. The use of experimental archaeology/ archaeometallurgy for the understanding and reconstruction of Early Bronze Age mining and smelting technologies. In S. La Niece, D. Hook and P. Craddock (eds.), *Metals and Mines*: 27-36. London: Archetype Pulications Ltd.

TIMBERLAKE, S., 2009. Copper mining and metal production at the beginning of the British Bronze Age. In P. Clark (ed.), *Bronze Age Connections. Cultural Contact in Prehistoric Europe*: 94-121. Oxford: Oxbow Books.

VANDKILDE, H., 1992. Metal Analyses of the Skeldal Hoard and Aspects of Early Danish Metal Use. *Journal of Danish Archaeology* 9(1990):114-132.

VANDKILDE, H., 1996. *From Stone to Bronze. The Metalwork of the Late Neolithic and Earliest Bronze Age in Denmark.* Højbjerg: Jutland Archaeological Society.

VANDKILDE, H., 2000. Material Culture and Scandinavian Archaeology: A Review of the Concepts of Form, Function, and Context. In D. Olausson and H. Vandkilde (eds.), *Form, Function and Context:* 3-49. Stockholm: Almqvist & Wiksell International.

WEILER, E., 1994. *Innovationsmiljöer i bronsålderns samhälle och idévärld.* Umeå: Arkeologiska Institutionen.