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Technology, Transformation and Symbolism: Ethnographic Perspectives on European Iron Working

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Ethnographic studies provide abundant accounts of the symbolism of iron, iron making, blacksmiths, and iron products. We find the transformative aspects of iron working to be striking in these cross-cultural studies; iron smelting is stated to be analogous to giving birth; the blacksmith's role in material transformations (ore to iron) is claimed to be a metaphoric model for social transformations *rites de passage*; the forging of artefacts in the smithy is said to constitute a model for conceptualization of the divine creation of the universe. In the interpretation of the iron working material in Europe little attention has been paid to symbolic, ritual and transformative significance of iron. It is the metallurgical or economic factors that have been stressed. I will in this article draw attention to the rich material, especially mythology, which we can draw on in the interpretation of the archaeological material, to get an understanding of the ideology surrounding iron production.

INTRODUCTION

The European tradition of iron research has been focused on the technical and economic aspects of these activities. This is seen in the discussion of the spread and development of iron working in Europe as well as the interpretation of the iron working activities. However if we look at metal working in a wider regional context we see that it is generally entrenched with symbolic meaning and ritual activities. In this paper I will, based on four ethnographic case studies, show the importance of symbolic and ritual aspects of iron work and discuss how these are intertwined with the technological factors. The purpose of the study is to see how these perspectives can give us some new insight into the European research on this topic.

John Alexander has criticized the interpretation of the spread and development of iron working in Europe to have been based on economically deterministic terms (Alexander 1983). The perspective has been that the advantage of adding iron seems obvious, and there has been a tacit assumption that when knowledge of iron reached a society it would be accepted and a growing sophistication of iron working would then follow. He uses the evidence from Sub-Saharan Africa to show that this was not the case. He sees the variation in the distribution and use of iron as being the result of religious, social and political factors rather than economic or metallurgical ones. Our ethnographic work can be a case in point.

If we look at the earliest evidence of iron, it is the ritual and symbolic aspects of the metal that are significant. The earliest evidence of iron working comes from the Middle East, in

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Anatolia. The early iron objects show that the symbolic and ritual significance of the metal was more important than the productive-technological aspects. The earliest metal was meteoric iron (or iron produced accidentally by being used as flux when smelting copper); we find this type of iron as far back as the fifth millennium BC. The symbolic nature of meteoric iron was probably due to the belief that the metal comes from heaven and is produced by lightning and thunder; such a substance was thus suitable to spin webs of meaning around. This could explain the strong symbolic, magical, and even cosmological significance of iron (Pleiner 2000:10–12).

The first smelted iron (13th century BC) was used to make ritual objects and ceremonial weapons. These were high prestige material being produced in the palace or the temple. The extraordinary importance and symbolic significance of iron, according to Pleiner, are illustrated by the finds of iron rings in the early royal tombs in Crete and Mycenaean tholoi, dated to the 14th–13th centuries BC (Pleiner 2000:10). Not only archaeological finds but also textual references, such as the Sumerian and Akkadian, suggest the symbolic importance of iron in rituals in the Hittite temples at Boghaszkoy (Pleiner 2000:8).

Even as iron was gradually produced on a much larger scale these aspects of the metal was maintained. It was also a metal looked upon with fear and viewed as evil. It was primarily used as a means of applying political control. Linguistic and archaeological data indicate that iron, at least in the early phases, was under direct control of the ruling groups, whether religious or secular, and a monopoly of craft specialists which would have facilitated the control by the ruling groups related to the palace or temple. The political control of iron is a dominant feature in the history of the metal. For example, it is referred to in the Bible:

> Now there was no smith found throughout all the land of Israel for the Philistines said lest the Hebrew make them swords and spears. So it came to pass in the day of the battle that there was neither sword nor spear found in the hands of any of the people that were with Saul and Jonathan (Samuel 13:9–14).

The metal monopoly was broken in the 10th century BC by the conquest of David, who reduced the Philistines to vassals. Here it is the Philistines who exercised monopoly of metal working, particularly in the 11th century BC in order to maintain political control over their neighbours (Hawkins 1982). Among the Assyrians in the 9th century the metal daggers of the rulers came to represent his army. We find centralization and monopoly of iron working in many instances. The kingdom of Kush in the Nile valley of Sudan, dating back to the 5th century BC, and the much later kingdom of Ghana, dating to the 8th century AD, are both examples of the political control of iron production (R. Haaland 1980, 1985).

Even if it was made into artefacts both for production (agricultural tools) and as means of destruction (weapons), it was, however, its role in exercising political control which was frequently underlined. The ambiguity of the metal is expressed by Pliny: ". . . iron, a metal which is once the best and the worst servant of humanity, for to bring death more speedily to our fellow man, we have given wings to iron, and taught it to fly" (Pliny, Natural History XXX1X:138); and "the Indo-European world viewed it equally harsh" (Pleiner 2000:20).

GENERAL OUTLINE

The ritual and symbolic aspects of iron working are also dominant features of these activities today. By drawing on case studies mainly based on fieldwork in Sudan and Ethiopia, and to a lesser extent Tanzania and Nepal (Fig. 1), I will explore the interconnections between technical processes and forms, and symbolic metaphorizations, with a view to identifying analytical dimensions which may be generalized across cultures. I will

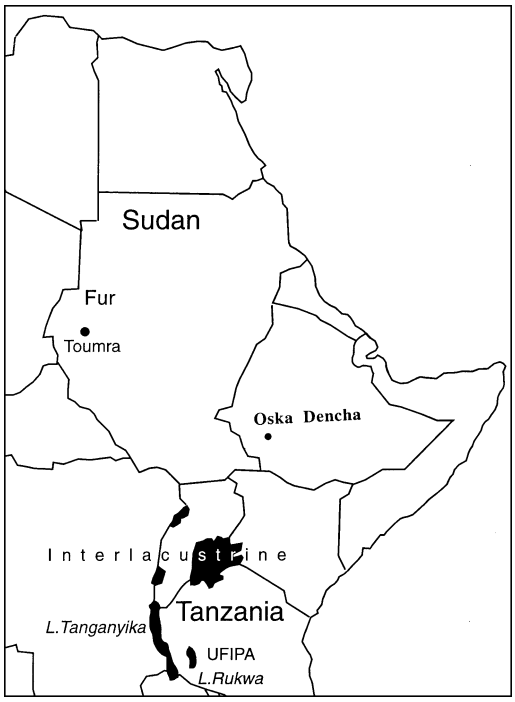

Fig. 1. *Main localities mentioned in the text.*

discuss ethnographic cases of iron smelting as solutions to practical tasks which are similar all over the world and which therefore tend to channel technological developments in similar directions. This provides the basis for analysing attributes of the physical iron producing structures (the furnace and the tuyeres), the inputs (ore and charcoal), the transformative process (smelting by fire), the human activities in the transformation (blowing the bellows) and the output (the bloom).

It is the symbolic aspect which is the main concern here, but since the sources of symbolization are grounded in universal natural constraints involved in transforming ore to iron, I shall first present short descriptions of the technological solutions people in different cultures have developed to tackle these constraints. By drawing on these case studies I will explore the evidence for ritual and transformative aspect of iron production in ancient Europe.

I will start with a brief discussion of the technology, which shows that there is a great variation in the four cases we have recorded on the ethnographic smelting of iron. There is variation in the technique of treating the slag, from the use of slag-pits to slag tapping, as there is variation in the type of furnace superstructure employed. Even if we find a shaft type that is used in all four cases, they vary from thin walled (only used once) to thick walled (re-used several times), and to high natural draught furnaces. However, cross-cutting the variation in technology is the strikingly similar symbolic and ritual activities surrounding smelting. The blacksmiths' role in the material transformation (ore to iron) is claimed to be a metaphoric model for social transformation (rites of passage) The act of smelting is looked upon as an act of reproduction. Inserting the tuyeres and the blowing of the bellows are seen as an act of procreation, the smith penetrating the furnace (woman) and fertilizing it; the product is the bloom (the child). Ideas associated with smelting are thus closely related to general ideas about procreation, which one seems to find as a cross-cultural phenomenon. I will start with a case study from south-west Ethiopia.

ETHIOPIA

I shall here present an ethnographic case study (fieldwork carried out in March 2000) of iron smelting in the village of Oska Dencha in the highland area of south-west Ethiopia, where people are still smelting iron. To my knowledge they are the only people still smelting iron; when Eugenia Herbert in 1993 wrote her famous book "Iron, Gender and Power" she states that today we can find no places where people are still smelting iron[1]. The furnace and the iron smelting activities take place outside the village. The iron smelting is based on a shaft furnace (Fig. 2) made of clay, with a slag-pit. The slag sinks to the bottom where a pit has been dug. The walls of the furnace are quite thick (12–

Fig. 2. *The shaft furnace is ready for smelting, from the village of Oska Dencha. Photo R. Haaland.*

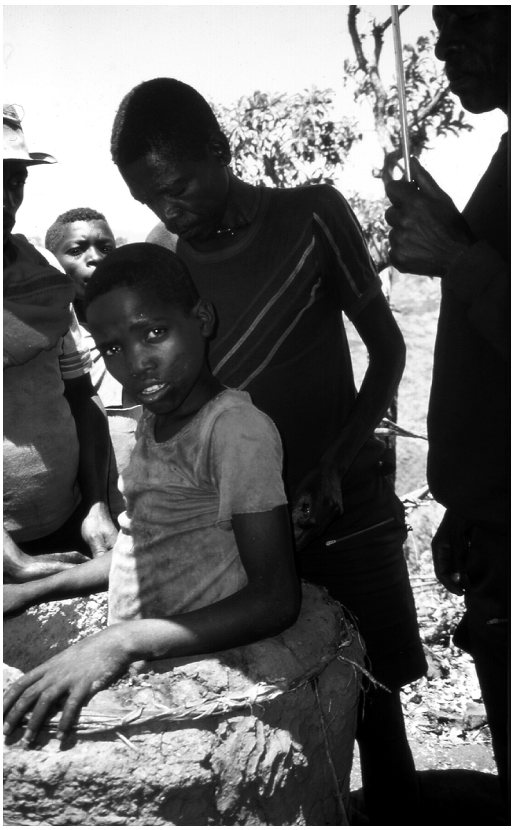

Fig. 3. *The son of the master smelter has climbed inside the furnace to remove the bloom. Photo R. Haaland.*

14 cm) and it can thus be re-used several times. The height of the shaft is around 80 cm and the pit 60 cm deep and 50 cm wide. Radiating around the base of the furnace were 15 holes made for five pot bellows (of clay) to be attached to the tuyeres. The ore is dug from small pits in a hill nearby. The raw material required is 107 kg of ore and 120 kg of charcoal (made from hard-wood trees). The smelting takes around nine hours, when it is completed it is left to the next day to cool and a small person (the young son of the smith) climbs inside the furnace (Fig. 3) to take out the bloom (G. Haaland et al. 2000, 2003).

The idea of sacrifice to the ancestors is a prominent part of the smelting activities. The master smelter sat down to drink the local liquor after first having poured part of it on the ground outside the pit, as a sacrifice to the god of his ancestors. He sacrifices a sheep when he starts to blow the bellows as the smelting activities start. It is the blood that is significant in the sacrifice: it is smeared outside the furnace, and bellows, to ensure a successful smelt. The taboos associated with the smelting are related to women, who must be kept away from when they are menstruating, since they are seen as polluted and thus will harm the smelting. The smelters should also avoid sexual intercourse during the smelt.

The ideology related to procreation is manifest in the local terms used for the objects and activities of smelting. The local terms for the tuyeres are the same as the male sexual organs, indicating that the smelting process is metaphorically associated with sexual intercourse. The furnace is perceived as the womb of a woman. When they take out the iron bloom they say the woman (the furnace) has given birth, and the slag is seen as the after-birth. Through the smelting operation a new object is created; what was ore has, during the smelting operation, become bloom.

Ideas associated with smelting and procreation seem to be especially prominent in Africa; but, as will be discussed below, we find them to be cross-cultural phenomena (Cline 1937, Wise 1958a, 1958b, Willis 1978, van der Merwe & Avery 1987, Childs 1991, Collett 1993, Herbert 1993, Barndon 1996a, 1996b, Schmidt & Mapunda 1997).

The metaphorical association between giving birth and making iron is also manifested in the idea that the woman giving birth is polluted and so is the smelter. When a woman is giving birth she is brought out of the house to a specially erected hut outside the village, just as the polluting smelting activities takes place outside the village boundaries (G. Haaland et al. 2004).

Other transformative aspects are expressed in the idea that the smelters were believed to have the evil eye, they could cause sickness and death to humans, and they could transform themselves into animals, they are accused of breaching human food taboos by eating ritually unclean food. People avoid drinking, eating or having intimate contact like sex with them, and they are set apart as a separate endogamous group, which are looked upon as unclean. The term for the smith is the big pot maker, the smelter and the potter are considered similar kinds of identities, and they intermarry. It is here a deeplying metaphoric association between smelting and pot making as activities involving transformation of earth (which is considered sacred) through fire.

People conceptualize iron smelting and pottery making as being intimately connected. The two activities and the objects they deal with have features that convincingly can be used to symbolize similarities as well as differences in other domains of experience. Both involve transformation of natural things (ore to iron, clay to pot) by the use of the same transformative agent – fire. The transformation of ore to iron does take place in a container, the furnace, which is similar to the pot. Both furnace and pot are constructed from clay but they differ in the sense that the furnace is sun-dried while the pot is fired. The two containers are also similar in the sense that they are vessels for transformation of natural items (ore and grain) to cultural items (iron and porridge).

The potter, like the blacksmith, is a master of fire. It is with fire that one controls the passage of matter from one state to another (Eliade 1962:78). In an evolutionary perspective pottery making emerged as an important component in the female domain of hearth centred activities – a domain focused on tasks connected to food preparation like fetching water and firewood, grinding grains, making the pots and cooking the food – activities taking place inside the house or inside the village. In other words, pottery is unambiguously placed in the life-giving context of motherhood, nurturing and human reproduction (R. Haaland 1997). Iron working on the other hand is ambiguously placed in a context of destruction (weapons) as well as in a context of production (tools). It is universally placed in a male domain – a domain which contrasts with the female domain by the situation of smelting at the outskirts of the village or the market. The smithy is of a more public character with its closer association with killing in hunting and warfare. Iron products are also ambiguous because both males and females use the productive life-giving tools like hoes and axes.

FUR, WEST SUDAN

In Darfur, west Sudan, iron smelting was practised among the Fur people until 1950s, when scrap iron started to be used. When we studied iron smelting in the 1970s[2] some blacksmiths still possessed the knowledge of smelting iron and volunteered to demonstrate the process (for further reference to the fieldwork see R. Haaland 1980, 1985 and G. Haaland et al. 2002).

The iron smelting is similar to the Ethiopian furnace as it is based on a simple shaft furnace with a slag-pit. The slag sinks to the bottom of the pit and is not tapped during the smelting process, but is separated from the iron in the smithy in a later process. The furnace is not re-used as it is always broken down after each smelt in order to retrieve the bloom, and is thus different from the Ethiopian furnace. A shaft less than 1 m high made of clay soil (this is a small sized furnace, larger furnaces were said to be c.120 cm high) was erected on top of an excavated pit 50 cm wide and 60 cm deep; the furnace walls are only 4–5 cm thick.

Radiating around the small furnace are four holes for the tuyeres, each hole holding two tuyeres each (seven holes for the big furnace). When the furnace is completed, plant fibres are tied around the shaft to prevent it from cracking during the smelt. On the outside walls of the furnace the blacksmiths drew some camel-like animal figures by smearing millet/sorghum flour mixed with water, to protect the smelt from the evil eye (Fig. 4). The iron ore consists of ferricrete sandstone taken from a sandstone hill situated around 35 km north-west of the village. The raw material required is a 100 kg sack of ore and two sacks of charcoal. The smelting process we observed took about 16 hours.

Our two ethnographic studies incidentally point to an important trend in the development archaeological research foci – from the technical and environmental oriented type of prosessual archaeology as illustrated here by our Sudan work in the 1970s, to a research agenda which to a larger extent attempted to cover symbolic dimensions of iron work, illustrated by the work presented above from Ethiopia.

Fig. 4. *Fur blacksmiths are starting to blow the bellows during the early part of the smelting operation. Note the figures drawn on the shaft furnace. Photo G. Haaland.*

Thus the main interest during the fieldwork was to explore the amount of charcoal required to transform a certain amount of ferricrete sandstone to a certain amount of iron and slag, with a view to establishing a framework or estimating how much firewood would be required to make the charcoal needed to produce the amounts of slag found in slag mounds of the past (R. Haaland 1980, 1985). However, we also made some observations related to symbolism of iron making.

Let us first look at the more subjective level of associations which the iron making led us to make, and I believe the participants as well. It does not take much imagination to connect the tuyeres and the attached bellows with the male organ, and the bellow blowing as analogous to intercourse. During the smelt the blowers now and then worked themselves up in rather ecstatic rhythm towards a climax like point after which they returned to a more leisurely pace. These phases were accompanied by intense singing (unfortunately not recorded) and exchange of challenges between the bellow blowers.

Material that could show whether such

symbolism on the subjective level had been developed into conventional objective symbols, was unfortunately not collected. Although the Fur material cannot demonstrate it I venture the hypothesis that the presence of fire in the smelting and its psychogenetic association with love and sex may also, among the Fur, trigger subjective associations linking the furnace with the female body. Smelting of ore as well as intercourse gives birth to something new – the bloom, which can be fashioned to important cultural products – and the child, which can be socialized to a cultured human being. Such associations are close at hand because the salient aspect of the work of the blacksmith is that it is an act of transformation of material things from something given by nature to something of fundamental practical importance for man's survival – weapons and tools (G. Haaland et al. 2002).

The transformative aspect of iron making is so striking that one might expect that people in different cultures would link it to other transformative processes experienced in nature, e.g. transformations taking place in a woman during gestation, as well as in society during rites of transition, and in the world of imagined transformations e.g. people transforming themselves to animals. The question is what they make out of such associations in terms of public symbols. I have already mentioned the animal drawings made on the furnace before the smelting starts. These drawings can be linked to wider systems of symbolization among the Fur. The drawings were painted with millet flour mixed with water and they were said to ward off the evil eye. In Fur symbolism such a mixture of flour and water is called *bora fatta* (milk white) and is generally metaphorically associated with mother's milk, which is seen as a metonym for solidarity in its prototypical form, namely the relation between mother and child (G. Haaland 1998). Bora fatta symbolism is typically invoked during events of critical importance in Fur society like birth, circumcision, sickness, rain and war rituals. The power of the symbolism has its roots in the nurturing and security experienced in the mother – child relations, and in the contrast of this relation to forces (mystical, social and natural), which are a threat to human well-being.

The technical process of iron production is a critical event, like childbirth; it may go wrong in the sense that iron is not properly separated. Worries about such failure were expressed as a fear of other people's evil eye. Use of the bora fatta associated item, millet flour mixed with water, is, in the context of Fur symbolism, the appropriate protection against such evil forces.

As the technical process of iron smelting is loaded with symbolic meaning, the technical specialist executing this process is also set apart from other community members. Iron working and pottery making are, among the Fur, seen as two complementary activities intimately connected within the same category called the mir. They constitute an endogamous group – a male is associated with blacksmith occupation and a female with pottery occupation. Smithing is to pottery making like husband to wife (R. Haaland 1985). We here find a similar linkage between potters and blacksmiths as we did in Ethiopia.

THE FIPA OF TANZANIA

The Fipa people inhabit west Tanzania in the mountain plateau east of Lake Tanganika. They are one of many Bantu speaking peoples in the area. The Fipa practised iron smelting until some 50 years ago[3]. Studies of the Fipa people and their iron production are quite extensive and probably more fieldwork has been carried out among these people than among most other groups. Wyckaert already described many features of Fipa iron smelting technology in 1914. Later contributions include Greig 1937, Wise 1958a, b, Willis 1978, 1981, Wembah-Rashid 1973 and Barndon 1992, 1996a, 1996b, 2001) As described by Brock the neighbouring Nyiha apparently had a very similar type of iron smelting

technology (Brock 1965). The above-mentioned publications as well as my own fieldwork (of July 1991) make it clear that the symbolic aspects of iron working is quite a pronounced part of their iron smelting (G. Haaland et al. 2002).

This is exemplified in Wyckaert's (1914) account of Fipa explanations of cases of failed iron smelting: "What does the chief do then? Does he check his ore if it is good quality? Does he check his flux to see if it is suitable to the quality of the ore? Will he try to find out if some natural cause has upset the operation? Occasionally yes; he will ask himself questions. Ordinarily, no! He will simply say with resignation, 'some spirits does not want this. Let us appease him with a sacrifice'. Or else he will say with resignation: 'My medicines are not worth anything anymore, let us find some others'. And he will really work very hard at coming up with rarer bones and more extraordinary feathers and the skin of even nastier snakes. Most often he will cry angrily, 'Again our women are behaving badly in the village"' (Wyckaert 1914:375, translated to English in van der Merwe & Avery 1987). I will very briefly sketch the outline of the Fipa smelting and ideology and will refer to the above-mentioned work for further reading, also see G. Haaland et al. (2002).

The Fipa iron smelting is technologically quite different from the two cases described. It takes place in a two-stage process, the first stage in a tall chimney like natural draught shaft furnaces (Fig. 5), where the ore is crudely smelted, and the second stage in a small 0.5 m high furnace where the slag is separated from the iron bloom by tapping the slag through a small opening at the base (Fig. 6). The natural draught furnace is 3 m high and around 2.5 m in diameter at the bottom. Ten holes which serve as ventilators are made at regular intervals at the base. The large opening is called the father door and a smaller opening opposite is called the mother door. Tuyeres are placed inside the furnace in such a way as to catch the air draught. The labour-intensive part here is to make the large furnace and the necessary large quantities of charcoal. After the furnace is filled with ore and charcoal it is lit from the top, and the smelting lasts for a night and a day. The bloom, consisting of charcoal slag and iron, is then put in the small furnace with more charcoal added, where three men blow the bellows from the top. It takes around four hours for the outflow of slag to start through the opening at the base.

The Fipa smelting operation is technologically quite complex and labour-intensive. In the context of both furnaces there is a strong ritual emphasis on sexuality. The large one is explicitly talked about as a virgin and a bride, while the small furnace is said to be like a woman giving birth. Inserting the tuyeres into the furnace and blowing of the bellows was explicitly associated with "heavy breathing during intercourse". One can see how iron smelting is seen as analogous to the reproductive act, particularly since the furnace is shaped like the female body, with thighs in the form of two clay lumps between which the red hot slag is channelled and flows. The Fipa people quite explicitly make the metaphoric connection between biological reproduction and the cultural production of iron.

Smelting thus takes place not only in a context of rich sexual metaphorizations; it is also surrounded by taboos imposing constraints on mixing the fertility of women with the fertility of the kiln. The blacksmith is prohibited from having sex during the smelting process. The compulsory celibacy for the smelters makes sense against the background of symbolic identification of the furnace as the wife of the smelters and the metaphoric association of smelting with sexual intercourse. Sexual intercourse with "real" women is looked upon as committing adultery towards the metaphoric furnace wife.

If we look at the transformative aspects involved in iron smelting they do not seem to have served as a source of metaphorical symbolization like we saw among the Fur. The transformative aspects of iron working are expressed through the smith's role in his

Fig. 5. *The large furnace is made ready for smelting among the Fipa. Photo R. Haaland.*

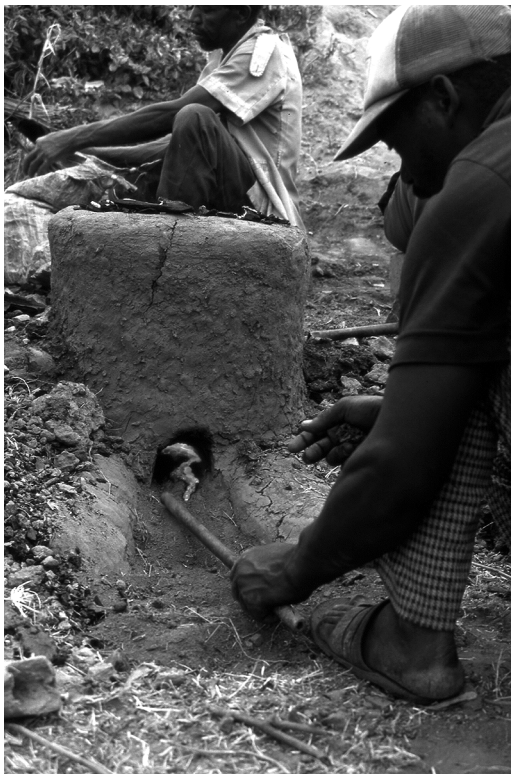

Fig. 6. *Slag is starting to flow from the small blast furnace. Photo R Haaland.*

ritual functions in the investiture of the king. In the interlacustrine area there also seems to be a strong association between iron working and leadership. This is often expressed in the idea of the king smith. This does not necessary mean that the king was a smith, but as de Maret states, they had an ideological-political link with iron working (de Maret 1985). This link is expressed, among other things, in the close association of the king with the main tools of the smithy (not the furnace) – the hammer and the anvil – e.g. manifested in the use of such items in the investiture of kings (Sassoon 1983) or in kings' grave goods (de Maret 1985). It is tempting to interpret this as based on an association of creation (forging) of power in the political field with the forging of tools in the smithy.

NEPAL

I will here very briefly refer to the ethnographic case study of iron working which takes us to Nepal[4]. The technology of smelting is based on a thin walled (8–10 cm thick) clay shaft-like furnace (c.120 cm high). A pit 90 cm wide is dug with a trench 120 cm long for tapping the slag (Fig. 7). They have two holes at the base of the furnace for inserting the tuyeres. The smelting takes around 11 hours. The smelting is also here regarded as an act of procreation and the furnace is seen as female, where gestation takes place. The smith has to refrain himself from having sex with his wife during the smelt as this is considered an unfaithful act towards the furnace, which symbolically is his "wife". If one did not observe these sexual taboos, one would enrage the ancestors and thus risk ruining the smelt. A symbol of the very sexual act of smelting is suggested by the fact that the smith is naked while inserting the tuyeres into the furnace. Tuyeres are termed tora, which is a slight modification from the Nepali term for male genetalia, which is turi. The blowing of the tuyeres is seen as "heavy breathing during intercourse".

The sacrifice, however, seems to play a more important role. One sacrifices to the god

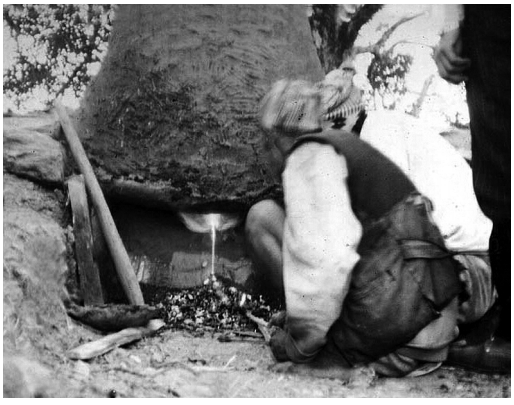

Fig. 7. *Slag is starting to flow from the shaft furnace, from the village of Loharkot, Nepal. Photo S. Rijal.*

of the mines, to the goddess of the forest, and to the furnace, before one starts the different activities, from mining, to charcoal burning, to smelting. A key element of the sacrificial ritual is the sprinkling of the blood of the animals killed. The transfer of blood symbolizes the transfer of life. After the sacrifice the smelters who perform the sacrificial ritual eat some part of the animal.

Comparing Nepal with the African cases described earlier, there are striking similarities, particularly with regard to metaphoric associations between furnace and women, smelting and sex. We have argued elsewhere (G. Haaland et al. 2002) that these similarities are all constructed on the ideas related to transformation.

CROSS CULTURAL PERSPECTIVE ON IRON SYMBOLISM

As our case studies have shown, objects and activities involved in iron making cannot be distinguished as being either symbolic or technological. The symbolism and the technology should rather be analytically separated as different aspects of the same empirical phenomena – in some cases the symbolic aspects play a dominant role in shaping their form, in others the technological aspect, e.g. blowing the bellows can be seen as a purely technical operation in the transformation of ore to iron but it is also a symbolic event communicating something to spectators about the social identity of the blacksmiths as well as the linkage of the activity to wider systems of symbolization. Similar arguments have been put forward by several researchers who have worked within African Archaeology (Cline 1937, Childs 1991, Barndon 1992, Herbert 1993, Reid & Maclean 1995).

EUROPE

This differs from European research traditions involved in the study of iron making. European archaeology has generally emphasized the technological aspects of iron production and has therefore mainly drawn on insights from technological sciences. This is not only due to our western mode of thought but is to a large extent affected by the lack of ethnographic material and studies where one can observe iron production in its social context. Consequently one has focused more on insights gained from experimental studies of iron working. These types of studies can give us an indication of how the technology of iron production worked (Gilles 1956, Tylecote 1980, Craddock 1995, Nosek 1985, Crew & Salter 1991, Bielenin 1992, Espelund 1999). The symbolic and ritual aspects cannot be replicated in such studies. However, in European cultural traditions one has a large store of myths, legends and folktales built around the magic and rituals of the smith, iron and iron working. In the European archaeological traditions, particularly the so-called prosessual tradition, this rich material has not been much exploited. Yet since the industrial revolution a gulf has opened between material science and religion. "The general unwillingness of archaeo-metallurgists to see prehistoric metal artefacts as anything other than the remnants of scientific experiments in some cumulative, progressive and rational development sequence – leading from the first tentative chemical flame-test, through copper, bronze and iron metallurgy, onward and upward to the achievements of aerospace industry – is linked to a intra-disciplinary divide between archaeological scientist and socio-cultural archaeologists and anthropologists" (Budd & Taylor 1995:134). The modern notions of economies of labour and the value of the produced materials is dominant – we use terms like metallurgy, industry technology, production centre, etc. What Budd and Taylor call for is putting the magic back. They argue that metal making was a non-scientific business, in which the various activities related to ritual and magic was important and interwoven in such a way that it could not be distinguished as technology or magic.

When we start to look at the archaeological

material from this perspective we can begin to detect features that indicate the use of ritual and magic. A very interesting example from the classical period in Greece is a black figure vase painting from Vulci depicting a furnace with a mask attached to the front. It is not clear what type of furnace it is, but Faraone (1994) suggests two possible interpretations: it can be seen as an effigy of a fire demon or it may have been used in a ritual to protect against the evil eye (i.e. to protect the smelt similar to our example from west Sudan). The point is that when we start to look for the aspects of metal working which cannot be looked at only from a technological perspective we will probably find the material to be quite rich. For those of us who have worked with ethnographic material especially from Africa there is no need for putting the magic back since that aspect has been recorded and discussed in studies since the beginning of this century; see Wyckaert (1914) and further elaborations in the cross-cultural study by Cline (1937), and as our case studies show. Green (2002) has looked at how Plutarch in the second century AD describes a ritual event supposedly taking place in fifth century Greece, which shows how iron is taken as a metaphor for fidelity in ancient Greece. She discusses the archaeological material from Iron Age Europe, which she describes as showing a symbolic attitude to iron. She looks at the ritualized treatment of iron objects, which includes breakage and special deposition in watery or cult places during the Iron Age. Most spectacular here is the find from Illerup in Denmark, dated to AD 200–400, with masses of intentionally broken iron weapons (Hvass 1980, Hedeager 1992). Green (2002) thinks it is significant to see how the divine smith is frequently depicted in Gallo-British iconography. She refers especially to an image of a smith-deity on a Roman potsherd, found near Huntington in central England. Green sees iron production as being fundamentally different from that of gold, silver and copper-alloy: "the package or constellation of experience in which the craftsman was involved arguably fed into cognitive perceptions associated with transformation, boundary-transgression and supernatural intervention, all of which fall within the remit of religious practitioners, particularly those with a role as visionary mediators between earth and spirit-worlds.. . . Their work was undoubtedly hedged around with rituals" (Green 2002:16). She also underlines the dual nature of the blacksmith.

A common theme within European literary and folklorist traditions is the twilight nature of the smith – Welend, Gueland, Vølundr, known through the north and west of Europe as the master of smith-craft, may appear as wise and honourable and as father of a heroic son, but also as dangerous and fierce opponent in the cruelty of his excessive vengeance. The artisan of mythology is often vital to creation and defence of cosmic order. Yet he may be like the Greek smith god Hephaistos, grotesquely shaped and subject to derision (Motz 1977:14). We find Vølundr in the Norse texts as Volund the master smith who could change shape like the shaman to mediate between human society and the supernatural world (Hedeager 2001, Simek 1993).

Hedeager has looked at the Scandinavian material and sees Volund's position as a good illustration of the smith's position in the cosmological world of the Old Norse text. Volund is not a dwarf, but he is no human being either. His forge is situated on an isolated island and he is set apart from society, and he possessed magical power. Hedeager (2001:491) refers to another "personified" smith Regin known from the great epic cycle of the Volsunga Saga. Regin is the smith who knows to forge a sword with the necessary magical power to kill Fafni, and he knows the right magical acts to perform before the fight can be successful. Regin is not part of human society: he is a liminal figure who belongs to the outside world. The common trait which comes across here is that the smiths, whether dwarfs or men, belonged to the outside male world by way of their magic; the objects they forged were essential

to the power position of the elite, whether gods or kings (Hedeager 2001:492).

By using perspectives from these Norse myths Hedeager interprets the specific archaeological material from Gudme. Gudme is a "central place" located at the Danish island of Funen. It is dated to the 2nd–6th centuries AD. At the site archaeologists recovered what is interpreted as a Chiefly Hall with a High Seat, a place related to divine and royal power. Hedeager has drawn attention to the close association between the great hall and the very rich metal finds. She is critical to the traditional archaeological view, which sees workshop areas as marginal to social and political power. She, however, sees this as an integral part of political and religious power, intimately linked to ideals of royal authority. If one follows the Old Norse mythology one would expect to find the workshop close to the hall. As quoted from Hedeager "By focusing on Gudme as a symbolic constructed place that represent specific concepts of cosmological order, I have tried to extend the explanation beyond the traditional references to 'trade', 'power', 'richness' . . ." (Hedeager 2001:506).

Burstrom (1990) has in a similar way combined archaeological finds with the ideas conveyed in the Old Norse myths. Iron slag is frequently found in Viking Age burials; the slag is found both deposited as grave goods and in the earth filling of the graves (Burstrom 1990). The earlier research on the topic was interpreted as an expression of the economic importance of iron production (Baudou 1963). However, Burstrom looks at it from a religious perspective, but as he points out, both explanations are probably valid, but it would be wrong to look at it only from an economic-technological aspect. He argues that we should try to get an understanding of the ideas underlying the process of iron working during the Viking Age. If we find remains of iron production outside the functional area where the iron working took place, we should try to examine the possible meaning of the material outside the production area. It is from this perspective that he looks at the numerous finds of iron slag from the burial context. He then goes on to look at archaeological material as it is manifested in the Runic stones to see if we can relate this to Norse myths. Based on the sagas, like Hedeager (2001), he focuses on the role of the dwarf-smith Regis as it comes across in the Volsunga saga. The smith has a supernatural power to wield a sword, which the hero Sigurd Fåvnisbane can use to slay the dragon Fåvne. There are seven runic stones, which he interprets to be "Sigurdsristningar"; they show a man slaying a dragon with a sword. The several runic stones with this motive and the many myths which have as a central theme the supernatural power of the smith are strong indications of the ideas that the smith in real life was endowed with supernatural/magic powers. Burstrøm furthermore points out quite an interesting archaeological find of a forge stone from Jutland, in Denmark from the Viking period. The forge stone[5] has the practical function of protecting the bellows from the strong heat of the forge. This stone depicts an image of a man with a stitched up mouth; Burstrøm relates this to the tale of Loke in Snorri's Edda. This is the long tale of the creation of Thor's hammer, Mjølnir, and it ends with the story of Loke losing it and then being punished by the dwarf smith Sindre by getting his mouth stitched up.

Burstrom has shown in his approach how one might use the mythology of the Vikings as it is presented in the Sagas. In his approach he sees iron production as a kind of ritual where the transformative character of the activities are central, transforming ore to iron – nature to culture. In this technologically complicated process of smelting iron, for it to be successful one had to perform certain rituals/magic to be able to succeed. It is in this light he sees the use of iron in burials as an important symbol of transformation, as is the transition from living to the dead, manifested in the burial, a similar view has been presented by Farbregd (1993).

Calissendorf (1979) touches upon similar

material when she looks at place names such as smed-or smedja, smidr which was popular as a personal name and appears on runic stones in phrases such as "raised this stone for his son "Smed" She takes this to indicate that the smith held a respected position, as the possessor of supernatural power. The transformative aspects of the smith's activities are also probably reflected in that their names are written on the runic stones, commemorating the dead. Their status transformed to the world of the dead. The Icelandic sagas written down in the high Middle Ages refer to iron in several ways. The numerous names for battle were jarnleikir (iron games). I believe that there is a great potential of getting a better understanding of the metaphorical cosmology surrounding iron and its work by looking at terminology used for the different objects[6].

A common theme throughout the Germanic world seems to be related to the tales of master smiths who learned their art from the dwarfs, and this is often linked to the supernatural power and invincibility of some weapon. The powers ascribed to the smith's tools are considerable. This applies especially to the smith's hammer. The hammer is seen as the symbol of the smith and the thunder or fire god Thor (Forbes 1950:83). I see the symbolic importance of the hammer as reflecting the importance of the smithy: the main tools of the smithy are the hammer and the anvil. It is tempting to see an association of creation (forging) of power in the political field with the symbolic use of the smithy, as suggested by Hedeager above (2001).

In folktales the blacksmith can rise as a potent force against the devil, able to trap him, but he is also pictured as one in alliance with the evil one to whom he has sold his soul in payment for magic powers[7]. It is plausible to assume that such ideas are related to the transformative nature of their work. Lotte Motz sees the double nature of the blacksmith, as does Green (2002), to reflect the double nature of the material in which he works, the menace or the blessing brought by the iron, by the ploughshare and the sword, by producing the means of production and the means of destruction. (Motz 1977:14).

In legends and myths in the European traditions we encounter the smith as set apart from the community, exemplified in his location in the depth of the mountains, earth or water, or on an island as quoted above. The smith god of the Greeks commands a smithy in the ocean, while the Latin Vulcan (the Greek god Hephaistos) rules the fires of Mount Athea, and the Irish Lom mac Liomatha lives within a cavern. This is the legendary smith (Motz 1977). However, the blacksmith as a craftsman does not seem to have been set apart in the farming community such as we have seen in Africa or the Indian sub-continent, where we saw the caste and caste-like features associated with persons performing this craft. When we meet the artisan in the historical sources in the Germanic world he seems to be integrated in the community mostly as a farmer, working part-time and seasonally.

If we have a closer look at the archaeological material from Norway, we find indications that ritual activities were performed at smelting sites. From the site of Stordalen in Trøndelag, smelting was taking place in the shaft of a furnace with a slag pit, and after completing the smelting activities, the shaft seemed to have been pulled down, and the slag pit closed with a flat slab of special slate. Such a closing of the pit does not seem to have had any functional purpose. Can this be seen as a symbolic closing of the pit and as a way to conceal knowledge, secret knowledge that was imbedded with symbolic meaning (Rundberget 2002)? The idea of a ritual destruction of shaft furnaces has also been proposed by Pleiner (2000).

In classifying furnace types, an important criteria has been to distinguish between the use of slag pits and slag tapping. The advantage of slag tapping is that it can be operated continuously over extended periods, thus economizing on fuel and raising the total output (Rostoker & Bronson 1990:31). The furnace with slag pits is thus technologically

simpler and they are found to be the oldest. This is a general pattern (see Tylecote 1987 for further references); we see the same pattern in Norway (Stenvik 1991, 2003). One has assumed that the technologically more advanced slag tapping furnaces were, over time, replacing the furnace with slag pits. This does not seem to take place; a case in point is Norway (Narmo 1997). We see the same pattern in England; while during the Roman period slag tapping was the main smelting technique, one finds that with the migration of the Anglo-Saxons from Jutland the furnace with slag pits were re-introduced again (Tylecote 1987). The discussion above illustrates what John Alexander underlined in his article from 1983, that by using the evidence from Africa we will also have to take into account religious, social and political factors, not solely the economic or metallurgical ones, when interpreting iron working material.

COMPARATIVE PERSPECTIVES

Smelting is, as we have seen in the ethnographic cases, hedged by restriction – taboos and protection against evil eye – which serve to surround it by a certain amount of secrecy or separateness. The most fundamental feature of the concrete processes taking place in the furnace is its transformative character, and the most striking feature of the objects and activities involved in this transformation is their potential to evoke association of sexual intercourse and gender imagery. The three features of separateness, transformation and gender associations are given saliency in iron symbolism "spun" around the furnace. The question is, for what purpose do people spin it? Looking at the African material it is strikingly clear that this symbolism to a large extent occurs in other domains of social life – most importantly domains related to status transformation which usually involve social separation of some kind; the blacksmith's wife may be the midwife as among the Mafa and Mande of West Africa (Podlewski 1965, Ardouin 1978); the blacksmith may be the circumcizer as among tribes several tribes in West Africa such as the Soninke, Malinke, Bamana, Fulani, and Mande (Wente-Lucas 1972:136, McNaughton 1988:67, Tamari 1991:230); the blacksmith can be involved in investitures. All such transformations, particularly initiation from child to adult, imply that continuity in the community's status structure is brought about by transformations of individuals' status repertoire. Such transformations are generally ritualized in forms that serve to encode in the initiands a taken-for-granted view of the necessity of the dramatic changes in behaviour which initiation brings about. The association of the blacksmith with secrecy, with transformations from nature to culture and with psychogenetic sexual associations connected with the furnace, involves attributes which are consistent with those required by ritual experts bringing about the social transformations in rites of passage.

The most prominent feature of European smithy imagery seems to be related to the domain of cosmology. If one can perceive the universe as created by human-like gods, the forger is an excellent image of the act of creation. From that kind of imagery the connection between natural phenomena, like lightening and thunder, can easily be linked to imaginations of the forging activities of a creator god.

CONCLUSION

My concern in this article has been to look at material from European iron working beyond the technological-economic factors, to get an understanding of the ritual-symbolic factors influencing iron working. In order to explore this I have presented ethnographic material from four different regions, which shows the significance of the symbolic metaphorizations surrounding iron working activities. For an observer of iron smelting, associations of sexual intercourse are easily evoked as tuyeres are inserted into the body of the

furnace by the male blacksmith and as the bellows are blown. With the slag coming out of the tap hole, the association of this with women giving birth to the iron bloom is also obvious. The dominant feature in our four ethnographic case studies is thus the transformative aspects of iron making. This is also what comes across in European myths and legends as well as in the context of archaeological material. The transformative aspect of iron making is so striking that one might expect that people in different cultures would link it to other transformative processes experienced in nature, not only transformations taking place in a woman during gestation but also transformations taking place in a society during rites of passage, as well as in the world of imagined transformations such as people transforming themselves to animals or being half human and half animal. The question is what people in specific communities make out of such associations in terms of specific symbols.

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NOTES

[1] Fieldwork among the Tsara in south-west Ethiopia was carried out by Data Dea, Gunnar Haaland and myself in March 2000. It is important to underline that even if people are still smelting in this area (they do it on a yearly basis), in contrast to the three following case studies, where smithing had not been done during the last 50 years, it was still work that we commissioned. We asked the smith to demonstrate the smelting process for use. We provided the necessary food and alcohol, which was needed to smelt. We did not see the construction of the furnace since this was re-used and could last up to five years with minor repairs.

[2] Fieldwork among the Fur people in West Sudan was carried out by Gunnar Haaland and myself in 1972 and by myself in 1978. The work was commissioned since we paid the participants food and drinks, which was needed, for smelting was done as a work party. We were able to see the smelting process with the construction of the furnace on both occasions.

[3] Fieldwork among the Fipa in West Tanzania was carried out by Randi Barndon and myself in July 1991. The work was also commissioned and the smiths were paid food and drinks for doing the smelting. I did not record the construction of the tall natural draught furnace, since this was a furnace re-used several times. My discussion is based on the observations by Greig (1937), Wise (1958a), Wembe-Rashid (1973) and Barndon (1992). I did observe the construction of the small smelting furnace and smelting in both furnaces.

[4] Fieldwork in Nepal was carried out by Suman Rijal in 1995 and 1998. Rijal first wrote his Master thesis based on the fieldwork he did in the Jajarkot village in central Nepal. This thesis was submitted at Tribuvhan University. The second set of fieldwork was in the village of Lohakot in Eastern Nepal. The work was submitted for a Master thesis in Bergen in 1998. Most of the work in this article is based on the fieldwork in Lohakot; his first fieldwork was a technological study, while Rijal in his second study focused on the symbolic and ritual aspects of iron smelting. In both cases he observed the construction of the furnace and the whole smelting process. Again it is important to mention that the iron working was commissioned like the above studies. I supervised Rijal for his thesis in Bergen and Gunnar Haaland supervised his thesis at Tribuvhan.

[5] The forge stone was made of soapstone from Norway.

[6] One should note that the Norwegian word for tuyeres is “avlstein” which literally translated means the breeding stone (personal communication, Bjørn Myhre, April 2002).

[7] Norwegian folktales published by Asbjørnsen and Moe the smith is described as the only person who can expose the devil who has transformed himself into a worm and hide in a nut.

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