

# Beeswax in metalworking in Viking Period Gotland

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Beeswax was an important trade good in the Early Middle Ages. Due to its primary uses though, for metalworking and in candles, very little of it survives in the archaeological record. This paper discusses the use of beeswax on Gotland in non-ferrous metalworking and presents two recently dated major finds of beeswax from the island. Radiocarbon has shown that both belong to the Viking Period.

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Trade in commodities plays an important role in most works on Early Medieval Scandinavia. Weapons, furs, timber, beeswax, glass beads, textiles and slaves were among the goods that, based on contemporary accounts, were traded by and among Scandinavians. As pointed out by Helene Clarke (1985, p. 118), very few of them are likely to have survived archaeologically. As an example she highlighted the discrepancy between written accounts and archaeological finds in England, where 13th and 14th century taxation records for incoming goods are preserved. They include a large number of import goods that, had it not been for the accounts, would have been unknown to us. If this situation is transferred to earlier trade, for which no detailed accounts exist, it is obvious that the scholarly perspective on trade risks focusing too much on luxury goods that are mentioned in contemporary accounts and underestimating the importance of more basic goods that are not mentioned. This is important as most of the trade goods, basic and precious alike, have rotted away, corroded beyond recognition or simply become vapourised. In the following I will focus on a trade good from the latter group: beeswax.

Early trade in beeswax is mainly known through

eastern sources that mention it being exported out of present-day Russia (Warnke 1987; Androshchuk 2013, p. 51). Given that beeswax, in later Medieval sources, is mentioned in connection with westbound trade from the Baltic Sea (cf. Galton 1971a, p. 60; 1971b) it is generally assumed to have been traded westward during earlier periods as well. From the 10th century onward, wax was generally connected to the massive need of candles in churches and other religious institutions (Crane 1999, p. 599 f). In Scandinavia, this practise was less important before the mid-11th century, though a number of 10th century wax candles have been found: e.g. in burials at Jelling (Krogh & Leth-Larsen 2007, p. 68 pp) and Mammen (Leth-Larsen 1991) in Denmark and Gniozdovo in Russia (Avdusin & Puskina 1988, p. 22). Instead it is probably safe to say that the most important use for wax in the period was metalworking, specifically casting in the lost-wax technique (*à cire perdue*).

## *Beeswax in Gotlandic metalworking*

Beeswax is one of the dark horses of early metalworking. Its plasticity and low melting point make it ideal for transforming a positive representation

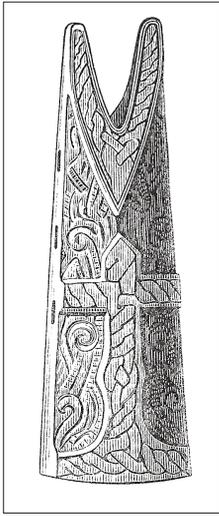


Fig. 1. Fish-head pendant from Öja parish on Gotland (SHM 2370). Drawing by Carl Fredrik Lindberg, after Montelius 1874.

of an object into a negative mould imprint. The wax is easily sculpted in three dimensions and just as easily melted out when the mould is fired and made ready for casting. This is, of course, also the central problem: wax used in metalworking is melted and re-used or vaporised in the process. It has recently been argued that wax played a much lesser part in casting than assumed in earlier works on metalworking – instead, master models or extant objects are said to have been used to create the negative imprints needed in mould making (cf. Söderberg 2001 w. refs). To some extent this is clearly true: reduplication was an important principle in the Viking Period. Some types of objects, like dress jewellery, can even be considered as mass-produced.

This does not necessarily exclude the use of wax though. Making certain objects actually required it. This is especially evident in the production of hollow objects. One example is cast fish-head pendants (Sw. *fiskhuvudformiga hängen*). In the 10th century such pendants (fig. 1) were largely mass produced – a normal set of pendants typically seems to have included 15–20 pendants mounted together as a semi-circular collar (Thunmark-Nylén 2006, p. 199 ff). Thanks to a find from Klints in Othem on north-eastern Gotland (SHM 34663:61), along with extant pendants in various stages of completion, the line of production can be reconstructed.

The Klints piece was first reported as half a pendant, but further study showed that it is actually a master model for the front face (Gustafsson 2011a, p. 95). As the finished pendants are hollow, the master simply cannot have been used to create moulds on its own; the hollow centre was created by means of a clay core. Several extant pendants show how this was achieved: the core piece, made from mould loam, was fixed by means of a number of strategically placed iron spacers. These held the core in place and allowed molten copper alloy to enter in between the outer mould, which carried the negative imprint of the master, and the core. This may sound simple in theory, but in practice it demanded wax. The master model could not, as with masters for flatter objects without under-cut details, simply be pressed into soft mould-loam to create a casting cavity. Instead it must have been placed on a flat surface where soft, fine-grained clay was pressed down over it. The master was then removed and the negative imprint in the clay coated with a thin layer of wax, probably by pouring molten wax in the cavity and allowing it to solidify briefly before pouring the excess out. The result would be a copy of the master, a front half of a pendant – in beeswax.

The wax model was then removed from the clay, either by peeling the latter off or simply by putting it in water where the unfired clay would dissolve. (The Klints master probably came with a master for the back of a pendant. Unfortunately it has not been recovered; the site at Klints was badly damaged by illegal landscaping during the extension of a golf course, and most finds were recovered by metal-detection of bulldozed top soil – Pettersson 2005.) The next step was to fit the front and back wax halves together, creating a complete wax version of a pendant. This was followed by the first stage in the production of the physical mould: filling the hollow centre of the wax model with mould loam to form a core. If the wax pendant had been embedded in mould loam at this stage the resulting mould would not, however, have been suitable for casting. To accomplish this, the aforementioned iron spacers had to be added. They were probably applied to the wax pendant right after the core had been inserted. Normally, one short spacer was placed at the bot-

tom of a pendant and one, longer, through the middle. The spacers were made long enough to protrude outside the wax model. This allowed them to be embedded in the outer layer of mould loam which was used to cover the wax positive. An un-fired pendant mould thus included, from the inside out: A) clay core, B) iron spacers, C) wax positive and D) outer mould (fig. 2). When the mould was fired the spacers kept the core in place and the cavity left by the lost wax was thus open to receive the molten metal. This reconstructed line of production is supported by the fact that many pendants retain spacers lodged in the surface. Sometimes it is also possible to observe remains of fired core clay adhering to the lower inside corners of damaged pendants. This serves to illustrate the line of production of one type of object where beeswax was necessary for the desired result.

Another Gotlandic example is a set of five cast yet unfinished sword pommels from Mästerby (Gustafsson 2011b). Through 3D scanning it has been established that one of the pommels was used as a master model to create wax positives for the other four. Since they are all hollow the same technique as with the pendants had been used, but due to thermodynamic shrinkage in wax, mould and metal (cf. Lønborg 1994, p. 154) the copies are all c. 5–6% smaller than the original pommel. In the 3D rendition of the pommels it is also quite clear that they were cast from wax positives, as the seams between what was once two halves are clearly visible.

#### *Two finds of Viking Period beeswax*

After the above, it seems safe to assume that there was great demand for beeswax among Gotland's metalworkers, and that the wax was largely reused or vaporised in the line of production. However, there are two major finds of beeswax from the island. The first is in the Swedish History Museum (SHM 11120), and measures when re-fitted 195 by 105 mm at its widest and is 30 mm thick. The present weight of the piece is about half a kilo, but it must once have formed part of a much larger circular cake, about 400 mm in diameter. It was found in Halla parish in Starrar, a drained fen on central Gotland, before 1900 when it was added to the collections.

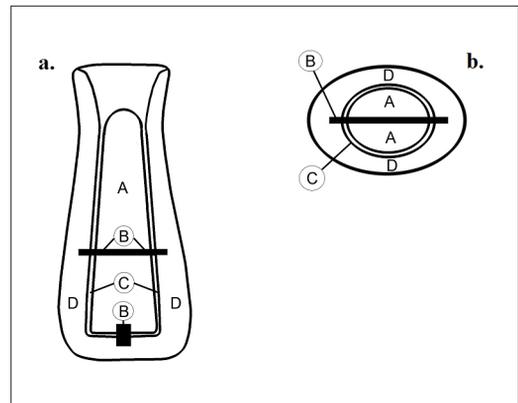


Fig. 2. Schematic cross-section of a mould for a fish-head pendant: a) vertical, b) horizontal.

The second find, in the Gotland County Museum (GF C9903), is a much larger cylindrical block with a diameter of 330 mm and a height of 110 mm, weighing 11 kg. According to the museum inventory it was found in Mästermyr fen on southern Gotland in 1951. This fen was once a vast wetland, large enough to stretch through seven parishes. Sadly, the brief entry on the find location and the year of recovery is all that is known about the find. It should be noted that in 1936 Mästermyr fen also yielded a rich and intriguing tool hoard (Arwidsson & Berg 1983). It is tempting to associate the two finds with each other, but due to our lack of contextual information on the wax find there is nothing to imply a connection. Why beeswax was originally deposited in wetlands is unknown. If the usual ritual perspective is left aside, a more practical reason may have been to safeguard the material from mice and other pests.

The two Gotlandic wax finds are both single finds and thus they cannot be dated by context. Still, catalogue entries in the Swedish History Museum refers to the find from Starrar as “potentially Bronze Age or High Medieval”. The Mästermyr block is displayed in the High Medieval section of the Museum's exhibitions. As a comparison, there is another block of beeswax from Sweden, weighing 13 kg. It was found in Lund, Scania in 1938 (KM 39273; Mårtensson & Wahlöö 1970, p. 112). It has not been dated but was found

in a charcoal-rich layer together with sherds of Baltic ware dating from the 11th or 12th centuries (Kjellberg 1947, p. 43 p).

Beeswax is eminently suitable for radiocarbon dating as it has a low intrinsic age; it is secreted by bees in a hive and the included  $^{14}\text{C}$  immediately starts to decay. Additionally, even though the amount of wax in the two Gotlandic pieces must represent a large number of hives, it is probably safe to assume that it was collected over a short period. I had the Gotlandic finds sampled for radiocarbon dating in 2014. The results were surprisingly similar: with over 95% likelihood both wax blocks were produced in the period 890–1030 cal AD (Possnert 2015). The block from Mästermyr (Ua-50647, 1068±30 BP) might be 5–6 years older than the one from Starrar (Ua-50648, 1062±30 BP), but both are without doubt from the Viking Period. According to the analyses they either date from 900–920 cal AD (10.3% and 6.2% probability for the Mästermyr block and the Starrar piece respectively) or 970–1020 AD (57.9% and 62%, respectively).

Regardless, they both originated in a period when non-ferrous metalworking thrived and large amounts of beeswax are likely to have been consumed on Gotland (cf. Gustafsson 2013). They thus offer important insights, both into how the wax used by Viking Period artisans once may have reached the island (the intact block from Mästermyr) and how it was further divided as it was used up (the Starrar piece). As to their geographical origin, further laboratory analyses might help to answer that question. Many written accounts point, as mentioned above, towards the Baltic States and western Russia as centres of early beekeeping.

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## Summary

Beeswax is one of the commodities that are often mentioned in discussions of Early Medieval trade in Scandinavia. Due to the nature of its main uses, in candles and metalworking, beeswax is rarely found archaeologically. In Scandinavia, prior to c. AD 1050, most wax was presumably used for the latter of the two purposes, in preparation of casting moulds according to the so-called lost-wax technique (*à cire perdue*). The plasticity of beeswax made it well suited for sculpting the intended objects, and its low melting point meant that it was also easy to melt it out of the casting moulds when these were fired and made ready for use.

The role of beeswax in non-ferrous metalworking has to some extent been disputed. Simpler objects may well have been produced without

the use of wax. For some object types however it was essential, in particular for the casting of hollow items. Early Medieval Gotland was a centre of non-ferrous metalworking, and its artisans must have been dependent on a steady supply of imported wax. Two major finds of beeswax have in fact been made on the island. The age of these finds, one from the drained fen Starrar in Halla parish on central Gotland and one from an uncertain location in the once vast Mästermyr fen in the south, has been unclear. Radiocarbon dating has now established that both are from the Viking Period (890–1030 cal AD, 2 sigma). The geographical origin of the wax is uncertain, but period sources point to the western parts of present-day Russia as a core area for early beekeeping.