Smith and death – cremations in furnaces in Bronze and Iron Age Scandinavia

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Introduction

Mircea Eliade discusses different smiths and their «Human sacrifices to the furnace» in his classical work *The Forge and the Crucible* (1962). Among others, Eliade refers to a group of traditional blacksmiths in central India and the myth where the god Sing-bonga sacrificed himself in the furnace. In another telling of this myth the divinities sacrificed the smiths since they had been intimidating and annoying the gods (Eliade 1962: 65-66). Eliade emphasises the necessity of performing sacrifice to the furnace, and that the myths relating to human sacrifice may underline the demoniac character of metallurgy. In Africa, for instance, miscarriages and abortions have been offered as a part of initiating the smithy, and this represents an intermediary form between the actual or the symbolic human sacrifice (Eliade 1962: 68). There is currently no evidence in Africa for proper use of human bodies in the smithy, but among the Achewa and Agoni tribes of the Dowa District in today's Malawi, a miscarriage had to take place before a furnace could be made. A medicine man instructed a small boy to throw a maize cob inserted with medicines at a pregnant woman, which caused her to have a miscarriage. The abortion was buried in a refuse heap, but during the night the medicine man dug it up, mixed it with medicine, and burnt it in the whole in the ground. The furnace was then built above the whole and thus keeping the abortion within it (Hodgson 1933: 163).

We think that Mircea Eliade was right when he emphasised the furnace as a sacrificial place of human beings, but we also think he missed three crucial aspects when he stressed the mythological origins of these sacrifices rather than why dead humans might be necessary in the smelting process. Following Lotte Hedeager's influential and thought-provoking research on the relation between technology and cosmology, and her interpretations of the meaning

of the Scandinavian animal style (e.g. Hedeager 1999, 2003, 2004a, 2004b), we will emphasise the intricate relation between smith and death.

Firstly, were humans sacrificed and burnt in the furnace in prehistoric times, and if this was done, how should we interpret it?

Secondly, we also believe that these sacrifices had a practical side, technology always embodies ideological fields of knowledge, and therefore, most ideology embodies technology. Regardless of whether the sacrifice was an animal or a human, it increases the temperature in the furnace when the fat tissues combust stressing that technology is linked to ideology in a very clear way.

Finally, we will argue that the furnace could be used for a variety of purposes transcending metal production such as smelting bronze or iron, for instance used for cremations, or more precisely; these technological processes were interwoven parts of cosmological processes.

Cremation is a ritual practice that could have taken place in the furnace, which smelts the role of smith and cremator into a transformer. The smith was not only a «smith» – as the master of fire he controlled and mastered several domains and mediated between various realms – between humans and gods, life and death (Goldhahn & Østigård 2007). The smith was truly «in between and betwixt» (Turner 1967), dangerous but necessary in society and cosmos.

Our aim with this article is to analyse the relation between smelting and cremation in order to gain more insights into the relationship between technology and cosmology. Thus, we will:

1) Emphasise temperature in cremations and that cremation as a practice is a difficult, technological process, which may necessitate ritual specialists in form of «cremators»;
2) Present and analyse empirical contexts where cremated bones have been found in furnaces from the Bronze and Iron Age Scandinavia;
3) Discuss the relation between technology and cosmology, and based on archaeological material put forward hypotheses regarding why the smith and the cremator belonged to the very same social and/or religious institution, where the smithy united and smelted together these different realms, and;
4) Focus on what cremated bones have been used to since in general only 10-20 percent of the deceased's cremated bones are buried in features or structures what we as archaeologist call «graves».

Temperature and cremation

Excavation reports where it is written, «that only some fragments of burnt human bones were found», conceal the fact that cremation is a highly complicated process (e.g. Kaliff 1997; Williams 2004). It is often assumed that crema-

tion is just a pile of stocks where upon the corpse is laid and that it burns more or less by itself. This is wrong because without properly building the pyre, the body will not combust and consequently the flesh will not burn. Improper, half burnt or charcoaled bodies are in most cultures and religions seen as highly inauspicious, and indeed, a ritual failure which may send the deceased to the lower (and/or torturing) realms (Oestigaard 2000a, 2005). Thus, cremation is a difficult technological process that embodies ideological meanings. In order to master the fire, one has not only to control the temperature, but one has to increase it and keep it steady for a certain period of time.

Different temperatures have most likely been applied as means of preparing the dead as sacrificial items for the gods – the dead could have been «cooked», «stewed», «boiled», «toasted», «roasted» and even «burnt» – and offered as meals to the gods (Oestigaard 2000b). A common thread for these modes of preparation is that they are all conducted at relatively low temperatures.

In modern cremations in Scandinavia, the oven is pre-heated to 700 degrees Celsius before the coffin with the corpse is inserted (fig. 1). The coffin starts to burn within 15 seconds and thereafter the body combusts due to the heat. If the temperature is lower than 700 degrees Celsius, the body will not ignite by itself. In the due course of the cremation, which lasts around two hours, the temperature may increase to about 1000 degrees Celsius. The ovens are controlled by cremators who adjust the temperature so it is neither too high nor too low (Ottesen 2006). The temperature seldom exceeds over 1000 degrees Celsius. One peculiar thing in this regard is the fact that some prehistoric cremations in Scandinavia seem to have been conducted at *higher* temperatures than in modern cremations, which is a point we will stress.

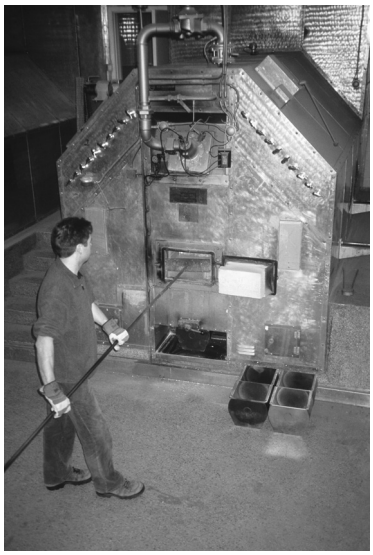

Fig. 1. Møllendal Crematorium, Bergen, Norway. Photo: Terje Oestigaard.

Per Holck has studied prehistoric burnt human bones from eastern and southern Norway, dated to Bronze and Iron Age. In his PhD, *Cremated Bones* (1987), he classified the burnt material into five different groups or grades of cremation or burning, corresponding to different temperatures (Holck 1987: 131-146):

Grade 0: Apparently unburnt. Although the bones have been on the pyre, they are so slightly affected by heat that they show no signs of being burnt. The temperature has probably not reached more than *200 degrees Celsius*.

Grade 1: Smoothing. Very slight, imperfect cremation due to lack of oxygen. Smoothing is more dependent on oxygen than on temperature, and therefore it is reasonable to assume that temperatures hardly exceeded *400 degrees Celsius* since changes in the bone substances occur at these temperatures.

Grade 2: Slight burning. The bones are clearly burnt but have retained a pale colour. Cremations at grade 2 have reached a maximum temperature of approximately *700-800 degrees Celsius*.

Grade 3: Moderate burning. The appearance of the bones is about the same as in the previous group or somewhat paler in colour. These bones have been exposed to temperatures of *1000-1100 degrees Celsius.*

Grade 4: Hard burning. The bones are almost white and have porous, chalk-like consistency. Bones of grade 4 have been exposed to temperatures probably between *1200-1300 degrees Celsius.*

Of 1082 finds examined, the percents regarding cremations at extremely high temperatures are striking (Holck 1987:146-149):

Grade 0: 6,5 %
Grade 1: 11,9%
Grade 2: 28 %
Grade 3: 73,5 %
Grade 4: 37,5 %

Since several of these grades of burning can exist simultaneously in one single find, for instance a bone can show traces of being burnt at both grade 2 and 3, the total percent is over 100. In this case, the total percent is 157,4 percent. The most intriguing thing with Holck's analysis is the high percentage of humans being cremated at grade 3 and 4, which indicate that almost 2/3 of all the burnt human remains have been exposed to temperatures which exceed modern crematoriums. Grade 3 equals temperatures up to 1000-1100 degrees Celsius, which is the upper limit in contemporary ovens in crematoriums. Grade 4,

however, which equals temperatures up to 1200-1300 degrees Celsius, exceeds far beyond modern crematoriums.

This gets even more intriguing, for temperatures up to 1200-1300 degrees Celsius are impossible to reach on a normal pyre. Although the temperature in parts of the flames reaches such high temperatures during a cremation, when the flesh burns, the bones themselves will not be exposed to these high temperatures. As indicated, the flesh self-combusts at around 700 degrees Celsius, but the open air will hinder the temperature from reaching much higher because the air will cool the pyre at the same time as it nourishes the flames. Hence, the majority of the cremations have been exposed to temperatures which are impossible to reach with open fire or on out-door pyres (e.g. Gräslund 1978; Holck 1987: 131-146; Sigvallius 1994: 15-32, cp. Williams 2004: 269-277).

To reach the high temperature that Holck documented could only be possible in some kind of oven-constructions, and although one can image that there have been separate prehistoric «crematoriums», the most obvious place where these temperatures could be reached and mastered is in the smithy. The smith was accustomed to controlling and mastering the fire, and as will be argued later, sacrifices of humans and animals may have been necessary to achieve such high temperatures. But are there any empirical evidence of cremations in furnaces, and if so, why would humans be cremated in the forge?

Cremations in furnaces – some Scandinavian case studies

Apart from the analyses of the human bones themselves, which clearly indicate that the bones have been exposed to temperatures higher than what is possible to achieve at open fire, there is also archaeological evidence from both Bronze and Iron Age where human bones have been found in what is interpreted as furnaces. There are, however, some methodological problems with such interpretations. Firstly, since the idea of the furnace as a crematorium has not been stressed, the excavators have often documented such constellations as one or the other, thus excluding the possibility that it could be both. Hence, based on the primary documentation one has to interpret the excavation reports sometimes in a different way than what the excavator did. This is not only a problem in Scandinavia, or as we wish to label it – a possibility; traces of metalwork and cremation are on and off found in other parts of Europe as well (e.g. Stewart 1985; Gibson 1994: 136), but this phenomena is usually interpreted as finds from different time horizons (cp. Bradley 2000: 157). Secondly, knowledge of the furnaces/ovens, particularly in the Bronze Age, is limited, and one must assume that there have been a variety of forges and methods, particularly because, as we will argue, the «smith» was not only a smith in our common understanding of the profession, but he had many different tasks structured around the fire

and the furnace. Thirdly, our case studies are from Sweden whereas the bone analysis with regards to temperature is from Norway (Holck 1987).

The last issue raises some problems. Unfortunately, there has not been a similar analysis of cremated bones found in Sweden, and we have not found Norwegian contexts where cremated bones are found in the smithy. This is most likely caused by the above mentioned excavation practices, because as indicated, the temperature analysis indicates that cremation in furnaces was a common practice. Despite the lack of coherent data from both Sweden and Norway, we think it is possible and legitimate to interpret the Swedish data from the Norwegian data, and vice versa, bearing in mind that contemporary nation states are not prehistoric realities.

From a Scandinavian perspective, there are clear archaeological indications that bronze and ceramic production have taken place at the same place where cremations have been conducted (Goldhahn 2007: Chap 2, 7, 9). One of these places is Stum in Halland, Sweden; an urn-grave that was excavated back in 1993 (Ängby 1998: 30-31). The «grave» was found in a ca. 10 m circular, dark layer containing some stones that, although disturbed in recent times, indicate that there has been a superstructure of stones covering the layer where fragmented pots, flint tools/objects, non-identified burnt bones and three fragments of moulds were found. It was in this layer the «grave» was buried. The «grave» was a 0,6 x 0,85 m wide pit where 285 grams burnt bone of an adult was found in an urn (fig. 2). The dark layer may indicate that this was the cremation site (see Artelius 1998: 38-42, Arcini 2005). The presence of fragments of moulds for metal production, stone artefacts and ceramics may suggest that these «handcrafts» were conducted paralleled with the cremation ceremony (Goldhahn 2007: Chap 7, 9).

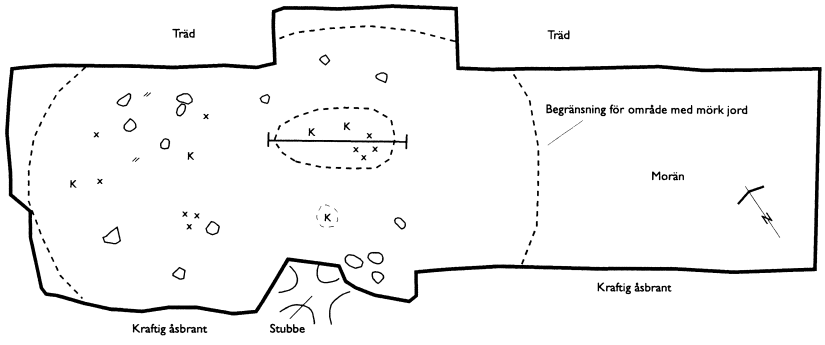

Fig. 2. Plan over the grave from Stum (after Ängby 1998). K = ceramics; x = moulds. ' = charcoal. Scale 1:50.

Another example from Halland in Sweden is Hjälm in Fjärås where a settlement site and cemetery were excavated in 1973-74 (Jonsäter 1979). The

artefacts give evidence to particularly intriguing practices since most of the material from the «settlement» was found underneath two «burial constructions» at the cemetery. The finds consisted of among other things 1800 pottery sherds, 54 fragments of moulds where three of them were found in «graves», burnt bones and burnt clay, fragments of bronze and flint objects, quartz, hearths and charcoal (Jonsäter 1979: 18-22). 90 percent of all the finds were found underneath these two constructions that have been interpreted as «graves» on top of a «settlement» (fig. 4). On the other hand, it seems more plausible that we have a situation where the smith has made bronze and ceramics at the spot where cremations have taken place. In one of these constructions – an 8 x 10 x 0,5 meter mound/layer of stones – a deposition of bones as well as an urn-grave was found (Jonsäter 1979: 42-48). Beneath these stones, several concentrations of burnt bones were found in relation to both bronze artefacts and ceramics (fig. 3). Beneath the stones, there also was found a pit containing slag (Jonsäter 1979: 44-45), indicating that some form of metal production has taken place at this spot.

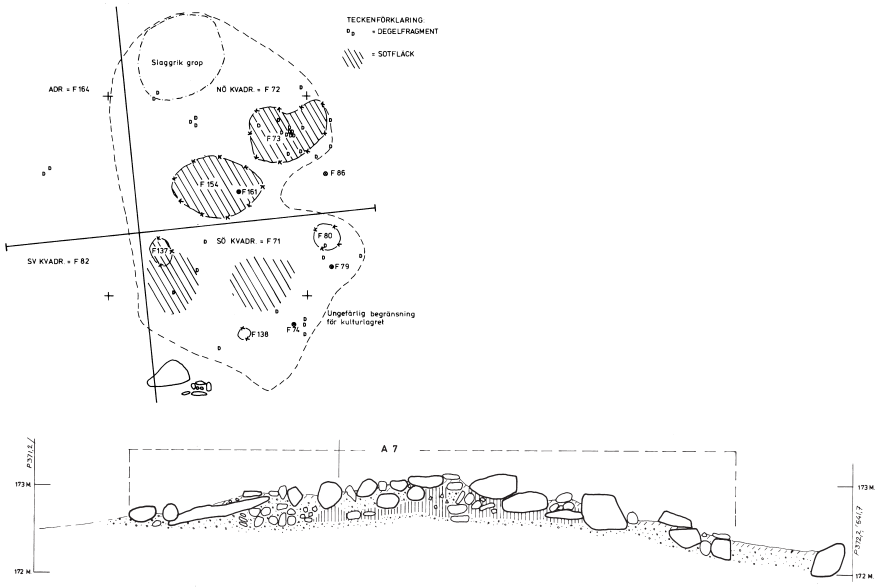

Fig. 3. Feature 7 from Hjälm at Fjärås, that has been interpret as a grave structure. D = moulds; K = ceramics; Lined areas = hearth (after Jonsäter 1979).

Under the stone construction there was a 5,5 x 9,5 meter dark layer, and at the bottom of this layer four, large charcoal patches were found varying in size from 1,3-2,2 m in diameter with the depth of 20 cm. One of these patches contained ca. 2 kg ceramics, 1 fragment of bronze, 2 complete moulds and 21 fragments of other moulds together with burnt clay and burnt bones (fig. 4). In another of these patches 0,6 kg ceramics were found together

with burnt bones and charcoal (Jonsäter 1979: 44-45), and this combination of metal production, ceramics and burnt bones was found at other places on this site as well (Jonsäter 1979: 50). Hence, there has been a close relation between cremation (death), bronze smelting and production of ceramics. In the Bronze Age, the «smith» was not only engaged in making bronze – the smith's knowledge of fire made him into a mediator between different realms with the furnace as the focal point. The smith was a cosmologist and a ritual specialist (Goldhahn 2007).

This pattern is even more visible at Hallunda in Botkyrka, Södermanland, Sweden. In 1969-1971, Hallunda was the first Bronze Age site in Sweden where large areas were stripped off, with the result that houses, hearths, furnaces, and graves were found (Jaanusson & Wahlne 1975a, Jaanusson & Wahlne 1975b; Jaanusson et al. 1978; Thedéen 2004). Hallunda is most famous for its large and highly varied production of ceramics (Jaanusson 1981, 1983) whereas the production of bronze has not gained a similar interest (see Wahlne 1989). Nevertheless, it is the combination of, and the relation between, the different handcrafts that should draw our attention (see Sofaer 2006 for a fruitful discussion).

Fig. 4. Some of the finds from Feature 7, moulds and crucibles (after Goldhahn 2007).

Hallunda is among the largest metal workshops that have ever been found from the Late Bronze Age in Scandinavia. More than a dozen ovens were found together with more than ten hearths and five stone pits. Half of the ovens where found within a house construction, which is usually interpreted as a «cult house» (Goldhahn 2007: Chap 9) and traditionally associated with burial rituals (Victor 2002). Around this «workshop» there was found some 30 constructions that have been interpreted as «graves». All graves contained cremated bones of humans and/or animals, and no less than one third of these contained remains of bronze production similar to the finds from the workshop. Within this cult house, 6 ovens were found and 6 more

outside (fig. 5). They were of different size and form, but have undoubtedly been used in bronze production, indicated by the large number of finds of moulds, crucibles, various tools for casting (Jaanusson & Wahlne 1975a: 15-95, see Indreko 1956; Janzon 1984, 1988; Tyrecote 1987: 56-61; Stenvik 1988; Craddock 1995: 37-46), and – cremated bones! Analyses of the various moulds show that swords, arrowheads, axes and rings, among other artefacts, have been produced at Hallunda. Based on 14C-analyses from two of the furnaces, the ovens A 40 and 46, which have respectively been dated to 2579±100 BP and 2735±115 BP (Jaanusson & Wahlne 1975b: 100-101), which give a calibrated dating between 840-520 and 1050-790 BC.

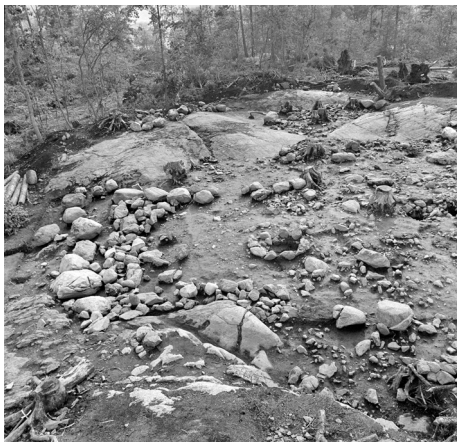

Fig. 5a. The eastern part of the stone built cult-house interpreted as a "workshop" at Hallunda. N. B. the furnaces and hearths (after Wahlne 1989).

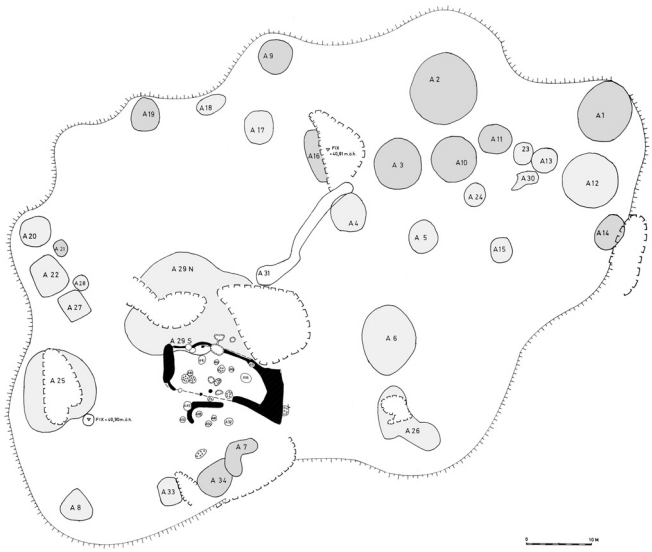

Fig. 5b. The bronze smiths 'workshop' (black) with the surrounding burials (grey) at Hallunda; those show how traces of finds associated with the furnace are marked with dark grey (reworked after Jaanusson & Wahlne 1975b).

Burnt, cremated bones were found in most of the furnaces at Hallunda, but these were never analysed (Lahtiperä 1988). Despite the lack of osteological analyses from these furnaces, we will argue that the cremated bones from the workshop should be seen in relation to the other cremation graves at the site. As already mentioned, about 33 percent of the constructions which have been interpreted as «graves» also show clear traces of metal production, so there is a close connection and association between the bronze smith and death rituals. Not least on a structural and symbolic level (Goldhahn 2007).

From Iron Age Scandinavia, there are at least three contexts in Sweden where burnt, human remains have been found in the furnace. In Linköping in Östergötland, an oven was found from the Roman period, cut into a structure that was interpreted as a grave. Another oven was found at the same cemetery, although already destroyed in prehistoric times, it was possible to date it to 278-429 AD. Among the remains there were both burnt and unburnt bones. The burnt bones were possible to identify as human beings, whereas the unburnt bones were teeth from cattle. In two other ovens small concentrations of burnt bones which have not been identified, were found (Carlsson et al. 1996). In Gavleån in Gästrikland, however, there is solid proof that a human has been cremated in the furnace. The deceased, who was found in the oven, is osteologcially determined to be an adult woman who was cremated together with her dog, and the grave/furnace is dated to the Viking period (Appelgren & Broberg 1996: 36). In another oven at this place, faint traces of burnt, human bones were also found.

At a cemetery at Bo Gård at Linköping's airport a smithy containing burnt, human remains was found. The smithy was a part of the cemetery that contained 46 cremation graves. The cemetery dates from 1400 BC-985 AD, and the furnace was dated to 540-860 AD or the Merovingian period (Larsson 2005: 106). There were two smithies. Small concentrations of burnt bones were found within and outside the structures together with slag, burnt clay and pieces of iron. 14,3 percent of the bones from the smithy area have been possible to determine, and although impossible to say whether it was a man or women, the bones once belonged to an adult human being. It is still uncertain if there were remains from any animals in this smithy (Larsson pers. comm.).

Although it would have been preferable with more empirical cases, particularly from Norway, there is without doubt sufficient archaeological evidence to say that humans have been cremated in the furnace in Bronze and Iron Age Scandinavia. This is also stressed by Holck's (1987) analysis, which suggests that it was indeed the most common practice even though the current finds of such furnaces cannot support this interpretation for the time being. But in the lack of a sufficient number of furnaces, we think we ought to rely on the bone analysis for three reasons. Firstly, as we will argue later,

one of the main purposes with cremation in the smithy was to use the bones for other purposes, and hence, it will only be in rare cases that we will find huge concentrations of bones in the furnace itself. Secondly, since the bones have been transported from the cremation site (in this case the forge) to the place where the bones are buried (Oestigaard 1999), the end station/product in the grave is where one will find the bones (which were not used for other purposes). Finally, it is through an interpretation of the bones and the high temperatures we may get an insight into why humans were cremated in the smith's furnace. Why was it necessary, from a technological point of view, to cremate people in the smithy?

Our answer to these pending questions is by linking technology to cosmology and vice versa. Copper smelts at 1083 degrees Celsius, but experiments have shown that temperatures around 1300 degrees are preferable for casting, since the metal becomes more fluid and hence easier to work with. Bronze is an alloy of copper and tin, and normally bronze consists of around 10 percent tin. Bronze has several advantages, not least as a finished bronze product it is harder than copper. During the smelting process it is also easier to work with bronze, not least since it possible to cast objects at a lower temperature (Oldeberg 1943: 135; Barber 2003: 121-122). Bronze containing between 8-13 percent tin smelts at around 830-1000 degrees Celsius (Jensen 2002: 129). Pure iron smelts at 1537 degrees Celsius, whereas the lowest temperature for smelting carbonized iron (which will be discussed later) is 1145 degrees Celsius (Espelund 2004: 30). The question then is how it was possible in a pre-industrial society to get such high temperatures?

As shown, cremations in open air will hardly reach a higher temperature than 700 degrees Celsius, and for smelting and casting both bronze and copper one needs specially made furnaces. It has been noted by many researchers that the introduction of bronze technology and cremation happens more or less simultaneously in Scandinavia, and that there must be a relation (cp. Kaliff 1997; Goldhahn 1999, 2007). One possible reason for this occurrence is that the corpse may have been used as the energy source that enabled the smith to gain temperatures above 1100-1200 degrees Celsius, and even higher temperatures. The fat tissues on the body are some of the best «fuel» in closed ovens because:

> «...a corpse creates a considerable surplus of heat [...] the measuring begins after the oven have been ignited, and we see that the temperature rises slowly to 700°C. From the moment the corpse is put in a steep rise in temperature occurs (exothermal reaction). This is caused by the ignition of the most combustible parts of the body (and the coffin), despite a constant supply of energy to the oven. After about 40-60 minutes the temperature

will decrease during the cremation of the less combustible parts of the body...» (Holck 1987: 38).

In contemporary crematoriums «a large body with ample fat will thus, strange to say, be easier to cremate than a lean body» (Holck 1987: 39). Based on scientific measurements, Holck has shown that if several bodies where cremated successively, the temperature increased even more, and could reach more than 1200 degree Celsius (Holck 1987: 37-38, fig. 6). This is not preferable in crematoriums today, but in prehistory this could have been one of the main aims with sacrifices of humans and animals in the furnace: it enabled the smith to get such a high temperature sufficient for smelting. In some cases it probably needed some more modification and further manipulation. Technology is em*bodied* with ideology, and vice versa.

Thus, technologically speaking, cremations/sacrifices in the furnace were practical and a way of achieving the high temperatures that were necessary for bronze and iron production. In the early phases of metallurgy this could in fact have been the only way to obtain the desirable temperatures. Human sacrifices to the furnace, regardless of whether they were already dead or killed before the smelting process, constituted and enabled this technological process which most likely was seen as magical or divine, or in the words of Mircea Eliade regarding smelting: «The act, par excellence, of the cosmogony, starting from a living primal material, was something thought of as a cosmic embryology» (Eliade 1962: 75).

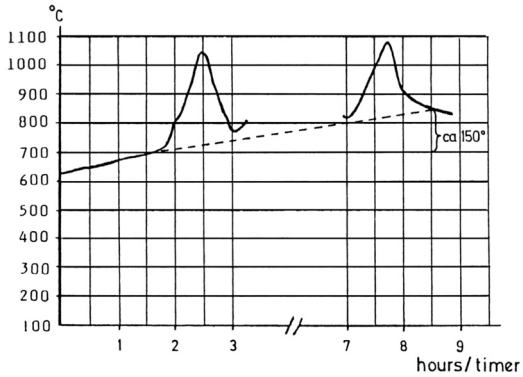

Fig. 6. Temperature increase in contemporary crematorium when successively one and two bodies are inserted. From Holck 1987.

Technology and cosmology

Although numerous ethnographic studies on smiths and metallurgy with archaeological implications have been conducted (e.g. Eliade 1962; Rowlands 1971; Herbert 1984, 1993; Haaland 1985, 2004a; Haaland et al. 2002; Barndon 1992, 2001, 2005a, 2005b; Helms 1993; Anfinset 1996; Schmidt 1997; Rijal 1998; Englund 1999), less studies have started with the archaeological contexts. In

this case regarding Bronze and Iron Age Scandinavia, we will argue that crucial aspects have been missed. Ethnographic analogies are a rich source for interpretations and inspirations, but perhaps the limitations are clearly visible as well, in these cases since analysing the past is not simply a study of the Other, but rather a study of the *unknown* (Fahlander 2001: 41). We will argue in this case that those ethnographic analogies may have been a hindrance to gaining new knowledge mainly because it forces our understanding of the smith into contemporary perceptions and frameworks where the «smith» is a profession only dealing with metallurgy. As Richard Bradley has expressed this dilemma in another place and context: «We [archaeologists] have to find our own path. The question that we need to consider is of interest outside archaeology, but the ethnographic evidence soon runs out. If they can be answered at all, it will be by archaeology alone» (Bradley 2000: 17).

Of course, we are also using ethnographic analogies, but in these cases we will argue that we are tracing practices that have no contemporary parallels, and this stresses the conceptual challenges we as archaeologists face when approaching the past (Insoll 2007). As we have shown above and elsewhere (Goldhahn & Østigård 2007), not only did the «smith» smelt bronze and iron and cremated dead people, he may also have made ceramics and been engaged in numerous other interactions between humans and gods – the dead and the living. The archaeological material culture and its context both challenge our preconceptions and support such interpretations.

There has been a shift in recent years from production to consumption in material culture studies. In other words, the importance is not mainly how the objects are produced with its successive social hierarchies, but how they are used. By employing material culture irrespectively of how objects are made, creates social relations and structures (e.g. Miller 1998). Nevertheless, even though metal production has defined archaeology since Christian Jürgensen Thomsen created the Three Age Period System in the early 19th century (Thomsen 1836), the people who made the objects have not been taken into consideration and analysed. The emphasis within the archaeological field has mostly been on how the «prestige» objects have been used in society by the elite (e.g. consumption). In the following we will return to the «Marxist» rather than the «neo-Marxist» approach and put emphasis on the social and religious/cosmological consequences of making artefacts of metal, bearing in mind the process where humans have been used as a means that made it possible. In the words of Eliade again, «The art of creating tools is essentially superhuman – either divine or demoniac (for the smith also forges murderous weapons)» (Eliade 1962: 29).

From a purely technological point of view, making objects in metal may necessitate sacrifice of human flesh in order to gain the temperature that is mandatory for smelting the metals. This embodied process was certainly a

cosmological one that involved all spheres or realms. Technologically speaking, making objects in metal is in its very essence, ritual, and every ritual has technological aspects. Hence, by studying those rituals where the technological processes are possible to trace archaeologically, one may get new insights into prehistoric society and different transcendental realms (Gansum & Oestigaard 2004; Goldhahn & Østigård 2007).

Even though we had some critical objections regarding the way ethnographic analogies have been employed for understanding prehistoric smiths and metallurgy in general, as we stated, contemporary sources are important for broadening our horizon and creating new possibilities and interpretations. In order to gain knowledge of how the smith has worked and his/her role in society and cosmos, we may indeed turn to ethnography. As mentioned, there has been a trend where the objects, particular those made of metal, have been seen as sacred. The bronze lures, the sun-disc from Trundholm and the gold horns from Gallehus are just some well-cited Scandinavian examples regarding how the smith's handicraft reflects cosmological realms.

Theoretically and practically in relation to metal production (divine revelation and manifestations such as the Kabaa in Mecca or the Holy Sepulchre in Jerusalem belong to a different category), there are two ways of making holy or sacred objects; either the producer (the smith) makes it holy through the very production or there are some kind of priests who initiates the objects after they are made and hence they become sacred.

The way Hindu statues of Kali in general but also other divinities are made in Faridpur district in Bangladesh, may illuminate parts of these processes. When the statue is completed, the priest initiates the statute and hence consecrates it whereby the divinity takes place in the actual sculptured model (Oestigaard 2005: 117-122). This has its reason in that the gods are obviously invisible, but still visible. «Not only are they present in a particular community, but they may be present if invoked in other communities and shrines at the same time. They must be in this place, and that, in the then and the now. They therefore obviously cannot be present *in person*; rather, they are there in *essence*» (Obeyesekere 1984: 51, original emphasis).

Nevertheless, in the process of making the statues, the statue-makers, who belong to a low caste in Bangladesh, engage in a divine interaction and relationship with the divinity that is going to be made. The statue maker has spiritual capacities and he is often a healer. Regarding Kali statues in particular and all statues in general (fig. 7), the spirit of the god or goddess takes part in his body when he makes the statue. The divinity determines the appearance of the statue even though it is made through the healer's heart, head, and hands. In this process of making the statue the healer and the god or goddess have intimate spiritual relations. The statue makers believe that

Kali has blessed them while making the statues, and without the blessing from the goddess it is impossible to make the statues. The statue maker is in direct contact with the goddess, and this intimate, religious relation is both a blessing as well as dangerous. If the statue maker fails and makes mistakes during this process, he may die (Oestigaard 2005: 117-122).

Fig. 7. Statue maker in Faridpur, Bangladesh, makes Durga-statue. Photo: Terje Oestigaard.

Although this example is from a totally different culture and religious context, it stresses two important aspects: Firstly, when the objects are completed, priests may initiate divine aspects and capacities into statues and artefacts, and social and religious hierarchies can be created as a consequence of the use of these objects with immanent powers. Secondly, the most prestigious objects in metal are assumed to encompass the whole or parts of the cosmological order, bearing in mind the technological process which seems to have included cremations of humans. Is it reasonable to believe that such objects are made from a purely technological point of view? Or is it more reasonable to believe that the smith was engaged in divine/cosmological relationships through the smelting process and hence being *the person*, or rather *the social institution*, who controlled and created these cosmological/divine relations through the furnace and fire?

The archaeological record may suggest some answers, and in particular the transition from bronze to iron in Scandinavia. During the Bronze Age it seems like the whole cosmology is depicted on the most prestigious bronze objects (e.g. Kaul 1998, 2004). When iron technology was introduced the former Bronze Age cosmology completely disappeared and the ornaments on the metals totally changed and got another distinct and different character. Hence, based on the overall picture and the all-encompassing changes that happened, the change from bronze to iron was not just a practical or economic transition. When the whole cosmology not only changed but

also disappeared from the objects, it may indicate that the metal itself was embodied with immanent powers. This is a clear indication that, as we see it, the process of empowering the objects happened during the making and smelting in the smithy, and that this was an intimate divine relation or cooperation. Smelting or creating bronzes was, to use Fredrik Barth's words from another context, «cosmology in the making» (Barth 1987).

In the Bronze Age, the cosmology in the making is seen in the uniform ornaments and motifs in all types of metallurgy and «smith»-works. Bronze and gold objects as well as rock art depict the same motifs and cosmic stories, which centred on the birth and rebirth of the sun. The so-called «cultic objects» from Bronze Age has its clearest parallels to the rock carving tradition (e.g. Kaul 1998, 2004; Goldhahn 1999, 2005a; Fredell 2003; Bengtsson 2004; Franke 2005). Hence, it seems as the «bronze smith» was identical with the «stone smith», or rather, it was the same ritual specialist and social institution that controlled the cosmological system which is depicted on both bronze and stone (Goldhahn 2007). Moreover, some of the rock panels have been damaged by fire, and the size of these destructions fit with the size of cremation pyres (Goldhahn 2005b: 58-59), linking cremation, bronze and rock-art into the realms of the smith as a ritual specialist (fig. 8). Based on a combination of activities which have strong structural and symbolic resemblances, it seems reasonable to interpret all these practices into a cosmological perspective where the «smith» had a central role in the social and ritual institution which made and manifested the cosmology through different transformation linking and unifying humans and the otherworldly spheres (Goldhahn 2007).

In the Iron Age a similar but yet different pattern is seen in relief brooches in gilded silver and bronze from the Migration Period (Oestigaard 2007). The animal style encapsulates the cosmological relations between humans and gods in metal objects and thus the smith (Hedeager 1999, 2003, 2004a, 2004b). In Style I animal motives dominate and each brooch is unique in artistic expression as well as composition (Kristoffersen 2000: 266). The depictions emphasise the transformation from one state to another – «it is something in between – something which is in the middle of a transition – or in the process of transformation» (Kristoffersen 2000: 271). The dualistic motif – separated animals and humans and various combinations of them and the transformation from human being to animals – is related to the Nordic heathen conception of the soul and shamanistic practices (e.g. Hedeager 1999; Kristoffersen 2000; Solli 2002; Price 2002) where the brooches express, in the words of Turner (1967: 99), «that which is neither this nor that, and yet is both» (quoted from Kristoffersen 2000: 272). Hence, regarding the smith who made these brooches as well as other objects with animal style emphasising transformative borders, again, is it reasonable to assume that the smith

has done this purely technologically, or has the smith been engaged with various divine realms in the process where the furnace was the medium?

Moreover, it seems that the technological and cosmological transformations relate to social transformations as well. Death is the final life-cycle ritual (van Gennep 1960), and funerals may relate to other life-cycle rituals and initiations (Oestigaard 2000a, 2005; Oestigaard & Goldhahn 2006). Ethnographically the furnace is often loaded with sexual metaphors and birth symbolism (e.g. Rijal 1998, Barndon 2001, Haaland 2004a, 2004b, Haaland et. al 2004), and there is a rich sexual mythology in the Scandinavian material relating to birth as well (e.g. Gansum 2004b, Barndon 2005a, Haaland 2006). From a life-cycle perspective, it seems that there is a double process of initiations which included both the deceased and the living (Oestigaard & Goldhahn 2006). The furnace is the place of birth for the dead, which is transformed into new life in metal objects. The most precious and prestigious objects are among others relief brooches and swords. Relief brooches are connected to the status of *the Lady of the House* (Kristoffersen 2004), a status and position she gains through *marriage*. Furthermore, it seems reasonable that swords were given to young men either in a *rite de passage* marking the transition from boyhood to adult or through honourable acts which marked a change in social position. Thus, the deceased was transformed through the materialisation in the smithy uniting the cosmological realms with this world and the living with the dead, which was socially manifested and materialised through objects related to life-cycle rituals and socio-ritual positions. This intriguing symbolic relationship between the smith, death and other life-cycle rituals suggests that the smith was a ritual specialist involved in a broad spectrum of ritual transformations and *rite de passages* (Goldhahn & Oestigaard 2007).

What has happened to all the cremated bones?

Another argument strengthening the interpretation that the smith was crucial in death rituals in general and in cremation in particular, apart from the high temperatures the bones have been exposed to as well as finds of bones in the furnace, is the striking absence of large parts of the cremated bones in urns and graves.

Based on measurements Per Holck did in Asker Crematorium in Oslo, Norway, the weight of a cremated skeleton was 3075 grams (3375 grams for men, 2625 grams for women). The volume of the bones before they were grinded was 7,8 litres (Holck 1987: 71-73). Other measures/analyses have given lower weights. A «normal» man whose weight is 70 kg has a skeleton which weights 4159 grams, and after a cremation the weight is reduced to 2829 grams, and for women the respective weights were 2700 and 1840 grams (Holck 1987: 121).

The average weight of the 1082 case studies Holck analysed was 269,7 grams for single deposits of cremated human bones. In many of these contexts it was impossible to identify the sex because there were too few remains. In those contexts where it was possible to identify the sex, it was in general more cremated bones. Hence, in the context were it was possible to identify men and women, the average weights were respectively 637,9 grams for men (with variation from 10 to 3175 grams) and 455,6 grams for women (with variation from 30 to 1950 grams) (Holck 1987: 119).

If we compare the actual presence of cremated bones in prehistoric contexts with the measures from contemporary crematoriums, in general only 10-20 percent of the deceased was deposited in the urn/grave. One may object that parts of the bones may have deteriorated and that the excavators have not collected all the bones, which is a problem with older excavations from the end of 19th century and the beginning of the 20th century. Nevertheless, the overall pattern is clear, just a minor part of the cremated body was placed in an urn/or scattered in the grave. The mere size of some urns also stresses this interpretation. Bucket formed pottery is a common trait in funerals in western part of Norway during the Migration period. These jars are used as urns, and the height of the jars varies between 4,3 to 15,5 cm and the average content is 1,5 litres (Fredriksen 2005:188-189). When these urns were made, they were intentionally made not to cover all the human remains, which are, as shown, around 8 litres. The same pattern is found during Late Bronze Age and the urns that have been used for burial practices (see Stjernquist 1961; Olausson 1987; Feveile & Bennike 2003).

From this analysis it is quite clear that only some of the cremated bones were transferred back or given to the descendants in order to be buried, and that the majority of the cremated bones were used for other purposes. This can be explained by the various contexts where human bones are found, both burnt and unburnt, such as in ceramics, pot holes, hearths, cooking pits, property borders (Gansum 2004a: 109), heaps of fire cracked stones, altar constructions (Kaliff 1997) and in cultivated fields (Kaliff & Oestigaard 2004), where the latter practice most likely is related to fertility rites and slash and burn agriculture (Arnberg 2005). Some of these spheres where cremated bones are found transcend the smith's realm, but based on the high temperature the majority of the bones have been exposed to, it seems likely that the smith has conducted the cremations in the furnace and used some of the bones for other purposes, and given the rest to the descendants who buried parts of them and used the rest in various ancestral rites.

Finally, it is possible to elaborate the technological relation between smith and death even further. The archaeologist Terje Gansum has worked in close cooperation with the smith Jonny Hansen (Gansum & Hansen 2004). During his education in 1960s, Jonny Hansen learnt how to use bone-coal

to carbonize iron in order to make steel. If bone-coal and charcoal are put around pieces of iron in the furnace, the physical structure of the iron changes when the temperature reaches 720 degrees Celsius. The carbon may penetrate as far as 3 mm into the surface of the iron and this transforms iron into steel and then weapons (Gansum 2004b: 42). The technological process and adding of both human and animal bones, may explain why the swords in the Viking Period had identities, immanent powers, and names such as *Tyrving, Gråsida, Kvernbitt, Gram, Fetbrei, Bastard* and *Skrep*, among others. As Gansum says, «we cannot be sure whether they used human bones in the process of making steel, but symbolically and ritually it seems likely. In this way ritual, technology and symbolism is fused together» (Gansum 2004b: 44). Moreover, as shown with the animal style, this seems to emphasise the transformation from humans to animals and the heathen concept of soul, and hence, there will not be a contradiction or opposition between using human as well as animal bones in the process of transforming iron to steel *and* decorating the objects. The smith was the person who had the powers to mediate between the different spheres, so it is no wonder than the smith was closely associated with death and death rituals of various kinds.

Conclusion

We have aimed to explore some of the smith's ritual domains in prehistoric Scandinavia. Based on analyses of the temperatures cremated bones have been exposed to, in combination with actual finds of human remains in furnaces, our aim has been to develop a synthetic perspective that may explain why smith and death were closely linked and associated. On the one hand, the flesh on corpses is a vital source of energy, which may enable the smith to reach temperatures sufficient for metal smelting and production. On the other hand, the objects the smith was making in both the Bronze and Iron Age seem to have incorporated as well as expressed these transitory and immanent qualities, and borders between life and death. Hence, it is impossible to separate technology from cosmology, and if we are right in these interpretations, the smith as a ritual specialist or this kind of institution had a much more central and vital role in cult and cosmology than what has been acknowledged earlier (Goldhahn & Østigård 2007). Through the furnace as a medium and with fire as a means, the smith controlled and mediated between humans and gods/cosmological realms – life and death – and in these technological processes the smith has most likely embodied the powers and engaged in spiritual engagements when he made objects in metal, and the decorative motifs in themselves may bear witnesses to this (fig. 7-8). Cremations may have enabled metal production in the very first place *and* the powers of the dead may have been transformed into the objects themselves, smelting together the spheres of smiths and deaths.

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