Marks of Fire, Value and Faith

Swords with Ferrous Inlays in Finland during the Late Iron Age (ca. 700–1200 AD)

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+VLFBERHT+

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1. INTRODUCTION

1.1. A brief overview of the development of the sword

The sword is a weapon with a long history. The first swords made of metal were developed during the early Bronze Age, launching a long evolutionary series of forms and styles in different geographical areas that continued through the Iron Age and into later times. Naturally, a sword is a weapon of war and duelling, but in prehistoric Europe it could have had multiple meanings. It could reflect wealth, status or power. Swords could also have symbolic meanings attached to religion or folk beliefs, or they could even be attributed with miraculous properties.[1] Throughout the Iron Ages the development of swords reflects changes in fashion and style and combat techniques, along with the development of iron-working skills.

This study focuses on the last stages of sword evolution during the Iron Age. From the Merovingian period (circa 480–720 AD) onwards,[2] changes take place in the material and shape of blades, as well as in the shape and decoration of hilts. The double-edged blade became standardized so that the length of the whole sword with a one-handed hilt was about one metre, commonly slightly less. Blades were equipped with one central fuller, the width of which was roughly one third of the blade width. The fuller is a shallow groove running lengthwise on the blade and making the blade lighter and stiffer. Pattern-welding, already developed during the Celtic La Tène culture phase (ca. 450 BC to AD 1),[3] was at its peak during the Merovingian period. Pattern-welding was used to compose the fullered sections of the blade, while the cutting edges were of better-quality steel. The area of the Lower Rhine is traditionally considered as the sword-smithing (and pattern-welding) centre of the Merovingian and the Carolingian Empire.

The blade form that was created during the late Merovingian period prevailed also in the first half of the Viking Age (ca. AD 800–1025 according to Finnish chronology).[4] It is generally accepted that the geometry of the blade underwent a change around the middle of the Viking Age, creating larger but somewhat lighter blades which were easier to handle.[5] Both the total length and greatest width of the blade grew, although exceptions are sometimes found. The blades also tapered more towards the tip than the earlier ones, which were of almost equal width.[6] The most noticeable change occurs in the materials of the blades. During the first half of the Viking Age pattern-welded blades were most commonly used. The turning point in the manufacture of

1 *E.g. Jackson 2010.*

2 *This dating corresponds to the Central European chronology, where the Merovingian Period is associated with the Merovingian dynasty in the kingdom of the Franks. Again, the Finnish equivalent used in this work is not strictly contemporary with this European period, but only the name 'Merovingian Period' has been used to distinguish the period from the earlier Migration Era. The term 'Merovingian Period' is rather new in Finland, and the old term for the period was 'Late Migration Period'. The same period is known in Sweden as the Vendel Period. In Finnish chronology, the Merovingian period is dated to between 600–800 AD, and this dating is used also in this work.*

3 *Ellis Davidson 1962: 34; Pleiner 1993: 117–118, 122–123. In its simplest sense, two different kinds of iron or steel are welded together and then manipulated in different ways to create various patterns on the surface of the finished object. Pattern-welding is discussed below in greater detail (Chapter 5.2).*

4 *E.g. Oakeshott 1960: 142; Oakeshott 2002: 7.*

5 *E.g. Oakeshott 1960: 142.*

6 *E.g. Oakeshott 1960: 142.*

the blades was around the middle of the period, when pattern-welded blades ceased to be used, being replaced by homogeneous and laminated blades.[7]

One reason for this change could have been the development of techniques of iron smelting, which enabled the production of large amounts of quite homogeneous steel.[8] This development may also be a partial cause for the emergence and continued use of iron hilt parts. Plain steel blades could also have been cheaper and faster to produce.[9] The laminating of blades occurred in the same manner as in some Roman swords, only the materials were now better.[10] Pattern-welding did not, however, completely vanish. It was still used to make inlays on the new, homogeneous or laminated sword blades. The inlays or inscriptions are normally on the upper third of the blade, near the hilt, in the fuller of the blade. These inlays were purely decorative, being of no meaning for the functionality or properties of the sword as a weapon.[11]

The most common actual inscriptions – in Latin letters – are ULFBERHT and INGELRII, both of which have been interpreted as names of blacksmiths, with INGELRII appearing somewhat later.[12] It is generally claimed that both smithies were somewhere in the Frankish realm, from which the products spread all over Europe through trade.[13] Besides these two names, also other ones appear, e.g. LEUTLRIT and BENNO, which are far smaller in number.[14] A great number of inlays consist of unknown symbols, for example various lattices, crosses and omega-like designs. ULFBERHT and other proper names have almost without exception symbolic motifs and lattice patterns on the other side of the blade. The same kinds of patterns also appear also on swords without any names of persons. In addition, some swords have strange inlays only resembling letters. At the end of the Viking Age religious invocations and Biblical sentences appear on the blades. The most common of these is 'IN NOMINE DOMINI', 'In the name of the Lord', of which there are many spelling variants and abbreviated variations among the finds.

It must be noted that the transition from pattern-welded to inlaid blades was not sudden. This may best be seen in the few blades, which are pattern-welded and also have inlaid marks on top of the patterned surface.[15] Inlaying iron is not, however, a Viking Age phenomenon. For example, a Roman sword found in Nydam, Denmark, has a lattice-like decorative pattern,[16] which was probably made with the same methods as Late Iron Age inlays.[17] Furthermore, the changes in blade technologies presented here are not strict rules. For example, the manufacture of simple, undecorated blades can be observed throughout the Iron Age. There were also single-edged swords in the Viking Age and some of these were pattern-welded.[18] No single-edged blades were inscribed, at least not those found so far. Sometimes single-edged swords are hard to distinguish from large fighting knives, scramasaxes.

7 *E.g. Oakeshott 1960: 142; Stalsberg 1989: 14; Edge & Williams 2003: 203. According to Aleksis Anteins (1968) pattern-welding was still in use in the Baltic countries as late as the 12th century, at least in spearheads.*

8 *E.g. Ellis Davidson 1962: 17.*

9 *Thompson 2004: 118.*

10 *Tylecote 1987: 276.*

11 *As a side note, soft iron was used in inlays in 9th and 8th century BC bronze artefacts, such as sword hilts and some forms of dress accessories. Radomir Pleiner (2006: 184–185) has noted that iron was more precious metal at that time. Technologically, these very early inlays are different from Late Iron Age ones.*

12 *E.g. Oakeshott 1960: 142–143.*

13 *E.g. Oakeshott 1960: 143.*

14 *For other proper names on European Viking Age blades see e.g. Oakeshott 2002: 8-9.*

15 *See e.g. Jones 2002a: 150.*

16 *Jones 2002a: 146.*

17 *Besides Nydam, there are also same kinds of blades from Illerup valley and Ejsbøl. There has been one experimental attempt to produce the same kinds of blades (Andersen & Andersen 1991), albeit with a different and more complicated technique.*

18 *See e.g. Peirce 2002: 40–41.*

After the Viking Age, the blades continue to look as if they were made of a homogeneous steel bar. Finally, pattern-welding starts to disappear completely, while iron inlays survive somewhat longer. It has been suggested that swordsmiths had had access to larger steel blooms, which enabled the forging of the sword blade from even a single piece.[19] New, narrower blades had correspondingly narrower fullers, which contained iron inscriptions fit in the fuller. Inlaid rods seem to be non-pattern-welded iron, and they are almost half smaller than those executed in the Viking Age. The majority of the inscriptions and symbols are of Christian origin, although some maker's marks (e.g. GICELIN) and unidentified symbols also exist. After these simple inlaid iron rods, all ferrous inlays start to vanish from the material. Inlays are still made on blades, but their material is a copper alloy of some kind, silver, or sometimes even gold.[20] The technique with which these non-ferrous inlays were executed is quite different from making iron inlays, and it permitted finer work and greater accuracy. The inlaid motifs are almost without exception interpreted as Christian symbols,[21] although Latin sentences and letters in the form of abbreviations exist. These non-ferrous motifs are also quite short-lived, and as a last step of development etched inscriptions appear. Even these disappear when ridged blades come into use during the Middle Ages, leaving no fuller into which fit an inscription.

In regard to the hilts, it is notable that during the Migration and Merovingian periods the hilt became standardized to consist of four separate parts: lower guard, upper guard, pommel and grip. Both the upper and lower guards are in most cases assembled with rivets from sheets of a copper alloy and some organic material.[22] The pommel is a decorative, triangular cap on top of the upper guard.[23] So-called ring-hilt swords were typical from the end of the Migration Period to the second half of the Merovingian Period. They had a small ring attached to the pommel; first the ring was loose and later it was cast together with the pommel.[24] At the beginning of the Viking Age the materials of the hilt changed. A typical Viking Age hilt is heavy, made of iron and in most cases decorated with wires and plates of non-ferrous metal alloys. Naturally, Viking Age iron hilts were designed to balance the grown blade,[25] although the heavy parts increased the total weight of the weapon.

The youngest Viking Age sword types already begin to display a radical change in the shape of the hilt. The upper guard is missing, leaving only the pommel to balance the upper end of the sword. The pommel is sometimes decorated with grooves to make it look like it was made of two parts.[26] The lower guard becomes longer and more slender. Swords dating from ca. 1000–1300 AD are much like medieval ones, having a discoid or brazil-nut shaped pommel and very long and thin lower guards – or crosses as they are frequently called.[27] These early forms of this knightly sword hilt were probably developed in the Mediterranean area and more precisely in the Latin regions

19 *Edge & Williams 2003: 203.*

20 *For some pictures see e.g. Leppäaho 1964b: 48–63.*

21 *E.g. Głosek 1984: 107.*

22 *Normally both guards were assembled so that a sheet of, for example, bone, horn or wood was sandwiched between two cast or forged bronze or silver plates. In many cases these plates were decorated with carvings and insets, not to mention gilding. The plates of each guard were kept together with two rivets, also decorated with large ball-shaped end caps and beaded silver wire. For examples of these kinds of Migration and Merovingian hilts see e.g. Behmer 1939, Evison 1967, Hackman 1928, Lindqvist 1932 and Montelius 1924.*

23 *The pommel caps can be interpreted as purely decorative, since they were normally hollow and thus they do not have any meaning in balancing the sword due to their low weight. In addition, these small, hollow pommels had no role in the assembling of the whole sword, and thus they were not necessary considering the functionality of the sword as a weapon.*

24 *Oscar Montelius (1924) divided the development of the ring-hilt into four phases: 1. the movable ring was cast separately, 2. the ring became immovable with a separately cast loop and they both became thicker, 3. the ring and its loop were cast as one piece, 4. the ring, its loop and the pommel were all cast as one piece.*

25 *Oakeshott 1960: 133.*

26 *See e.g. swords pictured in Peirce 2002: 116–119.*

27 *For pictures see e.g. Oakeshott 1991: 28–70.*

at the time of the first Crusades.[28] A notable feature is that the functionality of the weapon seems to gain importance, making the hilts simpler and undecorated. The blades also begin to change. After the Viking Age, the blades are no longer as wide as before, and they taper more acutely towards the tip, thus making the whole blade lighter. Correspondingly, the blades gain slightly more length. It should be noted, again, that the transition was not sudden and that large Viking Age-type blades were still made and used for some time.

1.2. The background and purpose of this study

At its most general level this work concentrates on the study of iron inlaid sword blades found in Finland and neighbouring areas and dating from the Late Iron Age.[29] The terms *iron inlay* and *ferrous inlay* are used in this study to refer to inlays made of ferrous material, whether pattern-welded or plain iron or steel. Sword blades with iron inlays appear and ultimately disappear over a relatively long period, presumably ca. 400–500 years,[30] and they represent one of the most important technical developments in Iron Age weapons production and technologies. These swords display a transition from an earlier technical innovation – pattern-welding – and the birth of the medieval tradition at the same time as ferrous and non-ferrous inlays begin to disappear.

My own interest in Late Iron Age swords arose when trying to experimentally replicate the manufacture of ferrous inlays such as the ULFBERHT inscription. This led to my MA thesis in archaeology, which presented the results of an uncompleted series of experiments, with the conclusion that ferrous inlays may have been produced in different ways.[31] This point of view was quite opposite to previous claims. While studying swords for my master's thesis, I examined a large number of radiographic images in the archives of the Conservation Department of the National Museum of Finland. The radiographs had been taken quite systematically since the 1970s, including images of over half of the swords recovered in Finland. These images, taken as a part of the conservation process, presented dozens of pattern-welded and inlaid blades. However, the information yielded by these radiographs remained unpublished, since so little attention was focused on the blades in earlier research.[32]

Besides a large number of ferrous inlays, other interesting things could be seen straight away from the radiographs. Firstly, the inlaid motifs varied greatly from one blade to another. In addition to Latin words and inscriptions, there were a very large number of different symbolic and geometric motifs. The most surprising motifs were unspecific characters, perhaps imitating Latin inscriptions, since some of them included a few correctly written letters. Also the materials of the inlays seemed to vary. Pattern-welded inlays were the most common ones, but there were also plain iron inlays. Moreover, the pattern-welding was sometimes executed in a different manner, giving a different kind of effect on the surface of the inlays. Both the above-mentioned perceptions concerning the variability of motifs and materials strongly suggest the existence of multiple makers of these inlaid blades. Similarly, the methods of pattern-welding of blades showed also strong fluctuation, but the focus was on the more diverse inlays.

28 *Bruhn Hoffmeyer 1963: 12–13.*
29 *For dating conventions used in this work, see Chapter 1.4 below.*
30 *See e.g. Geibig 1991: 155.*
31 *Moilanen 2006.*
32 *Regarding the Viking Age, the interpretations of many archived radiographs were included in the Jouko Räty's master's thesis (1983). This thesis, however, has not been published. Moreover, the interpretation of the radiographs remains somewhat obscure since the majority of the archived radiographic images were single images, whereas a stereoscopic image is needed to obtain a more accurate interpretation (see Chapter 3.3).*

The very basic question is how many blades with ferrous inlays have been found in Finland. My main purpose is first to identify swords marked with iron inlays. This involves the examination of nearly all Late Iron Age blades from the study area because no complete catalogues exist of all inlaid blades. The main reason for this is that in most cases the inlays are hidden under a layer of corrosion, and researchers are therefore unaware of them. Moreover, there are no complete lists of all the swords covered by the studied time periods, which means that these lists must be created first. It must be noted here that there are very few systematic studies of Finnish Late Iron Age swords,[33] and the find material is thus mostly unknown, apart from the hilts that can be classified and thus dated typologically. Even no exact figures of recovered swords are known, and apart from the hilt types, the blades have drawn very little attention. Since all kinds of swords, even from as restricted a period of time as Late Iron Age, would be far too vast a subject to cover, I decided to concentrate on blades with ferrous inlays, since they, as mentioned above, belong to an important stage of the development of the sword. In addition, it would be impossible to deal with all kinds of swords or sword blades in in close detail and in only a single study.

The second question concerns the diversity of the inlaid motifs and the materials used in the inlays, which has already been addressed in related research in other countries, and also by the Finnish scholar Jorma Leppäaho.[34] To make some sense of the variegated find material, the inlaid motifs are classified into different categories taking the contents of inscriptions, the layouts of different motifs and the materials and manufacturing techniques of the inlays into consideration whenever possible.

It may also be possible to arrange different inlaid motifs chronologically. The earliest symbols attached to sword blades may even predate the Viking Age, because they are found on otherwise pattern-welded blades.[35] In addition, some inscriptions can be found on swords, which have pre-Viking Age hilts, as mentioned above. Here the greatest problem in dating is caused by the fact that not all the swords have datable hilts. The problems of dating must also include the typologies and various features of sword hilts, although many swords were probably assembled from parts derived from different sources and makers. For this reason, the swords are documented as a whole, and are catalogued in the appendices of this work.

Along with cataloguing and classifying Finnish find material, attention is focused on the technology of ferrous inlays as implicated by the studied finds. If inlaid blades are interpreted as being forged in Frankish smithies, are the materials and forging techniques really the same, or are there considerable differences between different blades and inlays? These questions require in turn an answer to the question of how iron inlays were made, to which experimental archaeology is used to give answers. The technique – or techniques – of manufacture have been forgotten, because the tradition of iron inlays disappeared at the beginning of the medieval era, when inlays were applied from non-ferrous metals. During the Middle Ages, inscriptions made from different metals vanished completely from sword blades in Europe. With respect to above-mentioned line of thought, the possibility of local manufacturing traditions is present. A crucial part of this work is to define different manufacturing traditions, i.e. makers, among the examined archaeological find material, or on the whole, to see if this is possible.

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33 *Studies that more systematic in nature are as follows: numbers of different types of Viking Age sword hilts (Lehtosalo-Hilander 1985), overall classification and cataloguing of Viking Age or Carolingian swords (Räty 1983), and studies of Crusade period (ca. 1050–1150/1300 AD) iron inlays in sword blades (Tomanterä 1978). The last two of are master's theses. The work done by Jorma Leppäaho to reveal iron inlays was left unfinished and some of his results were compiled and published posthumously in 1964 (Leppäaho 1964b).*

34 *The posthumously published work of Jorma Leppäaho (1964b) has been used as a 'catalogue' for Finnish inlaid sword blades, although only a small part of the find material was presented. These finds, however, display a wide range of different motifs from correctly spelled names and invocations to obscure letter-imitating marks. Also the materials used in the ferrous inlays seem to differ from each other in many cases.*

35 *See e.g. Jankuhn 1951: 216; Geibig 1991: 155.*

Here it must be noted that the experimental part is based on my master's thesis,[36] where I tried to define the theoretical framework for iron-working experiments and forged seven sword blades with inscriptions, each with a slightly different technique. I conducted the forging experiments myself, because I have been trained in blacksmithing when I was young. As a result of my experiments I managed to conclude that there could have been several relatively easy techniques with which to create an inscription. However, my experiments created many additional questions, in which I tried to answer with additional experiments. Moreover, the experiments in my master's thesis called for more criticism, which in turn affected my interpretations. As the forging of a sword blade is a process with numerous stages it is quite possible that inscriptions could have been attached in different ways and at different stages of blade manufacture, and therefore a number of alternatives needed to be tried out. The results of this series consisting of the experimental manufacture of altogether thirteen blades were published in 2009.[37] In this work, the course of the experiments is only briefly discussed, and the focus is on the observations that emerged during the experiments, not to mention the results.

Along with the technological questions concerning the stages of acquisition and processing of raw materials and the manufacturing of the artefact, the whole concept or idea of ferrous inlays is discussed, as well as their meaning to the makers, sword-bearers and to the societies of the Late Iron Age, using Finland as a case study. The manufacture, use and discard of inlaid blades are then bound to the meaning and significance of these inlays and the blades decorated with them. In this work the themes and questions surrounding the technological topics are also connected to views on Late Iron Age production and trade of bladed weapons in Europe, and the development of blacksmithing technologies and their both general and local standards.

The disposition of the present work follows the individual parts of the sword. First studied are the blades, of which the materials, forging technologies, and signs of repair and use are examined, not to forget the classification by blade forms. The second feature is the inlay. The inlays are subjected to a wide-ranging examination including the classification and interpretation of motifs and inscriptions, and the study of their technology also through experiments. Both the blades and inlays are subjected to metallographic analyses to establish facts concerning the materials used and their properties. Thirdly the hilts are studied, the most basic examination of which includes the classification and dating of the swords according to previously established typologies. In addition, various features of the hilts, such as decorative motifs and techniques, the construction of hilt parts, and repairs are taken into account.

Finally, this work considers phenomenon of ferrous inlays studied mostly through the archaeological finds, but with other sources such as pictorial and literary sources also exploited whenever needed. These contemporary sources may shed some light especially on the use of inlaid swords. Contemporary sources, such as the writings of Arab travellers and medieval treatises on ironwork, can give some clues concerning iron inlays and their execution.

1.3. The number and distribution of the examined swords

The archaeological source material of this work is from Finland (Fig. 1), and the purpose has been to include all iron inlaid blades in Finnish collections.[38] Because of this, finds from the Åland islands

36 Moilanen 2006.

37 Moilanen 2009b.

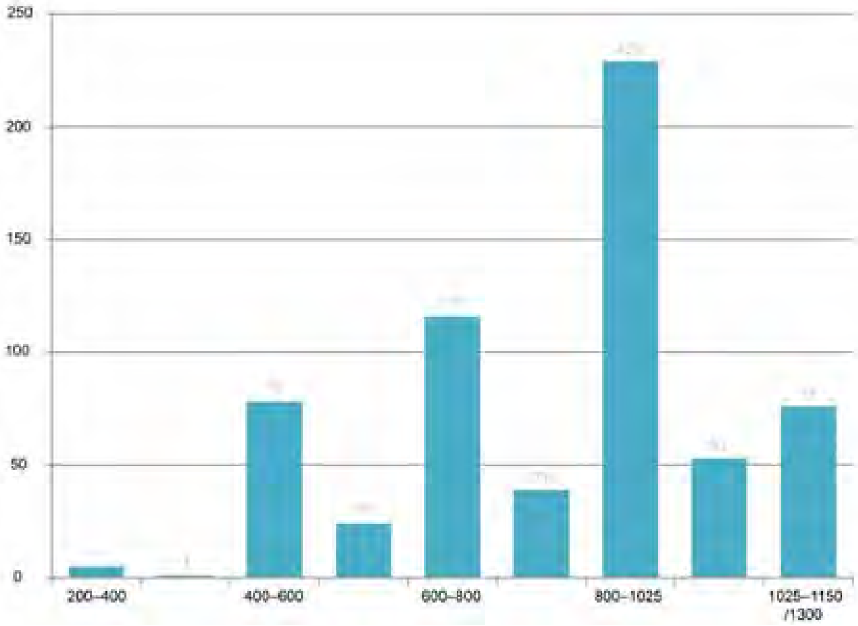
38 This includes both the collections of the National Board of Antiquities of Finland and swords catalogued in the collections of the Åland Museum and also in smaller local museums in Finland.

Figure 1.
The geographical area of the sword finds studied in this work including finds within the present borders of Finland, the Åland islands and ceded Karelia on the western shores of Lake Ladoga.

and ceded Karelia are included, since finds from both these areas can be found in the collections of the National Board of Antiquities, and more importantly, they have been in strong cultural contact with the settled areas of the Finnish mainland. In addition, some finds from geographically more distant locations are also catalogued under Finnish collection numbers. These finds from more remote localities ended up in Finnish collections mainly during the 19th century when Finnish antiquarians brought their finds with them from their expeditions. These items, which are mainly from Russia and some from Sweden, are not included here.

In this work only ferrous inlays are studied. After the Viking Age non-ferrous inlays replaced ferrous ones, although both ferrous and non-ferrous marks and letters may be found in otherwise similar kinds of swords. Due to the emphasis of technological aspects, however, only ferrous inlays are included. The manufacture of non-ferrous inlays was carried out in a different manner because of their material, and thus non-ferrous inlays belong to a different technological tradition than ferrous ones. Moreover, the phenomenon of non-ferrous inlays seems to have been considerably shorter-lived when compared with iron inlays, dating mainly from between the end of the Viking Age and the beginning of the Middle Ages in Finnish chronology, thus excluding some major developments in the evolution of the sword.

Taking into consideration the widespread trade networks of the Late Iron Age, the area of research should be as wide as possible to guarantee somewhat reliable results when considering the identification of separate inlaying traditions. In the light of this fact, the material of this work is moderately small, but on the other hand, the study of a more widespread material would require notably more resources and especially more time.



To be chronologically more precise, all sword finds examined in this thesis are dated to the Late Iron Age, circa 700–1200 AD. Although inscribed sword blades are traditionally dated to the Viking Age, some earlier and many later ones seem to exist.[39] For example, according to foreign finds some inlaid blades can be dated earlier than the Viking Age according to their hilts and find contexts.[40] In turn, many blades with small iron inlays have hilts that are considerably later than the Viking Age.[41] Also, the shapes of these blades suggest a younger date than the Viking Age.

Figure 2. ***The number of Iron Age complete swords, blades and blade fragments in Finnish collections, including the areas of mainland Finland, ceded Karelia and the Åland islands, with a total number of 621 finds. The finds are divided by the periods of the Finnish chronology. Columns between two periods present overlapping datings. In practice this means that these finds may be dated somewhere between the end of the preceding period and the beginning of the following one. In addition, 56 finds cannot be associated with a certain period of time according to typologies, find contexts etc., and thus they are not included in the diagram. Including these finds, the total number grows to 677.***

The finds of complete or fragmentary swords and their parts of the whole Iron Age in Finland have never been counted as a whole. An attempt at this is made in Figures 2 and 3. It must be noted that since the number of all Iron Age swords in Finnish collections is very large, it has been impossible to see and document all of them. The swords are scattered among various museum exhibitions and collections around Finland. Moreover, due to the situation at the National Board of Antiquities of Finland, the study of all possible sword finds would have taken a considerable amount of time in view of the nature of this work.[42] It should be noted that I began to study these finds already in 2004.

Figure 2 shows the numbers of complete swords, bare blades or blade fragments divided by time period.[43] It can be clearly seen that the finds increase from the Migration period onwards, dramatically peaking in the Viking Age. After this, the number of swords declines, which may be partly due to changing burial customs. In addition to the finds calculated in the illustration, there are 33 finds datable to somewhere from the Migration period to the Viking Age, 17 from the Merovingian to the Viking Age, and six finds from the Viking to the Crusade Period. This means that the contexts of these broadly datable finds (56 altogether) are such that the swords just cannot be dated more accurately. Some of them originate from a cremation cemetery with a long period of use, while some are stray finds. Moreover, some of these finds are in such poor condition that they cannot be morphologically dated, i.e. they lack hilts. In some cases the reason is that I have not been able to study the find personally. In any case, the more accurate dating of these finds does not dramatically alter the figure, since they tend towards the Viking Age as do the numbers in Fig. 2.

39 *E.g. Geibig 1991: 155; Jankuhn 1951: 216.*
40 *E.g. Geibig 1991: 155; Jankuhn 1951: 216.*
41 *E.g. Geibig 1991: 155; Oakeshott 1964: 34.*
42 *The most intensive and preliminary stage of my work, i.e. the study of the find material unfortunately took place when the National Board of Antiquities of Finland was being relocated with its archives and artefact collections. Due to this long process it was impossible to order material, not to mention to have the sword finds radiographed, which in turn was necessary to reveal all possible inlays on their blades. Considering the subject of this work, the aim was then to examine at least finds dating from the Merovingian, Viking and Crusade periods, although even not all of these could be delivered for me for investigation. Despite this, the number of studied blades is representative enough to answer the questions considered, since over 90 per cent of the swords from the above-mentioned three time periods were examined and documented.*
43 *See Chapter 1.3 below for dating conventions.*

In comparison, Figure 3 shows a similar statistic but this time consisting loose hilt parts without any part of the blade attached. This set differs from the finds of complete swords and blade fragments, since the Merovingian Period finds of this outnumber those of the Viking Age. Now both these Figures (2 and 3) do not show the number of "swords", i.e. the number of complete swords, but the numbers refer to catalogue numbers. In other words, many fragments, each calculated as one "sword" in the figure, may actually comprise one complete sword. This puzzle of fragments was not applied in the statistics of this work, because it would have required the examination of all sword finds, preferably all from one locality at the same time to be able to connect various pieces belonging to the same object. The same principle applies to the hilts, and this is what distorts the figure. In the case of the Migration Period and especially the Merovingian Period, the number of "hilts" includes several fragments of bronze hilt parts, most often from the same cemeteries. The hollow bronze hilts were broken for burial, or they melted and became fragmented on the funeral pyre.

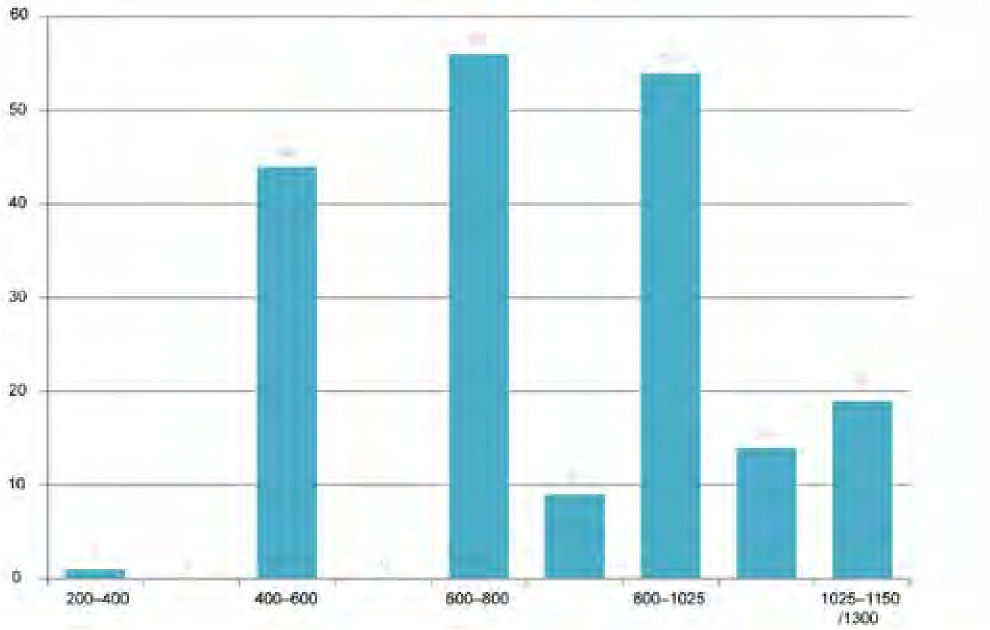


Figure 3. The number and chronology of separately found hilt parts from Finland, Åland islands and ceded Karelia. The diagram is arranged as in Figure 2.

To give a number, there are a total of 677 catalogued complete swords, blades and blade fragments (Fig. 2). This figure includes all finds from mainland Finland, ceded Karelia and the Åland Islands. In addition, only double-edged blades were taken into consideration, which means that scramasaxes and single-edged swords, which are sometimes hard to distinguish from each other, are excluded. Of all these 677 collection numbers, 18 have been found in the territory of ceded Karelia, whereas 62 are from the Åland Islands. The number of finds from the Åland Islands includes those catalogued in the Åland Museum, although these were not examined or radiographed due to practical reasons.[44] The number of separate hilt parts without any intact blade is 197, seven of which are from ceded Karelia and five from the Åland Islands. Altogether the number of swords and sword parts is 874 from the studied area. At this point it must be stated that the chronology is derived from the combination of hilt typologies, blade forms, find contexts, previous research, and types of inscriptions and motifs whenever available, and is discussed in more detail later.

The actual find material studied in this work consists of blades and blade fragments with iron inlays. Through the exhausting process of visual inspection and radiographic studies a total of 140 blades or blade fragments with iron inlays were found, these forming the main archaeological material of this study. In addition, eleven more are known from old radiographs and earlier publications.[45] Of this total of 151 finds, eight are from the Åland islands and five from the area of ceded Karelia. Roughly stating, the majority of the inlaid swords are from the Viking Age, the finds clearly concentrating in the 10th century. Clearly fewer finds date from the preceding century, and some are most likely from the second half of the 8th century. 11th and 12th-century finds, in turn, are clearly fewer

44 *The inlaid blades included in the collections of the Åland Museum are, however, included in this work as far as the information could be obtained from previous publications and old radiographs taken in the conservation department in Helsinki in the 1970s and 1980s.*

45 *These swords are finds KM 2886:10, KM 5215, KM 5868:80, KM 7134:1, KM 18000:3880, LiuM 26, ÅL 336:292, ÅL 337:106, ÅL 337:229, ÅL 337:528 and ÅL 345:113.*

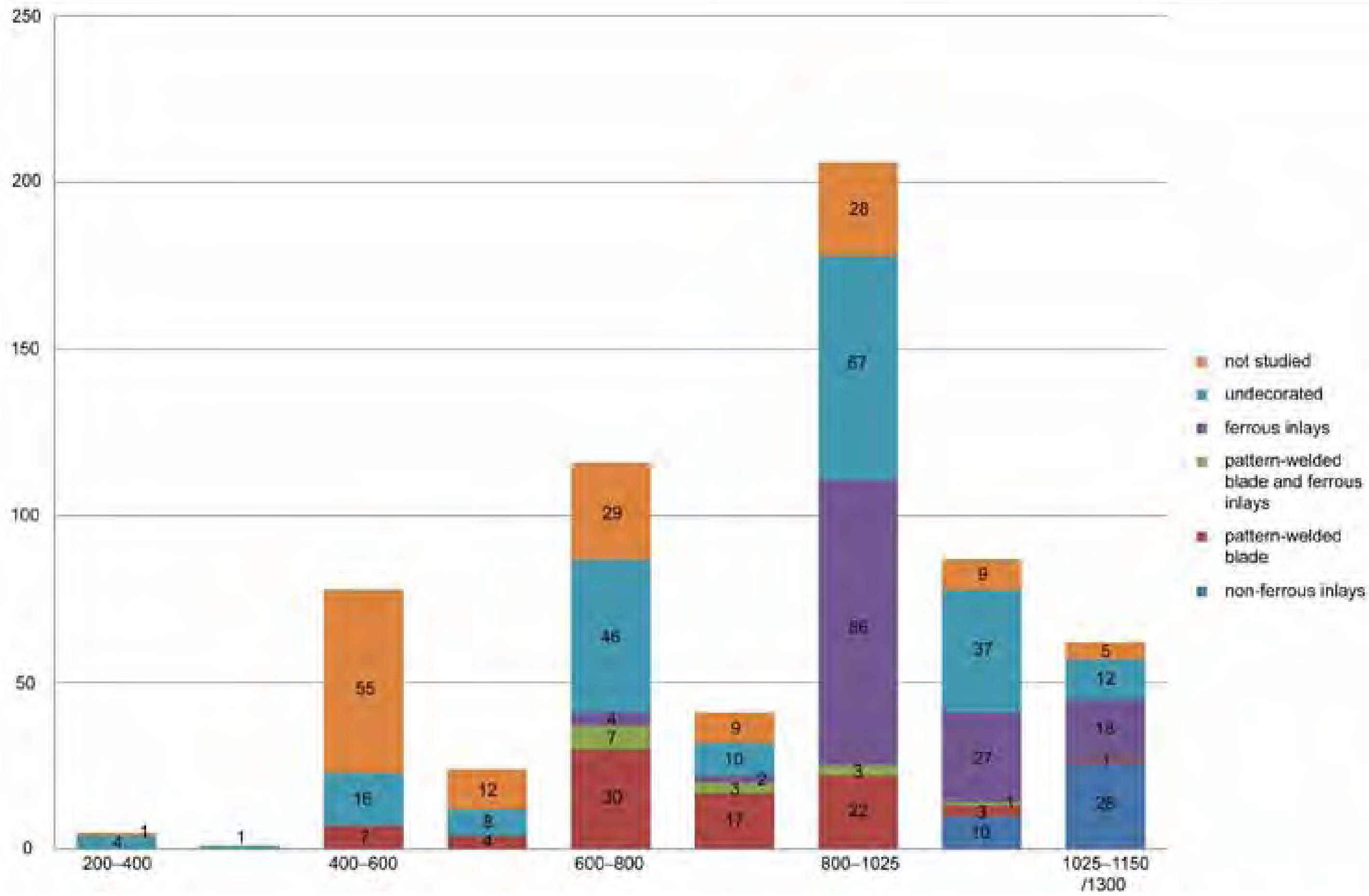


Figure 4. Types of blade construction and decoration observed in the finds of the studied area. In addition to the finds counted in the columns, there were 57 finds that could not be accurately dated. Of these blades, 38 were empty, six were pattern-welded, two had ferrous inlays on top of pattern-welding, one had ferrous inlays, and ten were not examined.

than those from the second half of the Viking Age. Again, a more accurate chronology is discussed later, and these figures are presented here just to create a picture of the whole situation in the area of research.

As a side note, the radiographic process revealed the decoration of all the studied blades (see Fig. 4). All in all about 77 per cent of all known swords, blades and blade fragments (677 catalogue numbers) were examined with radiographs and documented. In addition, some heavily bent blades from the middle Iron Age could not be radiographed, but they were still documented by other means possible. It is clear that the undecorated, "empty" blades dominate, but it must be remembered that the finds were in many cases in a very poor condition, so any possible inlaid motifs could have corroded away. Similarly, heavy corrosion may eat away thin pattern-welded panels on both sides of the blade if the blade was constructed in this manner.

With regard to the actual blade decoration, the blades with ferrous inlays were the most common ones. Pattern-welded blades come second, while blades with non-ferrous inlays are rarer. These numbers should not be taken with surprise, since the number of the sword finds in general concentrates on the periods when ferrous inlays were commonly utilized. Similarly, the finds decrease towards the end of the medieval period, as do the non-ferrous inlays typical of the post-Viking Age scheme.

As a last note to the studied finds, new ones are being continually discovered. The examination of swords with existing collection numbers was discontinued at the beginning of 2013, because the radiography of finds would have advanced with uncertain schedules, and also for the reason that this work needed to be finished within a reasonable time.

At least three swords with ferrous inlays were found in the autumn of 2013. A brazil-nut pommeled sword was found at Taka-Laurila in Hämeenlinna with the help of a metal detector. Another sword is known from Lempäälä, also x-rayed to show inlays. A third sword was recovered from an inhumation burial in Janakkala. This sword with a Petersen type Z hilt was accompanied by a disc-pommeled sword equipped with a blade containing non-ferrous inlays.

1.4. The chronological framework of this study

The term Late Iron Age is well suited to the dating of the iron inlaid swords. In this work the Late Iron Age covers a time span of ca. 700–1200 AD.[46] However, a division of the Late Iron Age into shorter periods would be better when comparing the chronology of different types. The period between 575/600 and 800 AD is called the Merovingian period in Finnish terminology. After this, comes the Viking Age (ca. 800–1025 AD). The end of the Viking Age is estimated as 1025 AD in the western and southern parts of Finland,[47] whereas the Viking Age of eastern Finland and Karelia ends about half a century later as indicated by pre-Christian burial customs.

There have been some suggestions that the time span of the Viking Age should be extended in both directions. It has been presented that it should begin at 760 AD, because Scandinavian influence can be seen in the east, on the shores of Lake Ladoga, at this time.[48] After all, the raid on Lindisfarne in 793 AD is still considered as having been carried out by 'Vikings'.[49] Ulla S. Linder Welin has investigated the coin finds from Lake Mälaren region in Sweden, and concluded that the settlers began to sail further east already before 700 AD, and during the following century these expeditions were conducted from the areas of Gotland and Öland in particular, although for example Russian chronicles do not mention this.[50] Also, the Viking Age would more likely have ended near 1100 AD, since pagan burial rites, some artefact types and silver hoards continued to exist.[51] Traditionally the end of the Viking Age is set in 1066 AD, when Harold III was defeated by William Duke of Normandy in the Battle of Hastings.[52] In the case of Finland, 1050 AD has been traditionally suggested, but Markus Hiekkanen has noted that since separate inhumation cemeteries exist way before this date, 1025 AD would be more plausible.[53] Also Pekka Sarvas is of this opinion, with reference to changes in dress ornaments as indicated by absolute coin dates.[54]

The periods within the Viking Age have been defined in different ways depending on the author and, of course, the find material that is referenced and analysed.[55] Iben Skibsted Klæsøe has combined the typological, morphology-based results to the decorative motifs often ignored by typologies, and suggested a periodization for the Viking Age.[56] According to her, there are three periods, the second one of which can further be divided into three shorter phases. Her temporal definition of the Viking Age runs from 750/775 to 1050/1100 AD. In this work, however, the chronology is referred to as centuries, not in any particular phase within the period, since the number of definitions would cause chaos.

The Crusade Period is dated ca. 1025–1150/1300 AD, the dates being from western and eastern parts of the country, correspondingly. It is currently suggested that the Crusade Period would have ended as late as 1200 AD in Western Finland.[57] This seems plausible, because throughout the 12th century, burial customs were continually developing towards a purely Christian tradition,

46 *Conventionally the Late Iron Age ends at approximately 1300 AD, but swords with ferrous inlays appear to fall out of use close to 1200 AD.*
47 *E.g. Sarvas 1972: 49.*
48 *Ambrosiani & Erikson 1996: 37.*
49 *E.g. Vikingatidens ABC 1981: 284–285.*
50 *Linder Welin 1974: 22.*
51 *In the case of Karelia, see e.g. Saksa 1998 and Uino 1997.*
52 *E.g. Vikingatidens ABC 1981: 284–285.*
53 *Hiekkanen 2010: 313.*
54 *Sarvas 1972: 50.*
55 *See Skibsted Klæsøe (1999: 90–91) for tables.*
56 *Skibsted Klæsøe 1999.*
57 *E.g. Sarvas 1971; Taavitsainen & Harjula 2004: 131.*

which seems to have been adopted at the very beginning of the 1200s.[58] According to Hiekkanen, some graves in Crusade Period cemeteries may be dated later than 1150 AD, and furthermore, no contemporary written sources exist in Finland before ca. 1200 AD.[59] In the eastern parts of Finland pagan burial rites continued until ca. 1300 AD.[60]

The term Crusade Period needs further explanation. The name is somewhat misleading, since the whole period seems to end in the western parts of the country when the presumed First Crusade arrived. This happened in the 1150s or maybe even later. The term 'Crusade Period' derives from the 1800s, when it was believed that the Crusade Period artefacts were contemporary with the First Crusade.[61]

It must also be noted here that some Finnish scholars have recognized a kind of "transitional period" between the Viking and Crusade Periods.[62] This short period of time has sometimes been referred as "time of barbaric Christianity", meaning that the Christian traditions, especially the burial tradition, had not yet been completely adopted.[63] This transitional phase is not used in this work, but is of some importance, since the classification of Finnish sword finds made by Jouko Räty in his thesis refers to this transitional period.[64] Besides on religious and traditional bases, Räty regards the sword hilt forms as also based on the Viking Age forms, representing also a transition between the Viking Age and the Middle Ages.[65]

It must be noted that normally the Late Iron Age is defined as beginning simultaneously with the Viking Age.[66] However, in this work the latter half of the 200-year period preceding the Viking Age is also counted as belonging to the Late Iron Age. The reason for this is that, while the golden era of inlaid blades seems to be the Viking Age and onwards, some inlaid blades most probably existed already before the Viking Age, as has mentioned earlier in this chapter. To avoid two terms – the Middle Iron Age and the Late Iron Age – the term Late Iron Age is used here since the majority of the inlaid blades are from the Viking Age and onwards.

58 *Hiekkanen 2007: 13–14.*
59 *Hiekkanen 2010: 325–326, 339.*
60 *E.g. Saksa et al. 2003: 384; Taavitsainen & Harjula 2004: 131.*
61 *See Schvindt 1893.*
62 *E.g. Cleve 1978; Sarvas 1971.*
63 *See Jaakkola 1938: 32–54.*
64 *Räty 1983.*
65 *Räty 1983: 88–89.*
66 *For an example in the Estonian chronology see Lang & Kriiska 2001: 102.*

2. RESEARCH HISTORY OF SWORDS WITH FERROUS INLAYS

Swords form a very important group of artefacts in archaeological research, and they are among the most studied objects of antiquity and especially of the Iron Age. For this reason, almost every archaeologist studying the metal periods has dealt with swords at some point. Moreover, there are many specialized weapon researchers. Because of these facts it would be impossible to present a complete history of research concerning swords, even of those with ferrous inlays.

This chapter briefly presents the kinds of things that have so far been studied about ferrous inlays and the swords bearing them. What kinds of questions have been asked in different times and what methods have been utilized to answer them? Here I also discuss the nature of these earlier types of studies, and their usefulness considering this work. The order in which these topics are treated is not chronological but bound to the nature and type of research. Because the study of iron inlays has mostly been unsystematic, at least before the 1990s, it would be too chaotic to progress in chronological order in the presentation of these topics. Instead, the history of research is first presented according to geographical areas.

2.1. Finland

In general, swords have not attracted as much attention as in neighbouring countries, not to mention that studies would have concentrated on a specific type of sword such as ones with ferrous inlays or pattern-welded blades. The majority of studies have dealt with the chronology of swords on the basis of their hilts, while the blades have been treated considerably less. Traditionally, the blades have been regarded as imported while some of the hilts may be of local manufacture. The assumption of trade imports has probably led to ignorance of research on blades, a situation which has been slightly improving since the end of the 1970s.

Between the second half of the 19th century and the Second World War, numerous Late Iron Age swords were accidentally found in various kinds of construction work and farming activities. Swords as well as other weapons, spearheads, shield bosses, scramasaxes and axes, were easily noticeable and thus collected when found, unlike smaller and fragmentary artefacts. Even though excavations at the find sites rarely took place, the location was often referred as a cemetery, often a cremation one, with dating according to the types of the recovered weapons, i.e. most often a spearhead or a hilted sword or some part of the hilt. Presentations of Finnish finds often included a mention or sometimes even a drawn picture of a sword find. Still no attention was focused on blades, even in those rare cases when pattern-welding or inlays were clearly visible.

During the first half of the 20th century, the Finnish scholar Jorma Leppäaho looked beyond the hilts to study the blades as well. Leppäaho had realized that the construction and decoration of blades varied, and more importantly, that in many cases the decoration was hid under corrosion. Leppäaho's pioneering work was to radiograph sword blades to reveal their hidden features. In addition, he used different kinds of lighting as well as polishing and etching to reveal ferrous and non-ferrous inlays as well as the pattern-welding of sword blades and spearheads. Furthermore, the Finnish collections contain several fragmentary swords, the broken cross-sections of which have been ground, polished and etched, still showing the manner in which the blade was constructed. It is highly likely that, though not published, these operations, too, belonged to the vast amount of work carried out by Leppäaho.

Unfortunately, Leppäaho's work was left unfinished due to his untimely death. However, some of his studies were compiled and posthumously published in 1964 in *Späteisenzeitliche Waffen aus Finnland*.[67] The book consists of photographs and drawings of Finnish Late Iron Age weapons, namely pattern-welded swords and spearheads, as well as inlaid sword blades, including pictures of some silver-decorated sword hilts, spearheads and axes. In regard to ferrous inlays, details have also drawn some attention, and different patterns in the inlaid rods have been noted, as well as some other technical details concerning the manufacture of the inscriptions. The work is by no means comprehensive and free of errors, because it was assembled from unfinished pictures and texts. Still, it includes 70 inlaid blades, 49 of which have inlays in iron or other ferrous material; the rest of the documented blades have copper-alloy, silver or gold inlays. This work has been considered so far the best pictorial guide to various Late Iron Age sword blade inscriptions. In connection with Leppäaho, it must be noted that he noticed the presence of possibly inlaid marks on sword blades depicted in medieval works of art.[68]

The appearance of Leppäaho's work had a profound influence on awareness of sword blade decorations in Finland. Newly found swords are mentioned as having inlays or pattern-welding if they were only visible with the naked eye. Nonetheless, the meaning behind the variation of inlaid motifs and appearances of pattern-welding was not understood, mostly because the origin of the blades was still considered as being somewhere in the Frankish realm. The Finnish scholar Unto Salo has interpreted some inlaid motifs and symbols as early Christian influence, thus representing research of a broader scale.[69]

Worth mentioning are two master's theses present at the University of Helsinki, both with some attempts to catalogue inlaid swords. Inlays of Finnish disc-pommeled swords were presented by Leena Tomanterä in her MA thesis, as well as ideas on the multiple makers of inlaid swords.[70] In addition, an attempt to list all Viking Age swords in Finland was made by Jouko Räty in his unpublished graduate thesis.[71] Räty also tried to classify different inlays and inscriptions, but he did not systematically search the whole Finnish material for inlays. Instead, his interpretations are based on the radiography archive collection of the Conservation Department of the National Museum of Finland. Some of his results were also published in articles.[72]

It must be noted here that Tomanterä's great interest in Late Iron Age swords has been the most valuable resource concerning the Finnish material. As a researcher at the Conservation Department of the National Museum of Finland, she has been able to study and radiograph a vast number of swords – along with other archaeological finds. These radiographic images and the information Tomanterä had gathered formed the starting point for this study.

67 *Leppäaho 1964b.*
68 *Leppäaho 1964a.*
69 *Salo 2005a & b.*
70 *Tomanterä 1978.*
71 *Räty 1983.*
72 *Räty 1978 & 1998.*

During the 1990s and later some swords from Finland and the area of ceded Karelia have been studied by the Russian scholar Anatoly Kirpichnikov. His studies have been related to a Russian-Norwegian sword research project on pattern-welding and inscriptions on Viking Age swords. Among other swords, Kirpichnikov has also examined a few Finnish blades bearing ferrous inlays, and published drawings of them in some of his articles.[73]

All in all, interest in archaeological sword finds has been curiously limited. One reason may be the uncertainty of the find material. No complete lists were ever drawn up, the closest attempt being done by Jouko Räty in his MA thesis, which was completed in 1983. Since then, several new sword finds have been made, most of them left unpublished, except the radiographic examination carried out during conservation by Leena Tomanterä. Also, the relatively poor condition of the finds, not to mention their fragmentary nature due to breakage during and before cremation, can be seen as causes behind the unsystematic research of Iron Age swords in Finland. A large number of 'swords' in Finnish archaeological collections consist of small blade fragments and loose parts of hilts, making for example the classification and sometimes even dating of these finds impossible. It must also be noted that the function of the sword in general as a weapon has aroused some interest.[74]

This work is not completely unique at the Scandinavian level, but new in Finnish archaeological research as an attempt to collect and present together swords with ferrous inlays. First of all, the experiments concerning ferrous inlaying of blades are not the first in Scandinavia, but the first to have been done in Finland.[75] Generally speaking, the phenomenon known as experimental archaeology is quite new in Finnish archaeological circles, having been properly utilized since the 1990s. Secondly, as a by-product of this work, lists of Finnish Late Iron Age sword finds are compiled, including additional information on the features of the hilts and the construction and decoration of the blades. Here five categories can be distinguished: 'empty' undecorated blades, pattern-welded blades, blades with ferrous inlays, blades with both ferrous inlays and pattern-welding, and blades with non-ferrous inlays. Thirdly, this work also introduces the methods and potential of metallurgical cross-section analyses to Finnish sword research.

2.2. Scandinavia

In Scandinavia, the development of sword research has been more rapid than in Finland. The roots of the study of iron inlays lie in the documentation and pictorial presentation of inlaid blades already carried out at the end of the 19th century. Among the first drawings of inlays are those made of a sword from Sæbø in Norway by the English philologist and archaeologist George Stephens.[76] Norwegian conservator Anders Lund Lorange also presented some visible inlays on Norwegian Viking Age blades with watercolour paintings.[77] At the time, the blades were not actually documented, for example, by measuring, being only drawn and presented visually, as kinds of curiosities. After Lorange, Jan Petersen, in his famous typological work, also noted various kinds of inscriptions and connected them with certain hilt types, thus giving them a dating.[78] The chronology established by Petersen is still widely used (see Chapter 7). Also worth mentioning is

73 *Kirpichnikov et al. 2004; Kirpichnikov et al. 2006; Kirpichnikov et al. 2009.*
74 *Pienimäki 2012.*
75 *See Pälikkö 2006 for a replica of a Gicelin-inscribed sword. In this case, however, no inlays were made but inscriptions were etched on the blade.*
76 *Stephens 1866–67: 407. This Norwegian sword is of particular interest since it has sometimes been interpreted as bearing inlaid runes, and is therefore dealt with later in more detail.*
77 *Lorange 1889.*
78 *Petersen 1919.*

a two-volume study Ada Bruhn Hoffmeyer in Denmark with information on medieval swords, including early examples with ferrous inlays.[79]

The Russian-Norwegian sword research project was launched in the 1990s. Its aim was to look for pattern-welding and inscriptions on Scandinavian Viking Age sword blades, and to experiment with different examination methods, which do not cause damage to the blades.[80] The project is not finished yet, but some articles have been published to present some of the findings.[81] The publications of the sword project include once again outlined drawings of the swords and the interpretations of their inscriptions and inlays, in most cases as seen in the radiographs. Under the ongoing sword project, the participants have also studied swords in other Scandinavian countries.[82] Moreover, an independent research by Anne Stalsberg is concerned with Norwegian ULFBERHT inscriptions concentrating on the cataloguing of inscriptions as well as listing the variants.[83]

The Swedish situation has been quite thoroughly and systematically examined. Viking Age sword blades from Sweden were examined with the help of radiography, and the resulting lists of inlaid and pattern-welded blades in the find material were published in connection with the finds from Helgö, Sweden.[84] This publication also contained metallographic analyses of Viking Age weapons, with the analysis of only one inlaid sword. In addition to this, another analysis was published in 1982.[85] Both analyses were made of the cross-sections of the blades, also showing the cross-section of the inlaid letter.

The research situation in Denmark had been surprisingly quiet with regard to Danish authors, and even mentions of Danish iron inlaid swords are very few.[86] According to Anne Pedersen, no new ferrous inscriptions were identified by Danish scholars during the nineteenth and early twentieth centuries.[87] The use of radiography was utilized only from the 1990s onwards.[88] The situation was changed by the work of Pedersen,[89] who listed altogether thirteen swords from Denmark with either an inscription or some other marking. In conclusion she has stated that the Danish finds display perhaps both original inscribed blades and poorer copies on the basis of the inlaid motifs.

All publications on experiments in attaching ferrous inscriptions have come from Scandinavia.[90] The first one was by the Norwegian blacksmith Kasper Andresen, who successfully attached a steel letter onto a sheet of iron.[91] The second, more recent, one was by another Norwegian blacksmith, Hans-Johnny Hansen, who managed to make a complete sword with an ULFBERHT inscription.[92] These attempts are also discussed later in Chapter 6, as well as work done by blacksmiths and re-enactors, who have been intrigued by this subject since 2000.

79 *Bruhn Hoffmeyer 1954.*
80 *Stalsberg 1994: 183.*
81 *E.g. Kirpichnikov & Stalsberg 1992, 1993a, 1993b, 1998a and 1998b.*
82 *E.g. Kirpichnikov et al. 2004 & 2006, Thålin-Bergman & Kirpichnikov 1998.*
83 *Stalsberg 2007a, 2007b & 2008.*
84 *Thålin-Bergman & Arrhenius 2005.*
85 *Törnblom 1982.*
86 *For cases of iron inlaid swords found in Denmark see Jankuhn 1951: 215 and Geibig 1989: 254.*
87 *Pedersen 2010: 310.*
88 *See Lønborg 1994.*
89 *Pedersen 2010.*
90 *The author's own experiments are not included here among these three publications, but they are presented below in Chapter 6.*
91 *Andresen 1993 & 1994.*
92 *Hansen 2007.*

2.3. Russia and the Baltic countries

Among the Russian scholars in this field, the most active one is Anatoly Kirpichnikov.[93] He revealed some inlays already in the 1960s by mechanical cleansing and etching, a method also used by Leppäaho in Finland a few decades earlier. In Estonia, practically the only archaeologist who has focused on Late Iron Age swords is Mati Mandel.[94] He has listed all Estonian Late Iron Age sword finds prior to 1991, noting also ferrous inlaid motifs whenever visible. Various inscriptions and their meanings have been addressed by the theologian Raivo Prank in his graduate thesis.[95] The thesis included inscribed swords from the Viking Age to the 11th century in Estonia, and along with his systematic research, he found some previously unknown inscriptions. Instead of archaeological questions, Prank considers the meaning and symbolism of various inlaid marks and motifs.

In the case of Latvia, Aleksis Anteins must be mentioned.[96] As early as the 1960s and 1970s Anteins conducted a vast number of metallographic analyses focusing not only on the forging technologies of weapons, but also on the properties of the used materials. As a pioneer, Anteins even measured the trace elements present in the pattern-welded inlays of one sword blade. Instead of ferrous inlays, Anteins is an expert on pattern-welded swords and spearheads, focusing most of his studies on these types of artefacts.

In Lithuania Vytautas Kazakevičius has published a monograph about Late Iron Age swords in his country.[97] Once again the main theme has been to examine all swords from a limited time period and a spatially limited area. All these authors have listed not only some domestic inscription types, but also their foreign counterparts, at least to some degree.

In Poland Marian Głosek classified swords from central Europe, i.e. from pre-1989 East Germany, Poland, Czechoslovakia and Hungary, from a time span between 900 and 1500 AD.[98] Besides hilt and blade types, also the blade decorations, both ferrous and non-ferrous, were arranged in chronological order. Głosek took as the typologies of Ewart Oakeshott as a basis, and dated the blade inlays according to the chronology of hilts and blade forms, and also with the help of find contexts.

The Russian scholar Donat Aleksandrovich Drboglav has contributed a whole book on the subject of sword blade markings and inlays dating from 800–1400 AD.[99] While also presenting some symbolical motifs, his main interest has been to interpret Latin inscriptions and letter sequences in connection with symbols and sentences related to Christianity. The established chronology is partially based on the evolution of certain Christian sentences, formulas and abbreviations, and partially on hilt types. Although Drboglav's material has been limited to a certain geographical area within Europe, but he has included finds from various localities. Even some Finnish finds have ended up in his work, being cited from Leppäaho's posthumous publication.

93 *Kirpichnikov 1961 and 1966.*
94 *Mandel 1991.*
95 *Prank 2011.*
96 *Anteins 1973.*
97 *Kazakevičius 1996.*
98 *Głosek 1984.*
99 *Drboglav 1984.*

2.4. Germany, the Netherlands and the Czech Rebublic

More detailed and inlay-specific studies have been done in Germany from a very early stage. A clearly distinctive forum has been *Zeitschrift für Historische Waffenkunde*, later known as *Zeitschrift für Historische Waffen- und Kostümkunde*. In this periodical, Rudolf Wegeli published already in 1903 an article on inscriptions found in German medieval sword blades. After this the subject has been discussed in a number of articles, some even concentrating on specific types of inscription. Also, the plain description of the swords and inlays quickly evolved into speculations concerning on origin and place of manufacture, which turned out to be the Frankish kingdom in the majority of cases. The subject has been discussed also in other later articles, sometimes even on an etymological basis.[100] The views have been quite varied, and it is also worth noting that before Leppäaho, the Swiss-born archaeologist Robert Forrer pointed to the inlaid marks on blades pictured in medieval art.[101]

Some larger works have also been conducted. Chronologically, the first one was a catalogue of European ULFBERHT swords compiled by Herbert Jankuhn.[102] Another German scholar, Michael Müller-Wille made an updated version of Jankuhn's lists and catalogued a total of 99 ULFBERHT swords from different literary sources.[103] His catalogue included the twelve Finnish ULFBERHT swords presented in Leppäaho's work. Müller-Wille's catalogue consisted of drawn pictures of nearly all inscriptions, but without any details of the technology of inlays. A third, more recent, work is Alfred Geibig's doctoral thesis.[104] Along with an attempt to create a typology for both Late Iron Age sword blades and hilt parts, he also discussed the classification and origin of various inlays and inscriptions in German swords.

Many German scholars have also speculated on the way the inlays were attached. Quite often these speculations have no practical basis and thus remain highly hypothetical. These theories will be discussed further in the experimental part of this work (Chapter 6). Theories about the technical matters concerning iron inlays were introduced mainly after the Second World War, although hypotheses have been made throughout the first half of the 20th century. As noted above, actual experiments in attaching iron inlays are a relatively modern phenomenon that came about during the 1990s and notably in Scandinavia.

In the Netherlands, conservator Jaap Ypey has published many articles and shown great interest in the technical matters and details of pattern-welding, including pattern-welded inlays on swords.[105] In his publications, detailed drawings are to be found, as well as hypothetical descriptions of the manufacturing processes of various kinds of Iron Age weapons with pattern-welding. In the Czech Republic particularly Jiří Košta and Jiří Hošek have studied early medieval swords, publishing analyses of pattern-welded and inlaid blades, among others, as recently as 2014.[106]

2.5. The United Kingdom

Research on ferrous inlays in the United Kingdom began in the 1950s, resulting in a few articles dealing with individual finds equipped with inlays and mentioned as curiosities.[107] Interest as well

100 *E.g. Müller 1970.*
101 *E.g. Forrer 1915–1917 and 1918–1920.*
102 *Jankuhn 1951.*
103 *Müller-Wille 1970.*
104 *Geibig 1991.*
105 *Ypey 1972, 1973, 1982a, 1982b, 1984 & 1986.*
106 *Košta & Hošek 2014.*
107 *E.g. Maryon 1950.*

as knowledge increased and some major studies of swords were published during the 1960s. These are the works of Ewart Oakeshott, namely his *Archaeology of Weapons* and *The Sword in the Age of Chivalry.*[108] Hilda Ellis Davidson published her study *The Sword in Anglo-Saxon England* in 1962. All these three books focused on summarizing the development of the sword mainly during the Iron Age, and sharing a common interest in the Viking Age, especially through Icelandic sagas in addition to the archaeological evidence. As new finds were recovered and new pattern-welding and inlaid motifs were revealed, interest has remained steady. As indications of this phenomenon, swords have been catalogued on a few occasions presenting also the inlays.[109]

The manufacturing techniques of swords have drawn much attention in the British Isles. Already in 1960, theories about pattern-welding and inlaying were introduced, based on the examination of archaeological finds.[110] This trend has continued later in small scale.[111] The actual analyses of finds began in the 1980s. The most extensive study in this area, considering all kinds of Late Iron Age swords, was conducted by Ronald Tylecote and Brian Gilmour,[112] which also included three inscribed blades.[113] Cross-sectional analyses combined with metallographic studies were used to determine how the blade was heat-treated and hardened. Another larger work was carried out by Janet Lang and Barry Ager, who radiographed several British sword finds with the aim of revealing pattern-welding and inscriptions.[114]

At present the analysis of the blade material, as well as its heat treatments, can be done from a very small sample sawn from the edge of the blade. The British archaeometallurgist Alan Williams has taken several samples of ULFBERHT swords found in Europe. He has also carried out some hardness measurements, which give clues about the quality of the blade material and heat treatments.[115] The accuracy and representativity of these analyses of small samples are discussed in more detail below. The roots of Williams's studies lie in the analyses that he conducted already in the 1970s.[116] His views on the subject have even generated a documentary on ULFBERHT swords and their manufacture.[117] Also worth mentioning is the unpublished doctoral thesis of Janet Lang, dealing with the functionality and purpose of pattern-welding particularly in the case of swords.[118]

2.6. Summarizing the history of research: four types of studies

Analysing the history of research, four kinds of studies can be distinguished. The first and most common one is the documenting and catalogue-type publishing of inlaid swords. The second category deals with the manufacturing of iron inlays in form of theories and experiments. This includes the study of the materials of inlays. Correspondingly, the third class consists of material studies of the inlaid blades themselves. The fourth category presents some of the questions that concern some wider-scale research, for example, when and where the inlays were made, what was their meaning, how were they traded, and so on.

108 *Oakeshott 1960 and 1964.*
109 *Oakeshott 1991; Peirce 2002.*
110 *Maryon 1960a.*
111 *E.g. Jones 1997.*
112 *Tylecote & Gilmour 1986.*
113 *For other analyses, see for example Anteins 1973, Edge & Williams 2003, Thålin-Bergman & Arrhenius 2005, Törnblom 1982 and Williams 1977.*
114 *Lang & Ager 1989.*
115 *Edge & Williams 2003, Williams 2007 & 2009.*
116 *Williams 1977.*
117 *This process has been recorded in a documentary titled Secrets of the Viking Sword, published in 2012 by the science channel NOVA.*
118 *Lang 2007.*

As mentioned earlier, 19th-century documentation consisted of drawing and watercolour painting, not of measuring. By the end of the 20th century, documentation had become more accurate and more systematic while the drawings still remain. The drawings have actually become more simplified and more schematic than earlier, when watercolours and more artistic, or more realistic, drawings were in fashion. All major works concerning inlays on blades include some kind of catalogue of the blades and/or the inlays, with very little attention focused on details. It is noteworthy that in many cases only visible marks and inscriptions are documented, although over the past few years, radiography, and especially stereoradiography (see Chapter 3.3), has been utilized to reveal the inscriptions. Sometimes stereoradiography has been applied to a limited find material quite systematically.[119] These somewhat systematic studies are not, however, aimed at finding not only the inlays but also at revealing the forging technologies of swords in general.

Normally there is some visual presentation of each inlaid blade. There are two options: either the blade is photographed, or it is drawn with its inlays. In most cases drawings are done, but the swords and their inlays are not always very accurately measured and thus replicated in the drawing. Furthermore, in many cases only the outlines of the inlays are drawn and no attention is focused on the patterns of the inlays, i.e. the materials of the inlaid metal rods. In some cases diagonal lines have been drawn inside the inlays to illustrate that the inlaid rod is 'twisted' or 'damascened', as is often stated. In the same manner, details concerning the manufacturing technique are usually ignored, mostly because researchers do not recognize such things. Traditionally it has been believed that all inlaid blades were made in Frankish smithies, and perhaps the problematization of the manufacturing technique has been considered unimportant.

A typical feature of these drawings of inlaid motifs and inscriptions is that they are not always drawn as they are seen, and instead the drawing is an interpretation of what has originally been inlaid in the blade. The reader does not have knowledge of what actually remains of the inlay, and what has been interpreted by the researcher. Sometimes, though, the marks that are still intact have been drawn with a continuous line, and the interpreted marks are drawn with a broken line.

One major problem is that the methods of study are stated only rarely. It is impossible to know whether the inlays were visible on the surface of the blade or were revealed by other methods such as radiography. Furthermore, was stereoradiography used, or were the inlays drawn from a single radiograph? This would be important to know, since it is quite difficult to distinguish the inlays of both sides of the blade from each other, especially from a single radiograph where the inlays of both sides appear on top of each other. Thus the question remains of the reliability of the drawings and the interpretations.

A better way to document the inlays is to photograph the inlaid part of the blade. This unfortunately happens quite rarely, and it is probably not done due to the poor visibility of inlays without any mechanical cleansing or radiography. It can also be very difficult to create a photograph in which the inlays or their remains are sufficiently visible. Also, the lack of photographic documentation in publications may be a result of insufficient resources, and thus a financial problem.

The studies of the technology, i.e. materials and forging techniques, have gradually taken place after the Second World War, when the help of the continually developing natural sciences was utilized. It became possible to easily analyse the chemical properties of iron and steel, as well as their microstructure, which could reveal how the iron was heated and worked. In the case of swords, they have been analysed in different ways to discover used technology that was used. Most

119 *For examples of systematic studies of Late Iron Age sword blades, see Lang & Ager 1989 and Thålin-Bergman & Arrhenius 2005.*

commonly, especially after the 1970s, analyses have been made from the cross-section of the blade to reveal the forging technique, but also chemical analyses are conducted.

In some cases, in connection with a cross-sectional analysis of an inlaid sword, a note has been made about the way the inlays appeared in the cross-section.[120] It is unfortunate that not many cross-sections have been analysed instead of an inlay. The objective seems to have been to establish the structure of the blade rather than the inlaying technique. Rather than studying the inlays, the cutting of the precious inlaid motif has been understandably avoided. One important point about the manufacturing technique of the inlays is that all scholars and researchers seem to think that there is only one possible way to produce an inscription. In my master's thesis and experiments done after that I managed to produce inscriptions in different ways.[121] Again, this will be discussed in the experimental section of this work.

Already at the end of the 19th century analyses were made to establish the carbon content of the blade, and thus the quality of the steel.[122] In the earliest analyses, the results are mainly suggestions, because the publications do not state from which part of the blade the reading was taken.[123] The carbon content of the blade could have varied, in view of the fact that blades could be laminated, and the produced steel was not exactly homogeneous.

The reasons for all the above-mentioned studies, whether mere cataloguing or more complicated technological studies, are usually some specific questions of broader scale. Of course the motive for cataloguing and documenting inlaid blades could well be the need to establish the number of these kinds of blades, and thus be able to deduce things such as the wealth of the society concerned or the scale of its trade networks. In many cases though, the question has concerned the origin of the inlaid blades. Where were they originally made and by whom? This has even led to the speculation on the locations of the smithies. Proper names such as ULFBERHT and INGELRII are thought to be even linguistically Frankish. With the help of linguistics there have also been attempts to establish the more precise location of the maker,[124] which is discussed later in connection with the origin of the Finnish finds and different inlaid motifs. There is also speculation on trade networks on the basis of similar kinds of inlays. The modern research of the materials of inlaid blades has even led to new theories on the trade of raw materials.[125]

The copying of inlaid motifs has also been discussed to an increasing degree. Traditionally, documentation and cataloguing have helped in identifying, for example, misspelt inscriptions, which are thought to be fakes made outside quality smithies. Recently the great number of revealed inscriptions seems to support the theory that inlays were copied. Unfortunately, the research so far does not address this subject in more detail, i.e. it does not include topics concerning all aspects of technology.[126]

A topic that is not so frequently discussed is the meaning of the inlays. This subject has been mostly forgotten since many blades have inscriptions in Latin letters, and their meaning is quite obvious. During the Viking Age the names written on blades are those of swordsmiths, as well as in some cases after this period when the name is followed by words 'me fecit', i.e. 'made me'.

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120 *See Leppäaho 1964b; Thålin-Bergman & Arrhenius 2005; Törnblom 1982.*
121 *Moilanen 2006 & 2009b.*
122 *E.g. Anteins 1973, Edge & Williams 2003, Jankuhn 1951, Petersen 1919, Thålin-Bergman & Arrhenius 2005, Tylecote & Gilmour 1986, Törnblom 1982, Williams 1977.*
123 *See Petersen 1919 and Jankuhn 1951.*
124 *E.g. Müller 1970.*
125 *See Williams 2009.*
126 *The material studies of the blades conducted by Alan Williams (2007 and 2009) are an exception, but still he does not have anything to say about the technique of inlaying.*

Then there are phrases derived from Christianity. Only during the last few decades have other symbolical motifs become more interesting, since there are many new sword finds with only symbols and not Latin letters. After all, if one wants to study the activities of copying inlays, one must try to at least speculate, what the different kinds of inlays meant to contemporaries.

Last but not the least comes the dating. Cataloguing has normally included the dating of the swords typologically on the basis of their hilts. The most used hilt typology is the one created by the Norwegian scholar Jan Petersen.[127] After Petersen, other scholars have presented revised typologies, often on the grounds of local find material and its dating.[128] These hilt typologies are now normally used to date the inscriptions as well. This poses some problems, which are further discussed in trying to date the find material discussed in this thesis. In this connection also different typologies are presented and discussed in more detail.

In addition to conventional typologies of hilt furnishings, there have been some attempts to date different types of inscriptions and inlaid motifs.[129] Different kinds of inlays, according to both their contents and materials, have been ordered in chronological sequences. Normally this is done by the additional help of hilt typologies, and it is also connected to the evolution of the blade. These classifications are further discussed in connection with the specific types of inscriptions as well as the dating of the finds studied in this work.

127 *Petersen 1919.*

128 *After Petersen (1919), revised local typologies have been constructed after the Second World War when the grown find material had to be systematically organized.*

129 *E.g. Anteins 1966, Bruhn Hoffmeyer 1954, Drboglav 1984, Geibig 1991, Oakeshott 1964, Wegeli 1903-1905.*

3. THE PROCESS AND METHODS OF RESEARCH

This chapter is firstly a short introduction into the world of iron and steel alloys and their properties. This basic understanding of the properties and the working techniques of the material under study is very important in order to understand the ensuing brief presentation of the applied methods of research, not to mention the section concerning the technology of inlays and inlaid blades. So much weight has been placed on the introduction of metallurgy and its research, because a large part of this work discusses the technical questions of the studied swords.

Each sword presented in this work was documented as a whole, including the blade, the hilt and its decoration, and the inlays. Present below are the attributes and details that were sought in each find, as well as the methods for acquiring the required information. To start with, the finds were measured. Then the inlays were revealed, in case they were not readily visible, after which they were documented and examined more closely. The blades were examined for their properties and materials, as well as the hilts, but more superficially. Finally a catalogue was created including scale drawings of the swords and their inlays. These stages of the research are discussed below in more detail.

3.1. Iron, its production and working

3.1.1. Iron and its alloys

Iron is a soft metal, silvery-grey in colour, and the third most common non-gaseous element in the Earth's crust.[130] Iron has a tendency to oxidize quickly in humid atmospheres forming a red or brown coating of ferric oxide or rust as it is commonly called. Pure elemental iron (Fe) is very rare, and in nature iron occurs as oxides in different kinds of ores. To obtain metallic iron, oxygen must first be removed by chemical reduction at a high temperature.

The properties of iron can be altered by alloying it with other elements. The most common and most important alloying element of iron is carbon (C), which together with iron forms carbides and creates a hard alloy called steel, which is harder and more brittle than iron and suitable for heat-treatments.[131] During the Iron Age, another important element was phosphorus (P), which increases hardness and corrosion resistance, but causes brittleness and creates a barrier for carbon diffusion.[132] High-phosphorus iron can even be work-hardened or cold-forged to make a tougher blade.[133] Phosphorus-rich iron has very coarse grain structure and it has been used intentionally in pattern-welding to create sharp contrasts between different metals (see Chapter 5.2).

130 Tylecote 1987: 47.
131 E.g. Peets 2003: 264.
132 E.g. Godfrey et al. 2003: 191; McDonnell 1989: 375; Thålin-Bergman & Arrhenius 2005: 26; Ypey 1980: 193.
133 Tylecote & Gilmour 1986: 9.

Smelted iron or steel contains also for example cobalt, manganese, nickel, silicon and sulphur, which are not intentionally added and are found in very small amounts as trace elements. Cobalt increases wear resistance,[134] whereas manganese increases the sensitivity to heat treatments by lowering the required temperatures.[135] Nickel increases strength and toughness but not the hardness of steel.[136] Also silicon toughens steel and makes the grain structure of steel coarser.[137] Sulphur is considered as an impurity, because it has a negative effect on the hot-shaping properties of steel.[138]

According to carbon content and other elements, there are different terms for different kinds of iron and steel. *Wrought iron* is closest to pure iron and contains less than 0.2 % carbon and often some slag.[139] *Steel* on the other hand contains carbon from ca. 0.2 % up to 2 %,[140] and also various alloying elements such as manganese, silicon, phosphorus and sulphur.[141] The modern term *carbon steel* is used to cover all alloys of iron with some carbon in them,[142] and is thus not very practical considering the distinction between steels of different carbon content. *Cast iron* has a carbon content of 2–6 % and a silicon content of 1–6 %.[143] *Pig iron* has 3.5–4.5 % or sometimes even more carbon and other contaminants such as phosphorus and sulphur, and is primarily used also in casting.[144] Due to their carbon content, only wrought iron and steel are easily workable and thus used in blacksmithing.

Iron and steel are composed of crystals, the form and size of which create the internal structure, the so-called *microstructure* of iron or steel. The properties of steel can be adjusted and changed radically by altering this microstructure through forging and heat treatments. Furthermore, the structural changes of steel while cooling are dependent on its carbon content. Steel with carbon content lower than 0.8 % is called hypoeutectic steel, whereas steel with a precise carbon content of 0.8 % is called eutectoid steel.[145] Hypereutectoid steel has a carbon content higher than 0.8 %.[146] This figure can also be called the boundary between low-carbon steel and high-carbon steel.[147]

Iron has two allotropic forms: α-iron and γ-iron. Besides these two, also δ-iron is known, but it is not a separate allotropic form but similar to α-iron (Fig. 5).[148] The melting point of pure iron is 1538 °C, and as iron cools down and crystallizes below this temperature, δ-iron is formed.[149] The crystal structure of this delta-iron is body-centred cubic and this form is known as *ferrite*, which is

134 *E.g. Mäki-Rossi 1950: 36.*
135 *E.g. Mäki-Rossi 1950: 34.*
136 *E.g. Hrisoulas 1991: 28; Mäki-Rossi 1950: 35.*
137 *E.g. Hrisoulas 1991: 28; Mäki-Rossi 1950: 33–34.*
138 *E.g. Hrisoulas 1991: 28; Mäki-Rossi 1950: 33.*
139 *E.g. Rodgers 2004: 72–73.*
140 *The determination of the carbon content of steel is sometimes problematic. For example Jüri Peets (2003: 264) defines steel as having carbon 0.2–1.7 %. Steel with a carbon content of 0.2 % will harden to some degree, but only steel with a carbon content higher than 0.3 % will harden enough to have some practical purpose (e.g. Buchwald 2005: 133; Hansen 2007: 18). Vagn Fabritius Buchwald (2005: 66) determines steel as having a carbon content between 0.4 and 1.7 %. Normal carbon steel is usually defined to contain a maximum of 1.7 % carbon, but heavily alloyed steels may contain even 2 % carbon and still remain workable (e.g. Mäki-Rossi 1950: 33).*
141 *E.g. Dossett & Boyer 2006: 9.*
142 *Thålin-Bergman & Arrhenius 2005: 25.*
143 *E.g. Bealer 1995: 31; Rodgers 2004: 72. Although cast iron was developed in China as early as from ca. 550 BC onwards, it was not intentionally produced in Europe until around the 1200s (Tylecote 1987: 325–327; Wagner 2001).*
144 *E.g. Rodgers 2004: 71–72; Serning 1979: 62. The cast iron produced in medieval blast furnaces was called pig iron, from which wrought iron was produced by re-melting.*
145 *E.g. Dossett & Boyer 2006: 19–22; Williams 1919: 132. The amount of eutectoid carbon varies roughly between 0.77 and 0.80 % depending on the used reference (Dossett & Boyer 2006: 19).*
146 *Dossett & Boyer 2006: 19–22.*
147 *Hansen 2007: 16.*
148 δ*-iron, which also is ferrite like* δ*-iron, appears in much higher temperatures than* δ*-iron.*
149 *E.g. Dossett & Boyer 2006: 12.*

magnetic, pure iron.[150] As iron cools below 1395 °C γ-iron is formed.[151] This gamma-iron or *austenite* has a face-centred cubic crystal structure and is a non-magnetic, mixed form of crystals in high temperatures.[152] As the cooling process continues below 912 °C ferrite is again formed, this time called alpha-iron (α-iron).[153] Different allotropes dissolve different amounts of carbon. Ferrite will dissolve only 0.02 % carbon, whereas austenite is capable of dissolving 2.1 % carbon.[154]

Now when, for example, hypoeutectic steel is slowly cooled, crystals of ferrite will be separated from austenite. At 723 °C the separation of ferrite crystals will stop, and the remaining mixed structure contains 0.83 % carbon. As temperature continues to decrease, the extra carbides in the remaining structure will be combined with ferrite crystals, creating a structure called *pearlite*.[155] When eutectoid steel is cooled, no ferrite will be formed, only pearlite. Hypereutectoid steel, on the other hand, will already at 900 °C form *cementite*, which is a very hard composite of iron carbides, ferrite and carbon.[156] After 723 °C, the remaining mixture of crystals will create *pearlite*.

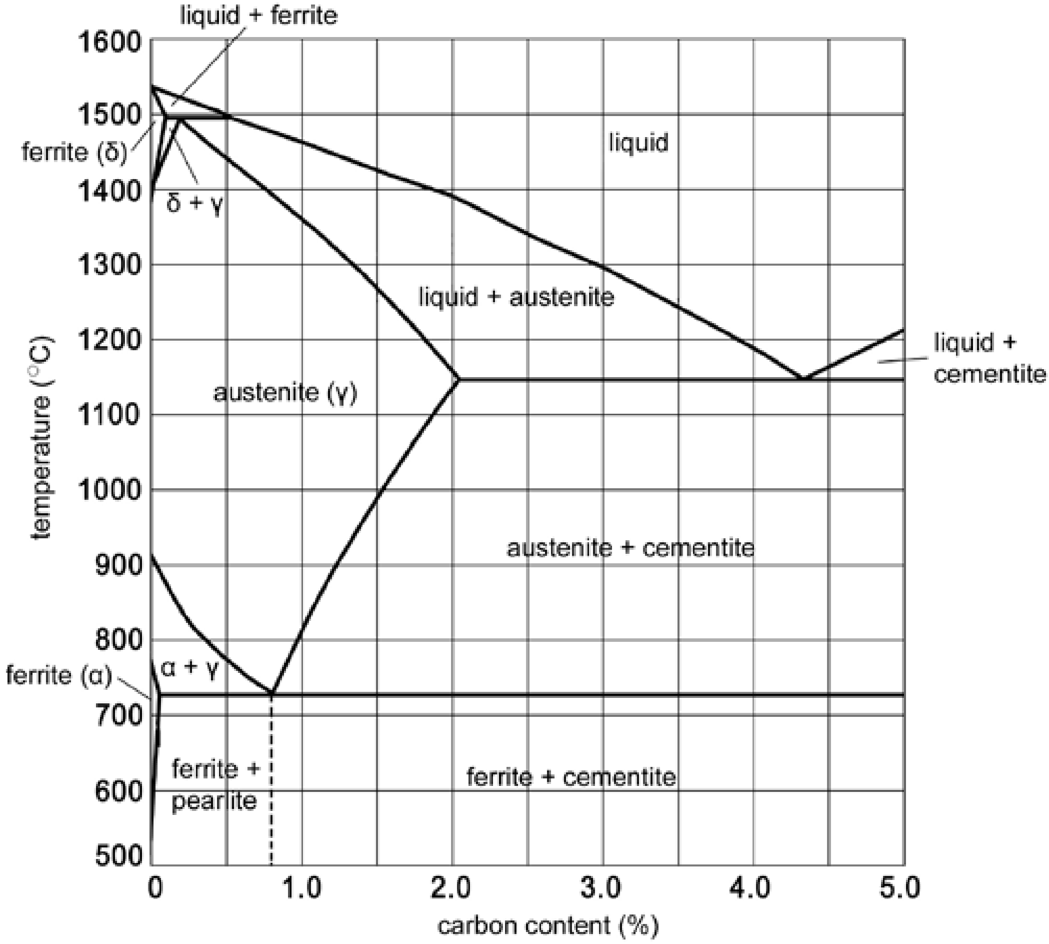

Figure 5. Simplified iron-carbon (Fe-C) phase diagram.

3.1.2. The prehistoric production and alloying of iron and steel

Before terrestrial ores were processed, meteorites brought the first iron that was used in the making of iron artefacts.[157] The earliest examples of the utilization of meteoric iron are from China, Egypt and the Mediterranean area.[158] The earliest signs of meteoric iron come from North Iran, ca. 4600–4100 BC.[159] This kind of iron can be classified as wrought iron, and it normally

150 *E.g. Dossett & Boyer 2006: 12.*
151 *E.g. Dossett & Boyer 2006: 12.*
152 *E.g. Buchwald 2005: 63–64, 66; Tylecote 1976: 166.*
153 *E.g. Buchwald 2005: 63–64; Dossett & Boyer 2006: 13.*
154 *E.g. Buchwald 2005: 66.*
155 *E.g. Dossett & Boyer 2006: 20.*
156 *E.g. Dossett & Boyer 2006: 9; Tylecote 1976: 166.*
157 *Meteoric iron has been utilized also later. For example Indonesian blacksmiths forged knives and short swords from meteoric iron as late as the 1800s (see e.g. Sachse 1989: 103–115).*
158 *Buchwald 2005: 24–25; Peake 1933: 640–641.*
159 *E.g. Buchwald 2005: 24–25.*

contains high amounts of nickel among other elements.[160] According to the archaeological record, smelted native iron was first utilized in the regions of Mesopotamia and Anatolia somewhere around 2400 BC.[161]

During the Iron Age, iron was produced by so-called direct process. The reduction of iron started with the acquisition of the raw material, i.e. iron ore. In Scandinavia the ore was extracted from lakes and bogs, and is known as *limonite* formed from iron oxides.[162] *Hematite* and *magnetite* are rock ores, and they have been used considerably less than lake and bog ores,[163] although some dissenting views have also been presented.[164] In Continental Europe and the British Isles mined ore was used since beginning of the Roman period.[165]

The raw material first had to be dried and roasted to get rid of soil and crystal water, and to make the pieces of ore more fragile.[166] Roasting was done either in stacks of wood on the ground[167] or in roasting pits.[168] The roasting process remained very slow and the temperature had to rise to a minimum of 400–550 °C.[169] After roasting, the ore was crushed into small pieces to be suitable for small furnaces.[170] The roasted ore was not normally stored but smelted immediately.[171] The smelting took place in a specific furnace, various types of which can be distinguished.[172] The walls of the furnaces were usually made of stones and clay, providing extra insulation from the surrounding earth in the case of sunken furnaces.[173] Furnaces built above ground level had either a slag pit or a small hole to tap off the slag from the furnace.[174] Charcoal was used as fuel[175] and the heat was generated with the help of one or more bellows or even by natural draught.[176]

In the so-called reduction process, iron was reduced from iron ore, but not melted. As a result, a bloom of iron with variable carbon content and a great deal of slag and other elements formed in the bottom of the furnace.[177] Here it should be noted that this description is very generalizing, and the process and its details have varied from place to place and from time to time.[178] The bloom was further refined by heating and forging to remove as much slag as possible. The bloom was heated in so high a temperature that the slag was melting, after which it was removed from the forge and hammered. To remove the slag and to homogenize the structure of iron, at least to some degree, the bloom was hacked, folded and forged many times.[179] After the bloom was clean enough, it

160 E.g. Buchwald 1975; Buchwald 2005: 25–28; Tylecote 1987: 101.

161 Buchwald 2005: 72.

162 E.g. Buchwald 2005: 91; Serning 1979: 52. Lake and bog ores are formed by the activity of the surroundings, and they occur in different shapes and sizes (Serning 1979: 57–59).

163 E.g. Serning 1979: 52–53; Tylecote 1987: 48–50.

164 Olof Arrhenius (1959), for example, has studied the phosphorus content of iron objects and has thus suggested that rock ore was primarily used before the Middle Ages. Also black sand consisting of magnetite has been suggested to have been in use during the Iron Age in Sweden (Lannerbro 1976). Some analyses of iron blooms also show that they were not reduced from lake or bog ore (e.g. Serning 1965).

165 E.g. Buchwald 2005: 91; Serning 1979: 55.

166 E.g. Peets 2003: 36–37.

167 E.g. Peets 2003: 36–37; Tylecote 1987: 53.

168 Serning 1979: 60; Tylecote 1987: 53.

169 Buchwald 2005: 91

170 E.g. Serning 1979: 60.

171 Buchwald 2005: 91.

172 E.g. Cleere 1972; Martens 1978; Serning 1979: 68–69. The classification of iron smelting furnaces is problematic because the remains are in many cases badly destroyed, and furthermore, there are great regional differences between different types of furnaces (see e.g. Buchwald 2005: 183–185; Tylecote 1976: 46–47, 54–55, 65–66; Tylecote 1987: 151–178).

173 E.g. Buchwald 2005: 225–226.

174 See e.g. Serning 1979: 69.

175 Buchwald 2005: 94.

176 E.g. Serning 1979: 85–87.

177 E.g. Lang 2007: 62; Tylecote 1976: 166. For analyses of blooms, see e.g. Buchwald 2003: 171–173; Peets 2003: 143–150; Pleiner 2003.

178 E.g. Serning 1979: 65.

179 E.g. Lang 2007: 25; Peets 2003: 151–155.

could be forged into some form of currency bar to be commercially used, or it may have been forged directly into objects.

During the Late Iron Age steel could have been made in different ways.[180] First, steel may be produced directly during smelting by adding more charcoal and tapping off the slag more often.[181] Secondly, in Russia and Karelia the iron bloom was heated in a forge until it sparkled, after which it was quickly cooled in water or snow. As a result of this process, the steely outer layers of the bloom crumbled away, and these crumbles were then welded into one piece of steel.[182]

The third method was carburizing or *cementing*.[183] In all simplicity, very thin pieces of iron could be heated in the middle of charcoal for several hours at a temperature over 912 °C, causing some carbon to incorporate into the surface of iron.[184] Often iron sheets were placed in the middle of a carburizing agent, such as bones, horns or skin, and covered in an airtight container and heated for several hours.[185] In this manner also local cementing could be done by simply covering the object with carburizer and then clay.[186] It is possible to incorporate carbon to a depth of three millimetres from the surface of the heated piece, in other words, an iron bar with a thickness of six millimetres can be turned completely into steel.[187] With regard to other alloying elements, phosphorus could have been obtained from crushed bones or teeth with the same method as carbonization.

3.1.3. Mechanical working of iron

Iron is worked or shaped by forging it with a hammer against an anvil. The principle behind the forging or *shaping* process is that material is not removed but shifted from one place to another. Iron and steel are forged in so-called forging temperature, which is ca. 770 °C at its lowest. Beyond this temperature, iron is no longer magnetic and is thus in an austenitic state.[188] The forging temperature is judged on the basis of the colour of the heated metal. At 770 °C the colour of iron is cherry red. The maximum forging temperature is ca. 1100 °C, the colour being bright yellow.[189] If iron is heated too much, it will sparkle and burn.

The piece to be shaped is heated in a forge. An Iron Age forge uses charcoal as its fuel, and the heat of the glowing charcoal is maximized by blowing air into it with bellows.[190] The part to be forged is heated so that charcoal is all around that part.[191] The flow of air blow must not hit the heated part directly. If this happens, the required temperature cannot be reached and the heated part will oxidize very easily. When the piece has reached the correct forging temperature, it is taken out of the forge and placed directly on the anvil for working. The forging may continue until the red colour of the piece has vanished. The hammer blows should be lighter while the piece gets cooler and cooler to avoid cracking it.[192]

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180 *See Peets 2003: 264.*
181 *Kolchin 1953: 51.*
182 *Peets 2003: 264.*
183 *This method is now called colour case hardening (CCH) among gunsmiths. The carbonization produces thin surface hardness as well as vivid colours on the surface of the polished and heated metal.*
184 *E.g. Thålin-Bergman & Arrhenius 2005: 25.*
185 *Peets 2003: 264; Pleiner 2006: 66. Terje Gansum (2006) has even suggested that human bone could have been used in the carburizing process.*
186 *E.g. Pleiner 2006: 67.*
187 *Hansen 2007: 35.*
188 *E.g. Buchwald 2005: 276.*
189 *E.g. Buchwald 2005: 132.*
190 *E.g. Peets 2003: 175–178; Thålin-Bergman 1979: 105–108.*
191 *E.g. Mäki-Rossi 1950: 50–51.*
192 *E.g. Mäki-Rossi 1950: 53.*

While forging hot iron, the particles are shifted from one place to another and the fibres are *packed*.[193] Iron can also be worked by cold-forging. In cold-forging the toughness and hardness of the forged piece increase, but the iron becomes harder to treat and more fragile.[194] For example some Viking Age swords are claimed to be hardened by cold-forging.[195] The forging should be done within certain temperatures. A temperature that is too low (i.e. below ca. 770 °C) will cause fractures in iron. Too high a temperature combined with too forceful hammering, when the piece is at or over the welding temperature, will also cause fragmentation of the forged piece.

During forging, a plate-like, magnetic hammer scale is formed. This scale consists of iron oxides, and it is created when hot iron reacts with oxygen in the air.[196] This oxidation slowly eats away the surface of the forged piece, since new oxide layers form after old ones are tossed away by the hammer blows. The thickness of the oxidized layer is related to the heating temperature and the atmosphere of the forge.[197] The scale formation is greater at high temperatures and oxidizing atmospheres. One way to reduce oxidation during shaping is to dip the hot piece quickly in cold water and let the temperature shock remove all oxides.[198]

There are several basic techniques of blacksmithing, or shaping to be precise.[199] These all have their conventional terms that are widely used, following are some examples. *Drawing out* means to forge an iron bar thinner, and *upsetting* means to make the bar thicker by hammering its ends. *Fullering* means widening of iron bar with the help of convex hammer or tool. As the result of fullering, there are one or several deep indentations in the iron, which may be smoothed by a technique called *flattening*. *Punching* means making holes with a punch in hot iron. In *drifting* the hole is being enlarged or shaped with special tools, drifts. In *cutting* the hot iron is struck with a chisel or against a so-called hardie to make a cut. *Chamfering* or *bevelling* is a technique of hammering where a diagonal surface is hammered to the end or edge of a bar.[200]

Separate pieces of iron may be joined with several techniques. In *shrinking* a cold piece is inserted into a hole in hot iron. When hot iron cools, it will shrink and grasp the cold iron tightly. In *riveting* the pieces to be joined have holes through which a rivet is pushed and then bradded. *Bradding* then means the upsetting of the end of a bar, e.g. a rivet, to prevent it from being pulled through a hole. *Banding* or *collaring* means wrapping hot iron around cold iron to make a joint.[201]

The best way to join iron pieces together is *forge-welding*. In technical terms, forge-welding is a way of welding by pressure, where the pressure is caused by hammer strokes.[202] In forge-welding the pieces to be welded are heated to a welding temperature, which is somewhere between 1100 and 1300 °C, depending on the carbon content of the pieces in question.[203] At this high temperature, the pieces still retain their original shape, but their surfaces are beginning to melt. These almost melted surfaces are joined by hammering them against each other. For this reason forge-welding is sometimes called *hammer-welding*. The most essential factor in forge-welding is the estimation of the correct welding temperature, which is done by looking at the colours of the heated metal.

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193 *There seems to be an endless debate over the usefulness of forging vs. so-called stock-removal method in the making of blades. It is unclear whether the forging actually 'packs' the crystals, and whether heat treatments normalize the crystal structure to such a degree that the crystals would again resemble the 'unpacked' form.*

194 *E.g. Tylecote 1987: 247.*

195 *This claim has been made by the Norwegian blacksmith Kasper Andresen, who made copies of Viking Age swords by hardening the edges by cold-forging.*

196 *E.g. Buchwald 2005: 276–277; Pleiner 2006: 110.*

197 *E.g. Tylecote 1987: 320.*

198 *E.g. Buchwald 2005: 277.*

199 *See e.g. Pleiner 2006: 55–65.*

200 *E.g. Bealer 1995: 125; Drew 1935: 22–28.*

201 *E.g. Bealer 1995: 127.*

202 *Buchwald 2005: 275; Maryon 1941: 118; Mäki-Rossi 1950: 136.*

203 *E.g. Hansen 2007: 39.*

Traditionally, pure iron should be 'white as fat' until it will weld, while high-carbon steel will weld at red-heat. Some blacksmiths prefer to have a few sparks flying off the heated piece, when the welding heat is reached.[204] However, sparks always mean that carbon in the heated piece is burning, and there is a great risk that the piece will be partially lost.[205]

Forge-welding requires a so-called *flux* or *welding compound*, which prevents the oxidation of the welded pieces and helps to remove slag from the welding seam.[206] Traditionally fine-grained quartz sand from a river or a lake bottom has been utilized as flux.[207] Fine sand will melt at a lower temperature than iron or steel, thus forming a paste-like shell around the welding seams. In addition, possible slag inclusions will be trapped in the molten flux. As a consequence, slag will be easily removed during hammering while the molten flux sprays off from the welding seam. It should be noted that it is essential to heat the welded pieces in reducing fire, since quartz sand does not work properly in an oxidizing atmosphere.[208]

There are other traditional fluxes, too. Instead of quartz sand, some kind of compound of sand and salt could have been used.[209] Some fluxes are pastes rather than powders. One pattern-welding experiment used a paste of pigeon droppings, flour, honey, olive oil and milk mixed together.[210] Japanese swordsmiths used a paste of fine-grained clay, powdered charcoal and stray ashes mixed together; this paste was spread to surfaces to be welded before the heating.[211] During the Roman Iron Ages some kind of phosphorus-rich paste was used for welding a pattern-welded blade.[212] Also arsenic could be present in flux to prevent the diffusion of carbon from the steel edge to the mild-steel core.[213] These traditional fluxes are almost forgotten, especially in modern-day blacksmithing, because industrial fluxes already began to be manufactured in the middle of the 19th century.[214]

3.1.4 The heat-treating of iron and steel

As stated above, the properties of steel may be altered by heating it at different temperatures and cooling it at different rates. At its simplest, heat-treating may consist of heating the steel to the critical temperature and letting it cool in the air. This relieves the internal stresses caused by forging,[215] and therefore the method has sometimes been called *normalizing*. *Annealing* is a process where steel is softened. It is suited to softening, for example, cold-hardened steels.[216] Annealing is done by heating the steel again to the critical temperature, but now it must be cooled very slowly among, for example, wood ashes etc. This procedure will soften the steel, enabling careful cold-hammering and easier filing and grinding.

The hardening of steel is based on the transformation of austenite into hard *martensite*. When cooling the steel very quickly, no cementite is formed. Instead, the iron carbides will remain as diluted into iron, which in turn creates a hard, needle-like structure. The hardening is normally

204 *E.g. Hansen 2007: 40.*
205 *E.g. Buchwald 2005: 281–282.*
206 *Hansen 2007: 39–40; Mäki-Rossi 1950: 137.*
207 *E.g. Andresen 1994: 197; Mäki-Rossi 1950: 138.*
208 *Buchwald 2005: 281. Quartz sand should react with wüstite (iron oxide), which is formed on the surface of heated iron in reducing fire, creating a kind of fluid slag.*
209 *Peets 2003: 216.*
210 *Anstee & Biek 1962: 80–81.*
211 *Bealer 1995: 356.*
212 *Rosenqvist 1970: 179.*
213 *Rosenqvist 1970: 184.*
214 *Mäki-Rossi 1950: 138–139.*
215 *E.g. Buchwald 2005: 133. See Pleiner 2006: 65–70 for another summary of heat-treating techniques.*
216 *E.g. Tylecote 1976: 166.*

called *quenching* or *quench-hardening*, because the cooling is achieved by plunging the hot object into a liquid like water or oil.[217] The resulting hardness depends on the carbon content of the steel: the higher the carbon content, the harder the steel will be.[218] Also the hardening temperature and the rate of quenching will affect the outcome.[219] If, for example, the rate of quenching is too low, no martensite is formed but only *troostite*, which is nowadays known as a fine form of pearlite, and not hard enough for edged tools or weapons. If the temperature is too low and no austenite is formed, there will be no martensite either.[220] Traditionally the temperature has been determined with the help of a trial piece, which is a long steel bar with evenly spaced hacked cuts.[221] This piece has been heated so that the other end is in white heat and the other in red heat, after which the whole piece is quenched. Then the bar is bent broken at the locations of the cuts, enabling the blacksmith to determine the correct temperature according to the structure of the quenched steel.

After hardening, steel must normally be *tempered*. In tempering the steel is kept at a low temperature (ca. 225–325 °C) for a short time to slightly soften the martensitic structure.[222] The temperature is again judged by the colour of the metal, which varies from straw yellow to blue and grey.[223] Tempering can be done with several methods, because the low temperature can be reached with alternative solutions. Probably the best way is to use warmed sand into which the steel is plunged.[224]

3.2. The measurement and documentation of the sword as a whole

All the following measurements were taken of each sword (Fig. 6). The numbers refer to the table in Appendix 1.

1 – total length
2 – length of the blade
3 – length of the hilt

4 – greatest width of blade below the lower guard or shoulders of the tang
5 – width of the blade near the tip before the point (usually some 5 cm from the tip)
6 – width of the fuller near the hilt
7 – width of the fuller near the tip before the point (usually some 2 cm above the ending point of fuller)
8 – distance of the lower end of the fuller from the tip
9 – blade thickness at the same locations as the width measures (the smaller measure is taken near the tip; sometimes the blade is of even thickness)

10 – width of the tang at its lower end beside the lower guard or the shoulders of the tang
11 – width of the tang at its upper end beside the upper guard or pommel or the end of the tang
12 – length of the tang or grip

217 *E.g. Tylecote 1976: 167.*
218 *E.g. Mäki-Rossi 1950: 198; Tylecote 1976: 167.*
219 *E.g. Mäki-Rossi 1950: 199–201; Tylecote 1976: 167.*
220 *E.g. Hansen 2007: 17.*
221 *E.g. Hansen 2007: 36–37.*
222 *E.g. Buchwald 2005: 133.*
223 *E.g. Buchwald 2005: 133.*
224 *Hansen 2007: 50.*

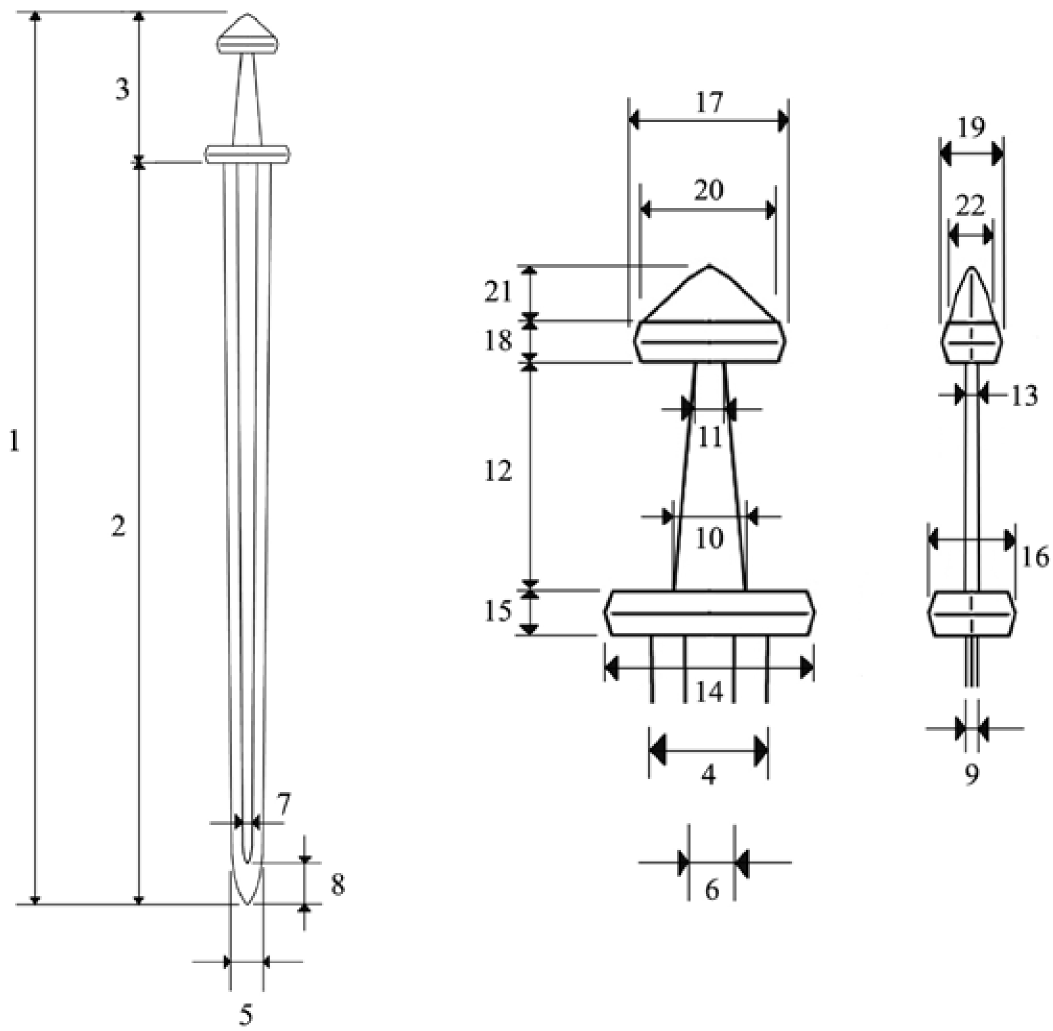
13 – tang thickness at the same locations as the width measures (the smaller measure is taken near the pommel; sometimes the tang is of even thickness)

14 – length of the lower guard
15 – height of the lower guard
16 – thickness of the lower guard

17 – length of the upper guard
18 – height of the upper guard
19 – thickness of the upper guard

20 – length of the pommel
21 – height of the pommel
22 – thickness of the pommel

Figure 6. Measurements of swords as presented in Appendix One.



All these measurements are given in millimetres, and it should be noted that the measurements are those that are preserved, whereby the original measurements could have been considerably different. The preserved dimensions are largely dependent on the methods of conservation as well as the degree of preservation. In some cases, the measurements could have been larger, especially those of the blade, when thin blade edges have corroded away. Sometimes the effect is precisely the opposite, when a thick layer of corrosion makes the measurements look much greater than they were originally. When the object is cleaned from all corrosion products, the dimensions – especially blade thickness – appear to be smaller than originally.

The condition of the find is defined as poor, fair or good. A find in good condition has only small, corroded dots on its surface, and its outlines, including the ridges of the fuller and the cutting edges, are well preserved. A find in poor condition is badly corroded and does not have preserved outlines or original metal surface. A find in fair condition is somewhere between these two categories; it is somewhat corroded, but some details can still be observed.

The measurements of the swords can be found in Appendix One. The statistics and features of measurements are discussed in connection with each part of the sword (Chapters 4.1, 5.1 and 7). Because of the great diversity of the material and dissimilarities in the condition of the finds, the measurements vary considerably. One reason for the different measurements is the different dating, and therefore style, of the blade and the hilt. Because the measurements are those that are preserved, they should be read together with the catalogue part at the end of this work (Appendix Two). The drawings in the catalogue shed some light on the degree of preservation of the finds.

The inlays were also measured in detail, including the width of the inlaid rod, the length of the inlaid motif, and the distance of the motif from the hilt or the shoulders of the tang. The height of the inlaid marks and letters was not measured, since it normally corresponds to the width of the fuller. Other features observable in blades are signs of use and repair, which may be observed in well-preserved blades.

The documentation of the hilt included measurements, the description of the decoration, and the way the hilt was constructed (Chapter 7). The material and technique of the decoration were inspected superficially. No metal analyses were taken from the hilts because the focus of this work, and also of the expensive analyses, was on the inlays of the blades and the blades themselves. Earlier research was used to give guidelines regarding the material of hilt decorations. The decorative techniques are compared with the help of measurements of, for example, how many grooves were carved for the decorative non-ferrous wires, and what kind of wire was used. Also the decorative motif itself was used to locate the hilt temporally and spatially according to its style.

The technical features, e.g. the riveting of the tang and the attachment of the pommel were also noted. In some cases radiographs were used to reveal the construction method of the hilt, but it was not systematically done and not even possible in all cases, since the hilts were sometimes too massive to be X-rayed thoroughly with the used device. The construction method refers here to the massive Viking Age hilts, which have a separate pommel and upper guard riveted together with one or two rivets and with different solutions. In connection with swords recovered from inhumation cemeteries, some traces of grips have been preserved. Also all traces of wear and repair are noted, since they can give indications of the use of the sword.

Other features observable in radiographs are the fibring of the iron as well as differences of corrosion caused by various materials, slag and welding. There are also clearly visible mechanical and sometimes soldered joints between the parts of the hilt and the tang of the sword blade. Moreover, the parts of the hilt are sometimes hollow, which can be seen very clearly from radiographs, as well as non-ferrous metal wires and plates used to decorate the parts. In some cases where the decorative metal has been lost in post-depositional circumstances, the grooves in which the decoration was applied can still be detected.

The hilts are categorized with the help of typologies. The types are mainly defined according to the Petersen typology.[225] Other typologies include some of the same forms as Petersen's system,[226] but it is clearer to use Petersen's classifications due to their accepted position in sword studies. In addition to the classification, various parts of the hilt are measured for the sake of comparison. Here it should be noted that not all hilts in poor condition could be classified.

Finally, it must be noted that hilts were documented firstly to give a general picture of the studied swords, a catalogue. Secondly, hilts were used in the establishment of the chronology for the blades and the inlaid motifs. In a broader context some features of the hilts were noted and written down, since this kind of information from these old finds has not been previously noted or published.

3.3. The revealing of inlaid marks: radiography and mechanical cleansing

Characteristic of the Finnish finds is a thick layer of corrosion hiding all decoration under it. Besides a layer of corrosion, swords recovered from cremation cemeteries are sometimes coated with fire patina, which is created by the high temperature of the cremation pyre. In addition to these, other substances are also to be found overlaying the blade, such as wood, textile or leather from the scabbard, in association with inhumation burials of course. In other words, the original surface of the blade is normally lost, and the inlays cannot be seen with the unaided eye. The same phenomenon applies to the pattern-welded blades. Corrosion can hide the patterns evident in the blade in its original condition, in the same way as the inlays and their patterns cannot be seen.

Radiography, or the X-ray examination, is a way of examining an artefact without causing any damage to it. At present, radiography is most often used in the conservation phase to establish the condition of the object, but it is also much used in the examination of structures of metal artefacts. In principle, radiography shows different densities of the materials used to compose the artefact. Non-ferrous metals have greater density than iron, so these metals look much brighter in radiographs.[227] The shown density can then be connected to the composition of the material, or then its thickness.[228] The thicker the examined material is, the brighter it will show in the radiograph. In radiography the current, the potential and the time of exposure can be adjusted to achieve the desired contrast in the picture.[229]

In the case of iron, radiographs do not show the difference between irons of different types, i.e. with different alloying elements. For this reason, very well preserved finds cannot be properly examined with the help of X-rays. Instead, radiographs show differences of corrosion as darker and lighter areas in the picture. The darker areas are naturally those more corroded, while the lighter areas have not corroded as much as the darker ones. The non-corroded areas look brighter because more material is present than in the deeper corroded parts.

225 *Petersen 1919. Main types A-Æ and special types 1–20.*

226 *Alfred Geibig (1991: 13–19) has listed different type names used by other researchers, which correspond to his own combination types and their variants. These also include some of Petersen's (1919) types, but also the following: Wheeler 1927, Jankuhn 1939, von zur Mühlen 1975, Nordman 1943, Bruhn Hoffmeyer 1954, Nadolski 1954, Oakeshott 1960 and 1964, Dunning & Evison 1961, Seitz 1965, Stein 1967, Ruttkay 1976, Menghin 1980, Müller-Wille 1982, Vinski 1983a and Głosek 1984. The dates established by these different authors are discussed below in Chapter 7.*

227 *E.g. Lang 1997: 53–55.*

228 *E.g. Middleton & Lang 1997: 9.*

229 *E.g. Middleton & Lang 1997: 8–9.*

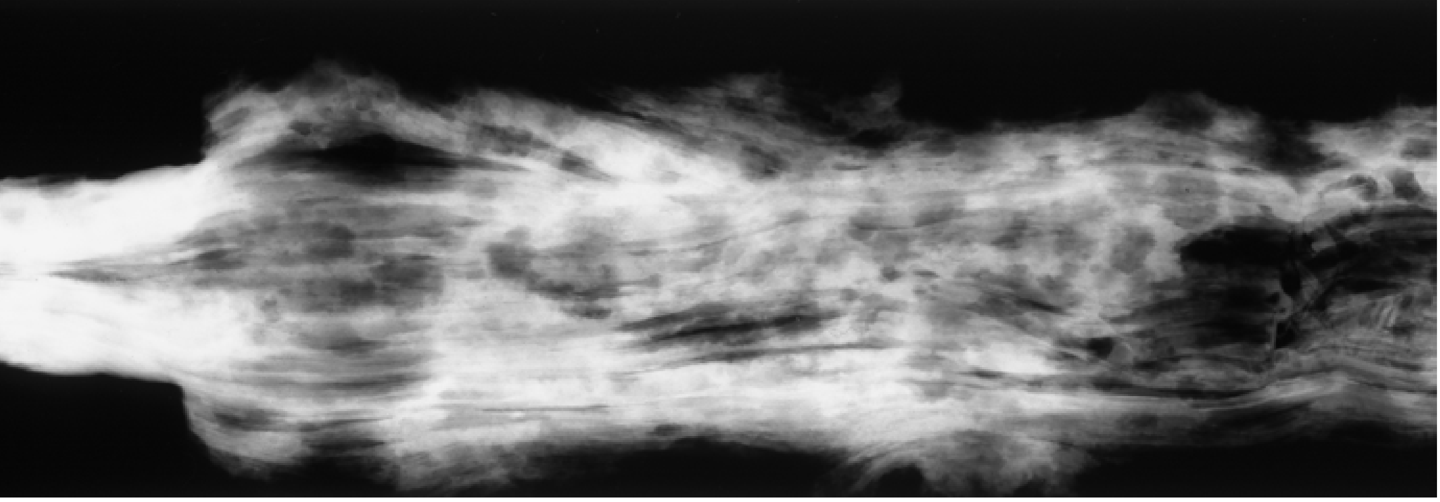


Figure 7. The corroded, fibrous structure of a forged sword blade (KM 5334:1), as shown in the radiograph (no. 591). The darker streaks are either slag inclusions or corroded welding seams or alterations of alloying elements, for example concentrations of higher carbon contents. Photo: Conservation Department, National Museum of Finland.

Differences of corrosion can be the result of different processes and materials. Normally corrosion starts from the surface of the object and penetrates deeper following the direction of the crystalline structure and welding seams.[230] Forging results in a striated, fibre-like structure, which is attacked in different ways by corrosion (Fig. 7).[231] This effect is simply called *fibring*, and it is normally caused by unidirectional working and forging of iron.[232] Iron was folded and welded to increase its toughness, and this too produces a wavy, striated structure.[233] One reason to fold and weld iron several times was to homogenize the structure and incorporate some additional carbon.[234] Mostly differences of corrosion are caused by slag, which increases the corrosion rate. Furthermore, welding seams tend to corrode faster and easier than the solid material.[235] Often welding seams contain also slag inclusions, which make corrosion even faster.[236]

One reason for differences of corrosion is the differing amounts of alloying elements present in iron. As a rule, the more carbon the steel contains, the quicker it will be attacked by corrosion.[237] Pure carbonless iron is corroded at a considerably slower rate. In some cases, non-carbon iron may contain such elements as phosphorus or nickel, both of which increase resistance to corrosion.[238] It must be noted that these elements were most likely deliberately applied to create a stronger contrast in the resulting pattern of the blade.

Besides metal, slag inclusions can be easily detected in radiographs. Slag has a different density than iron,[239] which causes the X-rays to penetrate it much more easily, resulting in black spots in those places where slag is present. Slag is usually formed during forging and welding operations, and may be a layer of oxidized iron or welding flux. In this way, pattern-welding, for example, may be easily seen from a radiograph.[240] Also wood does not become recorded in the radiographic image, because the low density of wood requires very low energy X-rays in order to be recorded on film.[241] The only traces of wood are the remains of scabbards and grips, which of course are situated always on the surface of the blade or the tang of the hilt.

Sword blade inlays are problematic, because the inlays of both sides of the blade will be visible in the radiograph on top of each other (Fig. 8). Normally, corrosion has destroyed many parts of the shallow inlaid rods, leaving much room for interpretation. Furthermore, depending on the condition of the find and the remaining thickness of the blade and the corrosion layer, the inlays

230 *E.g. Tomanterä 1986: 14.*
231 *E.g. Lang 1997: 41, 48.*
232 *Lang 1997: 41.*
233 *Ypey 1980: 193.*
234 *E.g. Tylecote 1987: 259.*
235 *Andresen 1994: 194.*
236 *Lang 1997: 49.*
237 *See e.g. Emmerling 1972: 310; Ypey 1980: 198; Thålin-Bergman & Arrhenius 2005: 30.*
238 *See e.g. Hrisoulas 1991: 28; Thålin-Bergman & Arrhenius 2005: 26.*
239 *E.g. Lang 1997: 48.*
240 *Thålin-Bergman & Arrhenius 2005: 29.*
241 *E.g. Middleton & Lang 1997: 28.*

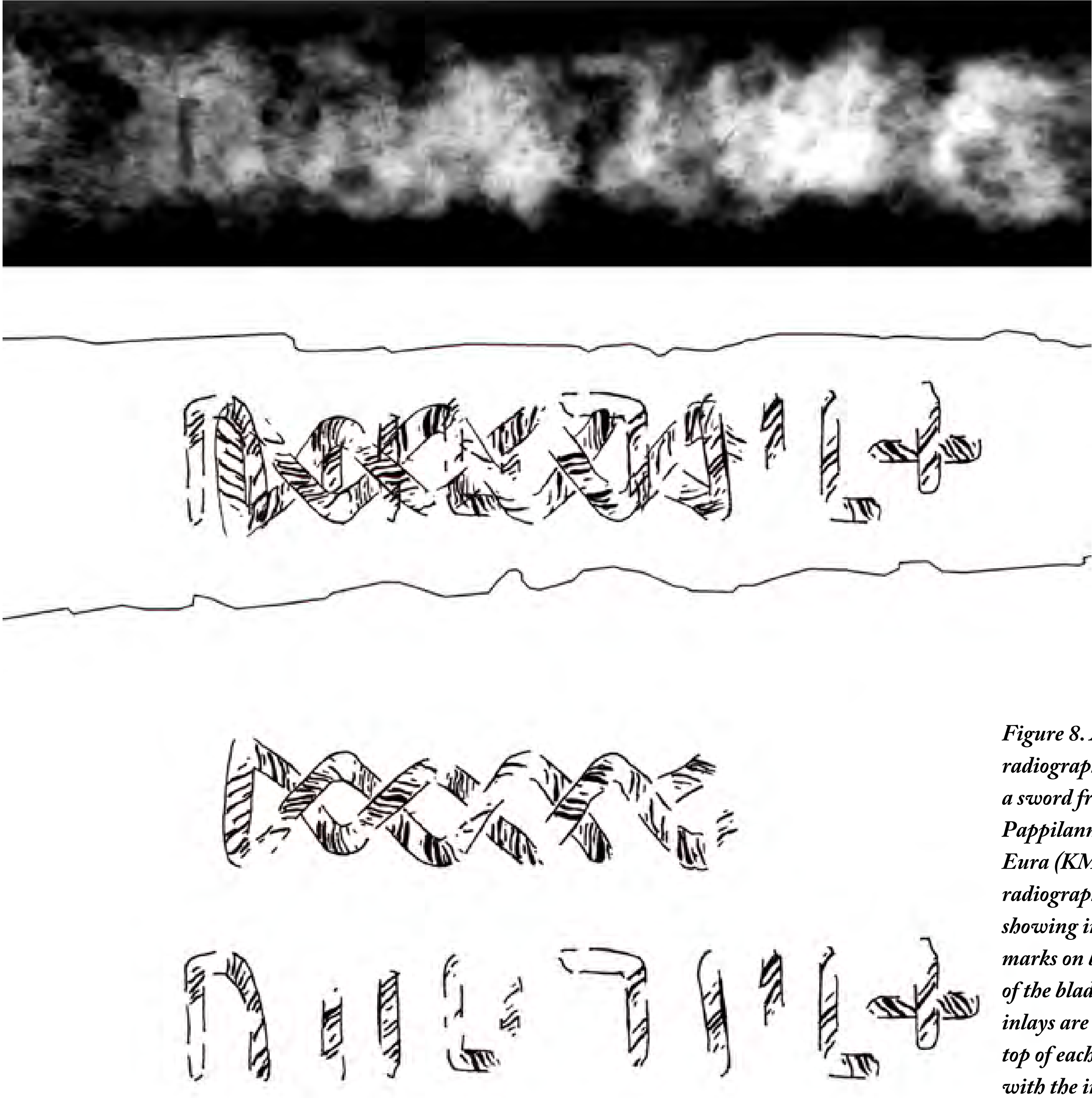


Figure 8. A radiograph of a sword from Pappilanmäki in Eura (KM 1120:1, radiograph no. 651) showing inlaid marks on both sides of the blade. The inlays are seen on top of each other, with the inlays of the reverse side appearing upside down. Above and below the radiographic image are drawings of the inlays, separated on both sides of the blade. Radiograph: Conservation Department, National Museum of Finland.

may be only slightly visible even in radiographs. This problem is called superimposition. All the features of the different sides of the blade are shown on top of each other in the two-dimensional image, posing challenges for interpretation. Stereoradiographs should be taken to create a kind of three-dimensional picture of the artefact. In stereoradiography, two radiographic images are taken of the same artefact, only changing the position of the find or the tube from which the X-rays are emitted.[242] A single radiograph is taken from straight above the object. In stereoradiography, two images are taken, both a certain distance from the centre-line, one from the left and one from the right. After the images are developed, they may be inspected with stereo viewers, creating a single stereoscopic image from two separate pictures and enabling the viewer to see what is above and what is below, i.e. a kind of three-dimensional image. This technique has been used especially in the study of pattern-welded and inlaid sword blades.[243] In the present study, the device used was made by Rich. Seifert & Co. in 1957, and the images were taken by moving the artefact, not the device.

The radiograph archive of the National Museum of Finland has many individual radiographs. In the case of inlaid blades, new stereo pairs must be taken to separate the inlays on both sides of the blade. Correspondingly, there were many blades with stereoradiographs taken by some other researcher or the conservator, namely Leena Tomanterä, so there was no need to take new

242 *E.g. Middleton & Lang 1997: 29–30.*
243 *See e.g. Lang & Ager 1989.*

ones. Again, some of these old stereoscopic images were of insufficient quality, and new ones had to be taken. This was mostly done when inlays were clearly present but they could not be fully distinguished from the old images, being either too dark or too bright.

Mechanical cleansing is a destructive method, in which the surface of the artefact is cleansed from corrosion products to bring out the original surface. The cleaned metal surface is then treated chemically to bring out the differences in the materials used in the construction of the artefact. This method is very effective in revealing the original surface of pattern-welded blades.

To start with, the blade to be examined is first cleansed, normally only a small part of it. The cleansing can be done, for example, with polishing stones, sandpaper, or electrically powered grinding and polishing tools.[244] Electrical devices generate some heat due to the friction of the polishing or grinding wheel, which requires caution.[245] This heat may destroy other information available, e.g. the heat treatments of the blade cannot be properly defined. The cleansing should be done in such a way that the grinding marks will not disturb the chemical etching of the surface and as a result the interpretations and observations themselves. For this reason, the cleansed surface should be polished to a very fine finish.

The chemical treatment is done with an acid or reagent, which reacts differently with different alloys of iron and steel.[246] Acid colours steel darker than iron. The greater the carbon content, the darker and deeper the etching will be.[247] As in the case of corrosion, carbon acts as a catalyst causing the acid to attack more aggressively the higher-carbon areas and thereby creating colour differences and topography between different types of iron and steel.[248] There are numerous acids that can be used. The most common in archaeometallurgy are probably sulphuric acid, nitric acid, and 2 per cent nital, i.e. nitric acid in alcohol.[249] Nital is perhaps the most commonly used medium for showing carbon distribution and grain structure.[250] Reagents are chemical mixtures that act in the same way as acids, while permitting the researcher to colour different metals in different ways than with plain acids. Oberhoffer's reagent colours the phosphorus-rich areas to a very light colour,[251] as is also done by Stead I reagent.[252] Stead I is most commonly used to show the distribution of phosphorus. The reagent Heyn colours iron dark and leaves carbon-rich steel much lighter in colour,[253] and the contrast is exactly the opposite as that achieved by some acids. The names of these reagents come from the name of the inventor of the reagent in question.[254] The treatment of iron with acids and reagents involves some serious problems. Heyn's reagent, for example, causes corrosion to increase, which inevitably leads to the destruction of the examined object.[255] The same can be said about all acids. After etching, the acid should be properly neutralized with an alkali, otherwise it will continue to etch, i.e. to eat away the surface of the object.

Mechanical cleansing was not used in this study to reveal the inlaid marks. Firstly, the number of swords to be examined was far too large to be cleansed and etched. A selection would have been necessary if only some of the swords were to be cleansed. Secondly, radiography was considered

244 *See e.g. Samuels 2003: 35–62.*
245 *E.g. Samuels 2003: 55–56.*
246 *For lists and compositions of different acid solutions and reagents see e.g. Bramfitt & Benscoter 2002: 221–241.*
247 *For chemical reactions in corrosion and the etching of iron and steel see e.g. Groysman 2010: 35–36.*
248 *For theory of etching see Vander Voort 1999: 166–171.*
249 *E.g. Vander Voort 1999: 212.*
250 *Vander Voort 1999: 212–213.*
251 *E.g. Thomsen 1965: 68; Vander Voort 1999: 6–7.*
252 *E.g. Rosenqvist 1970: 166; Vander Voort 1999: 5–6.*
253 *E.g. Salin 1957: 9.*
254 *For formulas of various reagents suitable for iron and steel, see Scott 1991: 69–71.*
255 *Stalsberg 1994: 184.*

to be a far better alternative because of the destructive nature of the method in question. Where more time and resources are available, the inlaid blades found with the help of radiography should be cleansed, because radiography has many serious limitations concerning the interpretation of the motifs and the determination of the materials of the items. Only the mechanical cleansing of the inlaid part of the blade would accurately show what is inlaid on each side of the blade. Furthermore, the materials of the inlays cannot be properly defined from radiographs. For example, pattern-welded rods normally appear as diagonal darker or lighter lines. The darker areas, which have corroded more, contain most probably more carbon than the lighter parts of the pattern-welded rod. Of course, the number of layers in the pattern-welded rod cannot be counted in any way. With regard to non-patterned inlaid rods visible in radiographs, their material remains even more obscure. If the surface of the blade was polished and etched, the relative carbon contents of the materials – both the inlays and the blade – could be deduced. The layer count of pattern-welded rods could also be measured, or at least estimated better than from radiographs.

3.4. Examination of inlays: microscopy

The inlays were documented and examined with as great accuracy as possible. Considering the research, the inlays fall into two categories: those that can be seen without the help of X-rays, and those that cannot be seen directly from the surface of the blade.

Low-magnification microscopes were utilized to examine the minute details. The nature of examined details can vary according to the research questions at hand. Typically, traces of manufacture and use are sought in metal artefacts. For example, traces of casting and filing can be detected. Minor traces of use and wear can sometimes be detected only with microscopy. Microscopes are also used for metallographic analyses, but in that case the magnification is far greater and able to distinguish the crystalline structure of the metal.

The low-magnification microscopes used should be stereomicroscopes, or so-called *binocular microscopes*, which can create a kind of three-dimensional view. A stereomicroscope consists of two separate optical systems, one for each eye. Stereomicroscopes usually have relatively low magnification, typically 2.5 – 50X, which is probably the reason why they are not so appreciated as research tools.[256] The examination of details can be made more efficient by attaching a video camera directly to the microscope. In this way, the details of the examined object can be seen directly on a screen, from where they can be recorded both as images or as live video. A normal camera can also be connected to a microscope to enable the photographing of details, which was used also in this work to document the details of inlays. Different kinds of transmitted, reflected or polarized light may also be utilized to create the desired contrast in the examined piece.[257]

In some cases, the inlaid blades had already been mechanically cleansed in connection with previous research. The inlays of these blades were clearly visible as colour differences. The colours fall into roughly two categories: shades of green and the contrast between grey and orange. Different shades of green dominated in these cleansed blades. These shades were most likely the result of etching with diluted nitric acid, although oxidation by water is also known to be used. The darker the shade of green, the more the material contained carbon. Some inlays were contrasted as light grey and orange shades. In these cases the etching medium that was used is not known. However,

256 *Caple 2006: 29.*
257 *E.g. Stuart 2007: 81–82.*

Figure 9.
A detail from a sword blade (KM 13419:2), showing inlays as corroded relief instead of colour differences. The blade has corroded more than the inlays, and thus the inlays are slightly elevated from the bottom of the fuller. The dark streaks around the inlaid rods are corroded welding seams. The inlays themselves are pattern-welded from two alloys of different carbon content. The layers with higher carbon content or lower phosphorus content have become corroded much deeper.

according to differences of corrosion, the orange or brownish colour of the inlays meant that the material contained more carbon than the lighter areas. The colours themselves could originate from the corrosion process, instead of some etchant. The lighter, grey areas were closer to iron than steel, and were left almost non-corroded. A third kind of visible inlay is a deeply corroded one. In some cases inlays and their patterns were visible as a relief, in which some materials were corroded deeper than other ones (Fig. 9). Above was noted that steel corrodes faster than iron. In the light of this fact, the areas corroded deeper had higher carbon content than those which had survived better.

What was then noted about these inlays visible to the naked eye? Firstly, the material: was the inlaid rod pattern-welded or not? If not, how much carbon could it have contained compared to the material of the fuller of the blade? Joachim Emmerling stated that the pattern-welded ribbons may be separated from each other by their composition and tightness of twists.[258] Then if the material is pattern-welded, how

258 Emmerling 1972: 300.

many layers does it contain? What materials are welded together? Is the pattern-welded rod twisted, and if it is, in what direction and how tight? If the material is not pattern-welded, are there any indications of the manufacture of the material, e.g. longitudinal slag inclusions? Could the material be pattern-welded or twisted, if there are no internal colour differences in the rods? Also the thickness of the pattern-welded layers can be measured in classification purposes.[259] This however, is useful only if the layers of the same pattern-welded band are of different thickness.

The materials of the inlays were not defined with maximum accuracy. It would have become too expensive, difficult and laborious to take samples of all the inlays, so the materials were separated only according to the colours of different metals. Different materials are normally defined as 'steel' and 'iron'; steel having higher carbon content than iron. 'Iron' could also have higher phosphorus content than 'steel'.

Secondly, all indications of the manufacturing technique were sought. The edges of the inlays were examined to see what kind of rod was attached to the blade. If the edges of the inlays were straight, the twisted pattern-welded rod must have been forged or filed even before attaching it to the blade. Correspondingly, if the edges were wavy, the twisted rods were most likely attached to the blade straight after twisting. These wavy edges and welding seams have also been found in pattern-welded blades.[260] The presence of dark streaks on the edges of the inlays could indicate slag or welding flux, and in addition, could indicate bad welds or pre-cut or pre-forged grooves for the inlays.

The depth of the inlays was measured by the pattern evident in the inlays. Due to their patterns, only twisted, pattern-welded rods could be measured for their depth. The pattern changes continually from the surface of the twisted rod towards the centre (see Chapter 5.2.2.1). The change is gradual from plain diagonal lines to a semi-circular pattern. If the pattern of the inlaid rod was semi-circular, then half of the rod was still sunken into the blade. In these cases, however, the depth could not be measured in millimetres, because it is impossible to say what the diameter of the inlaid rod was and how much the inlay widened during its attachment and forging of the blade. Another way to measure the depth of the inlays more accurately was to find an inlay that had corroded, leaving a pit in the blade. It could also be that the welding of the inlay had failed to some degree, and at least part of the inlay had dropped out, perhaps in post-depositional circumstances, when the successfully welded portion of the inlay was partly corroded away. In these two cases where the inlaid rod was missing, the depth of its pit could be measured.

The overall placement of the inlays could also tell something about the manufacturing stage of the inlays. For example, if the inlaid rods were not only in the fuller, but also on the bevels of the blade, they had most likely been attached before the fuller was made, for it would be difficult to attach iron inlays over the sharp ridge of the fuller. The corroded structure of the blade may also tell something about the technique used to attach the inlays. If the fibrous structure of the forged blade had become visible due to strong corrosion, this structure may be seen as altered in the inlaid section of the blade. If, for example, the structure is bent towards the blade edges in the inlaid section, it means that repeated hammering had taken place here. If the structure is directly under and next to the inlays, then the inlays have not been hammered very forcefully, and perhaps the inlays were attached into chiselled grooves.

Whenever possible, cross-sections of broken blades were examined to find signs of the forging technologies. A limited number of broken swords were subjected to metallographic analyses

259 *E.g. Emmerling 1972: 301.*
260 *Emmerling 1972: 303.*

combined with hardness measurements to find out how the blade was constructed and treated, and from what kinds of materials. If possible, the cross-section was taken from the inlaid section of the blade, which was broken of course. In this way more accurate statements could be made of the inlaying technique, both of certain sword blades and in general. The analyses of ten inlaid blades carried for this work were meant to be published in a brief article, but this article was not released during the completion of this work.[261]

After the whole material was studied, the inlays were classified into different categories. The first classification is simply based on the contents of the inlays. Different inscriptions form their own categories, as do certain inlaid motifs and their combinations. The classification is complicated by the fact that blades normally have inlays on their both sides. It may be that one side is similar to some other blade, while the other side is not. This makes things even more complicated. The second classification is material-based. Pattern-welded and non-pattern-welded inlays are separated, and the materials in these groups are further sorted out as their own groups. Due to radiography there will be a large number of 'uncertain' materials which cannot be accurately defined. This classification will then be combined with the first, content-based classification to see if there are any clear groups with same motifs or inscriptions combined with the same kinds of materials.

3.5. The technology of blades: metallography and hardness measurements

The material of the blade was also noted whenever possible. In most cases, the blade can be said to have a homogeneous structure, because that is what appears to be the case according to plain inspection of the surface of the blade. In the catalogue, however, this is not stated but only the exception when the blade is pattern-welded or proven to be laminated. Sometimes the blade may be corroded so that the corrosion has revealed the laminated structure of the blade. The components of this structure can be said to vary in carbon content, and thus definable as iron or steel. Sometimes corrosion that has occurred in even stages can be observed in radiographs, indicating a possible laminated structure.

The lamination of the blade is in general very hard to detect from radiographic images. Lengthwise welded pieces cannot be seen, once again due to the fact that X-rays cannot separate iron with different alloying elements. However, strong differences of corrosion can cause the laminations to show in radiographs. It may even be possible to see an iron sheet between pattern-welded panels in some deeply corroded pattern-welded swords.[262] Some researchers disagree with this; for example Janet Lang and Barry Ager claim that laminated edges of pattern-welded blades could not be seen in radiographs.[263] This is true, if the blade is well preserved. Computer-aided tomography (CT) can, however, reveal laminations with the help of several successive cross-sectional pictures.[264]

In some cases ready cross-sections were available to create more accurate picture of the construction of the blade. In the Finnish material, these were probably made by Jorma Leppäaho, as also mechanical cleansing operations, although the results remained unpublished. In this work the blade is in many cases defined as 'steel' or 'iron' in the same manner as the materials of the inlays on the basis of differences of corrosion. In the classification, the material of the blade is usually

261 See Moilanen 2015.
262 Ypey 1980: 198.
263 Lang & Ager 1989: 88.
264 See Wessell et al. 1994.

defined in comparison with the material – or materials – of the inlays. The inlaid rod, for example, may be pattern-welded from carbon steel and iron, while the material of the blade is somewhere between these two, according to the colours or the differences of corrosion.

A more accurate picture was sought with metallographic analyses. Metallographic examination also includes the polishing and etching of a selected part of the artefact or a sample of it. After etching, the surface is examined with a powerful microscope to reveal the crystalline structure of the object. The crystalline structure can give information about the manufacturing processes, i.e. heat treatments in the case of iron artefacts. Moreover, the general techniques of manufacture can be distinguished. The polishing and etching of the object are done in the same way as in mechanical cleansing, but in metallography only very small samples are needed. These are normally mounted in resin or plastic to make the polishing and etching easier.[265] The etching is most often done with Nital to bring out the grain structure.[266] Metallographic analyses are extremely useful in section cuts of edged implements and weapons. The blade is cut at some place all the way through, or only halfway through, and then the section is polished, etched and examined. If the blade is broken, it is easier to grind, polish and etch a section that is already broken. In this way the destruction of a complete blade is prevented.

Under a metallurgical microscope the grain structure is shown as a network of lines presenting the microstructure of the specimen. These patterns are then compared with specimens, whose compositions and heat treatments are known. Metal alloys normally have several crystalline phases, which can be distinguished from each other by the patterns shown in the microscope. Factors affecting the appearance of the structure are the alloying elements used, the temperature in which the metal was heated, and the rate of cooling. From these facts, combined with the results of chemical examination, both the composition and the treatment of the metal can be explained quite accurately.[267]

Sometimes metallographic analyses can lead to misinterpretations. The most problematic in the case of iron and steel artefacts is the identification of the welding seams. If they are not properly identified, the hypothesis of the manufacture of the artefact will be completely incorrect. For example, some blades have higher carbon content in the cutting edge than in the centre of the blade, which has led to conclusion that the blacksmith forged the artefact from a single lump of iron in such a manner that the carbon-rich areas ended up in the edges rather than in the middle.[268] In these cases the absence of any clear welding seams has led to false conclusions. In reality, the blade was most likely laminated so that the carbon steel edges were welded to an iron core. There have been attempts to solve this problem of almost invisible welding seams by creating lists of attributes for welding seams. Jerzy Piaskowski has suggested that a welding seam can be recognized from at least one of the following attributes: the seam is clearly visible, slag inclusions are trapped in the seam along its whole length, carbon or other elements change suddenly, or the direction of slag inclusions changes suddenly.[269] Radomir Pleiner has criticized these views with the argument that these above-mentioned attributes were defined with the help of modern materials, which do not necessarily correspond to prehistoric ones.[270] Individual factors also have an effect on the appearance of the welding seams in the finished piece.

265 *E.g. Samuels 2003: 14–15.*
266 *For different etchants and etching procedures used in metallography, see Vander Voort 1999: 165–266.*
267 *See e.g. Bramfitt & Benscoter (2002) and Vander Voort (1999) for examples and detailed procedures.*
268 *Pleiner 1973: 19.*
269 *Piaskowski 1971 and 1972.*
270 *Pleiner 1973: 21.*

In addition to the earlier cross-sections, metallographic analyses focused on selected finds, including macro- and microanalyses as well as ratios of elements present. The cross-sectional analysis placed some requirements on the condition of the find, and thus only broken blades could be analysed. The broken blade must be in such good condition that the surface of the blade must be slightly corroded. In other words, there must be as much material as possible remaining in the blade. If the blade is badly corroded, there would be no surface layers any longer but only the core of the blade. The analyses require a piece approximately five millimetres in length so that it can be mounted in plastic, polished and properly analysed. The samples for cross-section analyses are selected in such a manner that the cross-sections would show not only the structure of the blade but also the method with which an inlaid mark is attached. This would also tell of the inlaying technique and the materials of the inlays.

The materials of some blades have been analysed by other researchers. The British archaeometallurgist Alan Williams carried metallographic analyses of several blades, in addition to hardness measurements using the Vickers scale.[271] The results of these analyses and their critique are discussed below (Chapter 4.5.1). Hardness measurements, however, are also included in the present study in connection with cross-section analyses. On the whole, it can be stated that measuring the hardness of blades is a relatively new method of examining them. For example, in the case of a sword blade, measurements are taken from many parts of the sword, from the centre and from the cutting edges, to create an overall picture of the hardness of the blade.

There are several methods to measure hardness, the three most common ones being the Rockwell,[272] Brinell [273] and Vickers tests. The last-mentioned test is most widely used among metallurgists. In the Vickers test the hardness value is calculated on the basis of the indentation of a pyramidal diamond indenter. The value is given as the Vickers Pyramid Number (HV). This test is most commonly used in metallographic analyses and done to a polished surface of the object.[274]

All these above-mentioned methods of measuring always leave small traces on the object. Modern technology, however, has made possible portable hardness testers, which normally use some kind of acoustic resonators.[275] These devices enable the measuring of hardness in different scales, and also without any traces on the object to be measured. The values of different scales of hardness can be compared and easily converted.[276]

Hardness measurements can give hints of the manufacturing technique, and in the case of iron and steel blades, information about the heat treatments done on the blade. Furthermore, the quality of the material can be speculated. For example pure iron is around 100 HV, eutectoid steel around 250 HV, and quench-hardened eutectoid steel is somewhere between 600 and 800 HV.[277] Hardness measurements are most effective when combined with metallographic analyses. Together these two methods can produce very accurate descriptions of the materials and how they were worked. The problems here are possible depositional or post-depositional alterations in the materials, and the poor condition of the finds that are examined. For example, a badly corroded blade no longer has its outer layer, and the readings have to be taken from the visible, corroded, inside parts of the blade, which are often of different material than the outer layer of the blade.

271 *Williams 2009.*
272 *E.g. Scott 1985: 315–316.*
273 *E.g. Scott 1985: 312–314.*
274 *E.g. Scott 1985: 315.*
275 *See e.g. Vander Voort 1999: 372.*
276 *See e.g. Vander Voort 1999: 382–383.*
277 *Williams 2009: 122.*

In connection with technology and trade, the provenance of the swords can be the subject of speculation. One way to determine the provenance of iron is to analyse the composition of so-called trace elements. Trace elements are present in very small quantities, and they vary from one source of material to another. They can be measured in several different ways.[278] In the case of iron – as for all metals – the suitable methods are the chemical analysis, spectroscopy, spectrometry and isotopic analysis.[279] These methods will of course also explain the general composition of the material.

The provenance of the iron ore that is used can in some cases be geologically located on the basis of the trace elements and their ratios.[280] One way to speculate the provenance of certain types of iron ores to is calculate so-called F-ratios from the slag inclusions. For practical purposes, the F-ratio is that of the amount of silicon dioxide (SiO_2) divided by the amount of aluminium dioxide (Al_2O_5). This ratio is slightly different in various geographical areas of Europe. Some calculated ratios are 1–5.5 in Norway, 2–5.2 in Sweden and 7–16.2 in Denmark.[281] A simpler way is to look for local concentrations of various trace elements.

Central European ore probably originated from the region of ancient Noricum, which was a province already in Roman times, when it was known for its good-quality iron.[282] The ores have been documented as also in use during the Late Iron Age.[283] In the lower Rhine region especially vanadium-, manganese- and copper-rich Siegerland ore was used to make good steel, and phosphorus-rich iron could have been obtained from Wallonia.[284] The Noric siderite ore in the Erzberg region and the Austrian Alps contains typically distinctive amounts of manganese (over 5 %) and magnesium, as well as some calcium.[285] The level of phosphorus is very low, making the ore well suitable for steel-making. Manganese increases the hardness of iron and does not prevent the diffusion of carbon.[286]

In contrast, Scandinavian lake and bog ores contain variable but still distinctive amounts of silicon, manganese, aluminium and phosphorus in oxide forms.[287] Phosphorus, in particular, makes these ores unsuitable for steel-making, since phosphorus prevents the absorption of carbon.[288] To be more accurate, at least 0.2 % of phosphorus is needed to prevent the diffusion of carbon, smaller amounts do not alter the diffusion rate.[289] Danish ores seem to be striking in their very high amounts of phosphorus, approximately ten times that of ores in Sweden, Norway and Finland.[290] Finnish research literature mentions high phosphorus contents of lake and bog ores, as well as their cold-brittleness.[291] Belorussian ores have similarly high phosphorus content, ca. 2.95–9.64

278 *See e.g. Doménech-Carbó et al. 2009: 16–19; Dulski 1999.*
279 *E.g. Doménech-Carbó et al. 2009: 16–19.*
280 *E.g. Lang 2007: 76.*
281 *Buchwald 2005: 202, Fig. 205.*
282 *Salin 1957: 113–114. Noric ores were largely exploited during the Roman periods, especially during the 2nd and 3rd centuries AD.*
283 *Buchwald 2005: 124.*
284 *Buchwald 2005: 294; Salin 1957: 113–114; Ypey 1980: 193. Ores of Siegen were utilized especially during the 8th century.*
285 *Ellis Davidson 1962: 17. For more detailed information on the composition of Noric ores see Buchwald 2005: 124–125.*
286 *Ypey 1980: 193.*
287 *Buchwald 2005: 143.*
288 *Tylecote 1976: 68.*
289 *Ray 1991.*
290 *Buchwald 2005: 145.*
291 *Hoving 1946: 61–62; Rinman 1794: 36.*

%.[292] In comparison, low phosphorus contents have been found also from Latvian ores[293] as well as from Kievan Rus , where the content is below 1 % on average.[294]

Swedish ores contain two to three times more aluminium than Danish ores, while Danish ones have more calcium than Swedish ores because of chalk and tertiary limestone.[295] Buchwald has stated that during the period from ca. 700 to 1300 AD iron was not produced in Denmark in large amounts, but was imported from elsewhere.[296] Of course, the ores in the territories of modern-day Denmark vary, for example those of western Jutland are rich in phosphorus whereas those of central Jutland contain more potassium, calcium and magnesium than in western parts.

Norwegian iron is rich in manganese and titanium, but poor in phosphorus, making excellent pearlitic or pearlitic-ferritic steel.[297] This perception makes them appear to be very close to Noric ores in composition. To make things complicated, also Spanish ores are known for their high manganese content and very low phosphorus content, but they also contain some copper. Finnish lake and bog ores contain some manganese and phosphorus making them somewhat unsuitable for the production of good-quality steel.[298] To mention some geographically more distant examples, ores from the British Isles are also rich in manganese, and some are also rich in phosphorus. As a generalization, lake and bog ores contain larger amounts of phosphorus than mined iron.[299]

Phosphorus-rich iron was used all over Europe, since phosphorus-rich iron ores were widespread.[300] According to Olof Arrhenius, mined ore contains less than 0.25 % phosphorus, and ores from the bottom of lakes and bogs contain over 0.25 % phosphorus.[301] Ores associated with phosphorus, however, are relatively widespread; the production technology of iron affects to the partitioning of phosphorus between iron and slag, and phosphorus may be considerably diffused during the smithing stage.[302] One particularly interesting phenomenon is the appearance of so-called phosphor-tongues during the 11th century. These contain roughly 0.2–0.8% phosphorus, making them suitable for pattern-welding.[303] On the other hand, pattern-welding starts to cease at this time, and these tongue-like currency bars were probably used for other purposes. Also the arsenic content of iron could indicate a certain type of ore; arsenic is commonly found in metallographic analyses around the welding seams.[304]

It has also been stated that the determination of provenance according to trace elements seems almost impossible, because the smelting process of iron causes drastic chemical changes.[305] Furthermore, the same artefact made from the same material, may have different amounts of trace elements in its different parts, because forging and welding may change the amounts of the elements present. Thin pattern-welded strips, for example, can be hard to analyse, because the strips may have been contaminated by absorbed trace elements from the adjacent layers.[306] In theory, the used iron ore can be located also by small slag inclusions present in the iron. These

292 *Gurin 1982: tab. 2.*
293 *Anteins 1976: 72.*
294 *Kolchin 1953: 36–47.*
295 *Buchwald 2005: 147.*
296 *Buchwald 2005: 153.*
297 *Buchwald 2005: 153–154.*
298 *Buchwald 2005: 196.*
299 *For more specific analyses. see Buchwald 2005: 135.*
300 *Buchwald 2005: 177–178.*
301 *Arrhenius 1959.*
302 *Godfrey et al. 2003: 191.*
303 *Buchwald 2005: 329.*
304 *Tylecote & Gilmour 1986: 5.*
305 *Goffer 2007: 43.*
306 *Thålin-Bergman & Arrhenius 2005: 67.*

slags may originate from the smelting phase, and can reflect the chemical composition of the smelting slag, in turn reflecting the composition of the used iron ore that can be geologically located.[307]

In the case of laminated and pattern-welded iron artefacts, it should be remembered that different types of iron used to compose the complete object could originate from different sources.[308] For example in pattern-welding, the steel may be of local origin, but the phosphorus-rich iron could have been imported from elsewhere, or the other way round. As a material, iron can be forged and welded from one shape into a completely different one, whereby the possibility of reused material is also present, which makes it very difficult to determine provenance, at least if the origin of the object itself is sought.

3.6. Catalogue and drawings

All the documented swords were photographed and drawn in scale with the AutoCAD program. A digital image of the sword was imported in AutoCAD, after which its outlines and the most important details were drawn with lines. The inscriptions and inlaid motifs were also drawn with AutoCAD to gain maximum accuracy in the measurements and appearance of the inlays. These inlays were drawn separately, either from a digital image, or from a drawing made from a radiograph. The drawings of inlays were finally fitted to their places in the drawing of the whole sword.

All the drawings are included in the catalogue section of this study. The drawings are schematic, showing only the outlines of the swords and the most important features, e.g. outlines of the inlays and the decoration of the hilt. If the sword was strongly bent in one or multiple places, the flat sides of the sword were drawn straight while the picture from the side of the edge was drawn bent.

The pattern-welding of both the sword blades and the inlays were drawn by hand to create a realistic picture of the patterns. The darker areas of the patterns represent steel with higher carbon content than white iron. The carbon content of the blades was not illustrated in the pictures of the catalogue to avoid making the images too complicated and unclear.

The catalogue also contains information about find contexts and references to literature with information about the sword in question. The swords were also weighed and, whenever possible, the balance point was measured to form a picture of the way the sword was handled. The balance point is somewhere in the upper part of the blade, and it is measured as the distance from the lower face of the lower guard or the shoulders of the tang. Balance points were normally measured from complete swords with all parts of the hilt still in place, but in some cases the poor condition of the find prevented the measuring.

307 *E.g. Blakelock et al. 2009; Lyngstrøm 2003: 22.*
308 *Caple 2006: 144–145.*

4. BLADES

This chapter deals with the blades on which the inlays were attached. As with hilts, also the blades have been the subject of typologies relying on classification on the basis of the form attributes and ratios of measurements. The blade typologies are mainly aimed at arranging various blade forms chronologically. Presented here is the categorization of the studied blades according to existing typologies, as far as possible.

Swords with ferrous inlays were forged in various ways and methods of construction, the most common technique being lamination. There are also pattern-welded blades, which means that the inlays are attached on top of the pattern-welded mid-section of the sword blade. In the case of pattern-welding, the method of blade construction is quite clearly seen, sometimes even with the unaided eye, though more commonly with the help of radiographic images. Lamination is harder to observe, but in some cases it may be presumed. More accurate information can be obtained with cross-section analyses, as well as data on the chemical composition of the blade parts, both of which were done also for this work.

A comparison can be made with foreign published finds which are sufficiently studied and analysed. Is the find material studied in this work similar to or different from foreign finds? Some categorization may be made also on the basis of the construction and the material of blades, in addition to inlaid motifs and materials of inlaid rods. In this chapter, references to previous research have been divided according to the inlay-based classification presented in the next chapter.

The blades also have much more potential to show signs and traces of use, namely battle damage. This is also discussed here, critically, since damage may also be due to other factors, such as the burial custom and the way in which the sword was recovered. The remains of scabbards are also mentioned whenever their remains have been found accompanying or adhering to the blades.

4.1. Measurements

The inlaid blades can be roughly divided into two categories by their dating: pre-Viking Age and Viking Age blades, and later ones from the Crusade Period or possibly even later. The later blades were generally of more slender shape, which is of course natural considering the general development of blade forms. As becomes evident later, this division cannot be taken as a rule, since there are also some exceptions to it.

The measurements taken were as follows. The length of the edged portion of the blade was measured from the lower face of the lower guard or the shoulders of the tang to the tip of the blade, or to the broken part of the blade. The width of the blade was measured first near the hilt or the tang shoulders, and then near the tip, approximately five centimetres from the tip. If the measurement is made any closer to the tip, it would be too small since the tip begins to

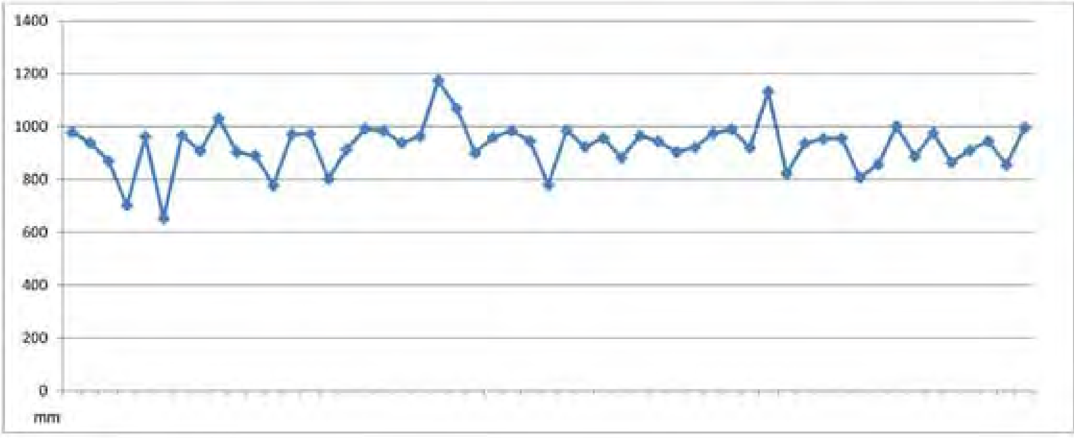


Figure 10. Chart showing the lengths of complete swords among the studied finds.

become sharper quite markedly. If the blade was broken, the smaller width was measured from the broken place naturally. The fuller was also measured in similar fashion: its length as far to the tip as it was preserved, its greatest width near the hilt, and its smaller width ca. two centimetres before the fuller starts to end, or in the broken part of the blade. The fuller usually tapered towards the tip in the same proportion as the blade. The thickness of the blade was measured from the same locations as the widths of the blade.

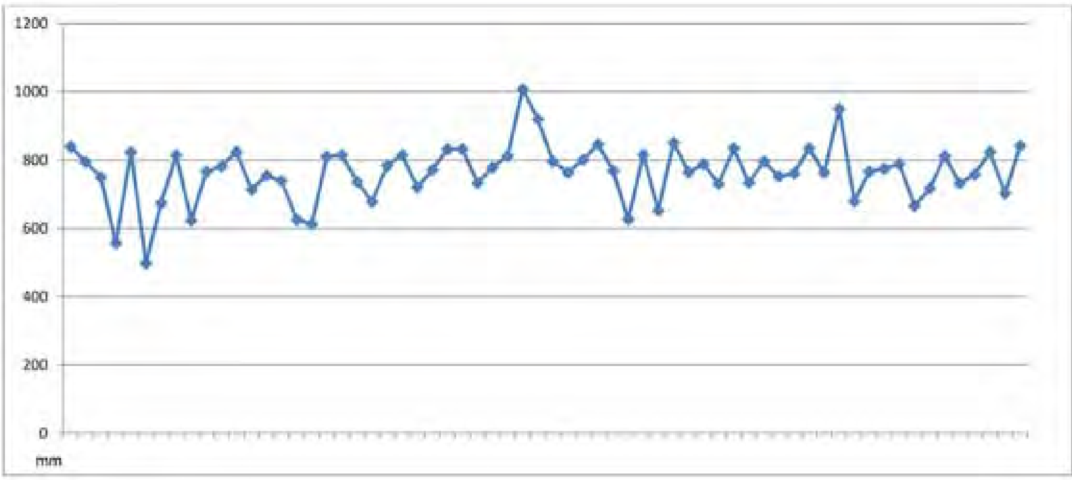
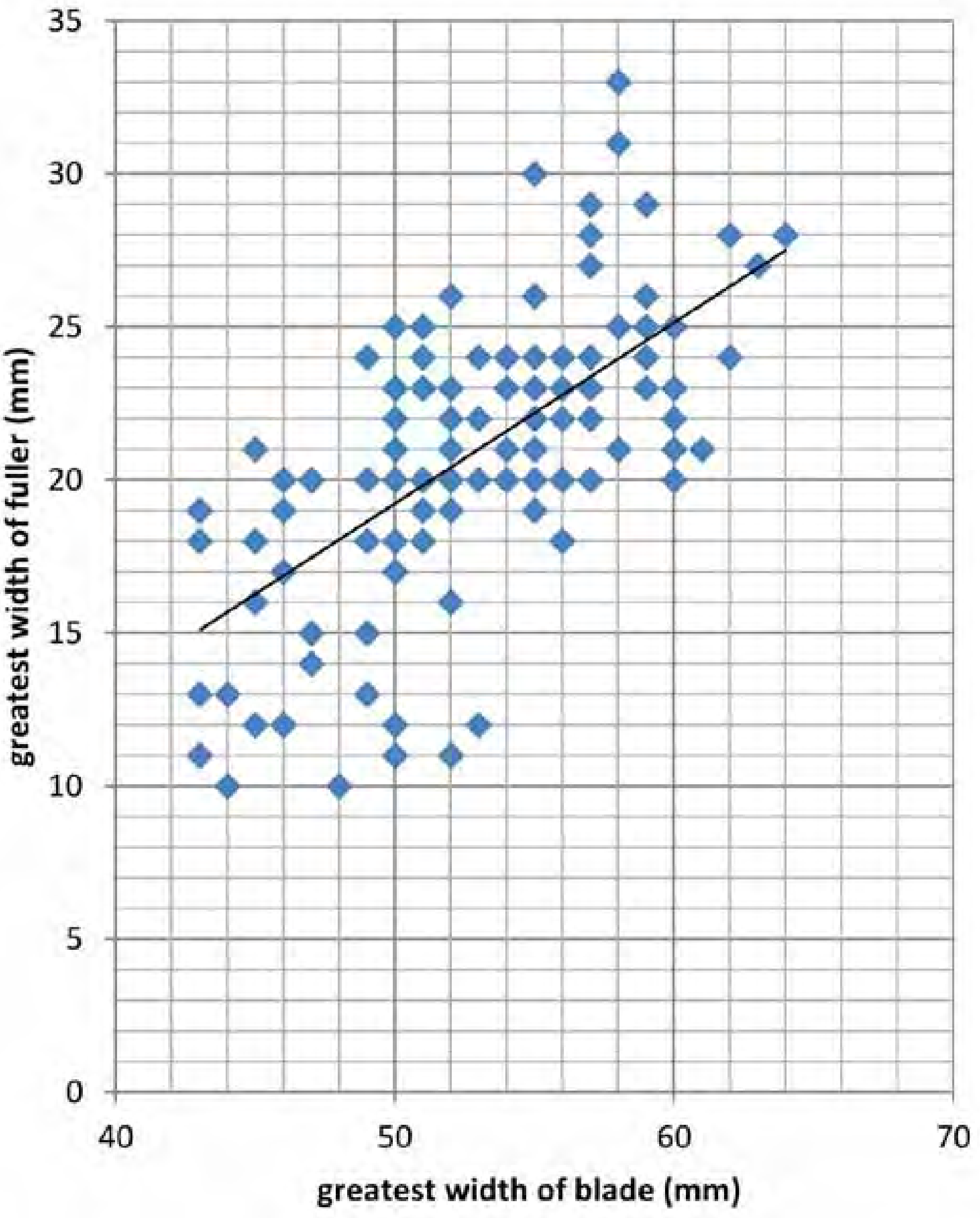


Figure 11. Lengths of the edged portion of the blade.

The length of the whole sword, whenever measurable, varied between 65.3 and 117.4 cm (Fig. 10). In 56 cases the length of the whole sword could be measured within sufficient accuracy, since many swords were otherwise complete, but the tip was corroded.[309] Here the total length means that the pommel has been preserved, from which the distance to the tip can be measured. The length of the edged portion of the blade varied between 49.8 and 100.8 cm (Fig. 11). Blade lengths could be measured from 64 blades, since the hilt or the tang did not have to be preserved for this to be done. The length of the blade was generally between 70 and 85 centimetres, and the whole sword between 85 and 100 centimetres. The extremities in connection with both blade lengths and complete sword lengths can be easily explained. The shortest measures were those taken from shortened blades. They could have been shortened from the tip, because the inlays were on the average in a normal position. The longest measures are explained by chronological matters; these were taken from narrow blades with hilts datable to the Crusade Period. These narrower blades were normally longer than their Viking Age predecessors.

The greatest width of the blade varied between 4.3 and 6.4 centimetres, while the greatest width of the fuller was between 1 and 3.3 centimetres (Fig. 12). The figure shows clearly that

309 *In four cases this measurement was taken from a previous publication (finds KM 18000:3880, ÅL 337:106, ÅL 337:229, and ÅL 337:528).*



the generalization that the fuller is about one third of the blade width is not completely true. The widths of both the blade and the fuller could be measured from altogether 114 swords.

The thickness of the blades does not vary dramatically. In normal cases the thickest part of the blade was near the hilt, and the blade tapered in thickness further towards the tip. The blades were normally four to six millimetres thick near the hilt, tapering to a thickness of about two to four millimetres, as measured approximately five centimetres from the blade tip. This is a perfectly normal phenomenon considering the handling properties of the blade. The weight must be shifted towards the hilt from the tip with the help of distal taper, both in width and thickness, otherwise the whole sword will feel rather clumsy due to the division of the weight.

Figure 12. Chart showing the correlation between blade and fuller widths.

4.2. Blade typologies

A typology of sword blades, concerning mainly medieval ones, has been drawn up by Ewart Oakeshott.[310] He classified the blades according to their proportions and changes in the fuller. Oakeshott's main typology is the one based on blades, since he maintained that the parts of the hilt were not strictly dependent on the blade form. Despite this, Oakeshott also made classifications of different pommel and crossguard types independently, mentioning always those commonly occurring with certain blade types. These in turn are called 'families', corresponding quite closely to the definition of a certain 'type' in other typologies. As a further note, illustrations and depictions in art of the period were used as an aid to establish dates for the types.

310 Oakeshott 1964 and 1991.

Oakeshott classified thirteen blade forms (X–XXII). Of these thirteen types, seven include additional sub-types marked with letters in alphabetical order, raising the number of form variants to altogether twenty-four. The time span of these blades is from 950 AD to roughly 1600 AD, and it is obvious that only small part of the blade forms may be associated with the blades studied in this work. With regard to the single-handed swords of the Viking Age and Crusade Period, the noteworthy types are X (950–1200 AD), Xa (1000–1300 AD), XI (1000–1175 AD), XIa (1100–1175 AD) and XII (1170–1350 AD).[311] The other types are equipped with either a hand-and-a-half grip or a two-handed grip. Furthermore, other forms with a single-handed grip also exist, but the blade form is clearly later and different from those studied here. A highly notable feature of these later or rarer single-handed sword blades is the fuller, which terminates already half way on the blade or even earlier. Also the cross-section of the blade may be different, i.e. of diamond shape, since some of the single-handed types have a blade with a central ridge.

The Polish scholar Marian Głosek has classified the blades in Central European swords from 900–1500 AD according to Oakeshott's typology, as he also did with the hilts.[312] As pointed out in connection with the hilts, the chronology must be noted here, since the material used by Głosek differs spatially from Oakeshott's material. Głosek dated Oakeshott's type X blades to 900–1225 AD, i.e. to a longer time span than originally proposed by Oakeshott. Finds of type XI date from 1000–1300 AD, a time-span almost twice longer than Oakeshott suggested. Similarly, type XIa is dated between 1050 and 1225 AD by Głosek, again to a longer time span. Interestingly, Głosek has noted that type XII blades occur in two temporally separate phases. They were first used between 1100 and 1325 AD, after which they disappeared and were taken into use again for a short period between 1400 and 1425 AD. The dating given by Oakeshott for this type corresponds somewhat to the first period of use as defined by Głosek.

In addition to classification of hilts, Alfred Geibig also prepared a typology of blades.[313] All in all, Geibig separated fourteen main types and five sub-types of blades from between 650 and 1200 AD, the latest types being used also after the latter date. The typology is quite versatile, because it is based on the metrical characteristics of blades, relationships of measurements of different blade elements, and methods of construction and decoration, including inscriptions and other inlays. All the types are worth considering while classifying the blades in this work, except only one. This is type number fourteen, which is a single-edged blade, dated to between 650 and 800 AD according to Geibig. No single-edged blades have so far been found to have inlays of any type. Since the types are numerous, as in the case of Oakeshott's typology, more accurate depictions are found in connection with the analysis of the finds (see below), and only for those noted in the finds studied for this work.

The French researcher Marc Maure has also carried out a very simple classification of blades, in which one-edged blades were distinguished as four different types (A–D) according to their length and width.[314] Correspondingly, also four types of double-edged blades were classified (E–H).[315] Of the double-edged blades, type G was the most common and type H comes as second. Blades of type G are 75–80 cm long and 5–6 cm wide, whereas type H blades may be five centimetres longer and over 6 cm in width.[316] Like the Maure's hilt classifications, the blade

311 *Oakeshott 1964: 28–41.*

312 *Głosek 1984. The finds studied by Głosek were from the territories of East Germany, Poland, Hungary and Czechoslovakia at the time.*

313 *Geibig 1991.*

314 *Maure 1977: 99.*

315 *Maure 1977: 100–101.*

316 *Maure 1977: 101.*

categorization only shows some frequencies of certain-sized blades, and his classifications are not referred to in this work.

A problem with blade typologies is that in most cases the blades are so badly corroded that no classifying attributes can be distinguished.[317] There is, however, the possibility of classification on a structural basis. This has not been systematically done, because it would need the help of radiography, thus being expensive and laborious.[318] In addition, radiography always leaves room for different interpretations, and accordingly this kind of structural division may also end up being totally incorrect, especially in the case of non-pattern-welded blades, the laminations of which may not be seen at all in radiographs.

It must also be taken into consideration here that it may be very difficult to apply both the blade and the hilt as principles of classification. It has even been suggested that a one-sided typology relying on hilts alone may be more valid than a combined one that also considers the blade.[319] It seems clear that many swords were combined from a blade from one source and a hilt from another, and considering all the facts that may have an effect on the use and chronology of certain sword parts, the typology may become incoherent.

4.3. The categorization of the examined blades according to typologies and measurements

The types referred to in this work are those proposed by Oakeshott and Geibig. This has been done firstly to keep things simple. Referring to all possible blade typologies complicates the picture too much and is also somewhat useless, since the aim here is to distinguish between various blade forms and to use them as an aid in the dating of the swords as a whole. Furthermore, because it is difficult to classify the badly corroded and fragmentary finds, other typologies could not create any more reliable information than the two that are used here.

Of all the examined 151 swords, 58 could be classified according to their blades. In many cases, however, the definition of a given type is not perfectly clear, since the third of the blade near the tip is in many cases more badly corroded than the rest of the piece. Therefore, the crucial measurement of the ending of the fuller is in some cases quite difficult to carry out. Good examples of this are blades of Geibig's types two and three, which are sometimes hard to distinguish from each other if the last part of the fuller is too corroded. It must also be noted that some complete swords recovered from inhumation graves are in good condition in principle, since the shape of the blade, i.e. the cutting edges, has been preserved quite well. On the other hand, these finds have not been conservated in some cases, while in others corrosion has taken place despite the conservation process. Since the blade is then covered by layers of rust, no fuller can be detected, and the blade type remains unclear. One may of course speculate, but the overall shape is in many cases of post-Viking Age type, making the definition of the fuller crucial in regard to classification.

In three cases (KM 370 from Hämeenlinna, KM 708 from Hämeenlinna, and KM 11063:283 from Eura) the blade has been shortened. Both swords from Hämeenlinna have a Petersen

317 *Stalsberg 2008: 8.*
318 *E.g. Andresen 1994: 194.*
319 *Jakobsson 1992: 25–26.*

type V hilt, while the sword from Eura is possibly of type N. These blades do not fit into any of above-mentioned categories, having been intentionally made originally shorter, or shortened for some other reason and having originally been of greater length. They are dealt with later in accordance with marks of use (Chapter 4.8).

A well-preserved pattern-welded blade without a hilt from Vehmaa (KM 2022:1) resembles Geibig's type one, which is somewhat short in form and had parallel or almost parallel cutting edges and a steeply curved tip. Characteristic of this type is the lack of a fuller, or the fuller is very shallow. Owing to the clumsy geometry, these blades have a heavy feel, having their balance point closer to the tip than any other type of blade. The length of the blade varies from under 70 centimetres to 90 centimetres. The greatest width of the blade is 4.7–5.7 centimetres. Geibig dates this type to approximately 650–800 AD.

The most common type is the one resembling Oakeshott's type X and Geibig's type two. There are twenty-four well-preserved blades, which can definitely be connected to this type. Geibig's blade type number two is a developed form of the almost parallel and heavy type one. Blades of type two have a slight taper towards the tip, and the fuller mirrors the shape of the blade by tapering at the same ratio as the blade. The fuller ends very close to the tip. Geibig has separated three variants of this type. Variant A is the heaviest one, having also the broadest fuller, over 2.3 centimetres at its greatest width. Variant B is somewhat slimmer (1.9 cm as the greatest width of the fuller), while variant C falls in between these two. The blade width near the hilt varies from 4.8 to over six centimetres, and the blade length is between 70 and 83 centimetres. Type two was in use from ca. 750 to 950 AD.

Geibig's type two closely corresponds to Oakeshott's type X, which is also a broad, tapering blade, having a wide fuller, commonly one third of the blade width. The fuller ends about 2.5 centimetres from the tip, and the average length of the blade is roughly 79 centimetres. The tip is normally rounded. The dating is approximately 950–1200 AD according to Oakeshott.[320] What are striking here are the consecutive datings established by Oakeshott and Geibig for similar kinds of blades. The reason for this is due to the nature of the find material used to establish the typology. Geibig concentrated on earlier finds than Oakeshott did, whose aim was namely to classify swords of the medieval period. Furthermore, Oakeshott began his classification, i.e. type X (ten) to run consecutively from the late Viking Age onward.

The types of hilts found on the twenty-four blades of type Geibig two/Oakeshott X are as follows: Petersen's types B (one find), H (seven finds), I (two finds), S (one find), V (three finds of which one is not certain), Y (two finds), Later variant of type X (one find), special type one (one find), and also the silver-plated type (one find). In addition to Petersen's types, one hilt is of the so-called Mannheim type, which is comparable to Geibig's type number three. Also one earlier type can be found, in particular Behmer's type VI or Helmer Salmo's Late Merovingian type.[321]

Four blades may be categorized as Geibig's type number three, also being close to Oakeshott's type X (finds KM 6923 from Sakkola, ceded Karelia, KM 7332 from an unknown locality, KM 9243:2 from Sauvo and KM 10372:1 from Kurkijoki, ceded Karelia). Of these the tip of KM 7332 has been possibly re-forged. Of these four swords, only KM 6923 and KM 9243:2 have

320 Oakeshott 1964: 28–29.

321 In this connection only the datings for the blades are presented, and the chronology of various hilt types is discussed below in Chapter 7.

a hilt, in these cases of Oakeshott's type A and Petersen's later variant of type X, respectively. Type number three is almost similar in form to type two. Although type three is slightly shorter on average, it tapers more towards the tip. The proportions are also slightly different, since the fuller tapers more than the blade, terminating further away from the tip than in the blades of type two. The blade width is between five and 5.7 centimetres, and the blade length is roughly the same as in type two. Type three is somewhat later than type two, ca. 775–975 AD.

Of particular interest is the blade of find KM 13419:1 from Turku. The fuller of the blade is pattern-welded, and the type falls into Geibig's type three, but also into Oakeshott's type Xa, according to its narrow fuller. Oakeshott's type Xa of is a sub-type of X, having a narrower fuller and a slightly longer blade, being in used from approximately 1000 to1300 AD. In combination with a pattern-welded blade and a Petersen type E hilt, the blade hardly belongs to Oakeshott's category of Xa, but only resembles it.

Eleven finds may belong to either Geibig's types two or three. The problem of definition lies in the tip or point section of the blade, which has either corroded away, or the ridges of the fuller are so corroded that its tapering and termination point can no longer be seen. The hilts of these ten swords are as follows: Petersen's types B (two finds), C (one find), E (one find), H (two finds), V (one find), later variant of type X (one find), and a pommel of a later variant of type X combined with a lower guard of type R or S (KM 9164:3).

One blade clearly belongs to Geibig's type four according to its measurements and proportions: KM 27141:1 from Hämeenlinna with a Petersen type R hilt. This blade is apparently smaller in its dimensions and more tapering than blades belonging to types two and three. In general, type four blades are also somewhat similar to types two and three. In type four, the cutting edges have an almost straight taper, while the tapering of the fuller may vary. Essential features are a very steep taper as in type five (see below), and the shorter length of the blade when compared with types two and three. The length of the blade varies from under 70 to 83 centimetres. The blade width falls between 4.5 and 5.1 centimetres. Geibig dates this form to 950–1050 AD.

A distinctive group of blades consists of Geibig's type five, close to Oakeshott's type Xa presented above. Altogether five blades can be definitely classified in this group, whereas in three more cases the type may be defined as Geibig's type five, but the tip is either missing or badly corroded. Four of these swords have a pommel of brazil-nut form, while one has a silver-plated hilt. Geibig's blades of type five are slim and long, tapering continuously in a convex shape towards the tip, instead of a straight taper. Geibig has distinguished two variants, the first having fullers of uniform width, and the second having a tapering fuller. The fuller in both variants does not reach the rounded tip. The length of the blade falls between 83 and 91 centimetres, and the greatest width of the blade is ca. 4.8–5.1 centimetres. The dating of this type of blade falls roughly between 950 and 1075 AD.

Two blades may be classified as belonging to Geibig's type six, resembling Oakeshott's type XI (finds KM 8723:165 from Köyliö and the sword from the Church of Huittinen). The sword from Köyliö has a disc pommel of Tomanterä's type A, while the pommel of the sword from Huittinen is of Tomanterä's type B. The tip of the sword from Köyliö is corroded. In general, Geibig's blade type six is very close to type five. Also type six tapers continuously towards the tip, but more steeply than type five. The fuller does not reach the tip. Two variants may again be distinguished. The first has continuous taper to the tip, while the second has a triangular tip section, i.e. the taper is straight along the lowest third of the blade. The width of the blade is

4.6–5.6 centimetres, and the blade length is 83-91 centimetres. The dating is approximately 1050–1150 AD. Quite similar to this Geibig type, Oakeshott's type XI is longer and narrower than type X, and equipped with a narrower fuller. The edges are straight for the two topmost thirds of the blade and then narrow to a rounded point. The length of the fuller is four fifths of the blade.[322]

The blades of two swords (KM 9419 from Salo and KM 12687:1 from Turku) can be classified as Geibig's type five corresponding to Oakeshott's type Xa or to Geibig's type 6 corresponding to Oakeshott's type XI. Owing to corrosion a more specific type definition is impossible. The pommel of the first-mentioned sword is disc-shaped and belongs to Tomanterä's type A corresponding to Oakeshott's type G. The other sword has a silver-plated hilt.

One blade may be categorized as Geibig's type thirteen or Oakeshott's type XI (KM 3631:1 from Rovaniemi with a disc-pommel of Tomanterä's type B), although the tip of the blade has been reworked and reshaped. The fuller continues to reach the tip, in which case only Geibig's type thirteen has such a fuller that is long enough. Geibig's type thirteen is a very long and narrow blade, having a continuous straight taper from the hilt to the tip. The fuller does not reach the tip, and is 1.2 centimetres or even less in width. The greatest width of the blade is between 4.3 and 4.5 centimetres. Actually, no blade of this type catalogued by Geibig had the actual point preserved, and thus the shape of the tip remains unclear. Despite this, the preserved blade lengths fall between 91 and 100 centimetres. According to Geibig, type thirteen dates from 1200 AD onwards.

4.4. Methods of blade construction

4.4.1. General points of view

The following presentation of the forging technologies of blades is based on multiple sources. The analyses of blades with ferrous inlays have been conducted earlier, but the results have never been compiled. In other words, the articles dealing with the analysis of swords, most often a single sword, do not refer to analyses conducted by other researchers. Here, I seek to collect all the related information to achieve an overall picture of the situation of how the inlaid blades were forged and treated.

In addition to earlier studies, the finds studied for this work are of crucial importance. Already some information can be gained by the naked eye and a stereomicroscope, especially in cases where the cross-section of the blade has been previously evened out and polished, but the results have remained unpublished. Also the features present on the surface of the blade may give indications of materials, and even the construction technique, especially in the case of blades with a completely pattern-welded mid-section.

In most cases the blades seem to be made of homogeneous steel. It is a traditional assumption that all blades from the mid-Viking Age onwards were made of homogeneous steel.[323] This assumption is based on the appearance of the blades, where no traces of pattern-welding can

322 *Oakeshott 1964: 31–33.*
323 *E.g. Oakeshott 1960: 43.*

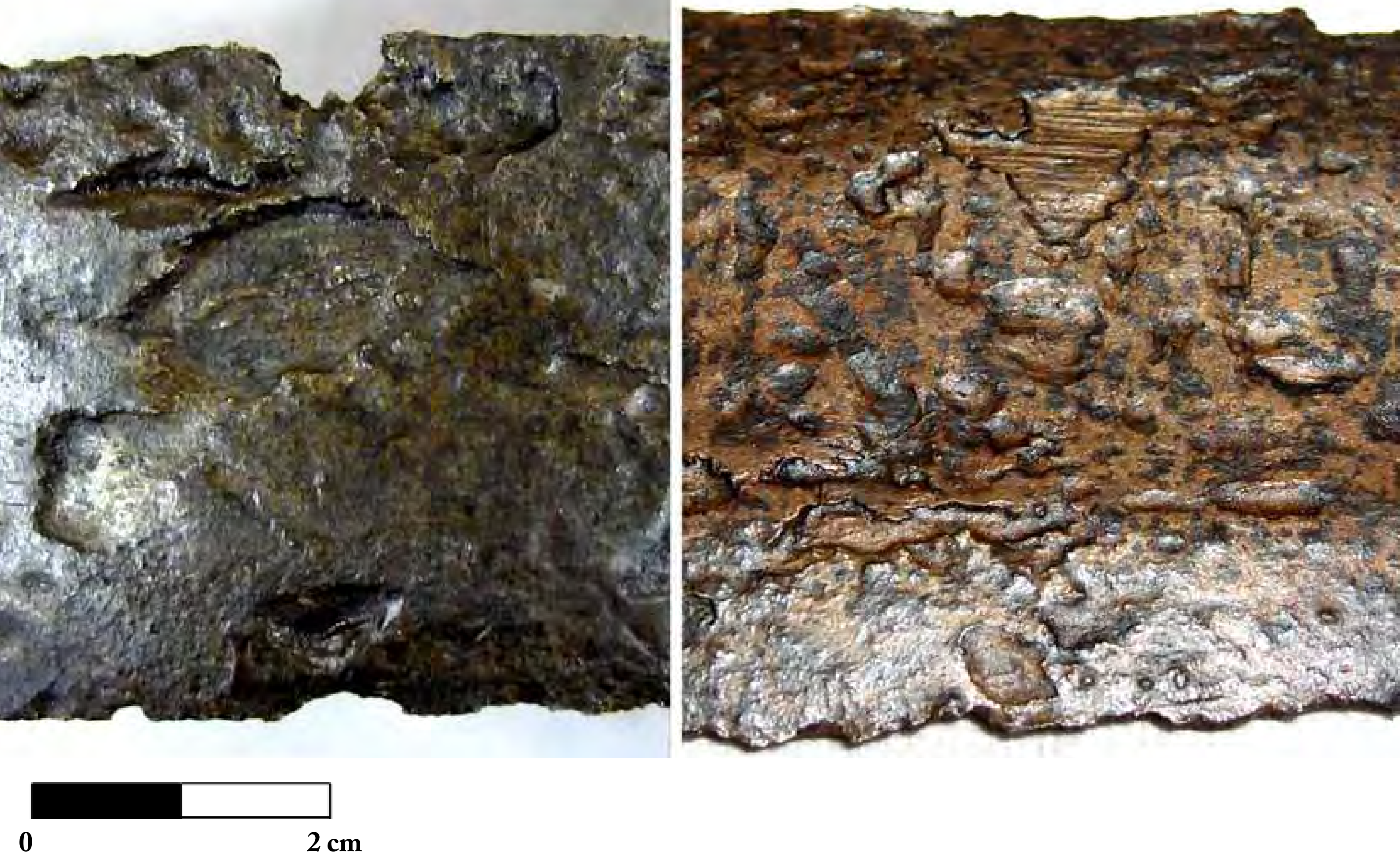


Figure 13. Possible laminated structures as seen on the surface of corroded sword blades. The higher-carbon outer layer of the sword has been corroded away, revealing an iron core, which has not corroded as much. From left to right: KM 3601:2 and KM 11198.

be seen – except of course the inscriptions and inlays. Furthermore, each blade is assumed to be constructed of the same, hardenable steel of nearly equal quality.[324] This is hardly the case, since most of the previously analysed blades were laminated from various materials (see below). Also, the lamination cannot necessarily be seen on the outside, neither from a new, polished blade nor from under a thick corrosion layer covering the find. In some cases though, corrosion has revealed structures that could indicate a laminated structure. The thick corrosion layer of these finds has been cleaned away. For example, an ULFBERHT sword from Hollola, Finland (KM 3601:2) has a large corroded area, beneath which there is a completely different-looking even surface (Fig. 13). It may well be that the steel surface of the blade has corroded away and revealed an iron core. In the illustrations in Chapter 4 these kinds of blades with layered corrosion are marked as possibly laminated.

The laminating of blades was done mainly on functional grounds.[325] A blade laminated from soft iron and hard steel remains flexible after hardening and still retains a hard cutting edge. Apart from the blades, the tangs are sometimes made of soft iron and welded onto the steel blade,[326] which was probably done to save precious steel for the blade itself.

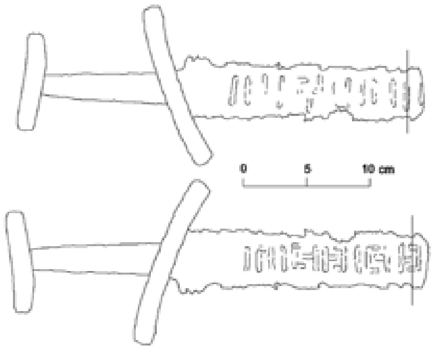
Ten blades with ferrous inlays were subjected to a more detailed analysis for the present study. The aim was to identify the materials and forging techniques used for the blades and the inlays. For this purpose the blades were examined from their cross-sections.[327] The original aim was to select blades with different inlaid motifs and inscriptions, dating from over a wide period of time. Instead, the blades were selected according to their condition. Since there was desire to cut any complete blades in half, the analyses were conducted on blades that were already broken and

324 E.g. Tylecote 1976: 67.
325 E.g. Tylecote & Gilmour 1986: 249.
326 Oakeshott 2002: 10.
327 The detailed results were meant to be published also in a separate article (see Moilanen 2015).

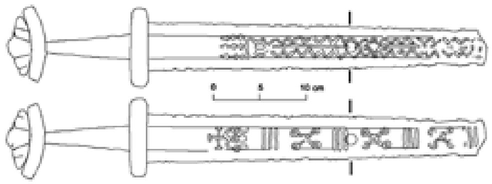
in which the point of breakage was in the middle of an inlaid motif. A total of eight blades of this kind were documented when it was time to conduct the analyses. Two more blades were added to provide a total of ten analyses as permitted by the National Board of Antiquities of Finland.

The analysed blades were quite different, despite the method of selection for the analyses (Fig. 14). One had letter-like marks (KM 2548:196 from Laitila), four had the inscription ULFBERHT either in complete or fragmentary form (KM 2548:277 from Laitila, KM 3423 from Vesilahti, KM 5960:3 from Hämeenlinna, and KM 9164:3 from Eura), and two had geometric motifs (KM 2979:8 from Mynämäki and KM 9142:8 from Nousiainen). Having both geometric motifs and ULFBERHT inscriptions, sword KM 9832 from Laitila has only a cross and a vertical line left in the blade. A sword from Hattula (KM 8120:1) had a unique motif consisting of lattices and the letters DU four times and alternately reversed. Another sword from Eura (KM 9164:2) had the poorly executed inscription AMENI and a variation of the text IN NOMINE DOMINI. All but one find can be dated to the Viking Age, while sword KM 9142:8 is more likely from the Crusade Period.

Of these ten blades eight were broken in the inlaid portion. Of these eight specimens, six were analysed in such a manner that a complete cross-section was cut from the broken location, consisting of both the cross-section of the blade and the inlay. In two cases out of these eight, the broken part was corroded too thin to be properly analysed, and as a result other means were used. A triangular piece was sawn from the edge of find KM 3423, showing a half cross-section of the blade as well as the inlay. Find KM 2979:8 was experimentally analysed by drilling a small, round knob from the centre of the fuller, including the cross-section of the fuller and the inlaid mark.

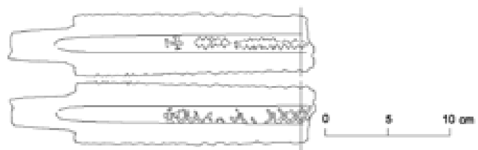


KM 2548:196

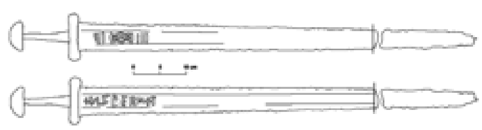


KM 2979:8

KM 5960:3



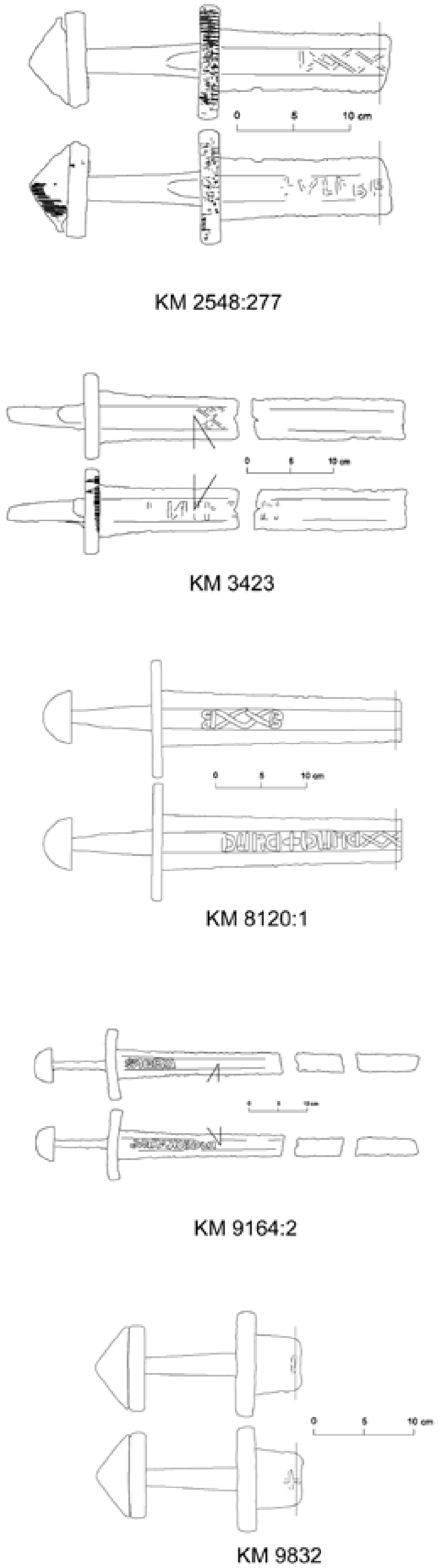
KM 9142:8



KM 9164:3

Figure 14a. Drawings of the five analysed blades as seen also on the catalogue part of this work. The part from which the sample was taken is marked with a line. The scale marked next to the drawings is ten centimetres.

Figure 14b. Drawings of the five more analysed blades as seen also on the catalogue part of this work.



The two finds from Pappilanmäki in Eura (KM 9164:2 and KM 9164:3) were selected for various reasons. It must be noted here that these specimens were used to establish the blade structure, since they could not be cut from the inlaid portion. Firstly, they were broken, albeit near the tip, but still a cross-section could be taken from the broken location. Secondly, the ULFBERHT sword (KM 9164:3) has been previously analysed, but only using a very small sample from the edge.[328] The purpose was then to verify the earlier results. Thirdly, the swords originate from an inhumation cemetery, meaning that the crystal structure of the blades was not altered by the heat of the pyre, and thus displayed the original treatments done on the blade by the smith. Fourthly, sword KM 9164:2 was selected to accompany the ULFBERHT sword, because the inlays on it appear obscure, and the sword originates from the same cemetery.

The samples were cut from the blades with an electrically-operated diamond saw, cooled by water to avoid overheating the samples. The samples were then cast inside transparent plastic discs, in which they were ground, polished and etched. Since the largest disc diameter was four centimetres, the wide cross-sections had to be further chopped by sawing, and this was done from one bevel of the sample. Before etching, the samples were investigated in a scanning electron microscope, and the elemental analyses were made by using energy-dispersive X-ray spectroscopy (EDS). The elements were analysed from the iron or steel itself, and also from slag inclusions and welding seams. After etching, the samples were investigated with a stereomicroscope and a metallographic microscope to discover their crystal structures. Finally, hardness measurements were made of various parts of the samples, with the results given on the Vickers scale (HV).

As a result, combining the analyses of the ten blades and the results of other analyses found in the research literature, the methods of construction of iron inlaid blades are divided into five crude categories, ranging from the simplest to the most complex. The simplest method was to

328 Williams 2009: 127–128, 153.

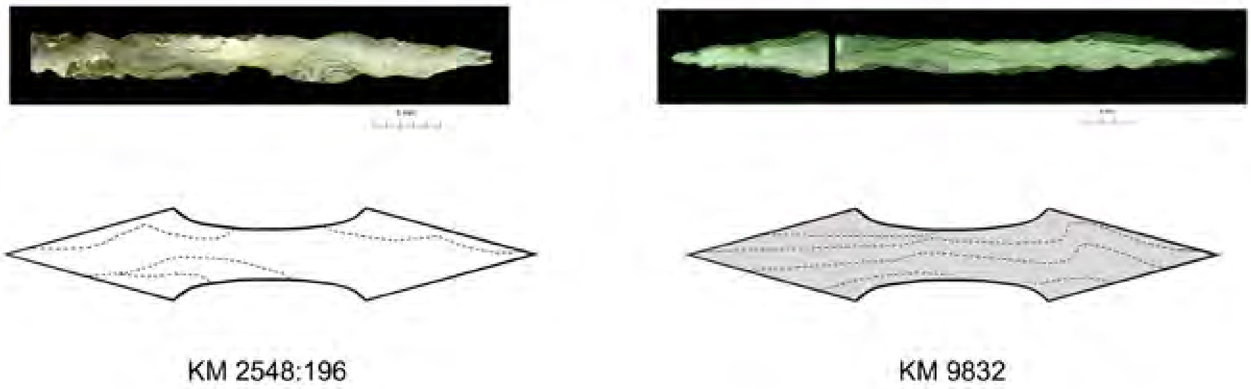


Figure 15. Cross-sections of swords KM 2548:196 and KM 9832, both folded and forged from a similar kind of material.

forge the blade from the same material throughout. A slightly more complicated method was to pile the blade from layers of different materials. The next step was to add separate cutting edges to a layered core. In previous studies blades with a soft core and a 'wrapped' steel case have been found. The most complicated method here is pattern-welding, meaning that the ferrous inlays were attached on top of the pattern-welded mid-section of a blade. It should be noted that no analyses were conducted here on pattern-welded blades with ferrous inlays, nor have they been done earlier either. With regard to the quality of the blades, the carbon content is of crucial importance, along with the manner in which the heat treatments were done, if they were done at all.

4.4.2. Blades folded from similar kind of material

Ultimately the simplest way was to forge the blade into its shape from the same material. Although the blade structure seems homogeneous, in reality the material is somewhat diverse here and there, since the iron and steel produced during the Iron Age was not of very even quality.[329] The blades made in this manner exhibit welding seams as a result of folding and welding to possibly homogenize the structure to some extent, and to create a larger blade blank from smaller pieces.

Two of the metallurgically analysed Finnish finds belong to this group (Fig. 15). Swords KM 2548:196 and KM 9832, both from Laitila, were made in this manner. Both show asymmetrical layers of what may be interpreted as the same material, folded a few times on itself and forge-welded solid. The first-mentioned sword had letter-like marks on its blade, while the second had only a cross and a line left, indicating a number of alternatives.

The blade with a Petersen type Q hilt, KM 2548:196, was folded from the same low-carbon (approximately 0–0.3 % C) material. Its microstructure shows areas of ferrite and pearlite, in addition to some coarsely ferritic spots. The hardness of the blade material varied between 99 and 195 HV, being on average 131 HV. The microstructure indicates that the blade was thoroughly annealed, and no traces of other heat treatments are visible any more, if they even existed. Most likely the annealed structure was caused by the cremation pyre, since the sword was found in a level-ground cremation cemetery.

KM 9832, a sword with a Petersen type H hilt, was also folded from the same material. The carbon content is slightly heterogeneous, displaying low and medium-carbon structures. Notable

329 See Chapter 3.1 for further references.

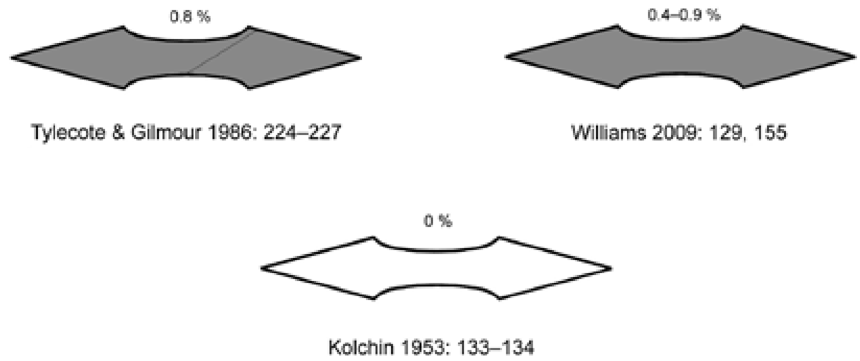


Figure 16. Cross-sections and information on analysed iron inlaid blades belonging to group one, which were forged and folded from a similar kind of material. The drawings were made according to information presented in the previous publications mentioned in the illustration.

features are the large slag inclusions inside the blade, located in the welding seams that were most likely created when folding the material for the blade blank. The welding appears to have been poorly done in places. The hardness of the blade parts is on average 168 HV (147–188 HV). The microstructure was annealed, i.e. heated to ca. 800 °C and then slowly cooled about 10–15°C per hour. Optionally the blade was heated in approximately 730–750 °C and kept at this temperature for a minimum of half an hour, preventing further cooling from affecting the structure. Although the sword is a stray find, it may have belonged to a cremation burial, and the blade had cooled slowly in the ashes of the cremation pyre.

Similar kinds of blades can be found in earlier studies. So far the most exhaustive metallographic study of weapons has been conducted by Ronald Tylecote and Brian Gilmour.[330] Among their material were three inscribed swords, all inlaid with possibly different lattice patterns identified from radiographs. One of these blades was assembled from two pieces of the same medium to high-carbon steel, having an average carbon content of ca. 0.8 % (Fig. 16).[331] The blade has not been hardened but it was annealed at below 700 degrees Celsius for a considerable time to make the blade slightly tougher. The hardness readings were between 138 and 239 HV in both parts of the blade. The sword was found from the River Thames, near Waterloo Bridge in London (catalogue number A 3670 in the Museum of London).

The most extensive analysis concerning the materials of inlaid blades is made by British archaeometallurgist Alan Williams, who was concentrating on ULFBERHT swords.[332] These swords have been a subject of interest since they have appeared as the most common inlaid swords, and they have a clearly readable inscription instead of symbolic motifs and figures. Williams conducted the analyses of very small samples removed from the blades. Based on the microstructure of these samples, Williams presented the carbon content of the blades as well as the applied heat treatments, if there were any. Hardness measurements were also taken of almost each blade.

Complete or half cross-section of an ULFBERHT blade was described by Williams in three cases. In the case of an +VLFBERH+T sword from Rakvere, Estonia (Virumaa Museum, RM 587/A21) was forged from a single piece of quite uniform pearlitic-ferritic steel with a carbon content of 0.4–0.9 %.[333] The surface of the blade was slightly decarburized and the structure appeared to be annealed, both of which may be due to a cremation burial.[334] The surface hardness of the blade was 160–320 HV.

330 *Tylecote & Gilmour 1986.*
331 *Tylecote & Gilmour 1986: 224–227.*
332 *Williams 2009.*
333 *Williams 2009: 128–129, 155.*
334 *Williams 2009: 129.*

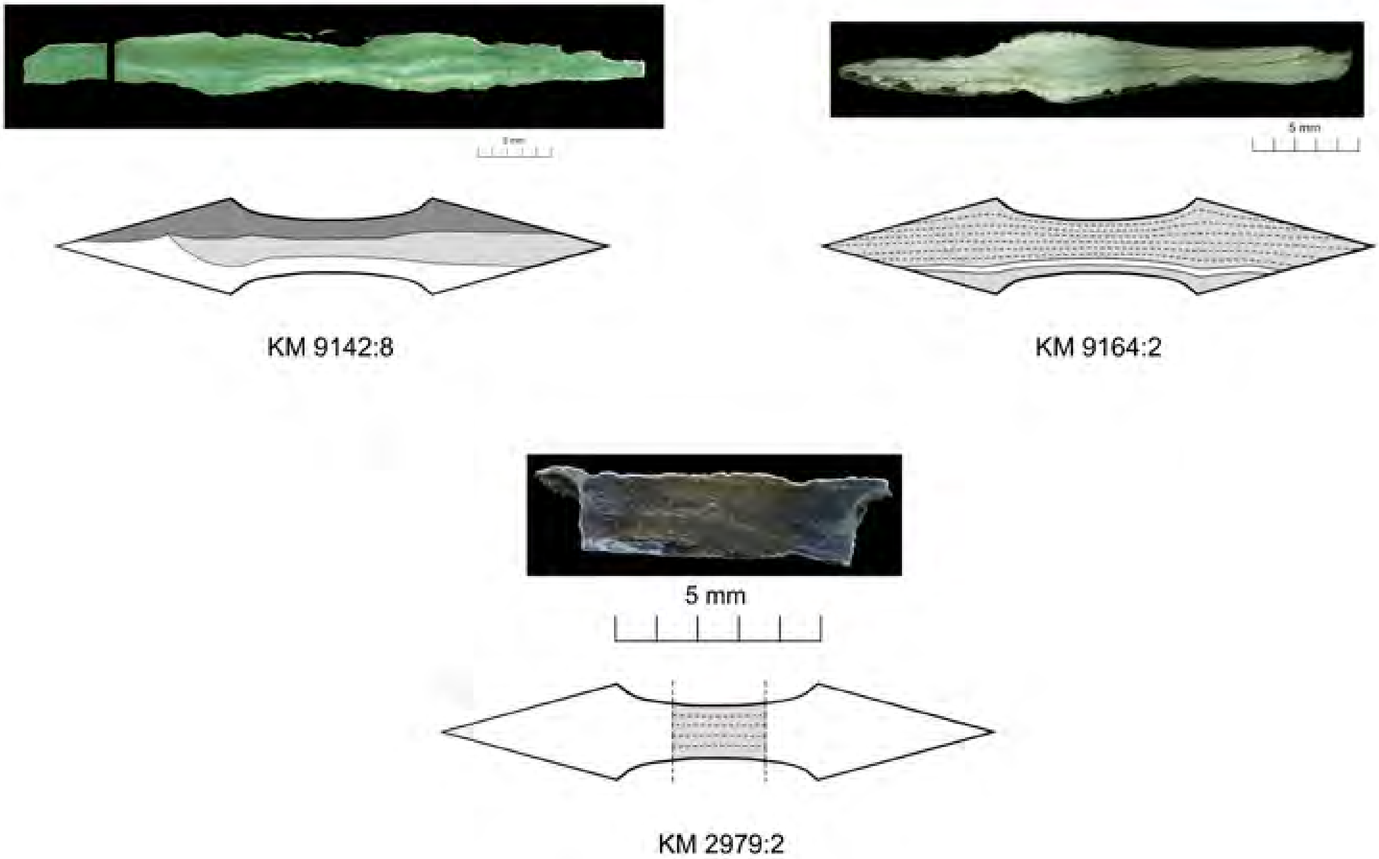


Figure 17. Cross-sections of three analysed Finnish swords with a piled blade.

There is a blade somewhat similar to the Finnish examples presented above from Gnezdovo, Russia. This blade was analysed by B. A. Kolchin and found to be of a similar kind of iron, i.e. ferrite, in structure.[335] Kolchin suggested that since the very edges of the blade were corroded away, the blade may have originally had thin, separately welded cutting edges. In this case, however, the edges were very thin, if they ever existed. The blade itself was inlaid with letter-like marks on one side and a lattice weave on the other.[336]

4.4.3. Blades piled from layers of different materials

These blades were made by welding layers of different kinds of iron and steel on top of each other, and then by forging the blade into shape. The structure of the blade thus resembles a sandwich. Among the analysed blades of this study, two or perhaps three belong to this category. Clear cases are swords KM 9164:2 from Eura and KM 9142:8 from Nousiainen. KM 9164:2 has a hilt of the later variant of Petersen's type X, and the inlays are variations of Christian phrases. KM 9142:8 is a hiltless blade fragment with small geometric designs on both sides of the blade.

KM 9164:2 was piled of the same kind of low- or medium-carbon steel, except one phosphorus-rich layer (Fig. 17). The hardness of phosphorus-rich layer is 232 HV, while other layers are 206 HV on average (194–221 HV). In this light, the sword blade in question may also belong to the first, above-mentioned category of a single piece of folded steel or iron. It is possible that the smith piled two kinds of material to produce a blade large enough. According to the microanalysis, the blade was cooled slowly after hardening, and then normalized or annealed afterwards. Another alternative is that the blade was at least partly hardened and then tempered in too high a temperature of ca. 700 °C. The sword has not been very good in use, since tempering in too high a temperature has taken place after possible hardening, producing a blade that was

335 *Kolchin 1953: 133–134.*
336 *Kainov 2012: 28, 30. See also chapter 5.3.4.2.*

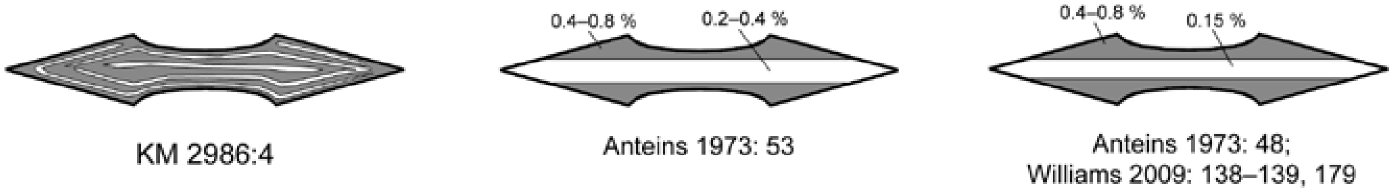


Figure 18. Schematic drawing of the cross-section of the sword KM 2986:4 from Tampere, as well as two examples of similar kinds of piled blades published during earlier studies by other researchers.

too soft. Since the sword was recovered from an inhumation cemetery, the treatment of the blade is most likely original that done by the smith.

Sword KM 9142:8 was piled of three layers on top of each other. The order of the layers is quite interesting, since one of the outer layers is of better steel than other ones. Normally it would be best to make the centremost layer of best steel, so it would naturally form the cutting edges when the blade is forged to shape. Perhaps in this case the purpose had been to extend this outer layer beyond the centremost one, as can be observed in the other bevel of the blade, but this has not been successful in all places due to the forging process, at least not in the analysed part of the blade. The centremost layer has an average hardness of 316 HV (286–346 HV), while the averages for the outer layers are 276 HV (252–302 HV) and 564 HV (517–617 HV), indicating low- and medium-carbon steels respectively. The carbon content is at its highest on one flat of the blade, while the lowest content occurs on the other flat, the centre falling somewhere between these two. Despite the unorthodox method of piling, the blade had been fully quench-hardened in 850–900 °C and tempered in a low temperature to produce as good a blade as possible.

At this point find KM 2979:8 from Mynämäki must be taken into consideration. The hilt of this sword is interesting, since the pommel and the upper guard are of Petersen's type Z, while the lower guard resembles a silver-plated type. The motifs are geometric on both sides of the blade. The small knob-like sample drilled from the fuller of the blade shows the same kind of material piled and welded on top of each other. The average hardness of the sample is 278 HV (256–292 HV), and the microstructure consists of a mixture of ferrite and pearlite, giving an indication of a medium-carbon steel. No further conclusions can be made since the sample was only a small disc in the middle of the fuller, and therefore nothing can be stated about the construction or materials of the blade bevels and cutting edges.

A hiltless fragment of an INGELRII blade from Tampere (KM 2986:4) had a readily polished and etched cross-section, although covered by conservator's wax. The sword had been broken in prehistoric times, and the breakage point was ground and polished most likely by Jorma Leppäaho.[337] The blade seems to be laminated from several layers of iron and steel so that the harder layers of steel have formed the surface of the blade (Fig. 18). More accurate analyses and observations could not be made at that point.

Two more cases of similar kinds of piled blades are found among the previous analyses. Both of them can be found in the publication of the Latvian researcher Aleksis Anteins (see Fig. 23).[338] A Petersen type H sword from Saaremaa, Estonia (IIE-K 85:129) bearing lattices and letter-like inlays was piled from three layers, the centremost being lower-carbon steel (ca. 0.2–0.4 % C), while the outermost layers had a higher carbon content between 0.4 and 0.8 %.[339] A strange

337 *It should be noted that of the examined finds, also swords KM 8911:91 from Mynämäki and KM 8120:1 from Hattula were prepared in the same manner. They have both been analysed later, the first-mentioned by Alan Williams (2009), and the second by the present author.*

338 *Anteins 1973.*

339 *Anteins 1973: 53.*

phenomenon is that the centremost layer reaches the cutting edges, making them soft while the flats are harder. All structures showed ferrite and pearlite.

Another sword analysed first by Anteins[340] and later by Alan Williams[341] was found in Randvere, Saaremaa, Estonia, and bears the inscription +VLFBERH+. It was made in similar fashion as the above-described sword. The blade was laminated from 0.15 % carbon steel sheet between two 0.4–0.8 % carbon steel layers in such a manner that the low-carbon core reached the cutting edges, creating a soft and dull blade. The hardness of the core layer was between 130 and 190 HV, consisting of only ferrite and pearlite.

4.4.4. Blades with separately welded cutting edges

These types of blades show a further development towards an increased functionality. Normally the core was layered in such a manner that the softest, more flexible parts were assembled closest to the core. The cutting edges were prepared from another, in most cases hardenable, steel material, and were butt-welded to the core that was assembled first. These blades are the most numerous among the examined finds. There were five Finnish blades exhibiting this kind of solution, and they included different variants according to their materials (Fig. 19).

While four of these five blades had clearly intentionally selected materials for the edges and the core, find KM 5960:3 was of particular interest, since both the core and the edges seemed to be of the same low or medium-carbon material. The hardness of the piled or folded core is on average 177 HV (138–221 HV), and the average hardness of the cutting edges is similarly 177 HV (107–235 HV). Although the carbon content seems quite low, it is still hardenable to some degree. The microstructure indicates a high tempering temperature of about 600 °C, having first been hardened below 730 °C and only partly at 800 °C. It is essential is that the blade became unevenly hot after the heat treatment. Considering both the microanalysis and the find context, the most probable interpretation is that the blade had been cooled in air after heating, i.e. in the ashes of the cremation pyre.

Swords KM 2548:277 from Laitila, KM 3423 from Vesilahti and KM 8120:1 from Hattula are made in a considerably better fashion. An ULFBERHT sword KM 2548:277, having a Petersen type H hilt, has two butt-welded cutting edges of an average hardness of 644 HV (419–839 HV). The edges were welded to a layered core, which can be divided into coremost parts and surface parts. The core parts have an average hardness of 264 HV (244–286 HV), while the surface layers gave an average of 352 HV (247–445 HV). All the hardness readings seem to increase close to the outer layers of the blade, the very core being the softest part of the blade. Excluding the very core, the parts are medium- and high-carbon steel, although quite heterogeneous in composition. The microstructure is martensitic indicating quench-hardening and tempering. The edge shows signs of complete hardening followed by tempering to a low temperature of perhaps 150 °C, or no tempering at all. The parts of the blade core are much softer indicating higher tempering temperature. Either this blade had been thoroughly hardened and the centre parts properly tempered, or only the steel edges were hardened allowing the core to be cooled more slowly.

A possible ULFBERHT sword, KM 3423, also having a Petersen type H hilt, or lower guard to be more precise, has a core piled from low- and medium-carbon materials. The inner layer

340 Anteins 1973: 48.
341 Williams 2009: 138–139, 179.

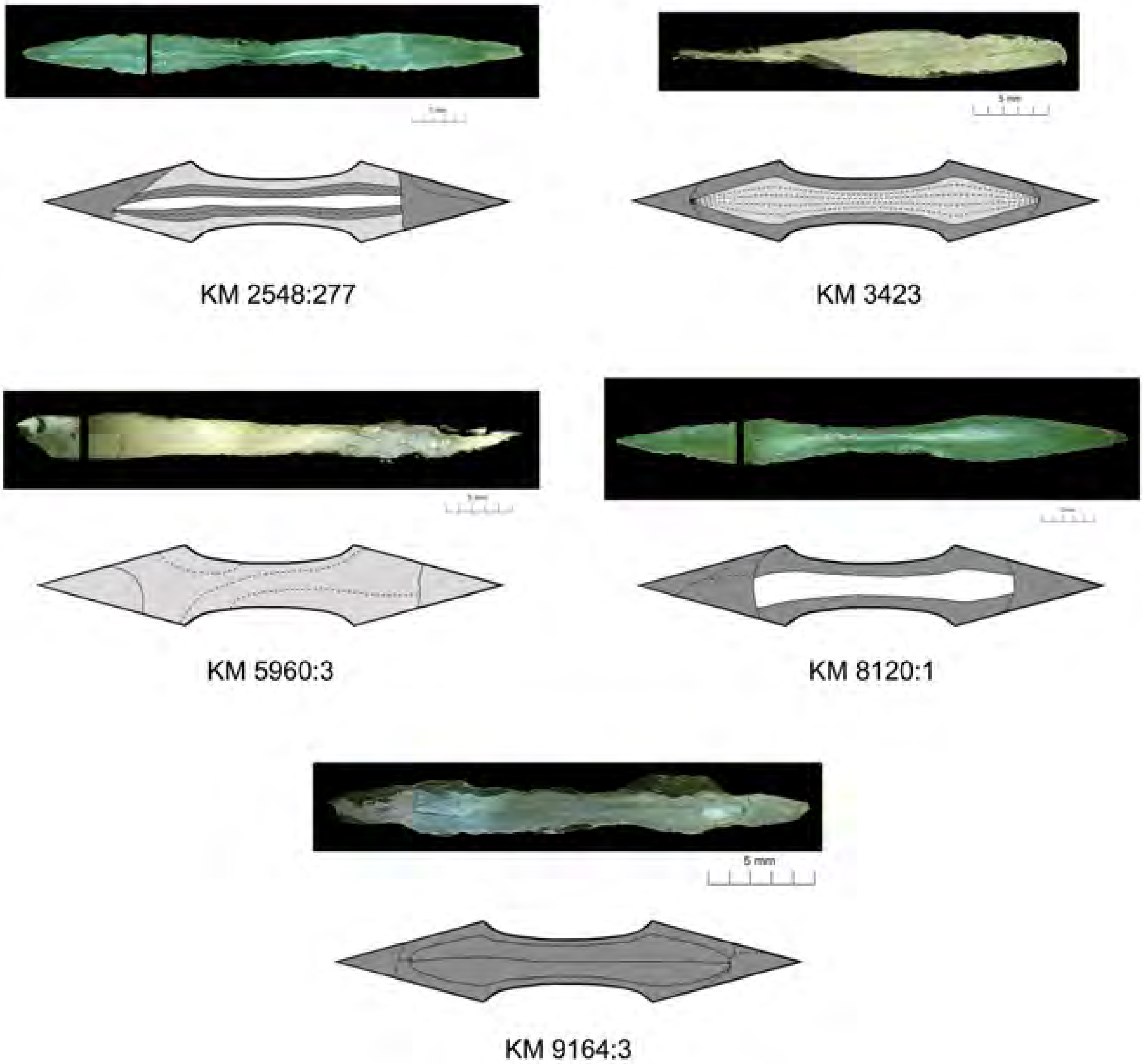


Figure 19. Analysed blades with separate cutting edges welded to a layered core.

of the core, also piled itself, has an average hardness of 198 HV (156–259 HV), while the outer layers are harder, ca. 475 HV on average (256–736 HV). The hardness of the cutting edges is on average 329 HV (308–362 HV). The microstructure is annealed, meaning that either the blade was hardened at too low a temperature, i.e. below 730 °C, or the blade was partly hardened and then tempered at a temperature of 250–300 °C. Once again, this annealed structure may have come about in the heat of the cremation pyre, and the blade had originally been properly quench-hardened.

KM 8120:1 is a fragmentary sword with a hilt of later variant of Petersen's type X, and a unique motif on the blade consisting of the repeated letter combination DU and geometric patterns. The core of this blade is piled from three layers, the ferritic one situating in the middle. The ferritic core has an average hardness of 266 HV (195–310 HV), while the outermost higher-carbon steel layers forming the surface of the blade are of average hardness of 386 HV (343–421 HV). The cutting edges gave an average hardness of 522 HV (489–566 HV). The sword had been partly hardened in such a manner that the edges had cooled more rapidly than the other parts of the blade. After hardening the blade was tempered at a low temperature. All in all, the workmanship is very good, resulting in a blade that was both hard and flexible.

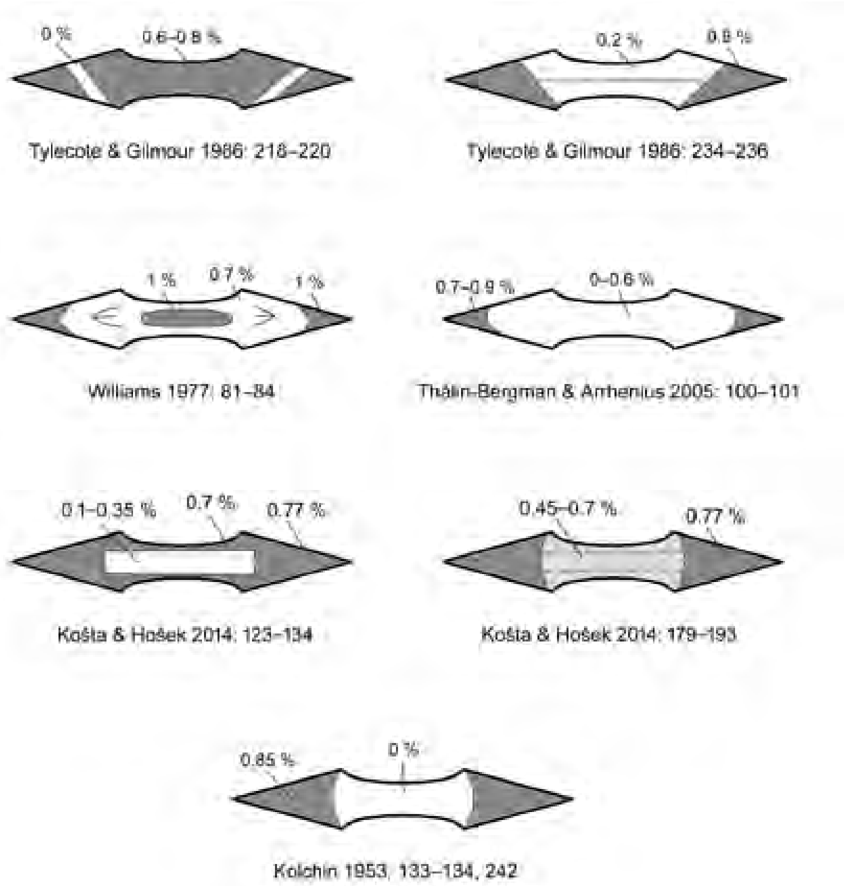


Figure 20. Schematic drawings of the cross-sections of blades with separate cutting edges as evident in earlier publications by other authors.

The fifth blade of this type, KM 9164:3 may be paralleled to find KM 5960:3. This blade has an ULFBERHT inscription, and the hilt is a combination of two types. The lower guard is of Petersen's type R or S, while the secondary pommel is of the later variant of Petersen's type X. The core is laminated from four parts, having separately attached cutting edges. It is interesting to note that all the parts seem to be of the same high-carbon material. The hardness of the core parts is on average 355 HV (249–470 HV), and the separate cutting edges are of an average hardness of 363 HV (260–447 HV). According to the microstructure, the blade was fully hardened and tempered at a moderate temperature. The hardness of the core is naturally then lower than that of the surface and thin cutting edges of the blade.

In regard to work by other researchers, Tylecote and Gilmour included two similar kinds of inlaid blades.[342] The first one was found in the River Thames near Reading (Reading Museum 112.66/1), bearing geometric motifs on its blade (see Fig. 20).[343] The core of this sword is of a single piece, but the scarf-welded bevels of the blade were assembled from various parts. One bevel is sandwiched from three parts: two being of the same material as the core (approximately 0.6–0.8 % C), and the middle part being ferritic and carbon-free, and thus considerably softer. The ferritic laminates are situated in the direction of the thickness of the blade, so they do not have an effect on the cutting properties of the blade in question. The martensitic cutting edge had an average hardness of 762 HV, while the other parts were softer. According to the microstructure, the blade was most probably quench-hardened from 725–750 °C.

Another sword published by Tylecote and Gilmour, found in the River Thames at Brentford (Museum of London A24419), had also geometric figures on its fuller.[344] The core was piled from two layers of low-carbon steel (ca. 0.2 % C), having two scarf-welded cutting edges with a carbon content of approximately 0.8 %. The average hardness of the cutting edge was 325 HV. The blade was air-cooled after forging, and no attempt at hardening was detected.

342 *Tylecote & Gilmour 1986.*
343 *Tylecote & Gilmour 1986: 218–220.*
344 *Tylecote & Gilmour 1986: 234–236.*

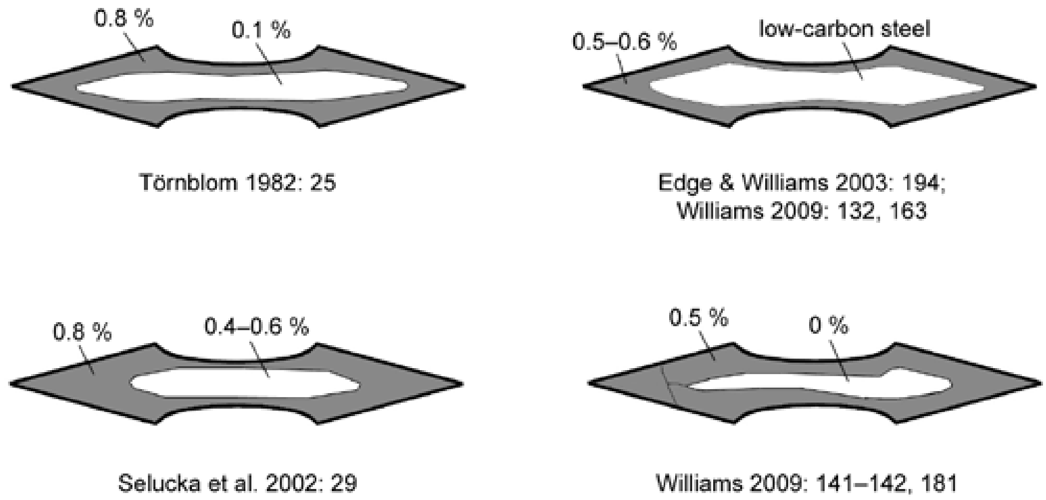


Figure 21. Cross-sections of blades with lower-carbon cores combined with a higher-carbon steel wrap.

A hiltless sword from Hulterstad, Öland, Sweden (SHM 3104, Statens Historiska Museum) was compiled of a heterogeneous core (0–0.6 % C) and higher-carbon edges (0.7–0.9 % C), showing a structure of fine pearlite.[345] This particular sword had the fragmentary inscription +VI FBERH+T.

A sword analysed by Alan Williams, bearing the inscription VLFBER(CH)T and kept at the Württemberg Landesmuseum in Stuttgart, also has a piled core and separate cutting edges.[346] The edgemost parts show a microstructure of pearlite and cementite, having a carbon content of ca. 1 %. They were welded to a core with multiple parts. The actual core seems to be of similar high-carbon steel as the edges, around which possibly four parts were welded. The additional laminates have a carbon content of approximately 0.7 %, and consist of pearlite and some cementite. The blade was cooled in the air after forging, and there had been no attempt to quench it.

Also two swords from Mikulčice, the Czech Republic, were found to have a piled core and welded-on cutting edges. Both of these had letter-like marks on their blades. A sword from grave 438 had a piled core, the coremost part being 0.1–0.35 % carbon steel (115–228 HV), and the surface parts being 0.7 % carbon steel (376–466 HV). The welded cutting edges were of 0.77 % carbon steel with a hardness of 458–495 HV, indicating an attempt of quench-hardening.[347] A sword from grave 723 was similarly piled from steels of 0.45 % carbon and 0.7 % carbon, the softer core steel having a hardness of 131–185 HV. The cutting edges were made from 0.7 % carbon steel (259–413 HV), showing that only the lower portion of the blade was quench-hardened.[348]

A sword with inscription +ING…..IT, with the last T turned upside down and possibly belonging to the group of INGELRII swords was discovered in Gnezdovo, Russia.[349] B. A. Kolchin analysed this blade from two separate locations: one cross-section from the place of the inlays and one below them. The blade has a ferritic iron core, which has separately welded cutting edges with a carbon content of ca. 0.85 %.[350] The crystal structure of these edges is finely martensitic, indicating successful quench-hardening.

345 *Thålin-Bergman & Arrhenius 2005: 100–101.*
346 *Williams 1977: 81–84.*
347 *Košta & Hošek 2014: 131-134. Collection number 594-2978/57. The hilt is of Petersen's type X. See also Fig. 20.*
348 *Košta & Hošek 2014: 185-191. The hilt is of Petersen's type N.*
349 *Kainov 2012: 46–51. See also Chapter 5.3.2.*
350 *Kolchin 1953: 133–134, 242.*

Figure 22.
Construction methods of pattern-welded blades with iron inlays from the research area. The 'undefined' layer count means that the layers cannot be counted.

Catalogue number	Total number of rods	Twisting of rods		Layer count
		Side A	Side B	
KM 293	6			7 (3 iron, 4 steel)
KM 2022:1	variable (see Fig. 4.16)			7 (4 iron, 3 steel)
KM 2939:1	1			undefined
KM 3336:31	4			7 (4 iron, 3 steel)
KM 3575:1	2 / 4			undefined
KM 6482	6			undefined
KM 6746:49	4			7 (4 iron, 3 steel)
KM 7703:2	2 / 4			undefined
KM 7752:1	4			undefined
KM 10369:3	4			11 (5 iron, 6 steel)
KM 11063:283	6			9 (5 iron, 4 steel)
KM 13419:1	4			9 (4 iron, 5 steel)
KM 22964:3	5			undefined
SatM 12563	2			undefined
ÅL 337:528	2/4			undefined
ÅL 345:113	2/4			undefined

4.4.5. Blades with a low-carbon core and a 'wrapped' steel case

The blades belonging to this category are found only in previous studies (see Fig. 21). They normally state that a steel case had been wrapped around a softer core.[351] The publications do not, however always note the presence of the welding seams, of which there should at least be one, if a steel sheet had been wrapped and welded around a core part. It can also be doubted whether they were to be included in the previous category of separately welded cutting edges, since there may well be welding seams between edges and a layered core. If the welding seams are well executed, they may be hard to notice without a very careful examination. For example, sword KM 8120:1 categorized above as having welded-on cutting edges, looks like a 'wrapped' one in the photograph of the only previous publication of the find.[352]

A total of four wrapped blades of this kind have been documented according to earlier research on the subject. In only one case were welding seams observed and the information published. This is a hiltless sword found from Mynämäki, Finland (KM 8911:91) with the inscriptions CONSTMIITNS (that is, a version of the name CONSTANTINUS) and REX.[353] The cross-section revealed that the blade of this sword was made from ferritic iron core with a 0.5 % carbon steel outer wrap welded around the core. It seems that the case steel was too small, since the cutting edge of the other side had been separately welded. The blade was not quenched.

351 *For an example of the technique, although with an undecorated blade, see Gopak & D'yachenko 1984.*
352 *Leppäaho 1964b.*
353 *Williams 2009: 141–142, 181.*

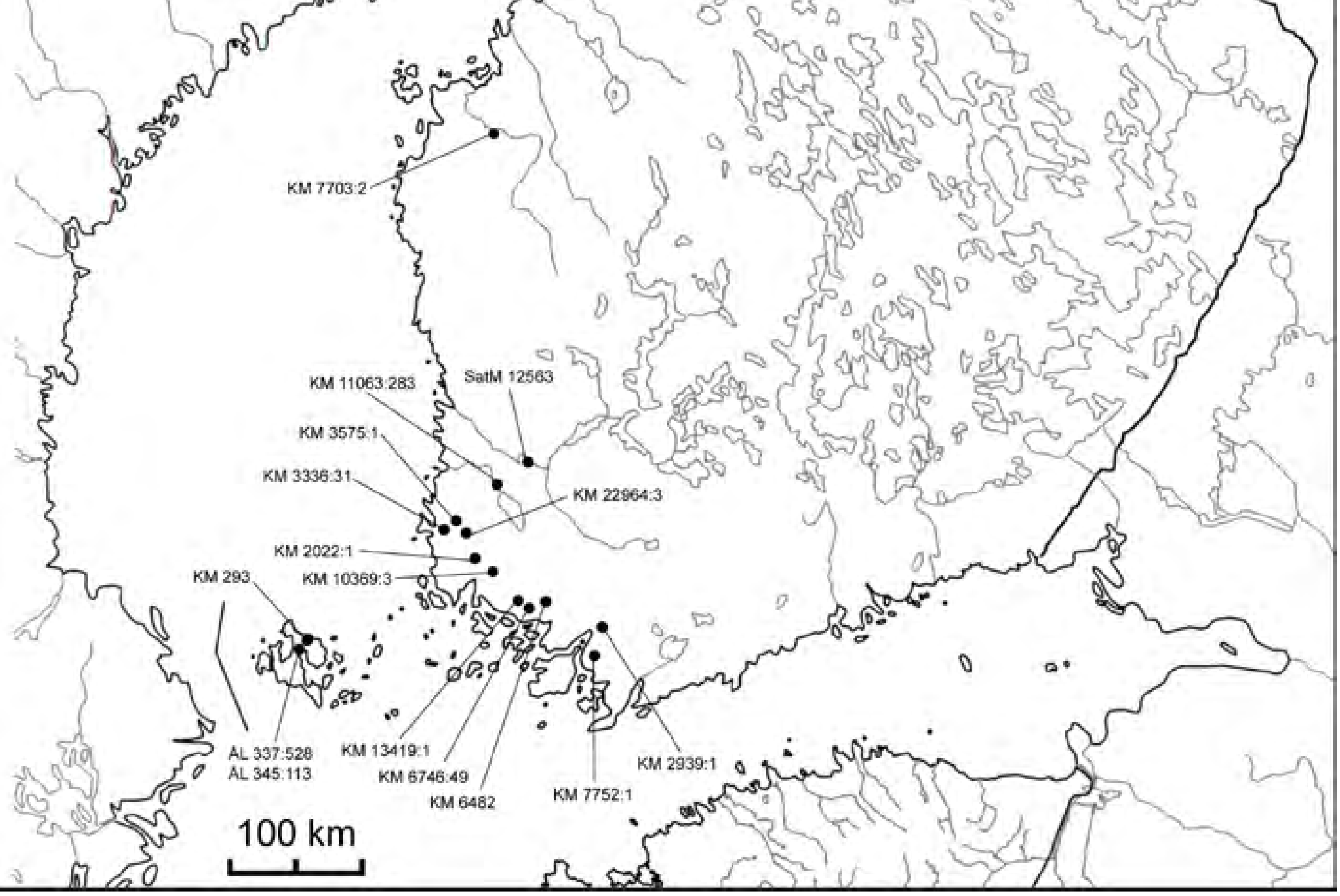


Figure 23. Geographical distribution of pattern-welded sword blades with ferrous inlays.

The other three swords with wrapped cases presented here do not exhibit any welding seams, or at least their existence was not mentioned in the publications. Alan Williams has analysed another blade with similar construction, this time with the inscription VLFBERN+T, originating from a private British collection.[354] According to Williams, this blade has an low-carbon steel core of mainly ferritic structure, and a medium-carbon steel outer wrap (0.5–0.6 % C), which had been quench-hardened to an average hardness of 467 HV (423–540 HV). The average hardness of the core is 236 HV.

A Swedish sword with the inscription ULFBERHT+ from Alands (SHM 907) has been analysed by Mille Törnblom.[355] This sword was said to have a low-carbon core (approximately 0.1 % C) surrounded by a higher-carbon steel outer wrap (ca. 0.8 % C). The core consisted of coarse ferrite and small patches of pearlite, while the wrap consists of fine-grained ferrite and pearlite. The low-carbon core itself was piled from 10–12 layers, which may be visible due to folding and welding, instead of intentional piling.

An ULFBERHT sword from Nemilany in Czech Republic may also be included in this category.[356] This time both the core and the outer wrap are steel, but there is still a basic difference in the carbon contents. The ferritic-pearlitic core is made of steel with a carbon content of 0.4–0.6 %, having a hardness of 185–235 HV. The wrap contains approximately 0.8 % carbon with a hardness of ca. 320–460 HV, also containing some cementite. Considering the fact that the hardness of the blade diminishes towards its core, it had been thoroughly quench-hardened. According to the microstructure the hardening had taken place at approximately 770 degrees Celsius.

354 *Edge & Williams 2003: 194; Williams 2009: 132, 163.*
355 *Törnblom 1982.*
356 *Selucká et al. 2002: 29.*

Figure 24.* *The surface of sword SatM 12563 from Kokemäki, Finland. The fuller appears to consist of a crude, twisted, pattern-welded bar, on which the iron letters INGELRII were welded. Below the photograph is a drawing clarifying the patterns and inlays.

4.4.6. Pattern-welded blades with inlays

Blades with both a pattern-welded mid-section and iron inlays have not been analysed in previous studies to explain the construction method or the materials used in them, except in one case. In the find material referred to in this work, there are a total of sixteen pattern-welded blades with inlays on top of the pattern-welded core.[357] No accurate material analyses or metallographic analyses were done on these blades. Instead, the manufacturing technique of the blade could be surmised on the basis of the patterns visible on the blade or in the radiographs. The possible constructions of these blades are presented in Fig. 22.

Geographically, almost all these finds have been recovered from the regions of Finland Proper (SW Finland) and Satakunta, in the municipalities of Salo, Turku, Nousiainen, Laitila, Vehmaa, Uusikaupunki, Eura and Kokemäki (Fig. 23). One is known from Isokyrö in the region of Ostrobothnia (KM 7703:2). Also the find from Kokemäki (SatM 12563) is only possibly intentionally pattern-welded and shows also an INGELRII inscription, making it clearly different from the other pattern-welded specimens discussed here. This in turn further limits the geographical distribution of these finds. Only exceptions are two swords from Saltvik, Åland Islands (ÅL 337:528 and ÅL 345:113).

357 *The technical aspects of pattern-welding are discussed below (Chapter 5.2.2) in connection with pattern-welded inlays and their details.*

The number of the pattern-welded rods in the fuller could be in any case counted, at least those used on one side of the blade. In most cases it is hard to distinguish if the different sides of the blade reflect the same rods or completely different ones. For example, if on one side of the blade two twisted rods are visible, it is hard to distinguish whether the whole blade is composed of two or even four rods. Moreover, there could be an iron sheet sandwiched between these pattern-welded panels of both sides of the blade, a feature which is even harder to detect, if at all. When stated that the blade is pattern-welded, it does not mean that the whole blade is of patterned steel, as in any modern pieces. Normally the bevels of the blade seem to be of better steel displaying only longitudinal streaks from forging and welding, while the portion of the fuller is pattern-welded.

In cases where the pattern-welding could be seen on the surface of the blade, the layer count could be estimated, or even calculated. Also the materials of the layers could be defined according to colour differences or differences of corrosion. The more corroded layers or those with darker colour could have higher carbon content than the other layers. These layers with higher carbon content are called here 'steel' while the other layers with lower carbon content or higher phosphorus content are called 'iron'.

As in the case of laminated blades (see above), the construction alternatives of pattern-welded blades can also be divided into separate classes, firstly according to the number of pattern-welded rods in the blade core, i.e. one, two or three as seen on one flat, and secondly according to the pattern, i.e. whether the rods are twisted along their whole length, or are the twists interrupted and showing areas of a straight pattern. The division made here is simple, since as stated above, it is sometimes hard to see how many pattern-welded rods were used on each flat of the blade.

The simplest blades have only one twisted pattern-welded rod visible on the fuller. One case of this is the INGELRII sword from Kokemäki (SatM 12563) (Fig. 24). The surface of the blade has colour differences in the form of diagonal streaks. They most likely indicate differences in carbon content. The central part of the fuller then seems to be made of pattern-welded steel, perhaps one thick layered bar, which was twisted and on which cutting edges were then welded. The pattern-welded material contains great amounts of steel, which is probably the reason for using inlaid letters of plain iron. Another sword showing only one pattern-welded rod is KM 2939:1 from Salo. This blade has non-patterned inlays on one side, and a pattern-welded panel on the other. The pattern-welding is executed as a thin layer on the narrow fuller on one flat of the blade, consisting of only one long, continually twisted rod.

The most common type has two pattern-welded rods visible on each flat of the blade, twisted along their whole length. The inlays were thus welded on the top of twisted pattern-welded bands. There are six examples, in three of which the total of the patterned ribbons is actually four, but only two are visible on each side of the blade. The number of the rods is revealed by the direction of twists, which is opposite on different sides of the blade.

The three blades made in this manner are as follows. KM 3336:31 from Uusikaupunki has two volutes and two vertical lines welded on top of twisted pattern-welded bars. KM 6746:49 from Turku has circular or spiral-like designs on both, almost opposite sides of the blade. KM 13419:1 from Turku contains a lattice and a figure-eight symbol on only one flat. An interesting detail in this last sword is that the inlaid motifs, especially the lattice, seem to have a non-patterned base, onto which the inlays were attached, perhaps first, and then the ready inlaid motifs were attached on the patterned rods. In the cases of KM 3336:31 and KM 6746:49 the layer count of the pattern-welded rods may be counted as seven, having four brighter (iron) layers and three darker, more corroded (steel) layers. KM 13419:1 was made of finer patterned rods containing perhaps nine layers, five of which are more corroded (steel) and four of iron.

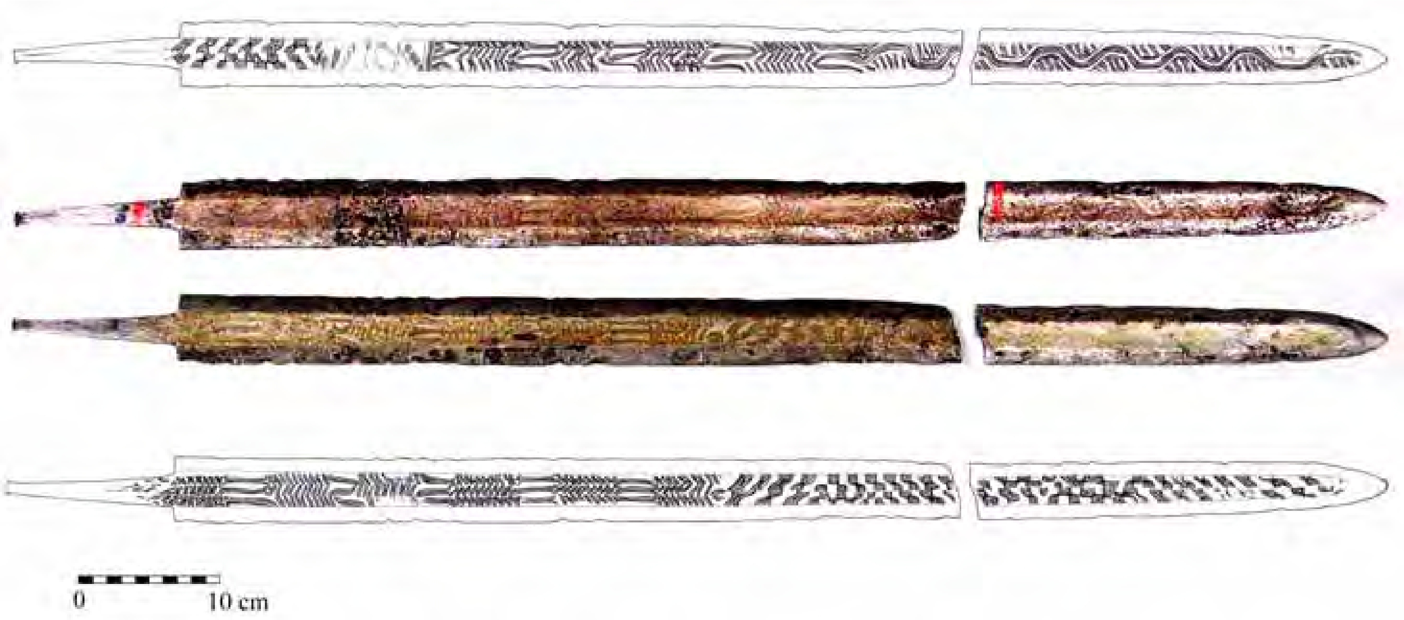


Figure 25. Sword from Vehmaa (KM 2022:1) from both sides, with accompanying drawings of the patterns.

The fourth case showing two continuously twisted pattern-welded bars on each blade flat is KM 7703:2 from Isokyrö. In this case, however, the twists seem to run in the same direction on both sides, and it cannot be said whether the core of the blade consists of four bars or only two, the blade thus exhibiting different sides of the same two bars on either side. The inlay on this blade is a mere S-shaped figure, executed in straight, pattern-welded material. In somewhat similar fashion, the finds from Saltvik (ÅL 337:528 and ÅL 345:113) show two twisted bars in the radiograph, but it cannot be known if the total number of bars is actually four. Both these blades have volutes, one on the first mentioned blade and two on the second one.

In three cases the pattern-welded rods, two visible on the fuller, had been interruptedly twisted. This means that the rods were not been twisted along their whole length, and the pattern was left straight in some parts of the fuller. In the case of swords KM 3575:1 from Laitila, KM 7752:1 from Salo and KM 10369:3 from Nousiainen the pattern is left untwisted under the inlays, otherwise the pattern is twisted, possibly all the way near the tip of the blade. KM 3575:1 has vertical lines and letter-like marks on one side, and two fragmentary lattices on the other. The inlays of KM 7752:1 correspondingly consist of letter-like marks on one side, and a geometric motif consisting of a lattice lined by four vertical lines and two crosses on the other side. These two blades appear to be somewhat similar, and since the patterns and inlays were revealed by radiographs, the layers of the patterned rods cannot be counted. The total number of rods in KM 7752:1 is four, two on each side, whereas this cannot be verified in the case of KM 3575:1.

In the case of find KM 10369:3, more accurate measures could be made. The blade is constructed clearly from four patterned rods, two on each side. On one side the rods were twisted all the way from the hilt to the very tip of the blade, whereas the rods were left untwisted near the hilt on the other flat of the blade, showing the inlay on top of the straight portion. There is only one inlaid mark, a figure 8 symbol. Furthermore, the layers of patterned rods could be counted as eleven, five of iron and six of steel.

The blades of the next level of complexity have three rods visible on the fuller, twisted along their whole length and having the inlays attached on the top of the twisted pattern. Two blades of this kind of blades were found. KM 293 from Saltvik, Åland has a simple lattice on the side of the blade. The pattern-welding of the blade itself was compiled of a total of six bands, having a layer count of seven (four 'steel' and three 'iron' layers). Sword KM 11063:283 from Eura had an S-shaped figure, again on only one flat. Correspondingly, this blade, too, had a total of six rods, but there were more layers: each rod containing nine layers, five of 'iron' and four of 'steel'. In this respect the blades were made quite differently.

Also a third blade was found to have three twisted rods, but only on one side of the blade (KM 22964:3 from Laitila). The other side was made of two twisted rods. In addition, the inlaid marks – volutes and N-shaped figures – were inlaid on a non-patterned surface and possibly welded on the sword core as a separate, inlaid piece. The layer count of the rods could not be defined from radiographs. Also the nature of the blade core remains unclear; it may have an iron core to which the pattern-welding and inlays were welded.

A more complex blade was KM 6482 from Turku, having two circular designs on one side of the blade. As in finds KM 293 and KM 11063:283 the blade was made of six bars, three on each side. In KM 6482, however, the pattern was a true interrupted twist pattern, requiring somewhat more skill to forge and weld properly. The three rods on each side have alternating sections of twisted and straight patterns. Furthermore, the twisted and straight sections did not correspond to those visible on the other side of the blade, clearly showing that the pattern-welded panels were made separately for each side of the blade.

In this connection, the only analysed pattern-welded blade with inlays must be mentioned. A Czech sword with a pattern-welded mid-section and two omegas on top of it was analysed by Jiří Košta and Jiří Hošek. This sword, recovered from the early medieval stronghold of Mikulčice, had a core of 0.5 % carbon steel and cutting edges of 0.7 % carbon steel, the fullers being covered with altogether six pattern-welded panels, three on each side of the blade.[358] The hardness values from the core were between 175 and 205 HV, and between 206 and 250 HV at the cutting edges. The sword was most likely heat-treated, but fire has demolished all traces of this procedure.

The unique sword from Vehmaa (KM 2022:1) not only has a pattern-welded mid-section, but also inlays of some kind. The inlays could have been executed with the same technique as in the other blades discussed here, but their technique of manufacture could also be completely different. The inlays of this sword are discussed below.

The pattern-welding on the blade from Vehmaa is completely unique (Fig. 25). It is formed from different panels on each side of the blade, and there could be an iron sheet sandwiched between these panels. The non-inlaid side consists of three alternately twisted bars along half of the length of the blade. Then two of these bars were welded together and twisted. The third rod is accompanied with a fourth, separate one, these two being twisted together. The inlaid side first consists of the four-rod construction similar to the lower half of the other side of the blade. Then appear the inlaid marks, after which three alternately twisted rods appear. Approximately in the halfway of the blade the central rod is lifted above the two rods, which are twisted all the way down the tip. Between these twisted rods, a fourth, non-twisted rod seems to be added. Finally, the original central rod was welded on top of three rods in a serpentine pattern. This serpentine pattern welded on a pattern-welded surface can also be found on a sword from Waal bei Nijmegen, Netherlands.[359] One side of this blade is pattern-welded from two continually twisted rods, while the other fuller contains a serpentine figure from the hilt to the tip welded on a pattern-welded surface.

It must be noted here that there are also other classifications and categorizations of pattern-welded blades. They do not, however, concentrate on blades with additional inlays but only on

358 Košta & Hošek 2014: 60–70. The hilt belongs to Petersen's type K.
359 Ypey 1981: 160, Fig. 4; Ypey 1982b: 386, Abb. 15.

ones with mere pattern-welding.[360] Janet Lang and Barry Ager classified the pattern-welded blades they found with the help of radiography from British material into three types (A–C) and their sub-types.[361] Their types did not include any with only one rod visible on each side of the blade. The twisted patterns made of two continually twisted bars were included in their category A, having no examples of interrupted twists but only continual twisting from the hilt to the tip. Category B included blades with three bands visible on each side. The sub-types of B had variations of interrupted twists, type B2a being similar to KM 6482 examined here. The blades of type C had all four pattern-welded bands on each side, but they are not discussed here, since no such compositions were found with ferrous inlays.

Ronald Tylecote and Brian Gilmour metallographically studied twenty-five pattern-welded blades, creating a system of classification containing as much as eight types (I–VIII).[362] Their types I and II have only one patterned rod on each side of the blade, type I having only one rod forming the whole core of the blade, and type II having individual rods on each side of the blade. Interestingly, the classification by Tylecote and Gilmour did not include blades with two bands visible on one side of the blade. The next category is that of three pattern-welded rods forming the whole core (type III). Types V and VI have all three rods on each side and a total of six rods for the core. Type VI has an additional iron sheet in the very core of the blade, the pattern-welding being in the form of thin panels on each side of the blade. Since Tylecote and Gilmour concentrated on the techniques of construction as seen in the cross-sections of the blades, the twisting of the rods was left unnoticed and thus excluded from the classification.

Also Jaap Ypey from the Netherlands has categorized pattern-welded blades.[363] Ypey's category G consists of blades with four pattern-welded panels, two on each side. Categories A, B, D and E operate with three pattern-welded ribbons on each side, B having only three banners throughout the blade. Classes A, D and E have an iron sheet at the very core to join the pattern-welded panels.

Joachim Emmerling from Germany has divided the pattern-welded blades from the Migration Period into twelve groups according to their construction.[364] Type one has only two twisted pattern-welded ribbons in the centre. Types seven, ten and eleven have a total of four ribbons, two on each flat, and in the form of thin panels. Type two is similar to type one, only having three pattern-welded rods instead of two. In similar fashion, types five and eight have a total of six rods, three on each side of the blade.

The type definitions in the above-described classifications of pattern-welded blades are not referred to here, but are mentioned to illustrate the diversity of methods of composing pattern-welded blades, and that the patterned blades with ferrous inlays do not dramatically differ from plain patterned ones in their techniques of construction. Some inlaid blades show only one patterned rod on one flat, while the actual pattern-welded blades were in principle of more complex construction. It must be noted that pattern-welding in iron inlaid blades is of somewhat simple form, consisting of two or three rods visible on each flat, while even more complicated patterns compiled of four or even five rods per flat are not represented among the inlaid blades. A reason for this may lie behind the complexity of the patterns of the blade: the more complex and detailed the pattern is, the harder the ferrous inlaid rods are to distinguish among the blade patterns.

360 *Referred to here are only those dealing with Middle or Late Iron Age blades with a central flat or fuller. Classifications have also been made, for example, of Celtic and Roman weapons, but since the blade forms are considerably different, not to mention the dating, these classifications are not discussed here.*

361 *Lang & Ager 1989: 88.*

362 *Tylecote & Gilmour 1986: 246, Fig. 103.*

363 *E.g. Ypey 1981; Ypey 1982b.*

364 *Emmerling 1972: 304, Abb. 9.*

Figure 26.
The carbon content, hardness measurements and heat treatments of ULFBERHT blades according to previously published analyses by other authors.

Source	Find place / catalogue number	Inlays	Carbon content (%) Core	Carbon content (%) Edge	Carbon content (%) Unknown place	Hardness (HV) Core	Hardness (HV) Edge	Hardness (HV) Unknown place	Heat-treatments
Group A									
Ellis Davidson 1962: 47; Jankuhn 1951: 225	Hamburg, Germany (Museum für Hamburg Geschichte M.1152)	+VLFBERH+T			1.2				
Petersen 1919: 209; Williams 2009: 125	Aker, Norway (Oslo Historisk Museum c.4690)	+VI FBERH+T	0.75	1.4 (average)	0.75				excessively hot-worked or annealed
Williams 1977: 81–84; Williams 2009: 125	Karlsruhe, Germany (Württemburg Landesmuseum 1973-70)	+VLFBERH+T (VLFBERCHT)	0.7	1					
Williams 2007: 236; Williams 2009: 127	River Elbe, Germany (Museum für Hamburg Geschichte 1965/124)	+VLFBERH+T	1	1		337–388	439–476		excessively hot-worked
Williams 2007: 236–237; Williams 2009: 127	Germany (Solingen, Deutsche Klingenmuseum 1973:w.5)	+VLFBERH+T					243–277		annealed or excessively hot-worked
Williams 2009: 125–126	Norway (Bergen Historisk Museum 882)	VLFBERH+ (VLFBERH+T)	1	2.7 (average)		253–308	226–279		
Williams 2009: 126	Norway (Bergen Historisk Museum 1483)	...H+T (VLFBERH+T)		1.3 (average)				295–360	
Williams 2009: 126–127	Norway (Bergen Historisk Museum 3149)	VLFBERH+T (VLFBERHHT)	1.7 (average)	0.5		204–286	220–274		excessively hot-worked
Williams 2009: 127–128	Eura, Finland (KM 9164:3)	+VLF ...ERH+T						417–476	
Williams 2009: 128	Laitila, Finland (KM 2548:839)	+VLFBERH+T						236–286	cooled rapidly in air
Williams 2009: 128	Private collection	+VLFBERH+T	0.5	0.5				279–322	cooled rapidly in air
Williams 2009: 128–129	Estonia (Virumaa Museum RM 587/A21)	...FBERH+T (+VLFBERH+T)	0.4–0.9	0.6–0.8				150–200	possibly annealed (cremation?)
Williams 2009: 129	Estonia (Estonian History Museum A.580:2020)	+(L)F(B)E(P)H+(I) (VLFBERHT)		0.6–0.8				178–246	cremated
Williams 2009: 129–130	Private collection	+VLFBERH+T		0.8–1				308–345	accelerated cooling or hot-working
Group B									
Selucka et al. 2002: 29	Nemilany, Czech Republic (Olomouc Regional Museum)	+VLFBERHT)	0.4–0.6	0.8		165–235	320–460		quench-hardened
Williams 2009: 130	Hämeenlinna, Finland (KM 19402:1)	+VLFBERHT+				210–220	310–390	388–476	tempered
Williams 2009: 131	Norway (Bergen Historisk Museum 1165)	VLFBER++ (VLFBERHT+)		0.5				234–261	accelerated cooling
Williams 2009: 131	Vesilahti, Finland (KM 10390:2)	+VLFBERHT+		0.5				116–223	excessively hot-worked
Williams 2009: 131	Private collection	...RHT+		0.5				264–564	hardened by slack-quenching
Group C1									
Edge & Williams 2003: 194; Williams 2009: 132	Private collection	VLFBERN+T	0	0.5–0.6		236	423–540		fully quench-hardened and tempered
Williams 2007: 237; Williams 2009: 132–133	Wisbech, Great Britain (Wisbech & Fenland Museum 1860.5)	–VTHBERHTC–NGEFLRII					326–379		hardened
Williams 2009: 132	Private collection	+VLFBERH+⊥		low/medium C				295–322	accelerated cooling
Williams 2009: 132	Germany (Germanisches National Museum FG.2187)	+VLFBEH+T	0.7–0.8					286–345	accelerated cooling
Williams 2009: 133	Tampere, Finland (KM 6066:1)	V ..... T						261–429	fully quench-hardened
Williams 2009: 133	Estonia (Saaremaa Museum K85-108)	... BE ...+ (+VLFBERH+)	0	hardenable steel		170–220	230–248		hardened and tempered
Group C2									
Williams 2009: 134	Estonia (Saaremaa Museum K85-122)	+(NN)...(P)E...H... (+VLBERHT+)	0.4–0.5			137–185	210–266		annealed
Williams 2009: 134	Estonia (Saaremaa Museum K85-120)	+VLFBERH+(T) (+VLFBERH)		0.3–0.6				169–217	
Williams 2009: 134–135	Norway (Bergen Historisk Museum 2944)	(VLFBERHCT)	0.2–0.8					163–289	annealed
Williams 2009: 135	Holola, Finland (KM 3601:2)	+VLFBERH++		0.5–0.6				195–217	prolonged annealing (cremation)
Williams 2009: 135	Norway (Bergen Historisk Museum 2695)	F ... T (VLFBERHH)	0.4	0.6		160–215	175–243		not hardened
Williams 2009: 135	Norway (Bergen Historisk Museum 1069)	HΓXINT+			0.6			226–279	
Williams 2009: 135–136	Norway (Bergen Historisk Museum 3993)	+IIE...			0.6			199–264	
Williams 2009: 136	Norway (Bergen Historisk Museum 1622)	... BRT (THURMUTH)		0.8		119–163	204–305		annealed
Group D									
Anteins 1973: 40; Williams 2009: 138–139	Estonia (Tallinn University, Institute of History AI 2643:108)	(+VLFBERH+)	0.15	0.4–0.8		130–190			
Williams 2007: 237–238; Williams 2009: 137	Pitt-Rivers Museum, Oxford (inv. no. 1555.2580)	+VITIFR I+⊥		ferrite			143		fire-damage
Williams 2009: 136	Tyrväntö, Finland (KM 6503:20)	+VLΓBERH+T		0.2				148–171	
Williams 2009: 136	Norway (Bergen Historisk Museum 1484)	...F V...			0.2–0.3			195–217	tempered
Williams 2009: 137	Sääksmäki, Finland (KM 2767)	+VLFBERH+		0.2				169–207	
Williams 2009: 137	Norway (Bergen Historisk Museum 946)	...R T... (VLFBERH+T)			0.1			165–236	
Williams 2009: 137	Norway (Bergen Historisk Museum 3315)	+IΓITT⊥⊥+		ferrite				230–240	
Williams 2009: 138	Vesilahti, Finland (KM 10390:5)	+VLEHRAH LN+–		0.3				149–179	
Williams 2009: 138	Kokemäki, Finland (KM 1174:2)	+VLΓP...		0.3				167–261	
Williams 2009: 138	Chertsey, Great Britain (Chertsey Museum)	+MFBERIT+						91–190	
Williams 2009: 138	Estonia (Tallinn University, Institute of History K85.121)	...B ... T (K L IIIH X D)		0.1					
other (not defined by Williams)									
Thålin-Bergman & Arrhenius 2005: 100–101	Hulterstad, Öland, Sweden (SHM 3104)	+VLFBERH+T	0–0.6	0.7–0.9					
Törnblom 1982: 25	Hogrän, Alands, Sweden (SHM 907)	VLFBERHT+	0.1	0.8					

4.5. Construction, composition and correspondence between various inlays

4.5.1. ULFBERHT swords in the focus of studies

4.5.1.1. Analyses and groupings of material by Alan Williams

Carbon has been considered as the most important element of iron, since the amount of carbon has a profound effect on the manufacture and function of the blade (see Chapter 3.1). The first attempts to define the carbon content of inscribed blades were already done at the end of the 19th century. In the case of inlaid blades, an important general consideration is that their carbon contents have been found to be considerably higher than in the earlier blades. Perhaps the discovery of these relatively high carbon contents of blades is partly the reason for the general argument that inscribed blades are of homogeneous, 'better' steel than those that were previously utilized.

The most extensive analysis concerning the materials of inlaid blades has been carried out by the British archaeometallurgist Alan Williams, who focused on ULFBERHT swords.[365] These swords have been a subject of interest since they have appeared as the most common inlaid swords, and they have a clearly readable inscription instead of symbolic motifs and figures. Williams carried out the analyses on very small samples detached from the blade. Based on the microstructure of these samples Williams presented the carbon content of the blades as well as the applied heat treatments, if there were any. Also hardness measurements were taken from almost each blade, and the result was a categorization of blades of various construction and manufacturing technique, as well as variants of spelling.

Williams separated four distinct groups among the ULFBERHT swords (Fig. 26). Group A consists of swords bearing the inscription +VLFBERH+T. Altogether fourteen swords of this kind were analysed, all of which may be hypereutectoid, i.e. crucible steel (see below).[366] Williams also states that only nine of them are clearly hypereutectoid, while one seems to be eutectoid steel, two are only partly eutectoid, and one is not even eutectoid at all.[367] Still Williams seems to be of the opinion that the uniformity of the microstructure of these blades makes it plausible that they all could have been made from crucible steel from different sources. Another feature of many of these fourteen blades is the appearance of cementite needles, which appear in connection with hypereutectoid steel and cast iron, both having very high carbon content.

Some of the blades had been analysed before Williams, and here he only referred to the previously published results. In the case of group A blades, a sword from Hamburg, Germany (Museum für Hamburg Geschichte M.1152) was found to have a carbon content of ca. 1.2 %, although the publications do not mention the part of the blade from where the analysis sample had been taken.[368] Another sword, this time from Aker, Norway (Oslo Historisk Museum c.4690), had been analysed and published in Jan Petersen's work, and was found to have a carbon content of approximately 0.75 %.[369] The analysis was made by the Norwegian engineer K. Refsaas from very small samples.[370] Williams has also analysed the blade, concluding that while the core contained 0.75 % carbon, the edges had 1.4 % on average.[371]

365 Williams 2009.
366 Williams 2009: 130, 139.
367 Williams 2009: 130.
368 Ellis Davidson 1962: 47; Jankuhn 1951: 224–225.
369 Petersen 1919: 209.
370 Williams 2009: 123.
371 Williams 2009: 125.

Williams himself has studied and published some of the analyses in his previous publications. A sword from Karlsruhe, Germany (Württemburg Landesmuseum 1973–70), bearing inscription +VLFBERH+T according to Williams, had 0.7 % carbon in the core and about 1 % on the cutting edges, displaying pearlite and cementite in the microanalysis.[372] Group A also contains two blades from Germany, one from the River Elbe (Museum für Hamburg Geschichte 1965/124) and another with no precise find location (Solingen, Deutsche Klingenmuseum 1973.w.5). Both had been published also earlier.[373] The first of these two had a carbon content of approximately one percent in all the analysed places.

The analyses published in 2009 also included nine swords not previously examined metallographically. The properties of these blades vary greatly, considering that they have been interpreted as being of somewhat uniform hypereutectoid steel. For example, the carbon content as well as the hardness readings are variable between the core parts and the cutting edges of the same blades (see Fig. 30). Normally the estimated carbon content in the core parts varies between 0.4 to 1 % while in one case from Norway (Bergen Historisk Museum 3149) it is as high as 1.7 % on average. Similarly, the estimates from the cutting edges vary between 0.5 to 1.4 per cent carbon, a peak being in 2.7 %, again in a blade from Norway (Bergen Historisk Museum 882).[374] A sword from Norway (Bergen Historisk Museum 3149) was hypereutectoid only in its central parts, which is somewhat peculiar.[375] In few cases the carbon contents are overall hypoeutectoid, but still the material is classified as possible crucible steel on the basis of the uniformity, possible absence of slag inclusions, and the appearance of the microstructure. In a similar fashion, also the hardness measurements are different between the core and the edges in many cases. Since all the blades in this category were not hardened by quenching, the variable carbon contents as well as hardness values can also imply laminated blades having different kinds of steel in their composition.

Williams also included some Finnish finds in his group A of hypereutectoid, 'real' ULFBERHT swords, two to be precise. A sword from Rukoushuone-Kansakoulunmäki in Laitila (KM 2548:839) was measured for its hardness, giving values between 236 and 286 HV.[376] The crystal structure indicated a rapid cooling in the air, which is no surprise since the blade is originally from a cremation cemetery. The carbon content is stated as 'varying', and the steel includes numerous slag inclusions; the microanalysis showing areas of ferrite and pearlite. In my opinion, it is doubtful that this is crucible steel.

Another Finnish find was KM 9164:3 from Pappilanmäki in Eura. The hardness range measured by Williams was 417–476 HV.[377] Williams has speculated that the blade may have been of ca. 1 % hypereutectoid steel according to its fine pearlitic or even bainitic structure possibly achieved by an accelerated cooling process. Furthermore, to promote the hypothesis of crucible steel, Williams had not observed any slag inclusions in the small detached sample. This sword was

372 *Williams 1977: 81–84. See also Chapter 4.4.3. and Fig. 46 for the cross-section. As a side note, Williams states in his 2009 publication that the blade had been forged completely from a crucible steel bar folded in two. This contradicts the evidence he presented in his 1977 publication. Also, the inscription was read as +VLFBERH+T in the article from 2009, whereas in the previous study it was read as VLFBERCHT with some letters remaining uncertain.*

373 *Williams 2007: 236–237; Williams 2009: 127.*

374 *Williams interpreted the blade as having been made from crucible steel, one ingredient of which was cast iron. This can be seen from the cavities with graphite still intact.*

375 *Williams (2009: 127) has explained this anomaly with the decarburization of the cutting edges and/or imperfectly melted crucible steel.*

376 *Williams 2009: 128.*

377 *Williams 2009: 127–128.*

also analysed by the author for its cross-section (see Chapter 4.4.4 and Fig. 24), and it was found to be laminated from several pieces of the same high-carbon steel. The average hardnesses were close to Williams's measurements. Only the microstructure gave a different indication. As observed through the cross-section, hardened and tempered structures were found, the core being naturally softer than the cutting edges.

Group B blades contain inscription +VLFBERHT+, the last cross being in a different place when compared to group A swords. According to Williams, these swords of group B are counterfeit swords imitating the original ULFBERHT swords of group A.[378] Williams also claims that because of the same spelling, all these group B swords could have been made in the same workshop. There are only five analysed group B swords. According to Williams these swords had an iron body with thin, sharp steel edges, which would give an impression of a good sword.[379] Of these five blades, three have hardened edges and two others are not hardened.[380] The carbon contents of these group B blades are notably lower than those in group A, between 0.4 and 0.8 per cent. These estimates, however, are also similar to some group A swords.

Two swords from the Finnish collections were included in group B. The first was found from Hämeenlinna (KM 18402:1), having hardnesses of 210–220 HV near the centre and 310–390 HV near the edge.[381] The sample from the edge showed tempered martensite, and the core is presumed to be of iron due to its lower hardness readings. Owing to the lack of a cross-sectional analysis this cannot be verified. The second sword was from Vesilahti (KM 10390:2), with a medium-carbon edge (ca. 0.5 % C), showing patches of both pearlite and ferrite.[382] The blade is stated to have undergone some hot-working, and the overall hardness range is 116–223 HV. Again, the technique of lamination cannot be definitely stated but only suggested.

Groups C and D consist of variant spellings of ULFBERHT. Group C swords are made of steel (fourteen swords), six swords being hardened and eight being unhardened.[383] With regard to this, the swords have been divided here in groups C1 and C2, the first class consisting of blades with hardened steel edges, and the second of unhardened blades. The core is softer steel or even iron. The carbon contents of this group have not been estimated very carefully, or at least they have not recorded in the publication. One sword from Estonia (Saaremaa Museum K85-108) has an iron core and edges made of hardenable steel, while a sword from Germany (Germanisches National Museum FG.2187) has a core of 0.7–0.8 % C, with the measurement lacking from the edges. The sword from a private collection is described as having low or medium-carbon edges. The inscriptions are otherwise recognizable as ULFBERHTs, except that some letters may be missing or are inverted and upside down. There are eight swords of group C2 with unhardened edges. In these blades the carbon content varies between 0.2 and 0.8 %. The crystal structures appear to be unhardened or annealed.

Mentioned among the group C1 swords, i.e. with hardened steel edges, is a sword from Tampere (KM 6066:1).[384] Its microhardness is between 261 and 429 HV, and the structure is quench-hardened martensite with some bands of ferrite and slag inclusions. This sword is said to have steel edges welded to an iron core. This, however, remains highly speculative.

378 Williams 2009: 139.
379 Williams 2009: 131.
380 Williams 2009: 131.
381 Williams 2009: 130.
382 Williams 2009: 131.
383 Williams 2009: 139–140.
384 Williams 2009: 133.

Similarly, one sword from Finnish collections is included in group C2. This sword was found in Hollola (KM 3601:2), having edges of medium-carbon steel (ca. 0.5–0.6 % C), and a microhardness of 195–217 HV.[385] The microstructure shows ferrite and pearlite and is indicative of an annealed structure, most certainly having come about in the cremation pyre since the blade is strongly bent. Williams speculates that according to the prior lamellar arrangement in the microstructure, it was mostly pearlitic, but hardening is not out of question. Also, the construction method of the blade remains obscure. According to visible layered corrosion, the actual core is of lower-carbon material, and the case of the blade is of steel of uniform appearance.

Swords of group D were made of iron or low-carbon steel that cannot be hardened (eleven swords).[386] Here the inscriptions are even more variable, some of which may not be connected to an ULFBERHT inscription in any manner. The carbon contents vary between none and 0.8 %, commonly being too low for the application of quench-hardening.

In group D a total of four swords from Finland may be found. The first of these is KM 6503:20 from Hattula (formerly Tyrväntö). Surprisingly, the inscription is almost correct, excluding a missing bar of the letter F, possibly ruined by corrosion. According to Williams, the edge is of 0.2 % low-carbon steel, and the hardness is 148–171 HV.[387] The microstructure consists of mainly ferrite and some pearlite. The second sword comes from Valkeakoski (formerly Sääksmäki), under collection number KM 2767 and bearing inscription +VLFBERH+. The missing letter T is most likely due to the breakage of the blade. This, too, has a 0.2 % carbon-steel edge with a hardness range of 189–207 HV, and also some slag inclusions.[388] The third analysed blade was KM 10390:5 from Vesilahti, showing the obscure and possibly imitative inscription +VLEHRAH LN++. The edge of this blade was low-carbon steel with a carbon content of ca. 0.3 per cent, a hardness of 149–179 HV, and a microstructure consisting of ferrite and pearlite.[389] The fourth sword, KM 1174:2 from Kokemäki with a fragmentary inscription +VLFP, had a similar kind of low-carbon steel as its edge as the previous sword from Vesilahti, and a hardness of 187–261 HV.[390]

The analyses conducted by Williams have some problematic issues.[391] First of all, the detached samples were very small, approximately one cubic millimetre in size. Moreover, these small pieces were sawn from corroded blades, so they did not necessarily contain very much metallic iron or steel any more but mainly corrosion products, which makes the size of the sample even smaller. We may ask if these kinds of small samples are representative enough of the whole blade, or even of the blade edges or the core, depending on where the sample was taken. Late Iron Age bloomery iron and steel were of quite heterogeneous quality, having differing carbon contents in different places and even hypereutectoid structures (see Chapter 3.1.2).

The location from where the sample was taken is not exactly stated in every case.[392] The analysed finds were highly fragmentary, and the sample may be from the edge or from the core. This naturally affects interpretations. The measurements of the carbon contents were made with wavelength-dispersive X-ray spectrometry (WDX) in only eight cases, all being presumably

385 *Williams 2009: 135.*
386 *Williams 2009: 140.*
387 *Williams 2009: 136.*
388 *Williams 2009: 137.*
389 *Williams 2009: 138.*
390 *Williams 2009: 138.*
391 *Some of the points presented here have also been presented in a short article by Eva Astrup and Irmelin Martens (2011), who also criticized Williams's procedures and some of his interpretations.*
392 *See also Astrup & Martens 2011: 204.*

hypereutectoid swords having inscription +VLFBERH+T. Otherwise, it is not stated how the carbon content was measured. Now, in those cases where the actual position of the sample is not stated, it is impossible to know that part of the blade from which the carbon content was measured.

Correspondingly, hardness measurements are taken from various places. In some cases it is clarified if the measurements are read from the centre of the blade or from the edge or bevel. It must be noted that in many cases the reading is slightly smaller in the centre of the blade, which may be caused by the different cooling rates of blade parts of different thickness during quenching. A thinner edge will harden more than thicker ridges of fuller or bevels. In the majority of cases, however, the measurements are probably taken from various, random places, making it impossible for the reader to make any further deductions about the blade properties. Moreover, the readings may not represent the blade in all cases if they are measured from the inlaid portion of the blade. Since inlays are normally made of different, contrasting material than the blade, it would appear different also under the measuring device and on the screen. In the case of Finnish swords, the hardnesses may appear lower since the majority of blades have been found in cremation cemeteries. A further negative aspect of the study is the lack of accurate provenances of finds. Cremated blades, for example, do not naturally reflect the heat treatments made by the smith.

Considering the subject of work, the greatest drawback of the analyses conducted by Williams is the insufficient examination of the actual inlays. Their materials were not examined but instead only the content and spelling of the inscriptions. In some cases, the inscriptions seem to be visible, but in other cases nothing can be seen from the surface of blade, and accordingly Williams has referred to some other author who has interpreted the inscription by some unknown means. According to Williams, groups C and D contain swords with variant spellings of ULFBERHT, but in reality the inlaid motifs are much more diverse and cannot be classified under the same category.[393] For example, some blades have fragmentary inscriptions, which could have originally been spelled as those in groups A or B, and some motifs do not contain any actual Latin letters, only letter-like marks.[394] The re-examination of inlaid materials and motifs would certainly make the four-group classification more complicated, and also closer to reality in regard to the variation of the blades and the inlays.

4.5.1.2. On crucible steel

Normally the blades were made from steel, which was the product of the bloomery process. First an iron lump was obtained by reducing it from iron ore. Carbon-rich steel was either separated from the resulting iron bloom or the iron was carbonized in one way or another to create steel (see Chapter 3.1.2).

Alan Williams states that according to his analyses at least nine +VLFBERH+T blades were forged from crucible steel, possibly even fourteen blades.[395] This crucible steel was developed and produced in Asia, especially in the regions of modern Sri Lanka, Uzbekistan, Turkmenistan and India.[396] Crucible steel was already produced before 500 AD.[397]

393 *See also Astrup & Martens 2011: 204–205.*
394 *See Williams 2009: 139–140.*
395 *Williams 2009: 130, 139.*
396 *Williams 2007: 233.*
397 *Bronson 1986; Verhoeven et al. 1998: 58.*

Source Find place / catalogue number Inlays	Carbon content (%) Core	 Edge	 Unknown place	Hardness (HV) Core	 Edge	 Unknown place	 Heat-treatments
Anteins 1973: 53 Randvere, Saaremaa, Estonia (IIE-K 85:129) I⊳⊲⊳⊲I / NLI^I	0.2–0.4	0.4–0.8					
Edge & Williams 2003: 191 Wallace collection A.456 ⊂				238	189		
Kolchin 1953: 133–134 Gnezdovo, Russia letter-like / lattice weave	0	0					
Kolchin 1953: 133–134, 242 Gnezdovo, Russia +ING.....IT	0	0.85					quench-hardened
Košta & Hošek 2014: 60–70 Mikulčice, Czech Republic pattern-welded mid-section; inlays: ⊂ ⊃	0.5	0.7		175–205	206–250		possibly quench-hardened
Košta & Hošek 2014: 123–134 Mikulčice, Czech Republic (594-2978/57) [illegible] / ○	0.1–0.35	0.7		115–228	458–495		quench-hardened
Košta & Hošek 2014: 179–193 Mikulčice, Czech Republic [illegible] / I	0.45–0.7	0.77		131–185	259–413		partially quench-hardened
Tylecote & Gilmour 1986: 218–220 Thames, Great Britain (Reading Museum 112:66/1) ⊳⊲⊳⊲⊳⊲	0.6–0.8	0–0.8		178–423	762		quench-hardened from 725–750 ˚C
Tylecote & Gilmour 1986: 224–227 Waterloo bridge, Thames, Great Britain (Museum of London A 3670) ⊳⊲⊳⊲⊳⊲	0.8	0.8		138–232	239		annealed near 700 ˚C
Tylecote & Gilmour 1986: 234–236 Brentford, Thames, Great Britain (Museum of London A 24419) ⊳⊲I⊳⊲I	0.2	0.8		157–181	325		no heat-treatments
Williams 2009: 140 Donnybrook, Ireland (Nottingham Castle Museum T608) FNHIJIT	0.2	0.3–0.4		250	520–550		possibly quench-hardened
Williams 2009: 141 Olomouc, Poland (Museum of Olomouc A94696) V B EH				197	545		
Williams 2009: 141 Private collection (loaned to Metropolitan Museum of Art, New York) HARTO FER		low-C steel				296	quenched
Williams 2009: 141–142 Mynämäki, Finland (KM 8911:91) CONSTMIITNS / REX	0	0.5					no quenching
Williams 2009: 142 Estonia (Saaremaa Museum K85-123) ... S... A			low-C steel				

Figure 27. Properties of metallographically analysed blades with other inlays than ULFBERHT cited from earlier publications.

In highly simplified terms, crucible steel was prepared in a sealed clay crucible by heating pieces of wrought iron, charcoal and organic parts of plants etc. together for many hours; a method that was described by al-Tarsusi in the 12th century.[398] As a further detail, the iron melted in the crucible could be of varying quality, for example both cast (high-carbon) iron and bloomery (low-carbon) iron, as described by al-Biruni in the 11th century.[399] Graphite flakes discovered by Williams from one Norwegian +VLFBERH+T sword could be traces of cast iron used in the crucible process, as was mentioned above.[400] The prolonged heating in a high temperature caused the iron absorb carbon from charcoal and organic materials, lowering the melting point enough to make the steel melt into a cake inside the crucible.[401] The higher the carbon content, the lower the melting temperature will be. The resulting steel had a high carbon content of 1.2 % or sometimes even 1.6 %.[402] As a considerably later development, crucible steel ingots were very slowly cooled, which allowed the preservation of large cementite crystals (i.e. iron carbides).[403] In India this kind of crucible steel was called *wootz*, and it often had a clearly visible net-like pattern resulting from carbides made visible by etching. Wootz steel is also referred as genuine damascus steel.

Crucible steel has certain properties that most likely have an effect on, for example, the attaching of inscriptions by welding. One of these properties is the relatively low working temperature of the steel.[404] Crucible steel should be forged at temperatures less than 850 ˚C. If the steel is heated any more, its characteristics such as toughness and flexibility will suffer. Also the forge-welding of crucible steel should be done at a very low temperature because of its high carbon content. It has been speculated that wootz ingots could be welded together to form a larger lump at a temperature of ca. 700 ˚C, at which carbon does not readily diffuse.[405] As a material for sword blades, crucible steel needed no quench-hardening, the steel being readily hard and providing a

398 *Williams 2007: 234.*
399 *Hoyland & Gilmour 2006: 148–174; Williams 2007: 234; Williams 2009: 126, 143.*
400 *Williams 2009: 125–126, 143, 149.*
401 *E.g. Williams 2009: 122.*
402 *Williams 2009: 122.*
403 *Williams 2009: 122.*
404 *Williams 2007: 233; Williams 2009: 143.*
405 *Tylecote 1976: 66.*

sharp edge, but only when forged at a low temperature.[406] Generally speaking, hypereutectoid steels would attain a hardness of 300–350 HV without any heat treatments.[407] In theory, wootz may be heat-treated and quenched, as long as this takes place at a low temperature.

One characteristic feature of crucible steel blades is that slag inclusions are very rare,[408] while bloomery steel normally has numerous slag inclusions varying in size. If the melting process is complete inside a crucible, no slag should be left inside the steel cake. Williams has noted that some analysed specimens from +VLFBERH+T swords are actually somewhat heterogeneous, which may be due to an incomplete melting process.[409] Iron and steel of differing quality and composition will naturally melt at different temperatures, and it may well be that not all parts in the crucible absorbed enough carbon to melt completely. This will result in uneven carbon content and some slag.

4.5.1.3. Other analyses of ULFBERHT blades

In addition to Williams's studies, some other analyses of ULFBERHT blades have been published. A sword from Hulterstad, Öland, Sweden (SHM 3104) had the following carbon content: core 0–0.6 % and edges 0.7–0.9 %.[410] According to its fragmentary inscription +VI FBERH+T, this would belong to group A as defined by Williams, although the cross-section clearly shows that this blade was laminated from several pieces (see Fig. 20). Furthermore, the authors of the analysis do not make any mention of the exceptionality of the blade material in regard to crucible steel.

Another Swedish sword with the inscription VLFBERHT+ from Hogrän, Alands (SHM 907) was measured for its carbon content, which was 0.1 % in the core and 0.8 % at the edges, the blade being laminated from several piled parts.[411] This would then fit into Williams's group B.

The cross-sections of swords analysed for this work are presented in Chapter 4.4. above. They included four swords with the inscription ULFBERHT either in complete or fragmentary form. Sword KM 9164:3 is discussed above in connection with Williams's results. Sword KM 2548:277 from Laitila with a laminated core and welded cutting edges was quench-hardened and tempered. It may be broadly stated that, according to its fragmented inscription +VLFBE and its welded and quenched cutting edges, the sword would belong to Williams' group C1, although the hardness measurements are higher than in any sword presented by Williams in his article. KM 3423 from Vesilahti has a very fragmentary ULFBERHT-like inscription (see Fig. 14). Again this blade may be included in group C1 of Williams, since it has a laminated core and welded-on cutting edges (see Fig. 19), bearing traces of quenching and now largely lost due to cremation. The steel is of low and medium carbon content overall.

A different kind of blade was that from Hämeenlinna (KM 5960:3), having a remaining inscription ERI I+T. This would be included in the group D. The overall carbon content is quite low, and the blade had been folded and welded from similar material, including the welded cutting edges (see Fig. 19). The hardness is somewhat low, 177 HV on average in all parts of the blade, and the structure was annealed most likely in the ashes of the cremation pyre.

406 *Williams 2007: 233.*
407 *Williams 2009: 122.*
408 *Williams 2007: 239.*
409 *Williams 2009: 122.*
410 *Thålin-Bergman & Arrhenius 2005: 100–101.*
411 *Törnblom 1982: 25.*

4.5.2. Other inlaid blades

Besides ULFBERHT blades, also swords bearing other inlaid marks have been examined, though not as systematically. Williams has examined six blades with other than ULFBERHT inlays, classifying them in category E as compared to the grouping of ULFBERHT swords (Fig. 27).[412] In addition to Williams, Ronald Tylecote and Brian Gilmour have included three blades with geometric inlays in their study. Also Aleksis Anteins in Latvia has studied inlaid blades, as also B. A. Kolchin in Russia. Jiří Košta and Jiří Hošek have analysed a total of three inlaid blades from the Czech Republic, one of which has a pattern-welded mid-section. Here the blades are discussed according to their inlays, rather than the author of the analysis, which also applies to the analyses conducted for this work.

There are five blades that are noted as having only geometric and symbolic figures. A Petersen type K sword in the Wallace Collection (catalogue number A.456), with an omega-shaped inlay was found to be softer at the edge (189 HV) than in the centre (238 HV), the values being averages from the whole blade.[413] Nothing else was observed about this sword. It is notable that the hardness readings on both the fuller and the blade vary on both sides of the value 200 HV, and the quality of the blade was very uneven. Furthermore, the blade most likely contains more inlaid marks than just one omega-like figure, since it was the only one visible on the radiograph taken primarily to picture the hilt.

The British material studied by Ronald Tylecote and Brian Gilmour included three inscribed swords, all inlaid with possibly different lattice patterns recognized from radiographs.[414] The pictures of the cross-sections of these three blades may be found in Chapter 4.4. The first of these swords, found from Thames (Reading Museum 112.66/1) had varying carbon content from zero to 0.8 %, the edge being quench-hardened to a hardness of 762 HV.[415] The hardening has taken place from a temperature of 725–750 degrees Celsius. The hardness of the core parts is between 178 and 423 HV. The blade was laminated, having two ferritic slices among pieces of better-quality steel (see Fig. 20).

Another sword analysed by Tylecote and Gilmour (Museum of London A 3670 from the River Thames near Waterloo Bridge in London), was made of the same kind of steel throughout (see Fig. 16), having a carbon content of approximately 0.8 %.[416] According to the microstructure and the hardness readings (core 138–232 HV and edge 239 HV on average) the blade had not been quenched but annealed near 700 degrees Celsius. Since the sword was found in a river, the structure is most likely original and not altered, for example, by fire.

The third blade studied by Tylecote and Gilmour (Museum of London A 24419 from the River Thames near Brentford) had an edge of 0.8 % carbon steel and core parts with lower carbon content, ca. 0.2 %.[417] The edges were scarf-welded to the low-carbon core (see Fig. 20). In this case no traces of heat treatments were observed, and the higher hardness of the edge (325 HV on average) compared with the centre (157–181 HV) is due to the variation of the carbon content.

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412 *Edge & Williams 2003: 191; Williams 2009.*
413 *Edge & Williams 2003: 191–193.*
414 *Tylecote & Gilmour 1986.*
415 *Tylecote & Gilmour 1986: 218–220.*
416 *Tylecote & Gilmour 1986: 224–227.*
417 *Tylecote & Gilmour 1986: 234–236.*

A Czech sword with a pattern-welded mid-section and two omegas on top of it was analysed by Jiří Košta and Jiří Hošek (see Chapter 4.4.6). This sword had a core of 0.5 % carbon steel (175–205 HV), the separately welded cutting edges having a carbon content of 0.7 % (206–250 HV). The surface of the fuller was covered with three pattern-welded panels on each side.[418] Originally this blade may have been hardened.

In the Finnish finds examined here at least two had geometric motifs on their fullers. Sword KM 2979:8 from Mynämäki, with complex patterns consisting of lattices, vertical lines and St. John's Arms, had a piled blade of perhaps medium-carbon steel (see Fig. 17). Its structure contained ferrite and pearlite, having a hardness of 278 HV on average. The sample was taken from the fuller, and thus the bevels and cutting edges remain uninvestigated. The other sword is a find from Nousiainen (KM 9142:8), which was piled from three different layers (see Fig. 17). The steels used were of low- and medium carbon content. The blade had been fully hardened at 850–900 degrees Celsius and then tempered at a low temperature, resulting in a hardness of 564 HV in the layer with the highest carbon content. The hardnesses of the other layers were 316 HV and 276 HV on average.

The third possible sword for this category is from Laitila (KM 9832) having only a cross and one vertical line inlay because of the breakage of the blade. These inlays leave much room for interpretation and creative conjecture. Whatever the original motifs were, the blade was folded from similar low- or medium-carbon steel of an average hardness of 168 HV (see Fig. 15). According to microanalysis, the blade had been annealed, possibly in the ashes of the pyre, although the find context remains uncertain.

A piled blade from Randvere, Saaremaa, Estonia (IIE-K 85:129) had two lattices and vertical lines on one side of the fuller, and letter-like marks on the other side. The analysis of the cross-section is presented in Chapter 4.4.3. (see also Fig. 18). It was noted that the centremost layer had a lower carbon content (approximately 0.2–0.4 %), not suitable for a proper blade. The flats were made of higher-carbon steel (ca. 0.4–0.8 % C).

Some of the blades analysed by Williams may be included in the same category of letter-like marks. A sword from Donnybrook, Ireland (Nottingham Castle Museum T608) has been interpreted as having marks resembling Latin letters, some of them inverted.[419] Williams analysed samples from both near the centre and from the edge. The centre sample contained only 0.2 % carbon and a hardness of 250 HV on average, while the edge had carbon content of 0.3–0.4 % and a hardness range of 520–550 HV. The blade microstructure indicated possible quench-hardening. A sword from Gnezdovo with letter-like marks was found to be ferritic throughout.[420]

Also two swords from Mikulčice were equipped with letter-like marks, both having also a piled blade with separate cutting edges. The core part of grave 438 sword was 0.1–0.35 % carbon steel (115–228 HV), the surface parts had 0.7 % carbon and a hardness between 376–466 HV, and the cutting edges had 0.77 % carbon and a hardness between 458–495 HV.[421] Steels of 0.45 % and 0.7 % carbon were used to compile the central part of sword from grave 723, while its edges had a carbo content of 0.7 %. The hardness of the core was between 131–185 HV, while the

418 *Košta & Hošek 2014: 60-70.*
419 *Williams 2009: 140.*
420 *Kolchin 1953: 133–134. See also Chapter 4.4.2 above.*
421 *Košta & Hošek 2014: 131-134. Collection number 594-2978/57. See also Fig. 20.*

values for the edge were between 259–413 HV.[422] Both of these blades were hardened, the latter one only on its lower portion though.

Among the analysed finds in this work, a sword from Laitila (KM 2548:196), bearing clear letter-imitating marks, was made of low-carbon steel (approximately 0–0.3 % C) throughout (see Fig. 15). The microstructure exhibited ferrite and some pearlite, and also coarsely ferritic areas. The hardness of the blade was on average 131 HV (99–195 HV), and the blade had been thoroughly annealed, most likely on the cremation pyre.

A sword from Olomouc, Poland (Museum of Olomouc A94696) has inlays interpreted as the letters V, B and EH, although without a picture of the find it is impossible to say if these are real letters or not. In any case, the blade has steel edges, and the core is of heterogeneous steel on one flat, and pattern-welded on the other. The hardness of the steel core was 197 HV, and the value for the edge was 545 HV. The pattern-welded side was composed of two contrasting kinds of steel, one of which contained a high level of phosphorus (259 HV in hardness).[423]

Similarly, a sword from Estonia (Saaremaa Museum K85-123) had inlays resembling the letters S and A according to Williams,[424] while Anteins has interpreted the inlaid motif as the letters HKIΛI.[425] A single analysis from an undetermined part of the blade indicates that this location was made of low-carbon steel with visible pearlite in the microstructure. A clearer case is the sword from Gnezdovo with the fragmentary inscription +ING…IT, having hardened cutting edges with 0.85 % carbon welded to a ferritic core.[426]

The Finnish finds analysed for this work include two examples with Latin letters other than ULFBERHT. Sword KM 8120:1 from Hattula (formerly Tyrväntö) has a laminated blade from a three-layered core and cutting edges (see Fig. 19). The actual core is mostly ferritic with a hardness of 266 HV on average, and the higher-carbon steel layers forming the fullers have an average hardness of 386 HV. An average hardness of 522 HV was measured from the very edges, which were hardened and tempered. The inlays consist of a combination of the letters D and U repeated four times and appearing with a lattice pattern on the opposite side of the blade.

Sword KM 9164:2 from Eura has the slightly corrupted inscriptions AMENI and …N… NEDNI. The blade was piled from low- or medium-carbon steel (average hardness of 206 HV), having one phosphorus-rich layer in the middle (hardness of 232 HV) (see Fig. 17). According to the microstructure the blade had been cooled after hardening and then normalized or annealed. Alternatively, the blade was hardened and then overheated with a temperature that was too high during tempering.

Another sword from Finland, this time presented by Williams, is from Mynämäki and bears the inscriptions CONSTMIITNS and REX (KM 8911:91). The cross-section revealed that the blade of this sword was made from iron core with 0.5 % carbon steel outer wrap welded around the core (see also Fig. 21).[427] The core was ferritic, while the outer wrap was made from 0.5 % carbon steel. The outer steel layers were pearlitic, in other words the blade was not quenched.

422 *Košta & Hošek 2014: 185-191.*
423 *Frait 2006; Hošek 2007; Williams 2009: 141.*
424 *Williams 2009: 142.*
425 *Anteins 1973: 51.*
426 *Kolchin 1953: 133–134, 242. See also Chapter 4.4.4 above.*
427 *Williams 2009: 141–142, 181.*

Catalogue number	Find place	Inlays, side A	Inlays, side B	Method of construction	Carbon content (%)		Hardness (HV)			Heat-treatments
					Core	Edge	Core	Edge	Unknown place	
KM 1174:2	Kokemäki, Äimälä, Leikkimäki					0.3			187–261	
KM 2548:196	Laitila, Rukoushuone-Kansakoulunmäki			folded from similar steel (Fig. 5.10)	0–0.3	0–0.3	99–195	99–195		annealed
KM 2548:277	Laitila, Rukoushuone-Kansakoulunmäki			laminated core and separate cutting edges (Fig. 5.14)	low	medium/high	244–286 / 247–445	419–839		quench-hardened and tempered
KM 2548:839	Laitila, Rukoushuone-Kansakoulunmäki				varying	varying			236–286	cooled rapidly in air
KM 2767	Valkeakoski (Sääksmäki), Rapola					0.2			189–207	
KM 2979:8	Mynämäki, Tarvainen, Junnila			piled core (Fig. 5.12)	medium		256–292			
KM 2986:4	Tampere (Messukylä), Takahurri, Kässä			piled blade (Fig. 5.13)						
KM 3423	Vesilahti, Kirmukarmu			laminated core and separate cutting edges (Fig. 5.14)	low/medium	medium	156–259 / 256–736	308–362		annealed
KM 3601:2	Hollola, Nokkola, Taka-Tommola					0.5–0.6			195–217	prolonged annealing (cremation)
KM 5960:3	Hämeenlinna (Kalvola), Pahnainmäki			folded core and separate cutting edges (Fig. 5.14)	low/medium	low/medium	138–221	107–235		annealed or tempered in too high temperature
KM 6066:1	Tampere (Messukylä), Takahuhti, Toivola								261–429	fully quench-hardened
KM 6503:20	Hattula (Tyrväntö), Anttila					0.2			148–171	
KM 8120:1	Hattula (Tyrväntö), Lepaa, Hinnonmäki			laminated core and separate cutting edges (Fig. 5.14)	low/medium	high	195–310 / 343–421	489–586		partially hardened and tempered
KM 8911:91	Mynämäki, Tursunperä, Franttilannummi			iron core with steel wrap (Fig. 5.16)	0	0.5				no quenching
KM 9142:8	Nousiainen, Moisio, Myllymäki			piled blade (Fig. 5.12)	low/medium	low/medium	286–346	252–302 / 517–617		quench-hardened and tempered
KM 9164:2	Eura, Pappilanmäki			piled blade (Fig. 5.12)	low/medium	low/medium	194–221	194–221		annealed or tempered in too high temperature
KM 9164:3	Eura, Pappilanmäki			laminated core and separate cutting edges (Fig. 5.14)	high	high	249–470	260–447	417–476	fully hardened and tempered
KM 9832	Laitila, Untamala, Raula			folded from similar steel (Fig. 5.10)	low/medium	low/medium	147–188	147–188		annealed
KM 10390:2	Vesilahti, Pörölä, Sassinsaari					0.5			116–223	excessively hot-worked
KM 10390:5	Vesilahti, Pörölä, Sassinsaari					0.3			149–179	
KM 18402:1	Hämeenlinna, Peltorinne						210–220	310–390	388–476	hardened and tempered

Figure 28.
Table summarizing the properties of metallographically and/or cross-sectionally studied blades in the Finnish material. The drawings of the inlays are interpretations by the author.

Here a note should be made concerning a blade with the inscription HARTO FER, as read by Williams.[428] In the photograph published by Williams the sword looks somewhat conspicuous, pitted by corrosion but still retaining its sharp edges.[429] The longitudinal streaked structure of the blade appears to be unchanged, especially in the inlaid portion, where the structure is normally wavy. The hilt does not belong to any definite type, but seems to be a strange combination of different types and styles and with odd proportions. The decorative motif seems to imitate that of a Swedish sword with a different type of hilt,[430] while the HARTOFER inscription, referring to the maker of the hilt, is found on the lower guard of an Irish Petersen type K sword.[431]

The same features can be partly observed in a group A sword from another private collection, which, even according to Williams, has an "unusually clear" inscription.[432] The blade is conspicuous and contains, according to Williams, ferrite, pearlite, carbides, cementite, and also slag inclusions. Williams has attributed this kind of uneven, heterogeneous structure to a failed smelt of crucible steel. With regard to the appearance of the sword, the hilt is a hybrid of Petersen's types S and Z, having no decorative elements visible although the corrosion is rather scarce. The ridges of the fuller are mostly blurred, but the cutting edges are mainly intact, which is also quite suspicious. In normal cases the edges would corrode first, and if the ridges of the fuller are corroded away, the blade will also be in very poor condition. Having seen many forgeries of Iron Age swords, these would be very likely candidates for this category. This is also suggested by the fact that they both are in a private collection, and their find contexts are not known or at least not published.

As a curiosity, we can mention here a sword illustrated by Ewart Oakeshott.[433] According to him, the hilt of this sword is of his own type X, and the sword dates from the 10th century. The sword appears to have the inlaid letters +EMEDE+, all in iron, according to the author. According to the caption of the related illustration, the surface of the fuller around the inlaid letters is copper-plated. The black-and-white picture does not confirm this statement, nor are any traces of mechanical plating visible. If the blade actually is copper-plated, it must have been executed with non-mechanical means, perhaps with the help of some sort of heated amalgam. This is not discussed here further, since no similar specimens are known from the research material.

4.6. Summary of metallographically analysed Finnish blades

After the general excursion into the technology of the inlaid blades, it may be useful to make a brief summary of the analysed Finnish finds and their properties, which are briefly presented in Fig. 28. To begin with, there are twelve ULFBERHT swords. Of these, six still have their inscriptions intact, while the other six have only fragmentary inscriptions, possibly originally spelt as +VLFBERH+T or +VLFBERHT+. With the variant +VLFBERH+T, the cross being before letter T as in Williams's group A of, three are complete (KM 2548:839, KM 6503:20 and KM 9164:3), and three are fragmentary and possibly spelt like this originally (KM 2767, KM 5960:3 and KM 6066:1).

428 *Williams 2009: 141, 180.*
429 *Williams 2009: 180, Figure 124.*
430 *See e.g. Stenberger 1964: 687, Fig. 270. This hilt is even of a considerable earlier date than inlays in Latin letters.*
431 *E.g. Peirce 2002: 66.*
432 *Williams 2009: 129–130, 158.*
433 *Oakeshott 1964: Plate 48 A.*

Even in a very small sample such as the six swords here the variation is striking. Even though the inscriptions and motifs are in principle the same in finds KM 6503:20 from Hattula, KM 9164:3 from Eura, and perhaps in KM 6066:1 from Tampere, excluding the details in the inlays, which are discussed later on, the materials and forging techniques differ. The edge of KM 6503:20 was made of very low-carbon steel (0.2 % C), KM 6066:1 was probably slightly better since it is harder and quenched, and KM 9164:3 was of higher-carbon steel throughout, quenched and tempered to produce a very good blade. Also KM 5960:3 from Hämeenlinna may have had similar motifs, but the blade is of quite poor quality, being folded and piled from a similar kind of low-carbon steel.

Sword KM 2548:839 has a slightly different kind of lattice on its reverse side, and is made of steel with variable carbon content. The cremation unfortunately destroyed the traces of possible heat treatments. KM 2767 from Valkeakoski is unique in many respects. The lattice is missing from the reverse side, being replaced by two volutes and a cross crosslet. Furthermore, the material of the edge is low-carbon steel with a carbon content of ca. 0.2 %, i.e. very soft and unsuitable for the cutting edge of a sword.

Swords KM 10390:2 from Vesilahti and KM 18402:1 from Hämeenlinna fit into group B as defined by Alan Williams, having the second cross as the last mark in inscription +VLFBERHT+. Again the lattices, or what remains of them, are not similar in these two specimens. The edge of KM 10390:2 is of 0.5 % carbon steel, while KM 18402:1 is most likely of higher-carbon steel having been hardened and also tempered.

In addition to these above-mentioned finds, swords KM 1174:2 from Kokemäki, KM 2548:277 from Laitila and KM 3423 from Vesilahti may be of either category, since their inscriptions are fragmentary or damaged from the end. In either case, the lattice on blade KM 2548:277 differs from other lattices among the analysed Finnish ULFBERHT blades. The lattices on KM 1174:2 and KM 3423 seem similar, although the vertical lines are missing from the latter. KM 1174:2 is of the lowest quality of these three, having a carbon content of approximately 0.3 % near the edge. KM 2548:277 and KM 3423 were constructed from a laminated core and welded-on cutting edges, although the first-mentioned was made of low- and medium-carbon steel, and the latter from a higher-carbon steel at least on the edges, having also been quench-hardened and tempered.

Sword KM 3601:2 from Hollola is unique since the ending of the ULFBERHT inscription is incorrect, having two T-shaped designs replacing the letter T and the second cross. The lattice on the opposite side of the blade also lacks vertical lines completely. The material is medium-carbon steel with 0.5–0.6 % carbon content, but unfortunately the cremation destroyed traces of possible heat treatments. Find KM 10390:5 is a unique sword having a clear imitation of an ULFBERHT inscription, but with most of the letters marked incorrectly. The edge is of steel with a carbon content of ca. 0.3 %, i.e. not very good for an edged weapon. In similar fashion, sword KM 2548:196 from Laitila with letter-like marks is of poor quality. The blade was made of similar folded steel with a carbon content from zero to approximately 0.3 %.

Geometric and/or symbolic motifs also appear in blades of varying quality. KM 2979:8 from Mynämäki, having rather complex motifs from lattices and St. John's Arms, among others, was found to have a piled core from medium-carbon steel. A chronologically slightly later blade fragment from Nousiainen (KM 9142:8) has a blade piled from low- or medium-carbon steel, bearing also signs of hardening and tempering. KM 9832 from Laitila is problematic in the sense that the blade was broken near the hilt, exhibiting only a cross on one side of the blade and

Catalogue number	Part of blade	Mg	Al	Si	P	Cl	K	Ca	Cr	Mn	Ni
KM 2548:196	overall, metal	0–0.09	0–0.05	0–0.05	0	0.02–0.1	0	0–0.02	0.01–0.11	0–0.12	0
	overall, slag	0	0.13	0.1	0	5.69	0	0.05	0	0.13	0.14
KM 2548:277	coremost layer, metal	0.04	0	0.04	0	0.08	0.02	0.01	0.05	0.09	0.08
	coremost layer, slag	0.6–0.81	0.51–3.3	1.61–30.43	0.05–0.24	0.03–6.49	0.22–2.4	0.43–2.76	0–0.04	0.28–0.66	0.06–0.11
	second core layer, metal	0.12	0.03	0.01	0	0.02	0	0.04	0	0.05	0.2
	second core layer, slag	0.94	6.45	32.55	0	0	3.04	5.99	0	0.53	0.02
	core, surface layer, metal	0	0	0	0	0.04	0.01	0	0.01	0	0
	core, surface layer, slag	0.38–0.89	2.1–4.9	31.93–33.97	0	0.04–0.06	2.65–3.35	2.97–5.24	0–0.01	0.41–0.52	0
KM 2979:8	overall, metal	0–0.23	0–0.24	0–2.3	0–0.09		0–0.25	0–0.75	0–0.08	0.06–0.22	0–0.19
	overall, slag	0.07–1.63	0.18–2.06	5.01–14.79	0–0.16		0.03–2.58	0.07–6.97	0–0.03	0.24–0.43	0–0.06
KM 3423	centre surface layer, metal	0.06	0	0.47	0	0	0.08	0.12	0.01	0.04	0.05
	centre surface layer, slag	0.39	2.17	35.36	0	0.03	3.87	3.92	0	0.81	0.01
KM 5960:3	overall, metal	0–0.05	0–0.14	0–0.04	0	0–0.1	0–0.08	0–0.07	0–0.08	0.01–0.13	0.06–0.49
	overall, slag	0–0.37	0.06–1.39	10.21–33.73	0–0.3	0–4.66	0.05–3.23	0.09–7.16	0–0.06	0.09–1.6	0–0.12
KM 8120:1	core, metal	0–0.03	0–0.13	0–0.03	0	0.06–0.07	0–0.02	0–0.1	0–0.05	0.02–0.14	0.13–0.18
	core, slag	0.15–0.66	0.32–2.57	6.81–31.55	0–4.87	0.03–0.2	0.47–5.37	2.24–8.6	0–0.02	0.33–1.64	0–0.02
	surface layer, metal	0–0.08	0–0.07	0–0.07	0	0.04–0.13	0–0.06	0–0.09	0–0.06	0.09–0.22	0.1–0.21
	surface layer, slag	0.02–0.45	0.3–2.49	7.24–32.53	0–5.36	0.06	0.16–5.37	0.23–9.72	0–0.09	0–2.8	0.03–0.06
KM 9142:8	coremost layer, metal	0	0.02–0.11	0–0.04	0–0.06	0.04–0.09	0–0.01	0	0–0.02	0–0.08	0–0.16
	coremost layer, slag	0.25–0.49	1.37–2.89	13.98–27.03	0.06–1.62	0.04–0.09	1.27–3.18	3.09–6.58	0	0.54–1.47	0–0.21
	surface layer, metal	0–0.04	0.09–0.12	0–0.04	0–0.03	0–0.05	0–0.03	0	0–0.02	0.05–0.11	0–0.04
	surface layer, slag	0.06–0.39	1.72–2.33	15.35–20.68	0–1.67	0–1.4	0.95–1.27	2.14–3.2	0.01–0.06	0.44–1.56	0
KM 9164:2	overall, metal	0–0.03	0–0.09	0–0.12	0–0.01	0.02–0.08	0–0.02	0–0.11	0–0.12	0–0.11	0–0.31
	overall, slag	0.03–0.49	0.18–1.49	0.34–20.76	0.06–2.51	0–0.1	0.03–2.42	0.07–8.76	0–0.08	0–0.15	0–0.23
	brighier middle layer, metal	0–0.13	0.06–0.09	0–0.01	0.53–0.76	0.04–0.13	0–0.05	0.02–0.07	0–0.09	0.01–0.07	0–0.17
	brighier middle layer, slag	0.02–0.32	0.12–0.32	0.1–4.08	2.83–14.07	0.01–0.1	0.09–0.52	0.05–18.28	0.03–0.08	0.08–0.09	0.02–0.17
KM 9164:3	core, metal	0.04	0	0.09	0	0.03	0	0.08	0.01	0.06	0.05
	core, slag	0.6–0.67	2.32–2.74	27–27.3	0	0.04–0.06	4.31–4.44	15.93–16.07	0	1.24–2.42	0
	surface layer, metal	0–0.06	0–0.04	0–0.05	0	0–0.05	0–0.04	0.04–0.05	0.03–0.07	0.13–0.18	0.07–0.22
	surface layer, slag	0.05–0.65	0.11–1.54	0.21–25.7	0–0.15	0.02–15.81	0.03–3.78	0.07–13.75	0–0.12	0.06–8.35	0–0.16
KM 9832	overall, metal	0–0.09	0.01–0.13	0–0.1	0	0.01–0.14	0	0–0.01	0–0.06	0.03–0.17	0–0.13
	overall, slag	0–0.45	0.11–3.68	0.91–21.31	0–1.09	0–0.22	0.03–1.93	0.04–0.98	0–0.06	0.34–18.62	0–0.16

Figure 29. Amounts of trace elements present in the ten analysed blades from the Finnish material. The values are presented as the lowest and the highest ones measured, correspondingly in each layer of different composition.

a vertical line on the other side. No matter what the inlaid motif has originally been, the blade had been folded of the same steel with low or medium carbon content.

In regard to other inlays with Latin letters, the variation in blades appears to be similar. KM 8911:91 from Mynämäki with the inscriptions CONSTMIITNS and REX was made of an iron core and 0.5 % carbon steel outer layers. KM 8120:1 from Hattula showing a repeated combination of letters D and U was a rather good blade having a laminated core, welded-on cutting edges of high-carbon steel, and a hardened and tempered structure. Sword KM 9164:2 with corrupted versions of the inscriptions AMEN and IN NOMINE DOMINI was piled from low or medium-carbon steels, with no heat treatments on the blade. The last one in this list, an INGELRII sword from Tampere KM 2986:4, which was not metallographically analysed, appeared to have a piled structure of at least two different steels.

In the light of the above discussion the Finnish finds seem to compare well with foreign finds in their variability. The wide range of quality of the blades is even more enhanced by the fact that the iron inlaid swords have now been analysed more from Finland than from any other geographically limited area in Europe.

4.7. Notes on trace elements and provenance

The determination of provenance, employing the amounts and ratios of various trace elements, has been discussed in Chapter 3.5, along with the problems of these kinds of determinations. Some trace elements have been measured in accordance with some previous analyses, but provenance has not been discussed. Here all noted trace elements are mentioned, but only a few of them a relevant with regard to the provenance of the iron or steel that was used, and even this depends on the amount of the trace elements in question. Since the analyses carried out for the present study were partly aimed at tracing the elements capable of indicating the origin of the steel, previous analyses by other researchers are first discussed, since the measurement of trace elements appears to be somewhat random.

In his studies of ULFBERHT swords Alan Williams made electron microanalyses of several swords. The published results, however, were not exact figures, but primarily consisted of notes made if certain elements were present in some amounts. In the case of the Finnish finds, Williams stated that the +VLFBERHT+ sword KM 18402:1 from Hämeenlinna displayed some manganese, calcium, magnesium, aluminium, and potassium in iron silicate inclusions.[434] Sword KM 6066:1 from Tampere with a fragmentary group A ULFBERHT inscription had some iron silicate inclusions with manganese, and some without.[435] KM 8911:91 from Mynämäki with CONSTMIITNS and REX inscriptions had similarly inclusions of iron silicate with manganese, calcium, magnesium, aluminium and potassium.[436] In all these cases the exact amounts were not given, and then virtually nothing can be said about the origin of the material.

Similarly, Williams has presented the found trace elements of other finds than the Finnish one, again without exact amounts or ratios. A sword from a private collection (ULFBERHT group B) contained some calcium and manganese in inclusions of iron silicates interpreted as bloomery slag. The same blades also contained some lumps of magnesium with a high silicon content, in turn interpreted as possible slagged furnace lining.[437] Another sword in a private collection, found in the River Danube at Abbsbach, had some traces of chromium in its structure.[438] A sword from Germany (Germanisches National Museum FG.2187) with the inscription +VLFBEH+T had inclusions of iron silicate with calcium and phosphorus, and some inclusions with manganese.[439]

A sword from Norway (Bergen Historisk Museum 1484) with fragmentary marks ...F V... contained inclusions of iron silicate with a high silicon content and some manganese, calcium, magnesium, aluminium, potassium, phosphorus and even some titanium. In some places the manganese content is stated to be high.[440] The presence of high manganese content and titanium points towards Norwegian ores.[441]

In three cases, Williams has published more accurate amounts of the analysed trace elements. Firstly, a sword from Donnybrook, Ireland (Nottingham Castle Museum T608) with marks resembling Latin letters had the following amounts of trace elements in the centre: manganese 0.1–1 %, sulphur 0.01 %, phosphorus 0.02 % and aluminium less than 0.01 %. The edge of the same blade contained manganese 0.1 %, sulphur and phosphorus less than 0.01 %, and nickel 0.2–0.3 %.[442] Again the concentrations are very low and no definite provenance can be assumed.

The second sword with more accurate analyses was found in Norway (Bergen Historisk Museum 1165), and may be included in group B of ULFBERHT swords according to Williams. To cite the highest amounts of observed trace elements, the blade contained magnesium 0.27 %, aluminium 1.3 %, potassium 0.53 %, calcium 1.27 %, and manganese 0.07 %. In contrast, a blade with letter-

434 Williams 2009: 130.
435 Williams 2009: 133.
436 Williams 2009: 142.
437 Williams 2009: 131.
438 Williams 2009: 132.
439 Williams 2009: 132.
440 Williams 2009: 136.
441 See Buchwald 2005: 153–154.
442 Williams 2009: 140.

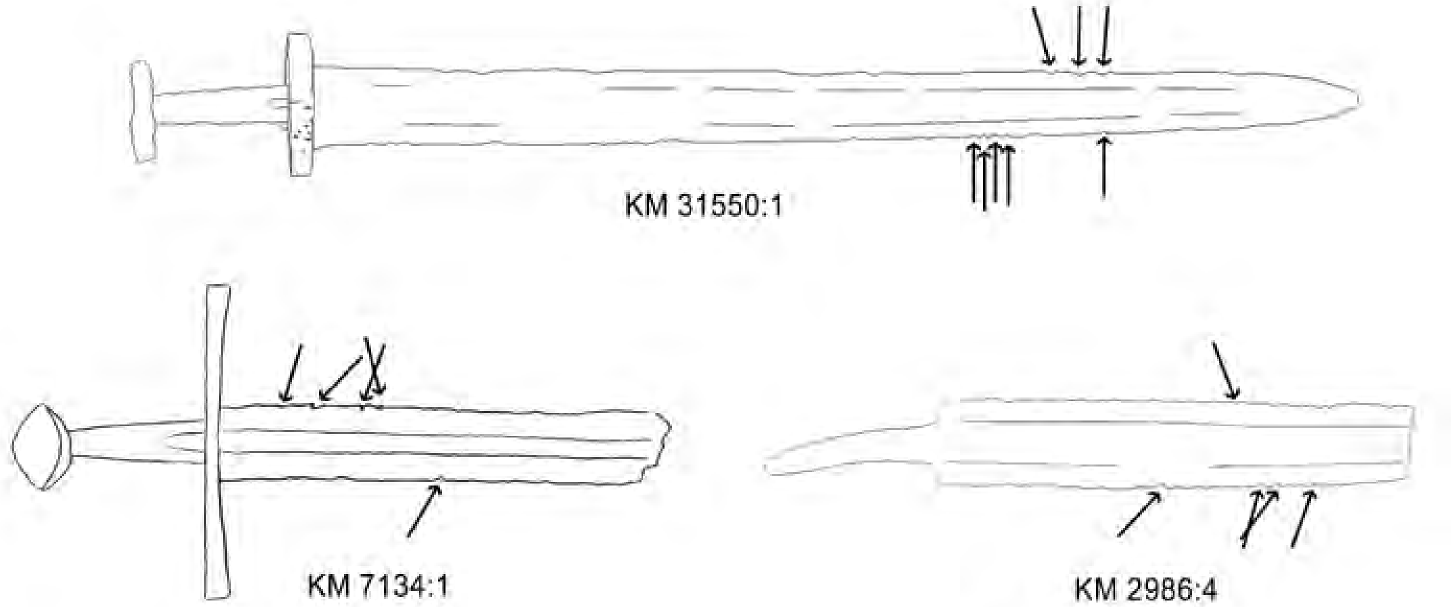


Figure 30. Drawings of three inscribed swords with nicked blades: KM 31550:1 from Jämsä, KM 7134:1 from Hämeenlinna and KM 2986:4 from Tampere. The arrows indicate the direction of the strike, which caused the nick.

like marks also from Norway (Bergen Historisk Museum 1069) had the following amounts of trace elements: magnesium 1.1 %, aluminium 6.04 %, potassium 2.69 %, calcium 3.05 %, and manganese 0.39 %.[443] These blades were clearly made from steels of different origin.

To mention analyses of trace elements by others than Williams, only Aleksis Anteins should be noted. One sword from Riga, Latvia with an ULFBERHT inscription (MIL-I 5608) contained 0.02–0.1 % nickel,[444] whereas a sword from Aizkraukle, Latvia (MIL-I 2898) with the inscription EEEBRHT contained 0.06–0.2 % nickel.[445] Nickel increases the toughness of steel but not its hardness. Nickel also increases the resistance to corrosion, and correspondingly resistance to etching mediums. No provenance, though, can be assumed.

The ten sword blades analysed for this work (See Fig. 14) were also analysed for their trace elements. This was done by energy-dispersive x-ray spectrometry (EDS). The readings were taken from various parts of the blade structure, mainly in visible layers of variable quality and from their slag inclusions. Some readings were also taken from the metallic matrix. The materials of the inlays were also tested, and these are discussed later in the next chapter. The amounts of trace elements in the analysed samples are summarized in Figure 29.

To briefly summarize, mostly the analysed finds do not have any significant trace element concentrations, at least not such that could tell about the origin of the used iron ore. Some speculations may however be made. Sword KM 2548:277 from Laitila with a fragmentary ULFBERHT inscription has higher aluminium content throughout, as possibly pointing towards Scandinavian, perhaps a Swedish ore. The very core layer of sword KM 8120:1 from Hattula with inlaid letters D and U has high amounts of potassium, calcium, manganese, phosphorus and aluminium, pointing towards Danish iron. The outer layers and the blade edges are also of quite similar composition, but contain no phosphorus. Also the measurements of the blade of KM 9142:8 from Nousiainen with geometric figures strongly resemble those of KM 8120:1.

It is interesting to note that one find, KM 9164:3 from Eura, has such trace element amounts, especially high manganese and low phosphorus that they could be connected to the Central European ores. The sword in question is an +VLFBERH+T sword, correctly spelt except for the

443 Williams 2009: 144.
444 Anteins 1973: 42.
445 Anteins 1973: 47.

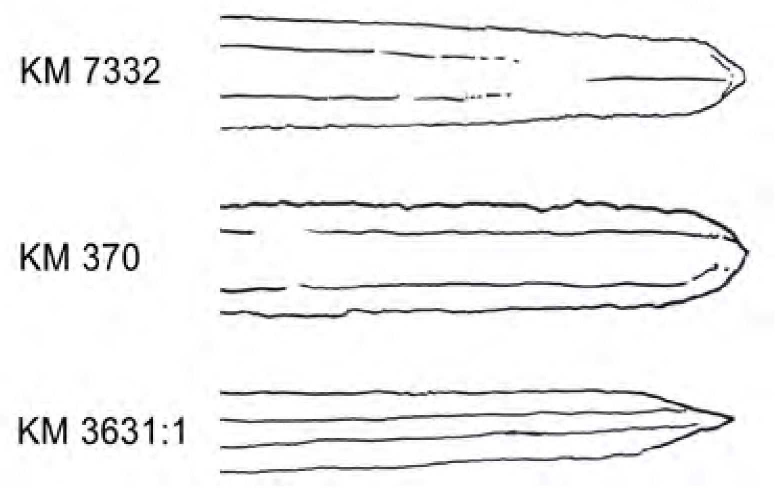


Figure 31.
Drawings of some unusual blade tips as observed in the studied material: KM 7332 of unknown provenance has a ridged tip, KM 370 from Hämeenlinna is rounded and shortened, and KM 3631:1 from Rovaniemi was also possibly shortened from a longer blade.

letter B, which looks slightly obscure. In this case it should be remembered that a similar kind of composition of the ore is also to be found in Norway. Unfortunately the conducted analysis excluded titanium, and it thus remains a matter of speculation whether the ore could have been from Norway or from Central Europe. Another slightly similar case is sword KM 9832 from Laitila, also having parts with high manganese content. The remaining inlays on this blade may also hint towards an ULFBERHT sword, although this is highly speculative.

All in all, most of the analysed iron and steel seems to be relatively pure without any significant amounts of trace elements, the only alloying element present in larger amounts naturally being carbon. Even the carbon contents are in many cases relatively low, considering that the aim was to produce a hard blade that was functional and durable in battle. The purity of the used steel is somewhat surprising, because if the material was of Central European origin, it should contain visible concentrations of trace elements, such as manganese.

4.8. Traces of use

Indicators of use and repair are met more often on blades than on hilts (see Chapter 7), which is a completely natural and reasonable phenomenon. Marks of wear and battle have often been neglected, because the finds have been considered to be too corroded to display any of these traces any longer in their present condition.[446] This is true of most of the find material, but several finds are in sufficiently good condition to permit the inspection of these features. The following discussion on traces of use and repair is based on an article by the present author,[447] with additional references to finds studied after its publication.

The most visible traces are nicks and bends on the cutting edges. Normally these can be recognized on the basis of their appearance: they are sharp-bottomed, i.e. somewhat triangular in shape, and their edges were bent outwards to form a small burr. On the basis of microscopy, if not even without it, these original traces can be separated from those resulting from post-depositional circumstances. Naturally, the original nicks were corroded, while those made for instance during the actual recovery of the find, have not corroded. In the case of bronze swords, some nicks could be interpreted as results of 'experimentation' with the sword by the finder,[448] but in iron weapons the traces are easier to recognize.

446 *E.g. Raninen 2006: 8.*
447 *Moilanen 2010a.*
448 *von Quillfeldt 1995.*

Nicks and burrs concentrate in two separate parts of the blade. The actual traces of hacks and cuts applied to an opponent's shield or sword or the like are found near the lowest third of the blade, which is called as the point of percussion. This point does not vibrate when something is struck with it, thus being ideal for delivering blows. Characteristically, the nicks in this part of the blade are almost perpendicular to the blade, and their depth varies between one and ten millimetres.[449] Nicks are also found near the hilt, from the part which is most solid for blocking or parrying the opponent's blows, leaving behind diagonal and angled cuts.[450] These traces of use are not only similar in all periods of the Iron Age, but are also found in Bronze Age artefacts.[451]

In the studied iron inlaid blades, clear nicks have been observed in the following roughly dating from the Viking Age: KM 2508:124 from Pudasjärvi, KM 2986:4 from Tampere, KM 8911:91 from Mynämäki, KM 30870:1 from Asikkala, and KM 31550:1 from Jämsä (Fig. 30). Later, Crusade Period swords also have nicks, at least finds KM 439:1 from Vesilahti and KM 7134:1 from Hämeenlinna. The cavities of the cutting edges of the swords are sharp, indicating that they came from striking the blade against some other sharp instrument, most likely the blade of another sword. The only exception in this regard is KM 8911:91, which has a convex nick on its blade. KM 2986:4 is strongly bent due to a very powerful strike on the blade flat, causing the blade to have fractured along the welding seam of an inlaid letter.

A +VLFBERH+T blade from Laitila (KM 2548:839) shows convex, fractured parts along its edge, ca. twenty centimetres from the broken tang. If the sword had been properly heat-treated originally, the hardened areas may have been brittle enough to have fractured under powerful blows. The sword in question was metallographically investigated by Williams, and the carbon content was found to be 'variable', and the structure was affected by the heat of the cremation pyre (see Chapter 4.5.1.1).[452]

In addition to the above, some swords in the Finnish material exhibit bent and blunted portions of the cutting edge, as well as bent tips.[453] These have not, however been found so far in iron inlaid swords. In the cases of both nicks and bends it should be kept in mind that an alternative interpretation for the damage of the period to the blade is ritual destruction carried out during the burial. Some of the slightly bent and blunted edges of Finnish swords are found in otherwise strongly bent blades, suggesting that all the damages were caused during the ritual killing of the weapon. In similar fashion, a sword may have been 'killed' by striking nicks along its blade.[454] However, since the direction and placement of the nicks in inlaid swords are similar to those observed in Bronze Age and Early Iron Age examples, as well as experimentally tested blades,[455] it is more likely that this damage came about in combat situations.

Also foreign iron inlaid sword blades show some marks normally interpreted as battle damage. These are normally only mentioned as a curiosity, lacking any systematic research. To mention a few, an ULFBERHT sword from Norway (Universitetets Oldsaksamling C257) has small nicks in the lower third of the blade.[456] An INGELRII sword found in the River Thames (British Museum 1856, 7–1 1404) has several battle nicks along its cutting edges.[457]

449 *E.g. Gebühr 1980: 70–77; Gebühr 2005; Moilanen 2010a: 4–5. The shape, direction and depth of the nicks evident in the Finnish finds correspond closely to those recorded from the Roman Iron Age sword blades found from Nydam bog in Denmark. Examples are also found in weapons recovered from other Danish bogs, such as Vimose, Illerup and Eisbøle.*

450 *See e.g. Gebühr 1980: 73; Moilanen 2010a: 5; Pleiner 1993: 159–161.*

451 *E.g. Bridgford 1997; Kristiansen 2002: 323–325.*

452 *Williams 2009: 128.*

453 *See Moilanen 2010a: 4–5.*

454 *E.g. Huurre 1979: 207; Karvonen 1998: 7; Pleiner 1993: 60.*

455 *See Moilanen 2010a: 5, 7.*

456 *Peirce 2002: 96–97.*

457 *Peirce 2002: 80.*

As the author has pointed out in his earlier article, all the above-mentioned damage including the nicking and breaking of sword blades is a phenomenon also encountered in the form of depictions in sagas and even in literature from historical times.[458] Also medieval and later swords display similar traces and in the same places as in Iron Age swords.[459] The material of the blades, which was quite soft in many cases, combined with the lack of proper heat treatments (see analyses above) allow deep cut marks to be made in the blades.[460]

In connection with damage, repairs to blades can sometimes be identified.[461] Perhaps one category of these kinds of examples are blades of abnormally short length. Among the studied blades with ferrous inlays, finds KM 370 and KM 708, both from the municipality of Hämeenlinna, as well as KM 11063:283 from Eura, are all apparently shorter than average. Since the ferrous inlays are in the same places as in all other inlaid swords, the blades must have been either shortened from the tip, or the whole blade was made originally to be short. The swords from Hämeenlinna still have their fullers well preserved, showing that the fuller continues almost to the tip and suggesting that the blades were shortened from longer ones (see Fig. 31).

Often in connection with short blades, the very tip of the blade is of unusual form, suggesting that it had been re-forged possibly after damage. KM 7332 of unknown provenance and having a unique combination of marks and Latin letters on its blade has a ridged, steeply tapering tip. A similar kind of triangular tip with a fuller extending to the very tip is found on the blade of KM 3631:1 from Rovaniemi. The above-mentioned, possibly shortened swords KM 370 and KM 708 have very round tips with the fuller continuing to the very tip. All these probably indicate re-forging, one reason for which may have been damage to the tip during battle. An alternative explanation for the short swords is that they were re-forged for a child or a young person, as was the case with a Petersen type M sword found in a boy's grave in Ringebu, Norway.[462] KM 7332 and KM 3631:1 are not, however, shorter than the average.

While the above-described shortened sword blades have their inlays in the normal position, a sword from Hämeenlinna (KM 16279) has deformed ferrous inlays on the tang, continuing only few centimetres on the blade fuller, where they actually should belong. One plausible interpretation for this find is that the blade had been fractured from the shoulders of the tang or very near this location, most likely under extreme stress, i.e. in combat. The only way to 'save' this sword had been to forge a new tang from the remaining blade. Somewhat similar are finds KM 4254 from Lempäälä, KM 11859:1 from Mynämäki and TMM 14105 from Salo, showing some of the inlays continuing under the lower guard, but not on the tang. In these cases the repair of battle damage is unlikely.

In regard to repairs, a +VLFBERHT+ sword from Hämeenlinna (KM 18402:1) is interesting, because it has a thicker and slightly different-coloured location almost halfway along the blade. This may be the result of forge-welding the blade whole from two pieces, possibly broken during battle.[463] This is also plausible in view of the properties of the blade, since it had been quench-hardened and tempered (see Chapter 4.5.1.1). The blade had possibly remained too brittle at this particular part, and it had not withstood the stress of use. A similar example has been also found in a 15th-century French context.[464]

458 *Moilanen 2010a: 7.*
459 *E.g. Kämpe 2010: Figs. 83 and 96; Oakeshott 1991: 107–261.*
460 *See also Moilanen 2008b: 23–25; Moilanen 2010a: 6–7.*
461 *See Moilanen 2010a: 8–10.*
462 *Peirce 2002: 86.*
463 *See Peirce 2002: 54.*
464 *Oakeshott 1991: 137.*

Because the thin cutting edges are the first to disappear after the deposition of the sword, the traces of sharpening are almost impossible to detect, although they must have existed. Even bronze swords from Central Europe show this phenomenon quite clearly.[465] As in iron knives, the blade tends to change its profile into somewhat convex shape, losing its width at the same time. Only one fragmentary find, KM 7961:1 from Mynämäki, with geometric patterns on its fuller, has convex cutting edges with an unusual taper from the lower guard, and also with a fuller wider than normally. All these features can be explained by the great degree of sharpening and honing of the blade while the hilt was attached to it. Of course, small nicks and burrs may be ground away or even hammered somewhat even, but these can no longer be detected from the finds.

What all the above discussion is trying to prove is that swords with iron inlaid blades were actually used in battle whenever needed, and they were repaired and re-sharpened, possibly by local smiths. It should be remembered that since the majority of the examined finds are badly corroded, all the originally visible traces of use and repair are no longer present, and may have been even more numerous than those detected today.

4.9. Remains of scabbards

Remains of scabbards are scarce. Since the scabbards were made of mostly organic materials, they were destroyed on the cremation pyre, if they were placed there at all. The only remnants of scabbards come from the inhumation burials. Of course, scabbard chapes are found in the same cemeteries as the inlaid swords, but none of them can be strictly associated with any of the examined swords.

The following finds, all from inhumation cemeteries, have some wood preserved on the blade: KM 2489:280-281 from Kaukola, ceded Karelia, KM 8602:130 from Köyliö, KM 8602 A:116 from Köyliö, KM 8656 H23:1 from Masku, KM 11063:283 from Eura, KM 13839:253 from Pöytyä, and KM 24740:242 from Eura. They all have more or less wood adhering to the surface of the blade, with the grains of wood running in the direction of the blade length.

The scabbard remains of KM 8602:130 have been examined more closely.[466] The scabbard was laminated of layers of various organic materials. The blade was protected by a layer of animal fur. The fur was attached to a wooden core, which was first covered with leather and then a textile on the surface. Other scabbards from the same cemetery appear to have been manufactured in a similar fashion.

In the European context, similar kinds of scabbards were widely used. For example, the scabbard of the famous pattern-welded and cloisonné-decorated sword from Sutton Hoo, Great Britain, was made of wood, possibly covered with linen, and lined with soft skin or fur inside.[467] Laminated scabbards have also been found in Ballateare and Cronk Moar on the Isle of Man,[468] Donnybrook in Ireland,[469] Hafurbjarnastadir in Iceland,[470] Haithabu in Germany,[471] Repton

465 *E.g. Kristiansen 1999: 177–178; Kristiansen 2002: 323–324.*
466 *Tomanterä 1972: 24–25.*
467 *Bruce-Mitford 1978: 284–285; Oddy & Tite 1978: 309.*
468 *Bersu & Wilson 1966.*
469 *Hall 1978.*
470 *Graham-Campbell 1980: no. 273; Roesdahl & Wilson 1992: no. 324.*
471 *Graham-Campbell 1980: no. 249; Roesdahl & Wilson 1992: no. 171.*

in England,[472] Skerne in England,[473] and Gnezdovo in Russia,[474] and Mikulčice in the Czech Republic[475] to only mention a few. All these have had wooden scabbards with linings of linen, animal skin and/or animal fur. While the internal construction of the scabbard seems to have been somewhat uniform to create the necessary protection for the blade, the decoration and mounts are subject to variations of style and fashion.

4.10. Summary and conclusions concerning blades

The blades appear to be highly diverse when compared with one another. To start with, the measurements were variable, insofar as the condition of the blade guaranteed reliable measurements. Less than half of the inlaid blades could be measured for the dimensions of their edged portion, while the rest of them were too corroded for this. According to the measurements, the width of the blade and the fuller, the length of blades – as well as the length of complete swords – was kept within a certain range, but the makers of the blades did not create blades of identical measures. This could be simply caused by the fact that the used raw materials combined with the technique of forging could not produce artefacts that were identical in their dimensions.

The typological assessment of the studied blades was also somewhat difficult, firstly due to the degree of preservation, and secondly due to dimensional variation. Again, less than half of the examined blades could be given a typological definition, mainly according to the typologies of Alfred Geibig and Ewart Oakeshott. The typological dating of the hilts attached to these blades corresponded to dates given for certain blade forms, although it must be noted that the dates of the blade types were broad compared to the chronology of hilts.

The methods of constructing the blades were also different. According to previous studies and the swords metallurgically examined for the present study, the blades can be divided into five types according to their internal construction: blades folded from similar material, blades piled from layers of different materials, blades with separately welded cutting edges, blades with a low-carbon core and a wrapped steel case, and blades with a pattern-welded mid-section. In all these categories the materials that were used also varied a lot from almost non-carbon iron to high-carbon steel. Also the heat treatments varied, leading to a wide variety of blades of differing quality.

No specific patterns may be observed when comparing the types of inlaid motifs and inscriptions with types of blade construction and quality. The ULFBERHT blades have been studied most extensively also by other scholars and scientists. It is interesting that the correct spelling of the inscription is not always connected to a blade of good quality, and furthermore, blades with a similar spelling of ULFBERHT may be manufactured differently with regard to the method of construction as well as the iron and steel which were used. Other inscribed blades also display variation, with blades with letter-like marks or clearly misspelt inscriptions being of poorest quality. A similar range of variation is also observable among previously analysed inlaid blades in other areas of Europe. These above-described observations lead to assume that iron inlaid blades were produced by multiple makers with varying skills.

472 *Biddle & Kjølbye-Biddle 1992; Roesdahl & Wilson 1992: no. 352.*
473 *Dent 1984.*
474 *Kainov 2012: 51, 53.*
475 *Košta & Hošek 2014: 288–294.*

The more accurate composition of the iron and steel in blades has been identified with the help of trace-element analyses, both in this work and in previously published studies by other scholars. Trace elements may be used to locate the provenance of iron ore, but these interpretations must be approached with reservation since not all scientists agree on this method. To be brief, most of the analysed Finnish blades do not display any crucial concentrations of trace elements. Only two blades showed elevated manganese content suggesting Central European or Norwegian ores. In some cases, elements such as aluminium suggest that the ore is Scandinavian. In any case the quality and composition of the analysed blades tell that they are not from the same workshop or locality, just as the variations in construction also indicate.

Finally, it must be noted that many well-preserved blades have nicks and burrs on the cutting edge, most likely indicating battle damage. There were also repairs, such as the re-forming of the blade tips, the shortening of blades and newly forged tangs, likewise proving that battles were fought and iron inlaid blades were used in these connections.

5. INLAID INSCRIPTIONS AND MOTIFS

This chapter is on the categorization of the inlays, motifs and inscriptions in the studied material. The division has been made primarily on the basis of the marked or inscribed contents of the inlays. On these grounds a total of five groups are separated: ULFBERHT inlays, INGELRII inlays, other inscriptions with Latin letters or clear letter combinations, letter-like marks, and geometric or symbolic motifs. The division is problematic, since letter-like marks may well be symbolic, but the distinction has been made on the basis of orderliness and geometry. The letter-like marks do not follow any precise pattern nor are the individual marks of any recognizable character, whereas symbolic and geometric motifs are clearly of some geometric pattern or they are arranged from known characters such as omegas, crosses and circles in a designated way. The ULFBERHT and INGELRII groups are regarded as separate from other maker's signatures because of their distinctively larger number.

To make things more complicated, a division has also been made on the grounds of materials of inlays. In the majority of cases the inlays are pattern-welded from two distinct types of iron or steel, although in different ways by altering, for example, the layer count of the welded inlay. Another way to classify and compare is elemental analysis, which was conducted on only a small part of the material. In addition to pattern-welded inlays, also plain iron or steel ones exist. These material-based divisions create sub-groups within the motif- and content-based groupings.

To fully understand the complexity and alterations of pattern-welded inlays and their material-based classification, it is necessary to briefly concentrate on the pattern-welding itself, in particular on its technical execution and details. At the end, observations of the examined finds are compared with and contrasted to the results of previous studies and analyses of foreign finds to see where here studied finds stand in European comparison.

This chapter also deals with the meaning of various inlaid marks and motifs, presenting alternative interpretations. Also foreign counterparts to the Finnish finds are presented as far as the publications allow. In most cases, the publications lack some crucial information, for example the measurements of the blade and the inlays, not to mention the inlaid materials.

5.1. Measurements and placement

The inlays and inscriptions were measured (Fig. 32) including the following measurements: the length of the inscription or the inlaid motif, the distance of the beginning of the inscription or motif from the lower face of the lower guard or from the shoulders of the tang, and the width of the inlaid rod. The height of the inlaid marks was not measured, because they normally correspond to the width of the fuller, i.e. the height of the inlaid marks was made to correspond to the height of the fuller. All these measurements were taken for the comparison of the finds.

Figures 32a–d.
Measurements of inlaid inscriptions and motifs in the research area.

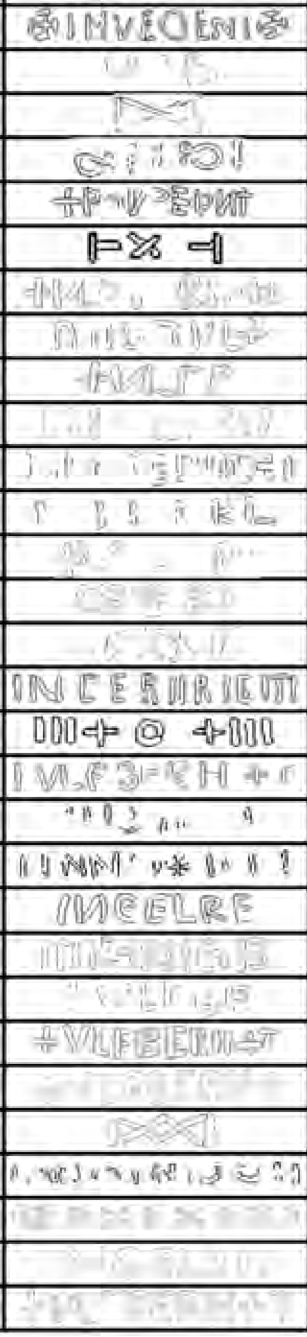
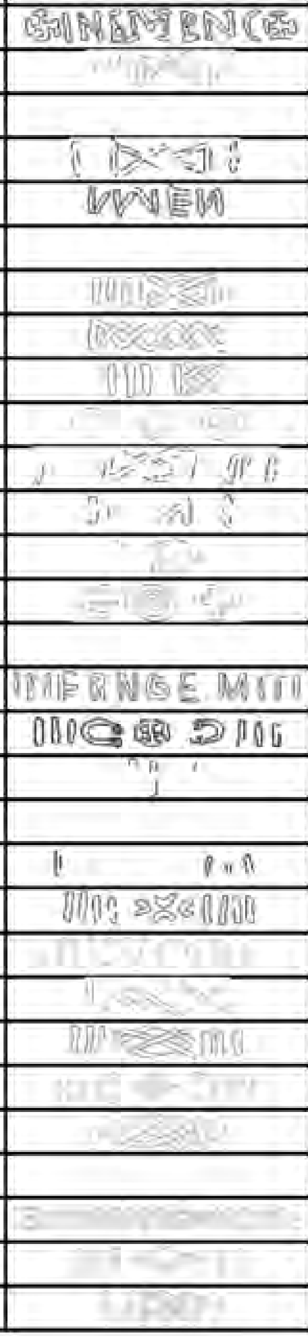
	Side A			Side B			
Calalogue number	Length of inlays	Distance from lower guard / shoulders	Inlaid motive 	Length of inlays	Distance from lower guard / shoulders	Inlaid motive 	Width of inlaid rod
KM 70	143	65		137	62		1,5–3
KM 287	69	69		102	64		2,5–3,5
KM 293	48	76					3
KM 369	78	88		70	80		2–3
KM 370	135	90		79	112		2
KM 439:1	48	116					2
KM 708	181	53		90	71		4
KM 1120:1	140	67		92	69		3–4
KM 1174:2	14	17		43	48		3–3,5
KM 1174:3	111	35		94	33		3–4
KM 1822:1	141	79		103	79		3–4
KM 1822:2	134	83		72	97		3–4
KM 1869:81	108	18		47	73		2–3,5
KM 1996:73	100	59		96	62		4–7
KM 2022:1	85	90					4–7
KM 2033:1	173	63		179	56		2,5–3
KM 2345:1	109	38		122	41		3
KM 2361	145	68		27	81		2,5
KM 2489:121	83	150					2–3
KM 2489:280–281	100	136		75	165		1–2
KM 2508:124	103	95		97	82		1,5–2,5
KM 2548:196	139	53		153	40		3,5–4
KM 2548:277	90	52		80	70		3
KM 2548:839	143	59		98	88		3
KM 2767	145	52		134	59		2–3
KM 2886:10*							
KM 2939:1	102	128					2
KM 2979:8	290	65		282	77		2
KM 2986:4	141	60		107	64		3–4
KM 3052:2	165	20		75	55		2,5

Figure 32b.

KM 3131:6	162	52		155	92		4–5
KM 3301:1	162	42		100	69		2
KM 3316:13	120	85		107	77		2–2,5
KM 3336:31	59	33					2,5–3
KM 3383:2	22	79		25	70		5–6
KM 3423	130	54		35	110		3–4
KM 3575:1	118			104			3–3,5
KM 3601:2	200	23		25	88		2,5–3
KM 3631:1	140	48		141	51		1,5
KM 3699:3	123	29		62	100		3–4
KM 4254	86	0		87	0		4
KM 4429:14	168	91					1–2
KM 4566:12	116	48		84	75		2–5
KM 4633:145	135	0		124	7		4–5
KM 4633:165	132	4		114	23		3–4
KM 4923:1	132	37		78	91		3–5
KM 5005	111	133		136	82		2
KM 5215*							
KM 5334:1	200	115		312	118		3–4
KM 5395:1	23	56		21	23		3–4
KM 5707:3	184	84		189	67		2
KM 5865:1	93	1		73	14		3–5
KM 5868:80*							
KM 5890:1	112	83		87	68		4–5
KM 5960:3	67	0		41	0		2
KM 6066:1	163	75		135	65		2,5–3
KM 6196:1	165	37		60	46		4
KM 6227:1	174	43		68	64		2,5–3
KM 6245 A:1	120	70		120	70		3
KM 6482	67	63					4
KM 6503:20	163	42		110	52		2,5–3
KM 6689:2	140	58		110	69		3
KM 6746:49	17	71		14	83		5–6
KM 6753:51	182	25		154	42		3–4
KM 6923	172	54		177	50		2–3
KM 7011	167	17		128	22		4–5
KM 7134:1*							
KM 7220:2	29	51		29	47		3–4
KM 7332	242	74		211	90		2,5
KM 7472:2	119	63		113	80		3–6
KM 7703:2	24	74					2–4
KM 7752:1	187	32		125	45		3–5

Figure 32c.

KM 7961:1	110	50					3–5
KM 8120:1	200	60		90	38		4–6
KM 8219	212	75		142	75		2,5–4
KM 8602:130	29	13		27	10		2,5–4
KM 8602 A:116	24	129		49	75		3–3,5
KM 8656 H23:1	92	107		48	136		1,5–2
KM 8723:165	160	59					1,5–2
KM 8896:25	122	34		120	40		3–4
KM 8911:91	162	38		52	60		2,5–3
KM 9142:8	112	69		112	69		2
KM 9164:2	140	17		83	19		3,5–5
KM 9164:3	130	18		98	25		2,5–3
KM 9243:1	74	91					3
KM 9243:2	139	59		60	77		3–4
KM 9389:1	17	89		28	94		4–5
KM 9419	115	60		185	82		2–3
KM 9562:1	175	65		185	65		3
KM 9778	130	35		100	51		3,5–4,5
KM 9832	19	26		4	36		3–4
KM 10349:1	110	46		122	48		3–4
KM 10369:3	53	77					3–5
KM 10372:1	195	78		192	66		2,5–3
KM 10390:2	118	32			66		3
KM 10390:3	33	97		99	65		2,5–3
KM 10390:5	190	24		72	73		4
KM 10413	204	23		111	70		3–5
KM 10906:1	97	93		57	136		3–5
KM 11063:283	35	24					2–3
KM 11198	201	56		195	53		2,5–3
KM 11242	23	48		21	51		3–4
KM 11840	149	49		168	49		2
KM 11831	93	65		33	83		2
KM 11859:1	111	0		83	14		4
KM 12033	84	43		122	46		2–2,5
KM 12687:1	146	55		136	72		3–5
KM 12690:299	126	116		114	136		2
KM 13399:3	148	77		77	105		4–5
KM 13419:1	112	82					4–5
KM 13419:2	133	41		117	32		3–5
KM 13839:253	169	34		128	44		3–4
KM 13962:322	78	120					3–4
KM 14196:69	23	92		20	89		2–3

Figure 32d.

KM 14684	17	49		122	75		4–5
KM 15175:1	185	41		151	31		3–4
KM 15181:2	116	47		81	62		3–5
KM 15467	40	28		32	52		4–5
KM 16279	102	0		76	0		3–6
KM 17208:375	133	65		67	102		4–5
KM 17208:561	85	65		85	65		2,5
KM 17208:588	232	33		227	30		2,5–3
KM 17777:1	191	32		165	32		3–3,5
KM 18000:3170	64	59		29	77		2–3
KM 18000:3880	76	59					3–4
KM 18402:1	168	32		80	55		2,5–3
KM 19901:202	131	84		95	94		1,5–2
KM 20127	162	52		84	88		4–5
KM 22106:23	132	45		76	72		2–3
KM 22964:3	165	89					4–5
KM 23607:490	63	92					2,5–3
KM 24740:242	103	32		45	42		3–4
KM 26301	136	38		120	41		3–5
KM 27141:1	132	26		88	67		3–3,5
KM 30870:1	114	0		102	37		3
KM 30985:1	151	15		102	75		4
KM 31017:1	43	124					2,5–3
KM 31550:1	146	50		115	65		2,5–3
KM 37257	109	46		37	62		2–4
HM 3047	95	35		24	65		4
LiuM 26							
SatM 10330	105	71		89	77		4
SatM 12563	127	72		112	68		3,5–4
TMM 13393	121	78		85	81		2
TMM 14105	70	0		60	0		3–4
ÅL 336:292	108	11					4–5
ÅL 337:106	53						4
ÅL 337:229	134	52		140	33		4–5
ÅL 337:528	23	97					2–3
ÅL 345:113	44	80					2–3
Huittinen, Church	300	95		332	93		1,5–2

In most cases the inlaid motifs of a blade were arranged in such a manner that their midpoints were at the same spot on different sides of the same blade. Of course there were some exceptions, and the fragmentary nature of inlays did not always tell whether or not the motifs were centred.

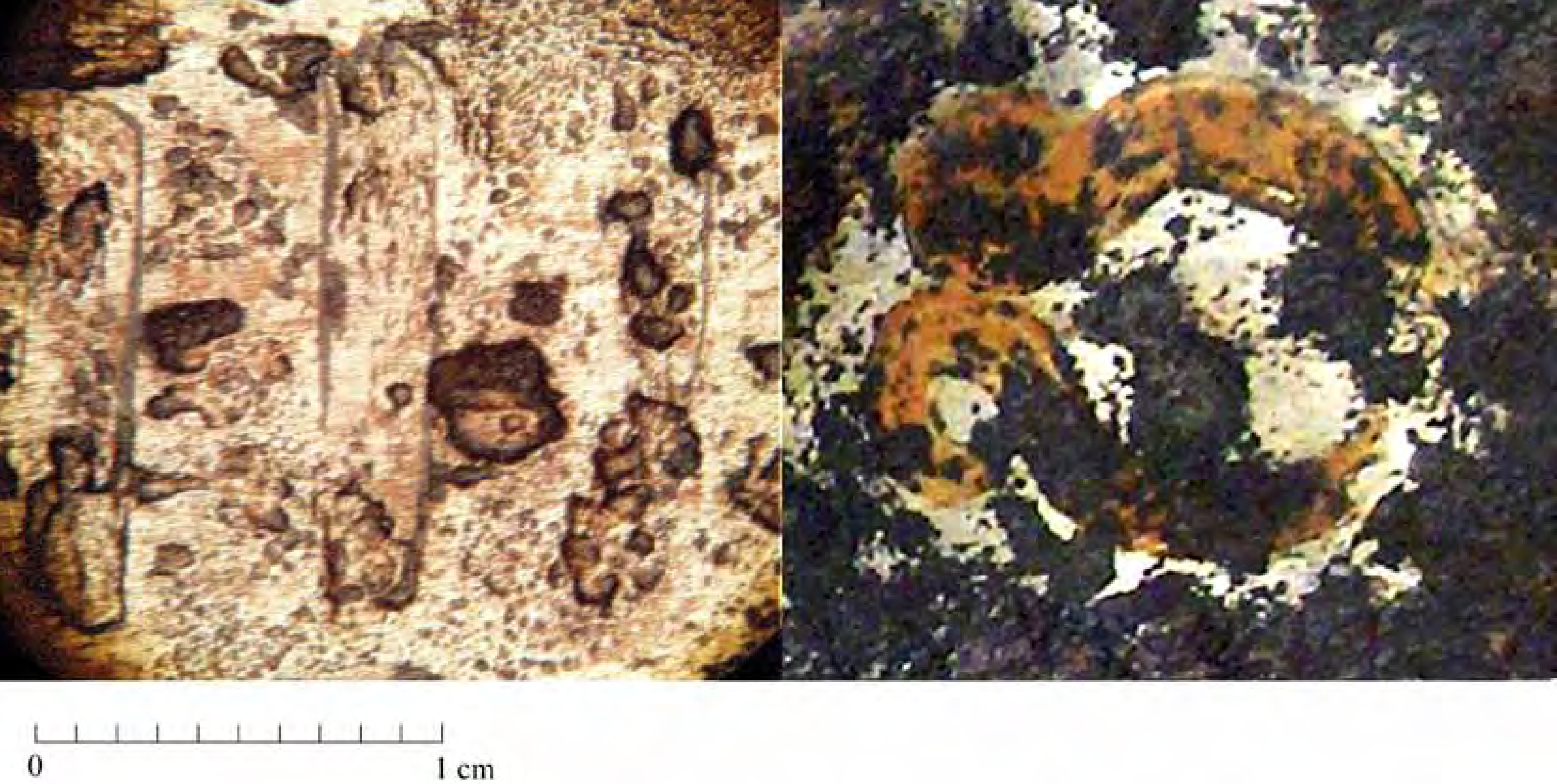


Figure 33. Longitudinal, dark streaks evident in most plain iron or steel inlays, indicating perhaps slag inclusions or corroded structure of material. Finds KM 2508:124 (left) and SatM 10330 (right).

In three swords, the inlays began under the lower guard (finds KM 4254 from Lempäälä, KM 11859:1 from Mynämäki and TMM 14105 from Salo). It must also be noted that finds KM 4633:145 from Eura and KM 5865:1 from Vähäkyrö had inlays not under the lower guard, but abnormally close to it, less than half a centimetre from it. In the case of KM 4633:145 it is possible that some inlays remain under the lower guard, but it was too thick to be penetrated by x-rays. In addition, in one sword (KM 16279 from Hämeenlinna) some inlays were found on the blade tang, indicating that the blade was perhaps broken near the shoulders, and a new tang was forged from the inlaid portion of the blade. Other blades where the inlays began under the lower guard could also have been repaired, or then the inlays were readily attached too close to the shoulders of the tang. It may also be that the tang had been re-forged to receive a particular hilt, and the tang had been shortened in this process.

The width of the inlaid rod also varied, normally according to the width of the fuller (see Chapter 4.1). Wider fullers were equipped with wider inlaid rods. It must be noted that in many blades the width of the inlaid wires or rods was not the same, but fluctuated a few millimetres or so in the same inlaid motif. This feature may be explained with the manufacturing technique in which the inlaid portion of the blade is heavily hammered, thus altering the width of the inlays.

5.2. The materials of inlays

5.2.1. Plain iron and steel

In principle, the classification of various inlaid materials is quite straightforward. At the simpler level, inlays were made from non-patterned iron or steel. Here 'iron' refers to inlays with less carbon than the surrounding blade or more phosphorus. 'Iron' inlays contrast as brighter against the darker blade, and they have corroded less than the blade due to their lower carbon content or higher phosphorus content. 'Steel' inlays are then made from material of higher carbon content than the surrounding blade, causing them to corrode more than the blade. These inlays have been distinguished as darker against the brighter blade.

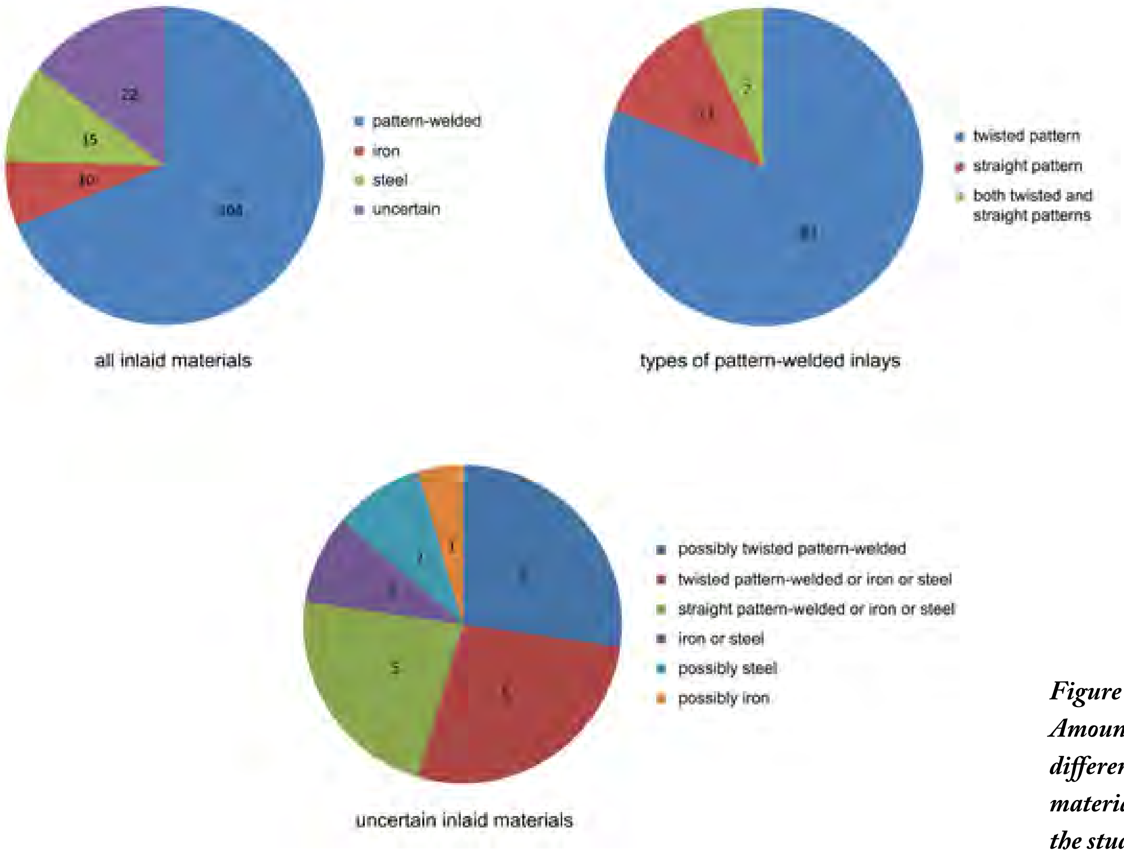


Figure 34. Amounts of different inlaid materials among the studied finds.

This plain classification is made for the very reason that the quality of the inlaid material cannot be determined more accurately without specific metallurgical analyses (see Chapter 3.5). The inlays of plain iron or steel rods have normally dark, thin, longitudinal streaks, which are either slag in the material or the corroded, piled structure of steel (Fig. 33). The streaks are also evident in radiographs of such inlays, although the carbon content of the inlaid material cannot be determined in most cases by mere visual inspection.

In fifteen swords the material of inlays is plain steel rod, defined by the fact that the carbon content of the rod is greater than that of the fuller of the blade (Fig. 34). In ten blades the rod is defined as iron, the carbon content of the inlay being lower than the fuller of the blade. Here it must be noted that there were numerous uncertain materials. In nineteen blades the material was so uncertain that it could not be accurately seen if the material was twisted pattern-welded rod, or pattern-welded at all. In some of these cases the material of the non-pattern-welded rod could not be defined either as steel or iron. The recognition of a non-twisted pattern-welded rod was also difficult, especially in cases where the inlays were observed from a radiograph. In all these uncertain cases, thirteen could have been of steel, although there are alternatives. In the same fashion, five of the uncertain inlaid materials could also be characterized as iron.

The materials used for the inscriptions have been the subject of much less attention than the materials of the blades, which were discussed in the previous chapter. The traditional view is that the inlays are iron while the blade is steel.[476] According to earlier studies, the main reason for the visibility of the inlays is the variation of the carbon or phosphorus content between the inlays and the blade. For example, a LEUTLRIT-inscribed sword from the River Witham in Great Britain appeared to have, after polishing and etching one inlaid letter, a steel blade with iron inlays according to the resulting colours.[477] Each inlaid mark displayed typical, longitudinal corrosion streaks.

476 *E.g. Oakeshott 1960: 143–144; Tylecote 1987: 276; Tylecote & Gilmour 1986: 248.*
477 *Maryon 1950: 177.*

In some cases inlays were made of phosphorus-rich iron to increase the contrast.[478] After etching, phosphorus-rich iron will remain even brighter than normal iron, because phosphorus-rich iron has larger grain size.[479] In this manner, the letters would have remained bright and shiny against the dull, steely background of the blade.[480] Although phosphorus tends to make iron more brittle, and it is regarded as an impurity in modern industrial steels, phosphorus-rich steel should, in addition, be easier to weld than steel without phosphorus.[481] Slag inclusions are formed in the welding seams by iron oxides, which are dissolved more readily by phosphorpentoxide formed during the oxidation of phosphorus-rich steel. Perhaps partly for this reason – the ease of welding – phosphorus-rich iron was used in the inlays, in addition, of course, to the increased contrast.

Among the finds analysed for this study (see Chapter 4.4), only two had plain, non-patterned inlays. KM 2979:8 from Mynämäki had iron inlays with an elevated phosphorus content (up to 0.78 % in the metallic matrix), while other trace elements were scarce. Owing to the presence of phosphorus, the hardness of the inlay was measured as 252 HV. The small intact part of the inlay visible in the cross-section of KM 9142:8 from Nousiainen had an average hardness of 267 HV (265–269 HV), and is most likely phosphorus-rich iron according to the differences of corrosion and the relatively high hardness readings.

A sword found from grave 723 in Mikulčice in the Czech Republic was analysed not only from its blade (see Chapter 4.4.4), but also from its inlays. In this case the inlays were made of phosphorus-rich iron or low-carbon steel with a maximum carbon content of 0.4 %. The amount of phosphorus varied between 0.7–1.3 %, the inlays forming letter-like figures.[482]

478 *E.g. Jones 1997.*
479 *Tylecote & Gilmour 1986: 251.*
480 *Thompson 2004: 117.*
481 *Thålin-Bergman & Arrhenius 2005: 108.*
482 *Košta & Hošek 2014: 193.*

5.2.2. Pattern-welded inlays

5.2.2.1. On pattern-welding in general

It is necessary to concentrate on the phenomenon of pattern-welding for a moment, since pattern-welding is firmly connected to the analysis, classification and manufacture of inlaid marks and letters. Pattern-welding is problematic already as a term, because different authors have used different terms to deal with pattern-welding. In colloquial speech the terms 'pattern-welding' and 'damascening' or 'damascus' are commonly used to mean the same thing. In reality, pattern-welding should be distinguished from damascening, because these terms originally meant two completely different ways of producing patterns on steel.[483] This fact has now been widely recognized.

Different authors have different terms for distinguishing between pattern-welding and damascening. Andreas Oldeberg separated between artistic and 'real' damascening, pattern-welding being simply the artistic one.[484] T. D. Kendrick used the term 'false Bulat' to describe pattern-welding, real Bulat meaning cast steel.[485] Carlo Panseri separated oriental damascus and welded damascus, and in addition also refers to imitations of both executed by simply etching with acids.[486] It has also been suggested that pattern-welding was carried out to imitate the patterns of crucible steel.[487]

***Figure 35.* The surface of a pattern-welded blade made by the author. The fuller of the blade consists of four pattern-welded rods, which are alternately twisted. Each rod in turn consists of seven alternating layers of iron and steel, the number of iron layers being four and steel layers three. Iron is lighter in colour and steel is darker. The blade bevels are also steel, but they are left unetched.**

483 *E.g. Anstee & Biek 1962: 71.*
484 *Oldeberg 1966: 214.*
485 *Kendrick 1934: 392. See also Sachse 1989: 68.*
486 *Panseri 1965: 12.*
487 *E.g. Williams 2007: 233.*

To be precise, damascening is used to mean the manufacture of crucible steel, practised in Syria, Persia and India and completely different from the pattern-welding used in Western Europe.[488] The damascening process creates a watered pattern caused by the heat-controlled crystallization of high-carbon steel.[489] The patterns were made visible by etching the completed polished blade with some mild acid. In etching cast steel, the eutectoid steel becomes dark, and the high concentration of iron carbides causes the eutectic cast iron to become white.[490] The prominent feature of crucible steel is that the carbon content is considerably high, somewhere between 1–4 %,[491] and for this reason it is considerably more difficult to forge and weld than smelted steel.[492]

The term pattern-welding means that at least two different kinds of iron or steel are welded together and then manipulated to create a desired pattern on the final object (Fig. 35). After polishing and etching, the different steels become differently coloured. The steel with higher carbon content will be etched darker and deeper than the one with lower carbon content. The material with higher carbon content will be eaten away by few hundredths of a millimetre.[493]

Before pattern-welded material was used in inlays, its primary use was to construct the middle sections of whole sword blades, and later on to make central parts of spearheads. It has been claimed that in its earliest stage the pattern-welded sword was only ornamental or a kind of prestige weapon, with little use in war.[494] According to Alan Williams, the advantages of pattern-welding were two-fold.[495] Firstly, it could be used to produce a steel-like material with controllable properties from poor-quality raw materials. Secondly, pattern-welding had a beautiful decorative effect. After being established, pattern-welding was most likely also a sign of quality and indication of high cost.[496] The blacksmith may manipulate the pattern-welded packs or bands to create a desired pattern and the more skilful the blacksmith, the more complex the pattern will be.

In a functional sense, pattern-welding can be regarded as useful for multiple reasons. With pattern-welding, smaller strips can be welded together to produce a larger lump of steel for a blade.[497] A further motive for pattern-welding could have been the reduction of carbon from steel, thus preventing the blade becoming too hard and fragile.[498] This, however, is not very likely considering that the carbon content of early pattern-welded blades was very low, and thus the carbon content could not have been too high to start with. Instead, materials with different carbon content could have been unified with pattern-welding, making the piece thus resemble a more homogeneous blade. The combining of iron and steel introduces the properties of both these materials into the blade: the hardness of steel and toughness of iron.[499] This claim is again challenged by the fact that in the majority of analysed pattern-welded structures, the carbon content was too low for quench-hardening, for example. It has also been claimed that pattern-welded blades were actually weaker than those forged from a single piece, because slag was trapped between the welding seams

488 *E.g. Maryon 1960b: 52; Sachse 1989: 67–68; Williams 2007: 233. See also Chapter 4.5.1.2.*
489 *Maryon 1960b: 52. For descriptions of this process and pictures of the end result see Sachse 1989: 69–73.*
490 *Smith 1957: 201.*
491 *Tylecote 1976: 66.*
492 *E.g. Smith 1957: 200.*
493 *Hansen 2007: 50–51.*
494 *E.g. Tylecote & Gilmour 1986: 1.*
495 *Williams 1977: 75.*
496 *E.g. Tylecote & Gilmour 1986: 2.*
497 *Stalsberg 1989: 14.*
498 *Tylecote 1976: 66.*
499 *Andresen 1994: 198; Ypey 1980: 193–194. Sebastian Pelsmaeker has stated that according to his experimental studies a pattern-welded blade was about four or five times tougher than a monosteel blade, enabling the making of a thinner and thus lighter blade (Pelsmaeker 2010: 77–78). The experiments organized by Janet Lang (2007: 123) gave same results.*

of pattern-welded blades, and thus the slag content was not reduced with that method.[500] This is verified by the observation that if a pattern-welded blade is bent or twisted, the welding seams are the first to tear regardless of how well done they appear to be in the finished blade.[501] Of course, the durability of a pattern-welded blade also depends on the welding skills of the blacksmith. If the welding seams have remaining slag and flux, the weld will not hold.

Although pattern-welding is now widely practised among bladesmiths and blacksmiths, both professional and even amateur, the procedure itself was not clear for scholars and researchers even half a century ago. Albert France-Lanord suggested that the chevron pattern visible in many sword blades was made by creating a pack of alternating layers of iron and steel, and then bending the pack back and forth to create a serpentine structure.[502] Maurice Janssens speculated that the patterns were created by winding and welding strips of iron around a central core made of steel.[503] This kind of rod was then ground or sawn lengthwise to form a twisted pattern. The theories of France-Lanord and Janssens were criticized by Herbert Maryon, who stated that a pattern-welded pack was created by arranging iron and steel bands alternately on top of each other. Seven strips were usually piled, alternately of steel and iron.[504] According to Maryon, the rods were welded together only after twisting, which was probably done with wooden clamps.[505] This theory was tested by John Anstee and Leo Biek, who conducted a series of experiments in which they created pattern-welded rods by twisting together iron strips and rods, quite successfully and with only minor obstacles.[506]

At present the viewpoints are much clearer. It is generally accepted that a pack of alternating layers of iron and steel was welded solid, after which the pack was lengthened and manipulated by twisting (Fig. 36).[507] In this way the pattern will end up being regular, whereas with Maryon's method the pattern will easily be distorted while welding the twisted rod solid. Normally iron layers are placed as the outermost layers, because they do not burn in the heat of the forge as easily as steel layers do.[508] Before welding, the pack was tied with a forged iron clip, then heated to ca. 1000 °C, and dipped into quartz sand used as a flux.[509] Preferably, the welded rods should be forged round before twisting to avoid the tearing of welding seams and sharp ridges,[510] although the process will also work with square rods that are butt-welded together.[511]

Of course the technique Maryon suggested is a working one, as proved by Anstee and Biek, but it is still much harder and more laborious than the method accepted today. Furthermore, using Maryon's method, pattern-welded rods with many layers, for example over ten, are very hard to accomplish, because the bands, which are not welded together, will warp during the twisting. The Norwegian blacksmith Kasper Andresen noted that a simple herringbone-pattern can also be produced by twisting together two wires, one of iron and one of carbon steel, in the manner suggested by Maryon.[512] It is not impossible that the patterns on some blades were manufactured with a technique like this one, because only a small proportion of pattern-welded blades have been carefully studied. However, the gradual changing of patterns created by a layered pack cannot

500 *Edge & Williams 2003: 203.*
501 *See Moilanen 2008b: 28.*
502 *France-Lanord 1948.*
503 *Janssens 1958.*
504 *Maryon 1960a: 28.*
505 *Maryon 1960a: 29.*
506 *Anstee & Biek 1962.*
507 *See e.g. Sachse 1989: 48, Abb. 62–65.*
508 *Hansen 2007: 43.*
509 *Hansen 2007: 43.*
510 *Hansen 2007: 44.*
511 *E.g. Pleiner 2006: 214.*
512 *Andresen 1994: 198.*

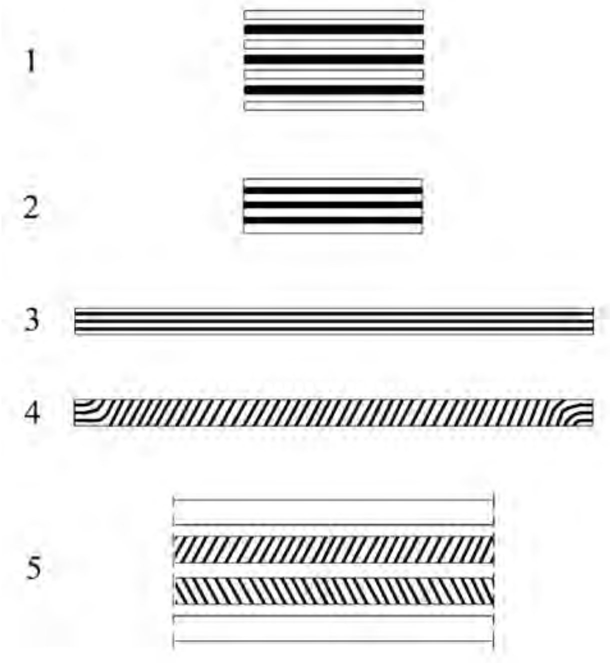


Figure 36.
The most common and widely accepted method for creating a pattern-welded blade with a herringbone pattern. A pack of alternating layers of iron (white) and steel (black) is welded solid (1-2), after which the pack is stretched by hammering (3). Then the pack, or rod, is twisted (4), and two of them are used to create the pattern, together with separately welded blade edges (5).

be created by twisting together iron and steel wires; the pattern will remain 'herringbone' all the way through.

The patterns on a completed blade were made visible by etching. Etching was normally done with some acid. For example vegetable acids such as fruit juice could have been used,[513] or cranberry or apple juice.[514] Possibly urine was also utilized.[515] Also the possibility of some corrosive mineral, such as vitriol, has been suggested.[516] Also tannic acid may have been in use, lending a deep blue-black colour to carbon-rich steel and increasing resistance to corrosion.[517] Although stronger acids are used at present, also mild acids can be used to reveal the pattern; the acid must only be heated first, and the blade must be kept in the acid for a considerably longer time.[518]

Having made many pattern-welded blades, I would point out that one alternative is to polish the pattern-welded section of the blade before quench-hardening and then quench the blade in such a manner that the pattern-welded portion is of uniform heat. Steels with different alloys will oxidize differently, and the quenching will remove the oxidized scale uniformly, creating some topography between different alloys. Now if the hardened, pattern-welded section is polished, only a small amount of re-polishing will create a shiny surface, which has darker patterns due to deeper, higher-carbon layers. This technique may also work with inlaid blades.

At this point a note should be made about the geographical distribution of the pattern-welding technique. Even though crucible steel was in widespread use in the Orient, European-style pattern-welding was also practised, for example in India and the Middle East.[519] Even similar patterns were produced, for example the Indonesian short, single-edged *klewang* sword has two twisted pattern-welded rods and a so-called wolf's tooth -pattern near the cutting edge, surprisingly similar to some European Late Iron Age scramasaxes.[520] These *klewangs* date from the late 1800s and early 1900s. After the Late Iron Age, the practice of pattern-welding was continued between the late 1700s and early 1900s in the form of pattern-welded barrels of firearms.[521] One of the

513 *Edge & Williams 2003: 203; Smith 1957: 200.*
514 *Andresen 1994: 198.*
515 *Arrhenius 1989: 100; Liestøl 1951: 88.*
516 *Smith 1957: 200.*
517 *Knowles & Whate 1958: 10.*
518 *Hansen 2007: 50.*
519 *See Sachse 1989: 87–90.*
520 *Sachse 1989: 106, Abb. 173–175.*
521 *Sachse 1989: 116–143.*

			Carbon content of layers (%)	
Source	Artefact	Dating (centuries)	Lighter (iron)	Darker (steel)
Anteins 1968: 22–23; 1973: 105	spearhead from Durbe, Latvia (LKM-13115)	11th–13th	0	0.3
Anteins 1973: 69	spearhead from Lejasbiteni, Latvia (MIL-1963:VII)	5th–10th	0	0.1–0.2
Anteins 1973: 78	spearhead from Salaspils, Latvia (MIL-I 907)	11th	0	0.2–0.3
Anteins 1973: 114	spearhead from Turaida, Latvia (MIL-I 471b)	12th–13th	0	0.2
Edge & Williams 2003: 202	sword in Rustkammer, Vienna (E 2050)	8th–11th	0.1	0.6
Košta & Hošek 2014: 60–70	sword from Mikulčice, Czech Republic	9th	ferrite + P	ferrite
Košta & Hošek 2014: 86–87	sword from Mikulčice, Czech Republic	9th	ferrite + P	ferrite+cementite
Košta & Hošek 2014: 163–167	sword from Mikulčice, Czech Republic	8th–9th	ferrite + P	ferrite
Košta & Hošek 2014: 232–234	sword from Mikulčice, Czech Republic (594-2978/86)	8th–9th	ferrite + P	ferrite+cementite
Liestøl 1951: 85	sword from Norway (C 788)	9th–11th	0	0.15–0.2
Pleiner 1993: 117–118	sword from Cleebronn, Germany (Museum Heilbronn BW 224)	6th–3rd BC	0.03	0.15
Pleiner 1993: 122–123	sword from Llyn Cerrig Bach, Great Britain (National Museum of Wales 44.32/4)	6th–1st BC	low-carbon iron	higher-carbon iron
Rosenqvist 1970: 171	sword from Norway (C. nr. 4746)	2nd–4th?	ferrite	ferrite+pearlite
Rosenqvist 1970: 179	sword from Oppland, Norway (C. nr. 14601)	4th	ferrite	ferrite+pearlite
Smith 1957: 200	sword from Lorraine, France	6th	0	0.15
Thomsen 1971: 74	spearhead from Hedeby, Germany	9th–11th	0	0.7
Thålin 1967: 234; Thålin-Bergman & Arrhenius 2005: 87	sword from Gotland, Sweden (SHM 7840:40)	6th–7th	0	0.5
Thålin-Bergman & Arrhenius 2005: 95	spearhead from Gotland, Sweden (SHM 19739:36)	9th	0	0
Thålin-Bergman & Arrhenius 2005: 108	spearhead from Gudingsåkrarna, Sweden (SHM 19952:7)	9th	iron	low-carbon steel
Thålin-Bergman & Arrhenius 2005: 111	spearhead from Gudingsåkrarna, Sweden (SHM 20185:3)	9th	0	0.1
Thålin-Bergman & Arrhenius 2005: 115	spearhead from Gudingsåkrarna, Sweden (SHM 19952:2)	9th	ferrite	ferrite+pearlite
Thålin-Bergman & Arrhenius 2005: 122	sword from Helgö, Sweden (SHM 2814)	6th–7th	0	0
Tylecote & Gilmour 1986: 117–121	spearhead from Gloucestershire, Great Britain	10th–11th	0–0.1	0.1
Tylecote & Gilmour 1986: 121–123	spearhead from Gloucestershire, Great Britain	9th–10th	0	0.1
Tylecote & Gilmour 1986: 134–136	scramasax from Reading, Great Britain (Museum no. 52.80)	9th–11th	0	0.1
Tylecote & Gilmour 1986: 137–140	scramasax from Gloucestershire, Great Britain (Swindon Museum 790308)	10th–11th	0	0.1–0.2
Tylecote & Gilmour 1986: 140–144	scramasax from Dorset, Great Britain (Dorset County Museum)	9th–10th	0	0.1–0.2
Tylecote & Gilmour 1986: 168–172	sword from Lenham, Kent, Great Britain (Maidstone Museum 3.1977)	6th	0	0.1
Tylecote & Gilmour 1986: 172–174	sword from Surrey, Great Britain (Museum of London 56. 106/13)	6th	ferrite	ferrite+pearlite
Tylecote & Gilmour 1986: 174–176	sword from Surrey, Great Britain (Museum of London 56. 106/14)	6th	0	0
Tylecote & Gilmour 1986: 179–180	sword from Sarre, Kent, Great Britain (Maidstone Museum KAS 825)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 179–181	sword from Sarre, Kent, Great Britain (Maidstone Museum KAS 823)	6th–7th	ferrite	ferrite+pearlite
Tylecote & Gilmour 1986: 182–185	sword from Wickhambreux, Kent, Great Britain (Maidstone Museum)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 185–186	sword from Bifrons, Kent, Great Britain (Maidstone Museum KAS 620)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 185–188	sword from Lincoln, Great Britain (Lincoln City & County Museum 6.66)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 188–191	sword from Cambridge, Great Britain (Peterborough Museum 16/1979/1)	5th–7th	0	0.1–0.2
Tylecote & Gilmour 1986: 191–194	sword from Eastrey, Kent, Great Britain (Maidstone Museum A.S. 121)	6th–7th	0	0.1–0.2
Tylecote & Gilmour 1986: 195–197	sword from Aylesford, Kent, Great Britain (Maidstone Museum)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 197–201	sword from Wickhambreux, Kent, Great Britain (Maidstone Museum)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 201–202	sword from Sarre, Kent, Great Britain (Maidstone Museum KAS 818)	6th–7th	0	0.1
Tylecote & Gilmour 1986: 202–206	sword from Sarre, Kent, Great Britain (Maidstone Museum KAS 830)	6th–7th	0	0.2–0.4
Tylecote & Gilmour 1986: 207–209	sword from Holborough, Kent, Great Britain (Maidstone Museum)	7th	0	0
Tylecote & Gilmour 1986: 209–212	sword from Reading, Great Britain (Reading Museum 51:80)	7th–9th	0	0
Tylecote & Gilmour 1986: 212–214	sword from Brentford, Great Britain (Museum of London 0.2112)	7th–9th	0?	0.4–0.8
Tylecote & Gilmour 1986: 213–217	sword from London, Great Britain (Museum of London A. 13591)	8th–10th	0	0.1–0.3
Tylecote & Gilmour 1986: 227–229	sword from Oxon, Cleeve, Great Britain (Reading Museum 256:63a & b)	9th–11th	low-carbon iron	low-carbon iron
Tylecote & Gilmour 1986: 229–232	sword from Thames, Great Britain (Museum of London A. 17923)	10th–11th	0.1	0.1
Tylecote & Gilmour 1986: 232–234	sword from Reading, Great Britain (Reading Museum 16:36)	10th–11th	0	0

Figure 37. Carbon contents of pattern-welded bands analysed in previous studies.

common patterns was a twisted rod which was wrapped around the barrel core. During the same period, also pattern-welded sabres and knives were produced, especially in Germany.[522]

The meaning and status of pattern-welded artefacts may be speculated as being of high value, since the patterns have been imitated both in Europe and in the Orient by mere etching with acids.[523] Although decorative etching has been known since the Middle Ages, this 'false pattern-welding' has been done especially during the 20th century, focusing on both edged weapons and firearm barrels. Normally these etched specimens can be distinguished from real pattern-welded ones by simply inspecting the patterns, which do not normally closely resemble those made by actual welding.

It is traditionally said that in pattern-welding, iron and steel are being welded together.[524] In many cases, as in this study, this is done to make the definition of materials as simple as possible. Secondly, it is not possible to measure all the elements present in all pattern-welded specimens in the find material. More accurate measurements of pattern-welded materials exist in the form of metallographic analyses.[525] Different combinations of materials have been observed in studies done so far on various kinds of pattern-welded objects of the Iron Age (Fig. 37). The most common combination is pure or fairly pure iron welded to low-carbon steel.[526] The materials of pattern-welded blades of La Tène period were still relatively poor, for example a sword from southwest Germany had separate cutting edges and a pattern-welded core of iron (carbon content 0.03 %) and very mild steel (carbon content 0.15 %).[527] Also a 6th-century sword blade from Lorraine had

522 *E.g. Sachse 1989: 144–179.*
523 *Sachse 1989: 184–193.*
524 *E.g. Airola 1987: 18; Böhne & Dannheimer 1961: 112; Leppäaho 1957: 627; Maryon 1960a: 25.*
525 *E.g. Bühler & Strassburger 1966, Böhne 1963, Höeg 1952, Liestøl 1951, Piaskowski 1965, Schulz 1955, Schulz 1959, Schürmann 1959; Schürmann & Schroer 1959, Thålin 1967.*
526 *E.g. Maryon 1960a: 28.*
527 *Pleiner 1993: 117–118.*

pattern-welding consisting of carbon-free iron and mild steel of carbon content ca. 0.15 %.[528] In comparison, the 'steel' in Merovingian pattern-welding contained ca. 0.2 % carbon.[529] Aleksis Anteins observed that between the 6th and the 9th centuries, pattern-welded bands were made of iron and low-carbon steel (carbon content 0.2–0.3 %).[530]

Pattern-welded blades from Great Britain analysed by Tylecote and Gilmour exhibit a variety of materials.[531] The sword blades were dated to the 6th-11th centuries. In these blades the pattern-welding was in most cases manufactured from strips of large grained ferrite (i.e. iron) and very low-carbon steel (ca. 0.1–0.2 % carbon). It should be mentioned that Tylecote and Gilmour also examined pattern-welded spearheads and scramasaxes, both of which had approximately the same kinds of materials as sword blades. Also Lena Thålin-Bergman and Birgit Arrhenius have analysed pattern-welding present in some Viking Age weapons from Sweden.[532] Normally the layers in pattern-welding contained ferritic iron and very low-carbon steel. It is noted that all layers with a low carbon content cannot be defined as 'steel', because of the low carbon content, sometimes as little as 0.2 %.[533]

The second observed combination of pattern-welded layers is iron welded together with high-carbon steel. In some cases the carbon content of the steel layers in pattern-welded rods was as high as 0.7 %.[534] For example, pattern-welding in a spearhead from Hedeby was made of non-carbon iron and steel with a carbon content of 0.7 %.[535] One sword blade from the Late Iron Age analysed by Tylecote and Gilmour had pattern-welding consisting of pure iron and steel layers of ca. 0.4–0.8 % carbon.[536]

The third alternative is to weld together low-carbon steel and high-carbon steel, the patterns having no pure, carbonless iron.[537] For example, already in some Roman Iron Age swords from Norway, ferritic low-carbon steel with little phosphorus, and pearlitic high-carbon steel were used in the pattern-welded ribbons.[538] The same was observed in other pattern-welded swords.[539] One sword from the Late Iron Age had two different steels in its pattern-welded mid-section: one with carbon content of 0.1 % and other with carbon content of 0.6 %,[540] whereas pattern-welding in one sword analysed by Thålin-Bergman and Arrhenius was constructed from low-carbon steel and steel with a carbon content of 0.5 %.[541] This combination of materials will produce a hard and tough blade when properly treated.[542]

Besides carbon, some other elements are present, the most important being phosphorus. In some analysed pattern-welded rods from Merovingian Period sword blades, the carbon contents of the laminated layers were not considerably different. Instead, there were differences in the phosphorus content of the laminates.[543] Edouard Salin also noticed that some nitrogen was present indicating

528 *Smith 1957: 200.*
529 *Salin 1957: 66–67.*
530 *Anteins 1968: 22–23; Anteins 1973: 30.*
531 *Tylecote & Gilmour 1986.*
532 *Thålin-Bergman & Arrhenius 2005.*
533 *Ypey 1980: 198.*
534 *Ypey 1980: 198.*
535 *Thomsen 1971: 74.*
536 *Tylecote & Gilmour 1986.*
537 *E.g. Thålin-Bergman & Arrhenius 2005: 31.*
538 *Rosenqvist 1970.*
539 *Bühler & Strassburger 1966; Schurmann & Schröer 1959; Thålin 1967.*
540 *Edge & Williams 2003: 202.*
541 *Thålin-Bergman & Arrhenius 2005: 87.*
542 *Rosenqvist 1970: 174–175.*
543 *Lang 2007: 66–67; Salin 1957: 66.*

carbonization by some organic materials.[544] Tylecote and Gilmour characterized the pattern-welded materials as high and low-carbon iron in some cases, the phosphorus content being higher in low-carbon material.[545] Furthermore, in all blades analysed by Thålin-Bergman and Arrhenius phosphorus was present in iron or strips with lower carbon content.[546] Similar phenomenon was observed by Košta and Hošek in Czech swords, the phosphorus contents varying between 0.6–1 % in one element of pattern-welded bands.[547] While welding together pure iron and carbon steel, the carbon contents of these materials will be evened out to some degree, and the danger of losing the pattern is great, especially with carbon contents close together.[548] If materials with some phosphorus are used, the preservation of the pattern is more certain, and the pattern will be even more contrasted.[549] As previously stated, phosphorus-rich material will be etched brighter.

It should be noted that patterns could emerge even if the materials used in the ribbons were of same quality. The pattern may be brought visible by slag trapped in the welding seams, and also by trace elements fused from the welding flux.[550] The series of experiments conducted by Anstee and Biek showed that the pattern is somewhat visible by using same qualities of iron.[551] The pattern-welding of same steel qualities is sometimes considered as a mistake made by the blacksmith, as are the pattern-welded packs with layers in the wrong places.[552]

An occasionally observed feature in pattern-welded rods is their layer count. In European Iron Age blades the pattern-welded packs normally had seven layers, while the numbers of iron and steel layers varied.[553] The layer count could also be higher than seven, for example in the case of some swords found from Nydam bog in Denmark.[554]

Albert France-Lanord claimed that normally the pattern-welded pack was constructed from four layers of steel and three layers of iron.[555] The same observation was made by Edouard Salin.[556] Normally, though, there were more iron layers than steel layers,[557] in most cases the total count being seven (four iron strips and three steel strips).[558] In one case a Merovingian sword blade had three layers of steel, as well as three layers of iron in its pattern-welded rods.[559] Joachim Emmerling examined a find in which pattern-welding was done in only three layers.[560] Emmerling also noticed that normally the outermost layers in the pattern-welded pack or rod are somewhat thicker than other, inner layers.[561]

In many cases the materials have been confused; it is not known whether the material is iron or steel. The reason for this is different etching mediums, which sometimes produce different kinds of colours (see Chapter 3.3). For example, Herbert Maryon[562] studied some of the blades which

544 *Salin 1957: 68.*
545 *Tylecote & Gilmour 1986: 251.*
546 *Thålin-Bergman & Arrhenius 2005.*
547 *Košta & Hošek 2014: 69, 86–87, 163–167, 232–234.*
548 *Thålin 1967: 236.*
549 *Thålin 1967: 236.*
550 *Jones 1997: 8; Tylecote 1976: 57.*
551 *Anstee & Biek 1962.*
552 *Ypey 1980: 201–202.*
553 *Ypey 1980: 195; Ypey 1981: 149.*
554 *Ypey 1980: 195.*
555 *France-Lanord 1952: 413–414.*
556 *Salin 1957: 60.*
557 *E.g. Liestøl 1951: 85.*
558 *E.g. Emmerling 1972: 298; Ypey 1980: 197–198.*
559 *Salin 1957: 71.*
560 *Emmerling 1972: 303.*
561 *Emmerling 1972: 300.*
562 *Maryon 1960a: 28.*

twisted		straight	
7 (3 iron, 4 steel)	1	3 (1 iron, 2 steel)	1
7 (4 iron, 3 steel)	4	3–5	3
7–9	2	5 (3 iron, 2 steel)	1
7–9 (all iron)	1	7 (4 iron, 3 steel)	2
7–13	1	11 (5 iron, 6 steel)	1
9 (5 iron, 4 steel)	1		
9–11	1	twisted and straight	
11 (5 iron, 6 steel)	1	3 (1 iron, 2 steel)	1
11 (6 iron, 5 steel)	1	3–5	2
13 (7 iron, 6 steel)	1	7 (4 iron, 3 steel)	1
		7–14 (4 iron, 3 steel)	1
		9 (5 iron, 4 steel)	1

Figure 38. Variable layer counts of pattern-welded inlays in the examined find material.

France-Lanord[563] examined, and also concluded that steel is light in colour and iron is dark. Jaap Ypey noted that this is true if the Heyn reagent was used.[564] It is not known, however, what medium was used. If some acid was used, the definitions of the materials would be the other way round.

5.2.2.2. Appearance and practical execution

In the examined finds the most common material for inlays seems to be twisted pattern-welded rod, which was found in altogether 98 blades. In some swords the material is pattern-welded, but left straight and plain without any twisting. Rods of this kind were found in eleven blades. Moreover, seven blades had inlays of both twisted and straight pattern-welded material. Of the nineteen uncertain cases mentioned above, six may have had inlays with twisted pattern-welding, five with straight pattern-welding, and three with at least some kind of pattern-welding.

The construction of pattern-welded inlays varies (Fig. 38). In some cases the layer count can be measured on the basis of colour differences or differences of corrosion. Normally, the rods are constructed of two materials of different alloying elements. It is assumed that the materials are in simple terms 'iron' and 'steel', both having different carbon contents. 'Iron' may also contain some alloying element resistant to corrosion, such as phosphorus. It must be noted that the layer count cannot usually be determined from radiographs.

In regard to twisted pattern-welded inlays, normally the layer count is seven or nine, although rods with a higher layer count do exist (Fig. 39). In four cases, the layer count is seven or nine, and in one of these all the layers appeared to be of iron. In four blades the layer count could be measured as seven with four iron and three steel layers, and in one case the seven layers consisted more steel layers than iron ones. In one case the layer count could be measured as nine (five iron and four steel laminates). The layers themselves are defined as steel and iron, usually so that the number of iron layers is greater. On one blade the layer count was very variable, between seven and thirteen, indicating that the pattern-welded pack had possibly been folded in two for some of the inlays. In one case there were nine or eleven layers, while two blades clearly had inlays with eleven layers. These two differed from each other in respect to the materials: one had more layers of iron, and the other had more layers of steel. One case could be counted as having thirteen layers, most of which were of iron.

563 *France-Lanord 1952.*
564 *Ypey 1980: 197.*

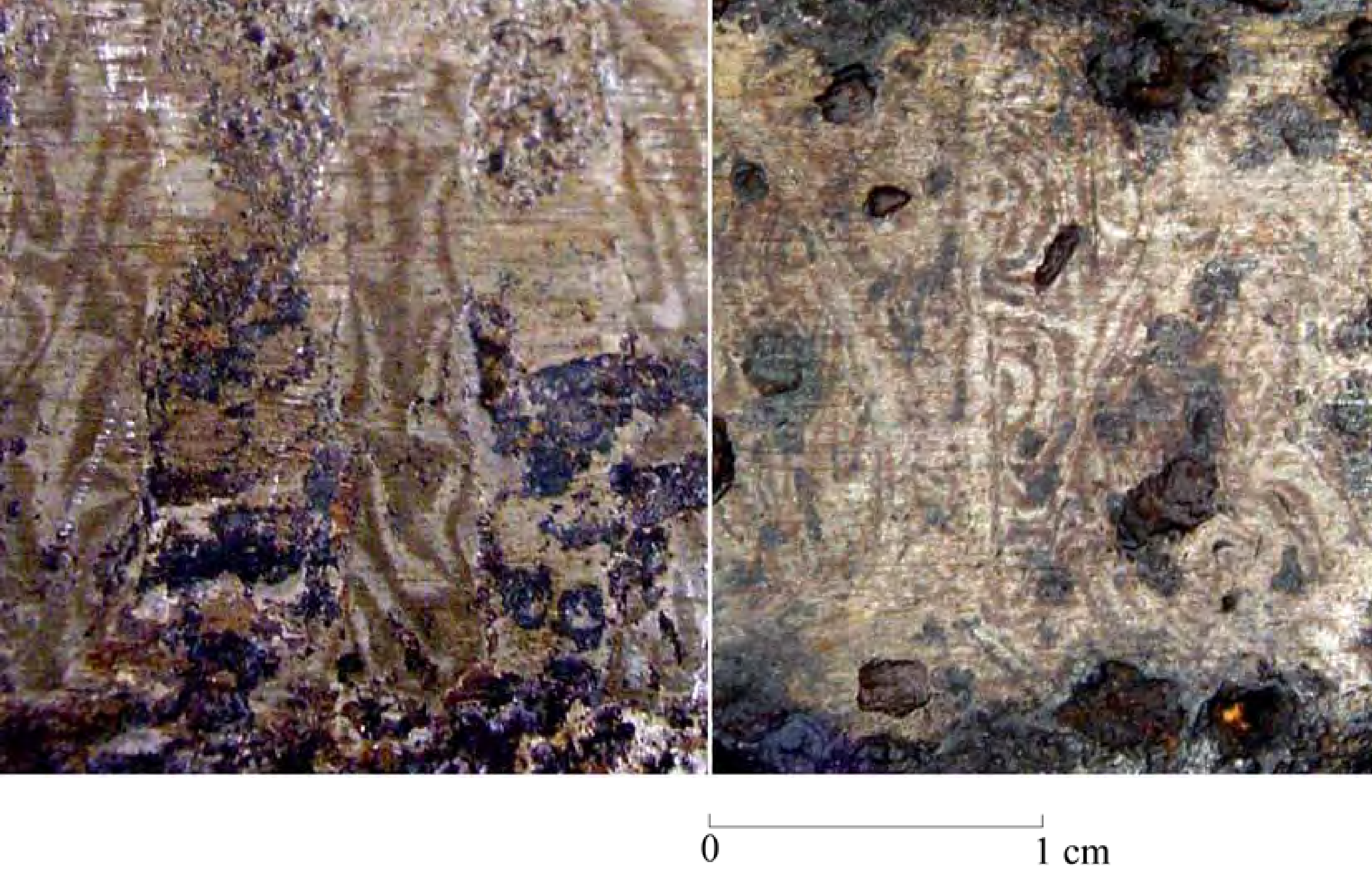


Figure 39. Close-up views of twisted, pattern-welded inlays with different layer counts. On the left is find KM 9778 with inlays of pattern-welded rod with seven layers. On the right is sword KM 9164:2 with inlays of pattern-welded rod with thirteen layers.

The tightness of the twists in pattern-welded rods also varies (Fig. 40). In some cases the twists are very loose (e.g. KM 2767), while in other the twists are very tight creating almost horizontal bands (e.g. KM 10349:1 and KM 18402:1). An interesting variation is a pattern-welded rod which was left untwisted (Fig. 41). Inlays of this kind have straight, longitudinal streaks, visible as colour differences or differences of corrosion. In all their simplicity, the inlays were made from a pattern-welded pack, the cross-section of which is shown on the surface of the inlay. For example INGELRII sword KM 6245 A:1 from Kangasala, Finland has an iron plate sandwiched between steel layers.

In the blades displaying only straight, non-twisted patterns, the layer counts were apparently lower. In three blades there were three or five layers. One contain only three layers, one of iron and two of steel. A slightly finer pattern was made in one blade with a total of five layers, three of which were iron and four were steel. Furthermore, the straight inlays were made in two cases of a seven-layered pack with four iron and three steel layers. This was similar to four cases also with twisted rods. The inlays of one blade showed a total of straight eleven layers, most of which were steel.

In cases utilizing both twisted and straight pattern-welded inlaid bands, the layer counts were also somewhat low. One countable example had only three layers, one of iron and two of steel. In two blades, the layer count was three or five. Again, this category included an example of the seven-layered pack, having the usual four layers of iron and three of steel. Another slightly similar case had the same kind of pattern-welded pack, although folded in twice and used also in this form with a finer pattern. In one more case the number of the layers could be counted, totalling nine, five of which were iron and four were steel.

In altogether five swords the materials seem to be divided in such a manner that the number of steel layers is higher. It is noteworthy that the thickness of iron and steel layers varies so that usually the darker steel layers are much thinner than the whiter ones made of iron. It is striking that in only

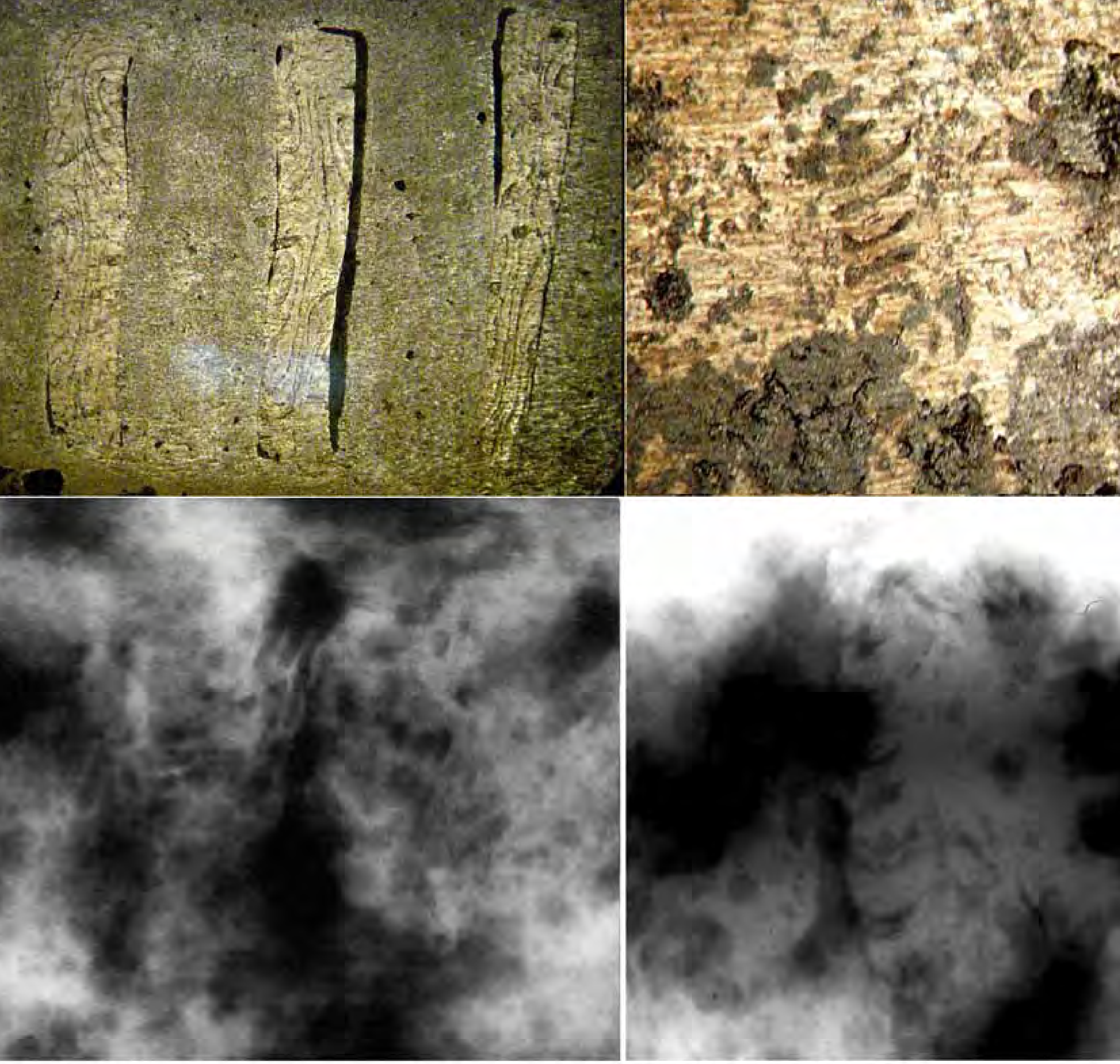
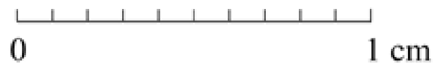


Figure 40. Twists of different tightness in pattern-welded inlays. On the left are presented very loose twists (KM 2767 on the top, KM 6227:1 below as seen in radiograph no. 553). On the right, correspondingly, are shown very tight twists, showing almost horizontal bands (KM 10349:1 on the top, KM 10390:2 below as seen in radiograph no. 600).



one case in previous research the number of layers of the pattern-welded pack used in inlaid rods was counted. This was done by Aleksis Anteins, and altogether seven layers were found in the examined inlays, four of iron and three of steel with different carbon contents.[565]

In regard to the previous studies of inlaid blades, in many cases the diagonal patterns of the inlays have been noted, and interpreted as some kind of 'twisted' rod.[566] Norwegian conservator Anders Lorange stated that the letters of a Norwegian ULFBERHT sword were made of 'twisted steel'.[567] Lee Jones observed that the inlays are pattern-welded in the same

565 *Anteins 1973: 54.*
566 *E.g. Jones 1997; Oakeshott 1960: 143–144; Petersen 1919; Tylecote & Gilmour 1986: 248.*
567 *Lorange 1889: Tab I.2.*

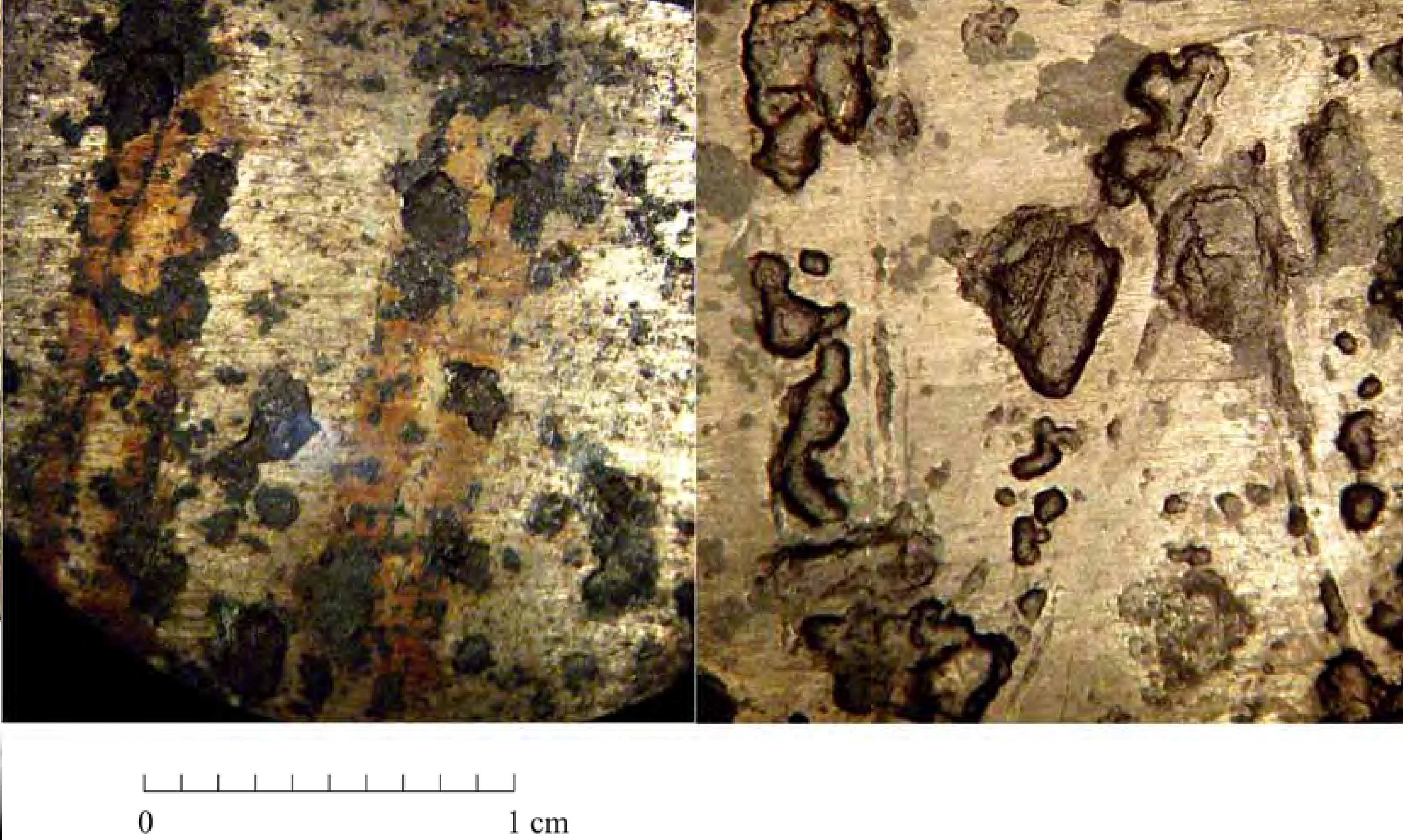


Figure 41. Inlays made of non-twisted pattern-welded rod. Finds KM 6245 A:1 on the left, and KM 8911:91 on the right.

way as in the case of whole sword blades.[568] Most often the material of the inlays is referred to as 'damascened',[569] although the meaning of the term was not accurately known.

In some cases the patterns have been given different names according to their appearance. Jorma Leppäaho used different German terms for different-looking materials in inlays.[570] *Spiraldamaszierung* means a semi-circular pattern on the surface of the inlays. *Stufendamaszierung* is used to describe a straight pattern, i.e. a pattern-welded rod, which is not twisted. *Winkeldamaszierung* means a twisted pattern-welded rod, which has diagonal streaks on its surface. The term *Streifendamaszierung* is slightly uncertain, and probably means some kind of longitudinal streaked pattern. These terms used by Leppäaho are not based on the material itself, but its appearance. This kind of classification is very dangerous, because nearly all described swords were ground and etched, and thus did not display the original surface at all. Even today very coarse grinding marks can be detected on the surface of the fuller of some blades examined by Leppäaho.

Other researchers have also given names to patterns of different appearance, assuming that they were done with different 'damascening' techniques. Böhne and Dannheimer distinguish three types of damascening: herringbone, striped and rosette.[571] B. Neumann also observed three kinds of damascening in the swords from Nydam bog: *Streifendamast* (straight pattern), *Winkeldamast* (herringbone pattern) and *Rosendamast* (curving pattern).[572] Curiously, Neumann could not explain how the *Rosendamast* was produced. Also Jaap Ypey has noted the patterns on inlays, referring to them with the terms *streifendamasziert* and *Z-tordiertem damast*, which means that the rod was twisted clockwise.[573] In connection with the last one, also S-twisted strands appear, the two terms indicating rods that were twisted in opposite directions.

568 Jones 1997.
569 E.g. Leppäaho 1964b; Petersen 1919.
570 Leppäaho 1964b.
571 Böhne & Dannheimer 1961: 112.
572 Neumann 1927–8: 24.
573 Ypey 1984.

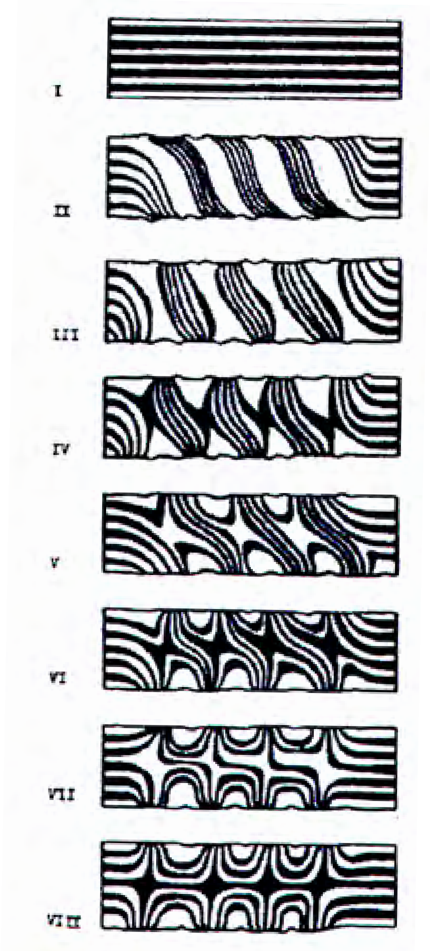


Figure 42.
Cross-sections of a twisted pattern-welded rod. The pattern changes gradually towards the centre of the rod (I–VIII). Below the drawing (from Anteins 1973: 17) is a photograph of a similar rod showing a rosette pattern at its right end, characteristic to the centre of a pattern-welded rod.

What effect may grinding have on the appearance of the inlays? Strictly speaking, the grinding process may change the appearance of the inlays a great deal. As Jaap Ypey[574] and Herbert Maryon[575] have noted, the pattern seen on the corroded blade is not necessarily the same that is visible on the polished and etched, new blade. This phenomenon in turn is related to the changing patterns of the twisted pattern-welded rod, sometimes called as 'torsion' damascening. The normal process of making a pattern-welded rod is as follows. First a pack made out of alternating layers of steel and iron is assembled. The pack is forge-welded together as one piece, after which it is drawn out by hammering to resemble a long bar. The bar is then twisted along its own axis.

The patterns of this bar change depending on how much is ground away from the side (Fig. 42).[576] In this way, different patterns can be produced from the same material by just altering the grinding depth, which is also done, unintentionally, when cleaning the finds mechanically to reveal the inscriptions. For example, the pattern on the inlays could have originally been semi-circular, close to halfway on the twisted rod (Leppäaho's *Spiraldamaszierung*), but it turned out to be only diagonal streaks (Leppäaho's *Winkeldamaszierung*) when the surface of the find was cleaned. The case could also be the opposite: originally the pattern was diagonal, but during the research the pattern was ground to appear to be semi-circular. In principle, there are actually two alternatives in pattern-welded rods, straight and twisted, and both have numerous variations according to the composition of the materials, layer counts and techniques of twisting.

5.2.2.3. The composition of the layers

Unfortunately the technology of pattern-welding of inlays has been only scarcely and randomly studied, particularly with the help of metallography. The definition of materials has been somewhat sketchy. For example, a Petersen type L sword from the Netherlands was stated to bear inlays pattern-welded from 'iron' and 'steel', based on an evaluation from polishing and etching.[577] The

574 *Ypey 1980: 201.*
575 *Maryon 1950: 175.*
576 *E.g. Anteins 1973: 14–18; Emmerling 1972: 299; Maragni & Jones 1997.*
577 *Willems & Ypey 1985: 106.*

Catalogue number	component of inlay	trace-elements										Hardness (HV)
		Mg	Al	Si	P	Cl	K	Ca	Cr	Mn	Ni	
KM 2548:196	brighter, slag	0.24–0.96	3.19–8.18	7.74–26.51	0.04–5.82	0.01–0.04	0.69–2.69	0.69–4.03	0.06–0.16	0.81–1.01	0–0.02	
	brighter, metal	0.07–0.1	0.03–0.07	0–0.07	0.15–0.46	0–0.11	0–0.04	0–0.01	0.06–0.07	0–0.04	0.02–0.04	173–211
	darker, metal	0–0.15	0–0.04	0–0.13	0	0.01–0.08	0–0.06	0–0.05	0–0.13	0.04–0.13	0–0.1	112–123
KM 2548:277	brighter, slag	0.24	2.63	14.44	7.44	0.12	1.18	1.15	0.03	0.23	0.04	
	brighter, metal	0	0.11	0	0.29	0	0	0	0.07	0.17	0.21	205–257
KM 3423	brighter, slag	0.1–0.6	0.12–4.35	13.55–26.55	0.22–2.33	0–0.05	0.03–2.97	0.13–6.09	0–0.05	0.83–4.39	0.05–0.18	
	brighter, metal	0–0.18	0–0.12	0–0.08	0.29–0.76	0–0.12	0–0.16	0–0.16	0–0.04	0–0.23	0.1–0.35	214–246
	darker, slag	1.74	0.61	18.2	0	0.03	0.09	2.8	0	7.13	0	
	darker, metal	0–0.13	0–0.13	0–0.1	0–0.03	0–0.09	0–0.1	0–0.12	0–0.1	0.03–0.21	0–0.4	114–197
KM 5960:3	brighter											140–154
	darker											140–154
KM 8120:1	brighter, slag	0.11–0.18	1.38–1.88	0.01–10.43	1.68–3.25	0.12–0.23	0.02–0.54	0.07–2.48	0–0.06	0.02–0.41	0–0.34	238
	darker, slag	0	1.54	27.59	0.75	0	2.1	0.4	0	0.03	0.14	
	darker, metal	0–0.07	0.01–0.03	0	0–0.32	0–0.00	0–0.03	0	0–0.07	0.05–0.12	0.03–0.28	173
KM 9832	brighter, slag	0–1.03	0.19–5.06	0.07–22.89	0–0.82	0.04–13.65	0–3.26	0.03–2.81	0–0.02	0–2.14	0–0.11	
	brighter, metal	0.01–0.14	0–0.1	0–0.03	0–0.92	0.03–0.07	0–0.04	0–0.07	0–0.09	0–0.27	0–0.08	

***Figure 43.** Trace elements present in the pattern-welded rods of some analysed Finnish finds, complemented with information from hardness measurements.*

laminates used in the pattern-welded inlaid rods differ in their composition to create the contrast, as in the case of other pattern-welding evident during the Late Iron Age.

Alan Williams analysed a small part of an inlay from a Norwegian ULFBERHT sword, and it appeared to be almost pure iron.[578] The Latvian researcher Aleksis Anteins analysed some of the pattern-welded inlaid rods of a sword from Durbe, Latvia (MIL-KRM 2023:1), and concluded that the laminates contain 0.2–0.3 % carbon.[579] In addition, one studied example of the practice of phosphorus-rich iron is an ULFBERHT sword from Öland, Sweden.[580] In the case of the above-mentioned sword from Durbe, more phosphorus was present in the low-carbon steel used in pattern-welding than in the iron layers.[581]

The cross-section analyses conducted for this study included eight blades with pattern-welded inlays, in six of which the materials used in the patterns could be examined from the cross-section of the blade (Fig. 43). In all cases where the inlay was intact enough to permit elemental analysis, the brighter component of the pattern-welding contained an elevated amount of phosphorus. This can also be deduced from the relatively high hardness measurements compared to the darker-etching component of the pattern-welding. The darker layers naturally contain more carbon than the brighter layers. It is also noteworthy that phosphorus-rich material was used in every studied case here, no matter what the inlays were, or how the blade was constructed. In other words, the contrast created with the help of phosphorus-rich material must have been widely known among contemporary bladesmiths, both skilful and less skilful ones.

5.3. Content-based grouping

5.3.1. ULFBERHT

5.3.1.1. Variation and spatial distribution of studied finds

In this study the main means of grouping the inlaid motifs is to refer to their contents. Since the find material is highly variable, the division has been made into five categories. The two ones dealt with first are person-names most common among the examined finds, and also in Europe in general. The first group consists of variations of ULFBERHT inscription. In this case, the content-based analysis also refers to previous studies. The geometric motifs evident on

578 *Williams 2009: 126, 150. The sword in question has the catalogue number 882 at the Bergen Historical Museum, and the inlaid inscription reads +VLFBERH+T.*
579 *Anteins 1973: 54.*
580 *Thålin-Bergman & Arrhenius 2005: 100–101.*
581 *Anteins 1973: 54.*

Catalogue number	Inlays, Side A	Inlays, Side B	Material of inlays	Blade construction	Blade type
KM 287			twisted pattern-welded		
KM 708			twisted pattern-welded		Geibig 2 or 3 / Oakeshott X
KM 1174:2			steel		
KM 1869:81			twisted pattern-welded (?)		
KM 2361			twisted pattern-welded		
KM 2548:277			twisted pattern-welded	laminated core, separate cutting edges (Fig. 5.10)	
KM 2548:839			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 2767			twisted pattern-welded (7–9 layers: all iron)		
KM 3052:2			straight pattern-welded (3–5 layers)		
KM 3131:6			twisted pattern-welded		
KM 3423			twisted pattern-welded	laminated core, separate cutting edges (Fig. 5.10)	
KM 3601:2			twisted pattern-welded		
KM 5868:80			twisted pattern-welded		
KM 5960:3			straight pattern-welded (3–5 layers)	laminated core, separate cutting edges (Fig. 5.10)	Geibig 2 or 3 / Oakeshott X
KM 6066:1			twisted pattern-welded or steel		Geibig 2 / Oakeshott X
KM 6196:1			twisted pattern-welded		
KM 6503:20			twisted pattern-welded		
KM 7011			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 9164:3			twisted pattern-welded (7–9 layers)	laminated core, separate cutting edges (Fig. 5.10)	Geibig 2 or 3 / Oakeshott X
KM 9243:2			twisted pattern-welded		Geibig 3 / Oakeshott X
KM 10390:2			twisted pattern-welded (11 layers: 5 iron and 6 steel)		
KM 10413			twisted pattern-welded		
KM 14684			twisted pattern-welded		
KM 15175:1			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 15181:2			twisted pattern-welded		
KM 18402:1			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 20127			twisted pattern-welded		Geibig 2 or 3 / Oakeshott X
KM 22106:23			twisted pattern-welded		
KM 27141:1			twisted pattern-welded		Geibig 4 / Oakeshott X
KM 30870:1			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 31550:1			straight pattern-welded or iron or steel		Geibig 2 / Oakeshott X

Figure 44. Features of ULFBERHT inlays.

the opposite sides of ULFBERHT blades are also categorized according to their similarities and differences, and then compared with the actual texts.

The inlaid motifs and inscriptions display surprising variation in the research area. There are thirty-one swords bearing the maker's name ULFBERHT (Fig. 44). Of these finds, twenty-two have a complete or almost complete inscription while nine blades or blade fragments contain only a partly preserved inscription, which may have originally read ULFBERHT. Taking all these swords into consideration, the name has two clear spelling variants: +VLFBERH+T (eleven normal cases and four variable ones) and +VLFBERHT+ (two swords), in which the latter cross is in a different position.

The variant +VLFBERH+T includes the following finds: KM 2548:839 from Laitila, KM 3052:2 from Mynämäki, KM 3131:6 from Akaa, KM 6503:20 from Hattula, KM 7011 from Kemiönsaari, KM 9164:3 from Eura, KM 14684 from Hämeenkoski, KM 15175:1 from Tampere, KM 20127 from Kokemäki, KM 22106:23 from Uusikaupunki, and KM 27141:1 from Hämeenlinna. In addition to the above, four more finds may loosely categorized as variants of +VLFBERH+T (KM 708 from Hämeenlinna, KM 2361 from Eura, KM 2767 from Valkeakoski, and KM 6066:1 from Tampere), according to the position of the second cross, but they have other features that are anomalous with regard to the eight normal ones presented above. In KM 708 the last letter T is reversed, like in one Russian find.[582] In KM 2361 the vertical beam of the first cross appears to be missing. The last T is missing in KM 2767, though this may be due to the breaking of the blade. While KM 6066:1 is too fragmentary in the middle portion of the inscription to reproduce it with certainty, the first cross seems, nonetheless, to be completely missing.

There are only four examples of the variant +VLFBERHT+: KM 10390:2 from Vesilahti, KM 10413 from Lieto, KM 15181:2 from Akaa, and KM 18402:1 from Hämeenlinna. Of these four, the text in KM 10413 is somewhat fragmentary, and its letters R and H look obscure, although corrosion has destroyed parts of them.

Find KM 3601:2 from Hollola is unique, since the last marks, the cross and the T, are joined as two similar cross-like inlays. In KM 5960:3 from Hämeenlinna the letter H and the second cross appear to be joined, and the horizontal bar of the letter H is missing, although this last feature may be due to the mechanical cleansing applied to the find possibly by Jorma Leppäaho. This inscription could be included as a possible variant of the spelling +VLFBERH+T. Also, the letter B in find KM 9164:3 from Eura looks like a simplified version. The letters V and L are strangely joined in KM 31550:1 from Jämsä. All the other strange features and missing inlays evident in the ULFBERHT swords examined here were most likely caused by corrosion.

There were nine fragmentary ULFBERHT inscriptions that could not be categorized. Three of them, KM 1174:2 from Kokemäki, KM 2548:277 from Laitila, and KM 5868:80 from Sastamala were broken in the middle of the inscription, and thus lack the portion with the second cross. The remaining six finds (KM 287 from Saltvik, Åland, KM 1869:81 from Hämeenlinna, KM 3423 from Vesilahti, KM 9243:2 from Sauvo, KM 30870:1 from Asikkala, and KM 31550:1 from Jämsä) were too corroded to exhibit all marks intact, especially the second cross. Moreover, sword KM 6196:1 from Saltvik, Åland has only vertical lines left at the place of the last two marks, the cross and the letter T. For this reason it is impossible to categorize this text, although it is otherwise complete.

ULFBERHT swords have geometric motifs on the opposite side of the blade, and these vary more than the inscription itself. Commonly some kind of lattice pattern is presented, the most common one being a woven lattice lined by six vertical lines, three on each side of the lattice. This motif is found as complete or almost complete in altogether ten cases (KM 2548:839 from Laitila, KM 3052:2 from Mynämäki, KM 6066:1 from Tampere, KM 6503:20 from Hattula, KM 7011 from Kemiönsaari, KM 9164:3 from Eura, KM 10413 from Lieto, KM 14684 from Hämeenkoski, KM 30870:1 from Asikkala, and KM 31550:1 from Jämsä). Six more may also be similar, although the motifs are somewhat fragmentary (KM 287 from Saltvik, Åland, KM 708 from Hämeenlinna, KM 1174:2 from Kokemäki, KM 5960:3 from Hämeenlinna, KM 20127 from Kokemäki, and KM 22106:23 from Uusikaupunki).

There are also fragmentary, simpler patterns containing a mere woven lattice (KM 3423 from Vesilahti and KM 3601:2 from Hollola) or a simple lattice (KM 9243:2 from Sauvo and KM 10390:2 from Vesilahti, both fragmentary). Also KM 2548:277 from Laitila has a simple lattice,

582 *Kirpichnikov 1968: 53, Abb. 6.*

although a longer one and also broken like the blade. There is somewhat similar-looking example from Krasniy Rog, Russia,[583] and another one from Rheinland-Pfalz bei Speyer, Germany, with the inscription in form +VLFBERHT+.[584] KM 1869:81 from Hämeenlinna, KM 6196:1 from Saltvik, Åland, and KM 15181:2 from Akaa have remains of some kinds of small lattices as well as possible vertical lines, one in each blade. In similar fashion, KM 2361 from Eura shows only some fragments of vertical lines. These three last-mentioned swords cannot be classified more accurately by their highly fragmentary geometric motifs.

There are also more complicated and longer designs. KM 15175:1 from Tampere contains two woven lattices lined with vertical lines. Almost similar cases with minor fluctuations in the actual inscription are known from an unknown location in Sweden,[585] Salaspils, Latvia,[586] and Mežotne, Latvia,[587] not to mention a sword from Lithse Ham in the Netherlands, having almost identical text and figures, except that the second cross is in another place and the pattern-welded rods are more flattened and robust.[588] KM 3131:6 from Akaa also contains two woven lattices, although fragmented, and two vertical lines between the lattices with none lining them. KM 18402:1 from Hämeenlinna has an incomplete lattice weave preceded by a vertical line. In similar fashion, a fragmentary lattice weave is present in sword KM 5868:80 from Sastamala. Lattice weaves can be also seen in foreign ULFBERHT blades, for example from Vanse,[589] Eid,[590] and Hellebost, Norway,[591] and also from Rokot, Russia,[592] as well as Gnezdovo.[593] KM 27141:1 from Hämeenlinna has a double lattice pattern with accompanying vertical lines. The find from Valkeakoski (KM 2767) is unique in respect to the lack of lattices, since it contains two volutes and a cross crosslet lined with vertical lines three on each side. A sword from Gnezdovo with a Petersen type E hilt has two omega-like designs lined by vertical lines, and having lines also between them, all figures being non-patterned iron.[594]

When combining the motifs from different sides of the blades some similarities may be observed. Designs with the inscription +VLFBERH+T accompanied by a woven lattice and six vertical lines can be recognized in a total of five examples (KM 2548:839, KM 3052:2, KM 6066:1, KM 6503:20, and KM 9164:3). Also KM 14684 may be read into this category, since it has seven vertical lines lining a woven lattice instead of six. In addition, eight more blades may be included in this category (KM 287, KM 708, KM 1174:2, KM 5960:3, KM 20127, KM 22106:23, KM 30870:1, and KM 31550:1), although their inlays are fragmentary due to the poor degree of preservation or fragmentary nature of these finds.

583 *Müller-Wille 1970: 80, 88. The sword is catalogued in the collections of the Museum of Kiev, and the hilt is of Petersen's type H.*

584 *Geibig 1991: 117, 208, 289, Taf. 79. The hilt is of Mannheim-Speyer type or Geibig's combination type 4.*

585 *Anteins 1966: 113–114, Abb. 2; Anteins 1973: 43–44; Müller-Wille 1970: 78, 85. Catalogue number LVM-5608 with a hilt of Petersen's type I.*

586 *Anteins 1966: 113–114, Abb. 2; Anteins 1973: 43–44; Müller-Wille 1970: 78, 86. Catalogue number LVM-DM 1906 in the Latvian History Museum and a hilt of Petersen's type Z.*

587 *Müller-Wille 1970: 78, 86. Catalogue number LVM 64609 in the Latvian History Museum with a hilt of Petersen's type H.*

588 *Ypey 1986: 139-143.*

589 *Müller-Wille 1970: 77, 84. Museum of Stavanger 1021. The hilt is of Petersen's type S.*

590 *Müller-Wille 1970: 78, 85. The sword has the catalogue number 3149 in the collections of the Museum of Bergen 3149 and has a hilt of Petersen's type H.*

591 *Müller-Wille 1970: 78, 85. Catalogued in the Museum of Bergen under number 1165. The hilt is of Petersen's type H.*

592 *Müller-Wille 1970: 80, 88. A sword in the museum of Smolensk, having a hilt of Petersen's type E.*

593 *Kainov 2012: 31–32, 36. The hilt is of Petersen's type I decorated with silver wire inlays.*

594 *Anteins 1973: 43–44; Kainov 2012: 20–21; Kirpichnikov 1968: 53, Abb. 6; Kirpichnikov 1970b: 56–57; Müller-Wille 1970: 80, 88; Stalsberg 1989: 16, Fig. 10. The catalogue number of the sword is GIM-khr. 12 a/1 195 in the State Historical Museum in Moscow.*

However, the categorization like this is not as straightforward as it may first seem. The most noticeable differences arise from the appearance of the lattice patterns, mainly in the arrangement of the inlaid rods. For example, the lattice in KM 20127 is somewhat poorly done, since it is not strictly geometric but rather disorganized in appearance. The lattice of KM 2548:839 lacks the vertical lines within which the lattice is usually lined. KM 6066:1 has a simplified version of the lattice, since it lacks certain lines completely. Furthermore, the arrangement of the inlaid rods seems to vary.

Taking into consideration the materials of the ULFBERHT inlays, the find material itself proves to be further varied. An inspection of the blades with either the complete or fragmentary inscription +VLFBERH+T accompanied by a woven lattice and six vertical lines, shows that almost all of them have twisted pattern-welded inlays, in two cases with seven or nine layers. In the case of KM 3052:2 from Mynämäki the inlays appear to have been made of straight pattern-welding of three or five layers. The fragmentary blade KM 5960:3 from Hämeenlinna also has seemingly straight pattern-welded inlays, with only three or five layers. Also the material of KM 31550:1 from Jämsä is either straight pattern-welded or plain iron or steel. This find bears a striking resemblance to swords from Waal bei Nijmegen, Netherlands,[595] and Gjersvik, Norway.[596] Also the inlays of KM 6066:1 from Tampere may be either pattern-welded or then plain steel. Also the fragmentary inlays of KM 1174:2 from Kokemäki are most likely steel.

In all other, unique cases of ULFBERHT blades apparent in the studied finds, mainly with varying motifs on the opposite flat of the blade, the inlays were made from twisted pattern-welded rods. They usually have two clearly contrasting materials used to compose the layers, but in the case of KM 2767 from Valkeakoski the twisted rods contain seven or nine layers of a similar kind of iron.

Compared with foreign finds, almost all these ULFBERHT swords are characterized by pattern-welded or "damascened" inscriptions, whatever the latter may mean. An ULFBERHT sword from Søndfjord, Norway, illustrated in Anders Lorange's work, appears to contain plain iron inlays.[597] A sword from grave one from the cemetery of Biskupija-Crkvina in Yugoslavia has been claimed to have an etched ULFBERHT inscription on a possibly pattern-welded base, and is dated to the beginning of the 9th century according to the context.[598] Also another ULFBERHT blade has been claimed to have a pattern-welded mid-section.[599] Although these cases are plausible, at least the first one with an etched inscription sounds and also seems dubious. Firstly, the published drawing of the sword has only a very small-scale inscription randomly placed in the middle of the wide fuller, while normally the text was well-fitted to correspond to the width of the fuller. Secondly, a shallow etched text or markings are very unlikely to survive when a sword has been buried in the ground for over a thousand years.

To summarize the twenty-five ULFBERHT inlays and their accompanying geometric motifs, none of them seem to be identical to each other, taking into consideration the contents of the inlays, their appearance and arrangement, and their materials. Both the correctness of the actual inscriptions and the geometric motifs seem to vary a great deal. In association with the inscriptions, there are joined and reversed letters, as well as variations in the crosses. The geometric motifs include of course neat ones, but also strangely deformed ones, which may suggest the presence

595 *Ypey 1984: 216–217, Abb. 2; Ypey 1986: 142–143.*
596 *Pentz 2012: 128, Fig. 21. This sword has a Petersen type K hilt.*
597 *Lorange 1889: Tab. II.2.*
598 *Geibig 1991: 122–123; Mirnik 2004: Tabla 12; Müller-Wille 1970: 77; Vinski 1966: 301; Vinski 1983b: 499, number 11.*
599 *Vinski 1983b: 500, number 18.*

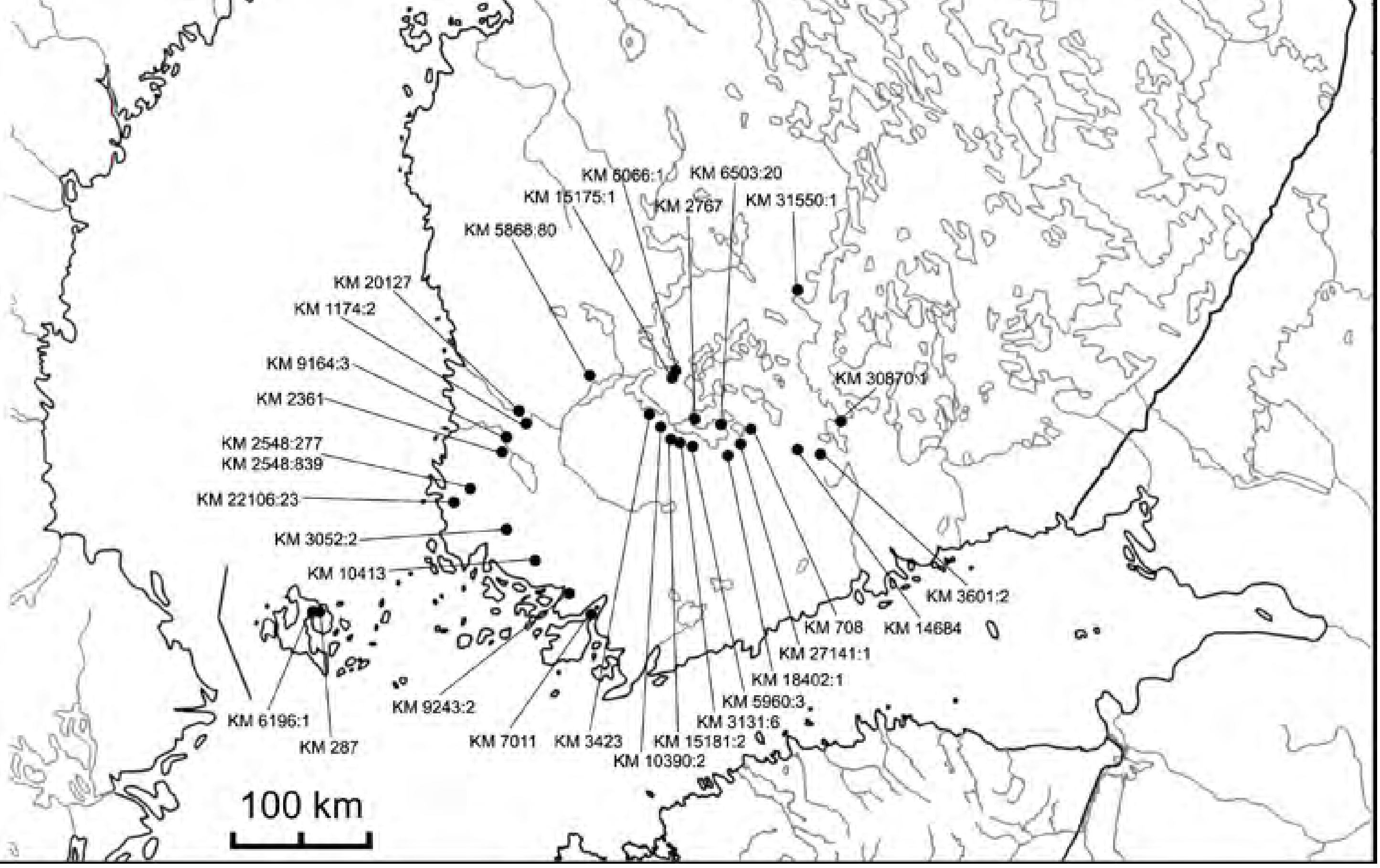


Figure 45. The geographic distribution of swords with ULFBERHT inlays.

of different smiths of various levels of skill. Also the practical execution and the materials of the inlays point in this direction. Characteristic to the technical execution of sword blade inlays is that every letter has to be made from smaller parts. In the ULFBERHT texts the arrangement of these parts, i.e. the part of a letter that is made first, also varies.

In addition to the above, the four analysed ULFBERHT blades (see Chapter 4.4) must be considered here. Although they all had separately welded cutting edges, the lamination of the blade core as well as the materials used for both the core and the edge varied. This is no surprise since the arrangements of the texts of these four specimens were different from each other, especially the lattice patterns. In one of these blades (KM 5960:3), even the inlaid material was not twisted pattern-welded but straight, having fewer layers than the twisted ones.

Here we must mention Alfred Geibig's classification, in which he categorized ULFBERHT swords as 'originals' and 'copies' according to certain details of the inscriptions, mainly in the layout of the letters and crosses (see below). According to Geibig, the original ULFBERHTs in the Finnish material are finds KM 1174:2, KM 3052:2, KM 5868:80, KM 6066:1, KM 6503:20, and KM 9164:3. Copies are finds KM 369, KM 2548:839, KM 2361, KM 2767, KM 3601:2, and KM 10390:2.[600] Geibig's definitions are based on small details such as reversed or joined letters and so on, and the list of ULFBERHT swords is taken from Leppäaho's posthumous publication.[601]

The "originals" as interpreted by Geibig all have correctly spelt inscriptions, either complete or fragmentary. A closer look at the blades and their inlays, however, reveals considerable differences. The materials of the inlays vary from plain steel to straight and twisted pattern-welded rods. Similarly the materials are different, ranging from low-carbon to high-carbon steel (see Chapter 4.4). In this light, the quality of these sword blades was quite varied to be originally from the same smithy. Naturally this kind of variation is also present in the category of Geibig's "copies". A note must be made of the KM 369, which is an ULFBERHT sword according to Leppäaho's

600 *Geibig 1991.*
601 *Leppäaho 1964b.*

publication, but due to errors in this posthumously compiled work, the illustration in the text actually belongs to sword KM 708.

The spatial distribution of the variants of ULFBERHT blades is presented in Figure 45. It is notable that more blades of this kind have been found in the Tampere region than in the regions of Finland Proper and Satakunta. The variant +VLFBERH+T is known from all the above-mentioned areas, but the variant +VLFBERHT+ is concentrated in the Tampere region, with only one example from Finland Proper. The geometric patterns on the opposite sides of the blades are somewhat randomly divided. Except for one find from Finland Proper, all the patterns that are more special than a woven lattice with six vertical lines were found in the Tampere region.

Unto Salo has noted that the distribution of ULFBERHT swords in Finland, being limited to the Vakka-Suomi area in the Finland Proper region, the Satakunta region, and in valley of the River Aura, resembles the distribution of jewellery possibly connected to trade with the Birka region in Sweden.[602] It must be noted here that at the time the corpus of identified ULFBERHT swords was very limited, compared with the investigations for the present study.

5.3.1.2. Alternatives for interpretation, dating and origin

In the studied find material, also on the European level, Ulfberht is the most common proper name appearing on the blades. Unlike some other names such as Benno, Beno, later Gicelin, and even some examples with the name Ingelrii, the name Ulfberht is not followed by the phrase “me fecit”, i.e. “made me”. Still Ulfberht is simply and generally interpreted as a blacksmith or a bladesmith. Since the Ulfberht blades are dated as an earlier phenomenon than the Ingelrii blades, it has been suggested that Ulfberht was a blacksmith innovating the custom of ferrous inlays, or at least the custom of marking the blade with an inlaid maker’s name.[603] As has become evident in this study, the pattern-welded marks during the time of Ulfberht were already a reproduction of an old technical tradition.[604]

Besides the traditional theory of a single sword-maker, alternative explanations have also been suggested. While Ulfberht may have been a blacksmith or a swordsmith, his smithy could well have been operated by slaves, since the slave trade was commonly practised in the Carolingian empire.[605] This hypothesis has been used to justify the errors in spelling, since slaves most likely lacked the skills of reading and writing.[606] Thus Ulfberht was a blacksmith merely supervising the production of swords and their quality.[607] This theory has, however, its drawbacks. If Ulfberht, for example, supervised the quality of the blades, would he not have also supervised the inlaying process of the name, not accepting all kinds of misspellings of his own name?

Generally Ulfberht has often been seen as a brand of its time.[608] The blades marked with this name have traditionally been regarded as of high quality, and often also attached to richly, mainly geometrically decorated hilts.[609] In connection with the good quality of the blades, which perhaps refers to the quality of the steel and the techniques used to harden the blades, Ulfberht swords

602 *Salo 1982: 18–19.*
603 *Ellis Davidson 1962: 46.*
604 *See also Kirpichnikov 1970a: 172.*
605 *Stalsberg 2007a: 17.*
606 *Stalsberg 2007a: 17. For example, one of the oldest ULFBERHT variations according to hilt typologies is spelt +VLFBEHT+, interpreted as the work of an illiterate slave (Stalsberg 2008: 20).*
607 *Stalsberg 2007b: 12.*
608 *E.g. Andresen 1994: 201.*
609 *E.g. Kirpichnikov & Stalsberg 1993a: 37.*

have been considered as better-balanced in comparison earlier swords, making them more swift and efficient in combat.[610] Thus Ulfberht as a person has been regarded as responsible for the change in the general attributes of the sword during the middle of the Viking Age. Of course this point of view is challenged by the early dates of some ULFBERHT swords, according to the hilt typologies and find contexts.

Other figures than Latin letters in the motifs of ULFBERHT swords point towards Christianity. Most importantly the crosses, which are generally accepted as emblems of Christian faith.[611] Unto Salo has suggested that perhaps the swords with inlaid crosses, in particular, made Finnish people of the period increasingly aware of Christian symbols and namely Christianity.[612] On the other hand, a cross is a very simple mark that was already used in the Stone Age. The cross crosslet evident in sword KM 2767 is more rare in the Finnish archaeological material as a whole.[613] According to Salo, the three vertical lines evident in the majority of ULFBERHT swords may represent the Holy Trinity, especially in connection with other Christian symbols.[614] Similar meanings may be sought for these above-mentioned figures also connected to other kinds of inlaid inscriptions and motifs and not only ULFBERHT.

At a very general level ULFBERHT inlays have been dated to the later Viking Age.[615] Rudolf Wegeli placed them between 900 and 1000 AD.[616] Ada Bruhn Hoffmeyer dated ULFBERHT swords between 850 and 1050 AD, dismissing the very beginning of the Viking Age.[617] Later studies suggest that the time span was longer, the first blades bearing this name appearing already around 800 AD, i.e. where the beginning of the Viking Age is traditionally set.[618] Also the use of these blades is suggested as extending up to the 12th century.[619] The swords with ULFBERHT inlays are dated to a period of roughly two hundred years,[620] hinting towards the name of a smithy rather than an individual. According to Jouko Räty, ULFBERHT strictly dates from the Viking Age at least in the Finnish material, and all later examples from the 11th and 12th centuries have a newer hilt attached to an older blade.[621] The considerably wide time span of the hilts has also been observed in Norway, where they date from ca. 800 AD all the way to the 12th century.[622]

Having studied the chronology of ULFBERHT swords more deeply, Anne Stalsberg has calculated that one third of these swords date from the 9th century, and the rest of them mainly from the 10th century, some examples being of even later date.[623] In the Norwegian material, these swords may be dated throughout the Viking Age, and Stalsberg emphasizes that certain variants of the text cannot be definitely dated to a certain century.[624] The chronology of ULFBERHT swords is problematic, since they have to be dated in accordance with hilt typologies, especially those found

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610 Jankuhn 1951: 212.
611 E.g. Salo 2005b: 122–123.
612 Salo 2005b: 122–123.
613 Salo 2005b: 128.
614 Salo 2005b: 76–78.
615 E.g. Petersen 1919: 101. The dating has normally been established according to the hilt types appearing in connection with the blades. Michael Müller-Wille (1970: 72–75), for example, has stated that the most common hilts on ULFBERHT swords are Petersen's types H, T, X, S and V, all datable to the latter half of the Viking Age.
616 Wegeli 1903–1905.
617 Bruhn Hoffmeyer 1954: 110–111.
618 Kirpichnikov & Stalsberg 1993a: 37. Alfred Geibig places ULFBERHT inlays in his own blade types two and three, giving a dating of 800–950 AD (Geibig 1991: 154–155).
619 Olsen 1972: 528.
620 E.g. Ellis Davidson 1962: 48; Oakeshott 1960: 143; Stalsberg 2007a: 17.
621 Räty 1978: 18.
622 Stalsberg 2008: 8.
623 Stalsberg 2007a: 16.
624 Stalsberg 2008: 10.

in waterlogged locations in the Frankish areas and Great Britain.[625] Stalsberg regards the early appearance of ULFBERHT swords to be connected with the Carolingian renaissance, ca. 800 AD, when the use of written language expanded.[626] Moreover, ULFBERHT blades may have been of such high value that they were re-hilted later on to newer types of hilts.[627] One implication of the later utilization of an older blade is a sword from Västmanland in Sweden showing a silver cross added later on top of an ULFBERHT inscription.[628] A similar case is also known from the Netherlands.[629] It is also possible that some of these blades could have been given a typologically older hilt from some older sword.

Traditionally, ULFBERHT has been considered to be a Frankish name,[630] more accurately West-Frankish, having been made from iron ores extracted from the Pyrenees.[631] The more accurate location of the smithy has been suggested in the Middle Rhine or near the town of Passau on the upper Danube,[632] or in the Rhineland region of the town of Solingen.[633] At some point the name was suggested to be even from the territory of the modern-day Netherlands, although this theory has been regarded as somewhat unlikely.[634]

Linguistically, the name ULFBERHT has commonly been divided into two parts, VLF and BERHT. The first part of the name, VLF, has been considered as western Frankish,[635] or even Nordic.[636] The ending BERHT has been considered as clearly Frankish,[637] most commonly appearing in the central areas of the Frankish kingdom.[638]

The variations in the spelling have been suggested to be also of Frankish origin, because the correct spelling of the name could have been uncertain at that time.[639] Already in the Frankish areas the name shows numerous dialectical variations. Anne Stalsberg[640] has listed the variants evident in the *Libri Confraternitatum Sancti Galli* dating from the 9th to the 11th centuries,[641] for example Uolfberht, Uolfbernt, Uolfbernus, Uolfberht, Wolfbert, Uolfbertus, and Wolfbertus. The provenance of ULFBERHT, both as a name and as a blacksmith is complicated by the fact that the name does not appear in any Frankish literary sources. This is strange since a swordsmith like him must have been an important person, and furthermore, the production of weapons was supervised and controlled by the king.[642]

One explanation for the variation has been given in an article by Herbert Jankuhn, where the spelling variants are regarded as caused by differences of spelling evident at different times, for example BER(H)T is an older form than BRAHT and BRE(H)T.[643] More commonly though,

625 *Stalsberg 2008: 9.*
626 *Stalsberg 2008: 16.*
627 *Stalsberg 2008: 10.*
628 *Thålin-Bergman & Arrhenius 2005: 50. The catalogue number of the sword is VSM 362 in the Västmanland County Museum.*
629 *Ypey 1986.*
630 *E.g. Jankuhn 1951: 218–220; Müller-Wille 1970: 82; Petersen 1919: 149.*
631 *Lorange 1889: 58–59.*
632 *Jankuhn 1951: 219; Oakeshott 2002: 7.*
633 *Oakeshott 1960: 142–143; Stalsberg 2008: 1.*
634 *Jankuhn 1951: 218; Stalsberg 2007a: 17.*
635 *Müller 1970: 91.*
636 *Bernhardt 1928; Lorange 1889: 18.*
637 *Lorange 1889: 18.*
638 *Müller 1970: 91.*
639 *Lorange 1889: 19.*
640 *Stalsberg 2007b: 13; Stalsberg 2008: 17.*
641 *Piper 1884. For the sake of clarity, the work in question is a codex of the fraternity of the Monastery of St. Gallen located in the modern-day Switzerland.*
642 *Stalsberg 2007b: 12.*
643 *Jankuhn 1951: 219.*

the variants have been interpreted as possible Nordic copies.[644] It must also be noted that in a linguistic sense the name ULFBERHT in its correct form could also be Scandinavian, because the prefix W had vanished in Scandinavia, while it was still in use in the Frankish areas.[645]

5.3.1.3. The spatial distribution of ULFBERHT blades in Europe

There have been several attempts to calculate the total number of ULFBERHT swords. In connection with the Russian-Norwegian sword project, the number has been suggested to have been as high as 180 blades, 55 of which were found in Norway.[646] Interestingly, the number of ULFBERHT blades seems to have decreased, since a later publication by Anne Stalsberg, also participating in the sword project, mentions 167 examples from altogether 23 modern countries of Europe.[647] According to the latest published information, 44 have been found in Norway.[648] The reasons for this notable decrease in the number of these types of swords can only be guessed. Most probably it is a question of interpretation, i.e. which variants are to be counted as ULFBERHTs and which are not.

What is striking in the geographical distribution of ULFBERHT swords is that only a very small number of them, between sixteen and nineteen, have been recovered from the Frankish areas, which are divided between modern Belgium, France, West-Germany, Italy, Netherlands, Spain and Switzerland.[649] The majority of them, 144–147 specimens, have been found in 'pagan' regions, and also four from England, which was Christianized at that time.[650] As Anne Stalsberg has correctly noted, the distribution of the finds does not give the correct picture of the use of these swords, because both the find contexts and research activities affect the number of recovered swords.[651] For example, the finds from the pagan areas are mainly connected to the burial rite, while those from the British Isles and the Frankish areas are stray finds or have been recovered from waterlogged environments. It is thus likely that these swords were also used extensively by the Franks, but the burial conventions did not include grave goods, such as swords.[652]

5.3.1.4. Variations and copies

Variations within the Ulfberht text have been noted from an early stage. Rudolf Kloos distinguished six variants.[653] The first has the letters V and L joined. The second variant includes the somewhat flattened letters E, F and L, having abnormally long horizontal bars. The third category has the letter F, L or T turned upside down. In the fourth variant, the lower horizontal bar of the letter F is abnormally low. The fifth category is characterized by its broken letter B. In the sixth category the diagonal bar, or 'tail' of the letter R is very short. Now these variants concentrate on the appearance and placement of the inlays, instead of any changes in the contents themselves. As becomes evident in the experimental part of this study (Chapter 6), these above-mentioned "variations" may have easily come about by accident during the manufacture of the inlays, thus making the division meaningless. Only noteworthy thing is that if several letters are upside down, it may suggest something considering the literacy skills of the smith.

644 E.g. Thålin-Bergman 1983b: 271–272.
645 Stalsberg 2008: 16–17.
646 Kirpichnikov & Stalsberg 1998a: 508.
647 Stalsberg 2007b: 14.
648 Stalsberg 2008: 1; Stalsberg 2010.
649 Stalsberg 2008: 10.
650 Stalsberg 2008: 10. See also Jankuhn 1951.
651 Stalsberg 2008: 10–11.
652 Stalsberg 2008: 13.
653 Kloos 1970: 90–91.

Compared with these variants defined by Kloos, the ones characterized by Alfred Geibig are somewhat similar.[654] In general, all fluctuations from "normal" spelling are considered as signs of copies or counterfeits. These include, for example, the letter L, F or T upside down, a joined V and L, a circle-like design replacing the second cross between the letters H and T, two consecutive crosses instead of one, two T's instead of a cross and the letter T, a missing letter such as F or R, and only few correct letters among the letter-like marks.

Interesting notes have been made in connection with the two crosses, normally part of the Ulfberht text itself. The text is either spelt as +VLFBERH+T or +VLFBERHT+, the second cross switching the place and the first one always starting the inscription. According to Norwegian archaeologist Anne Stalsberg the variant +VLFBERHT+ is rarer.[655] Anders Lorange noted already in the end of the 19th century that the combination +T is a feature bound to certain inscriptions in a certain time period.[656]

Lately Stalsberg has been concentrating on namely Ulfberht swords during her participation in the Russian-Norwegian sword project. Her theory is that the two crosses in the name Ulfberht meant the same kind of social status as crosses in other inscriptions evident in other contexts.[657] Stalsberg maintains that since some names such as Ingelrii, Cerolt and Ulen appear without crosses, the status of the makers is different.[658] Stalsberg has connected the crosses to ecclesiastical organization, namely to Roman Catholic abbots and bishops, whose signature is normally preceded by a simple cross.[659] For example the signature of the Catholic bishop of Oslo is "+Bernt I. Eidsvig" or plain "+BE".[660] In this connection the cross is connected to jurisdiction, not consecration, and this tradition could have come about during the Gregorian reforms, i.e. under Pope Gregory the Great, who died in AD 604.[661] Stalsberg notes that also the names of monasteries begin with a cross, but a place called Ulfberht is not known.[662] Stalsberg concludes that the first cross in the name Ulfberht does not imply that the maker was a bishop or an abbot, but he could have had some position in the ecclesiastical or monastic hierarchy.[663]

One hypothesis concerning the appearance of the letter T and the second cross is that the name was originally spelt +VLFBERH, having a ligature on the upper right corner of the letter H, and when the ligature had disappeared, the letter T was added to accompany the second cross.[664]

Stalsberg has also a suggestion for the second cross in the Ulfberht signatures. According to her, the second cross may indicate that Ulfberht had a different position than for example a bishop or abbot, and it was possibly the sign of a master swordmaker.[665] Since the cross is not always in the same place, Stalsberg suggests that there were actually two men called Ulfberht, having the same position in the production chain of these sword blades.[666] According to hilt typologies, the blades with the spelling variant +VLFBERH+T are slightly older than those with the inscription +VLFBERHT+, giving grounds to assume that these were men in succession in the 9th and 10th centuries.[667]

654 *Geibig 1991: 118–119.*
655 *Stalsberg 2008: 6.*
656 *Lorange 1889: 19.*
657 *Stalsberg 2007b: 13.*
658 *Stalsberg 2007b: 13.*
659 *Stalsberg 2007b: 13; Stalsberg 2008: 18.*
660 *Stalsberg 2007b: 13.*
661 *Stalsberg 2007b: 13.*
662 *Stalsberg 2007b: 13.*
663 *Stalsberg 2007b: 13; Stalsberg 2010.*
664 *Jankuhn 1951: 220.*
665 *Stalsberg 2007b: 13; Stalsberg 2008: 19.*
666 *Stalsberg 2007b: 13; Stalsberg 2008: 19.*
667 *Stalsberg 2007b: 13.*

It should be noted here that Stalsberg also recognizes many variants on the basis of the layout of the letters, for example, and that over half (74 out of 135) of all identified Ulfberht blades in Europe belong to variants one or two, other variants being considerably rarer.[668] This has been explained by the fact that the actual smiths who forged the blades and inlays were illiterate, leading to misspelt inscriptions, some of which can be found even from the area of the early medieval Frankish kingdom.[669] Stalsberg does not, however, rule out the possibility of imitations made outside the Frankish areas. The core idea is that the smiths themselves were illiterate, while Ulfberht, or the two Ulfberhts, were masters or foremen controlling the production.[670] Stalsberg has compared the situation to that of medieval coinage, where the name of the monyer was struck on the coins, and not that of the man doing the practical work.[671]

According to Stalsberg, the geometric motifs, which also have a vast number of variants, may possibly indicate the detachment of troops, for which the blades were intended, a certain smithy, a certain quality, or even a certain officer, for whom the blade was made.[672] According to the tables in Stalsberg's publications, the simple lattice patterns seem to predominate. The idea of a connection with a certain smithy or a certain maker has also been suggested in the case of other maker-inscribed swords. For example a LEUTLRIT-inscribed sword from Great Britain contains an S-shaped figure on the opposite face of the blade, being interpreted as some kind insignia of the maker.[673] Furthermore, the last letter T is upside-down, as analogous to the inscription on Ethelwulf's (AD 836–858) golden ring.[674]

Alan Williams's classification was also mentioned above in Chapter 4.5.1.1. He connected the phenomenon of the cross changing its place to the locality of the smithy. According to him, blades with the inscription +VLFBERH+T (group A) are the "original", high-quality pieces that were forged from possibly crucible steel.[675] Williams considered the blades with the inscription +VLFBERHT+ (group B) to be later imitations, although fairly good ones, since they had hardenable steel edges. The motive for this possibly lay in the need to imitate a tough and sharp original, according to Williams, a crucible steel blade, and the inscription was there only to convince the buyers.[676] Groups C and D include all kinds of spelling variants, the variation being greater in group D. The variations may include for example reversed and missing letters, which were also evident in the Finnish material.

As noted above, Williams does not take into consideration the inlays themselves. In addition, his attention is concentrated on the appearance of the ULFBERHT text, in many cases relying on an interpretation by some other researcher.[677] The geometric motifs on the opposite side of the blade are ignored completely, although they show greater variation than the texts themselves. Furthermore, the materials of the inlays are not treated. On this basis, Williams's classification cannot be applied to the categorization of the inlaid motifs.

In addition to the Ulfberht blades, the Ingelrii blades also have a lattice pattern on the opposite side of the blade. Normally the lattice is lined with vertical lines, as also in the case of Ulfberht swords. It is essential to notice that not all lattices are similar, but there is instead some variability,

668 *Stalsberg 2007b: 13.*
669 *Stalsberg 2007b: 13–14.*
670 *Stalsberg 2008: 18.*
671 *Stalsberg 2008: 18.*
672 *Stalsberg 2007b: 13; Stalsberg 2008: 7, 10.*
673 *Maryon 1950: 178.*
674 *Maryon 1950: 178.*
675 *Williams 2009.*
676 *Williams 2007: 239.*
677 *See also Astrup & Martens 2011.*

in the same fashion as in the actual inscriptions. One line of thought could be that similar kinds of inscription variants combined with similar lattice patterns represent the same swordmaster or family of smiths.[678] This theory could also be applied to both Ulfberht and Ingelrii swords (see below).

The lattices may also have been understood also as Christian symbols. For example the simplest lattices appear to be composed of consecutive St. Andrew's crosses. The problem here is to define whether these kinds of lattices were meant to be several crosses, or if they were merely decorative designs or meant as marks of the blacksmith.[679]

How have the Ulfberht blades been understood, for example, in Scandinavia? If we are to believe the traditional theory of Continental European origin and illiterate buyers in the north, perhaps these blades were considered as the best and the sharpest because of their "magical" symbols.[680] The inlays may then have had significance as having some sort of magical powers. It has been suggested that even Finnish illiterate blacksmiths copied these Ulfberht signatures to add their effectiveness with these magical marks. According to this interpretation, this activity can hardly be considered as counterfeiting the originals. A more down-to-earth approach is that the pattern-welded marks indicated good quality.[681] It may well be that if the original Ulfberht swords were of comparatively good quality, the maker had felt some pride over his profession, and had the urge to mark his product in such a complicated manner.[682] Of course at the simplest level, the ULFBERHT brand was well-known and desired, which led to counterfeiting.[683] As Stalsberg has correctly noted, only the variations in the forging technologies may distinguish different makers, and between imitations and originals.[684] It has even been speculated that some ULFBERHT blades may well be copies of copies.[685] This, of course, complicates the picture even more.

The likelihood of copying of ULFBERHT inscriptions has been fuelled by certain finds from very early on. A sword from roughly the Late Viking Age from the River Nene near Wisbech in England has the misspelt inscriptions +VFLBERHTCC+ and +INGEFLRII+ on the opposite sides of the blade, and has been interpreted as a copy.[686] Another possible attempt to produce a copy of an ULFBERHT sword is the one with the inscription EEEBRHT, recovered in Aizkraukle, Latvia.[687] A sword from Bengtsarvet, Sweden has the inscription PULFBRII on one side and a woven lattice and six vertical lines on the other, indicating a copy of an ULFBERHT blade.[688] In addition, one Norwegian sword bears the text +VLFBERH+T on both sides of the blade.[689] A sword from Mannheim, Germany has the name spelt as +VLFBEHT+.[690] A somewhat later version was found in East Germany with the text Ulfberht on one side of the blade, and +IINIOMINEDMN on the other, indicating a version of the phrase "IN NOMINE DOMINI".[691] Also some finds lack the geometric motifs, showing letter-like obscure motifs

678 *Räty 1983: 171.*
679 *Prank 2011: 104.*
680 *Vilkuna 1975: 78.*
681 *Stalsberg 1989: 22.*
682 *Källström 1952: 84–85.*
683 *E.g. Räty 1978: 17.*
684 *Stalsberg 2008: 1, 20–21.*
685 *Lønborg 1994: 10.*
686 *E.g. Anteins 1973: 45–46; Müller-Wille 1970: 76, 82; Oakeshott 1960: 143; Stalsberg 2008: 7.*
687 *Anteins 1966: 114, Abb. 2; Anteins 1973: 47; Müller-Wille 1970: 76, 82. The catalogue number of the sword is LVM-DM I 2898 in the Latvian History Museum.*
688 *Kirpichnikov & Stalsberg 1998: 498–499, 501, 503. The catalogue number of the find is SHM 22293:II in the Swedish History Museum.*
689 *Müller-Wille 1970: 77; Stalsberg 2008: 7.*
690 *Geibig 1991: 117, 207, 267, Taf. 57. The hilt is of relatively early Mannheim-Speyer type or Geibig's combination type 4.*
691 *Stalsberg 2008: 7.*

Catalogue number	Inlays, Side A	Inlays, Side B	Material of inlays	Blade construction	Blade type
KM 2508:124			iron		
KM 2986:4			twisted pattern-welded (9–11 layers)	laminated (Fig. 5.9)	
KM 6245 A:1			straight pattern-welded (3 layers: 1 iron and 2 steel)		Geibig 2 or 3 / Oakeshott X
KM 6689:2			twisted pattern-welded (7–9 layers)		Geibig 2 / Oakeshott X
SatM 12563			iron	pattern-welded (Fig. 5.14)	

Figure 46. Features of INGELRII inlays.

instead, such as a sword from Saaremaa, Estonia.[692] If these kinds of blades with two names or their imitations can be made, why not blades with a name or a misspelt one accompanied by a geometric pattern of some kind?

Alfred Geibig has distinguished three categories of ULFBERHT copies.[693] The first group includes anonymous blacksmiths or swordsmiths from within the Frankish areas, copying the brand of their compatriot. The second category comprises likewise anonymous smiths, this time outside the Frankish areas. The third group consists of later-manufactured blades, no longer contemporaneous with the original Ulfberht or his counterfeiters. Good examples of the last group are ULFBERHT inscriptions accompanied by Biblical phrases, for example IN NOMINE DOMINI and its variations.

In my opinion it seems difficult to determine which ULFBERHTs are originals, because even some correctly spelt ones were made from different materials and with various inscriptions replacing the geometric motifs, which in turn may be connected to Christianity and/or various smiths. It is also possible that the variations in geometric patterns may also be due to copying.

5.3.2. INGELRII

5.3.2.1. Features of the studied finds

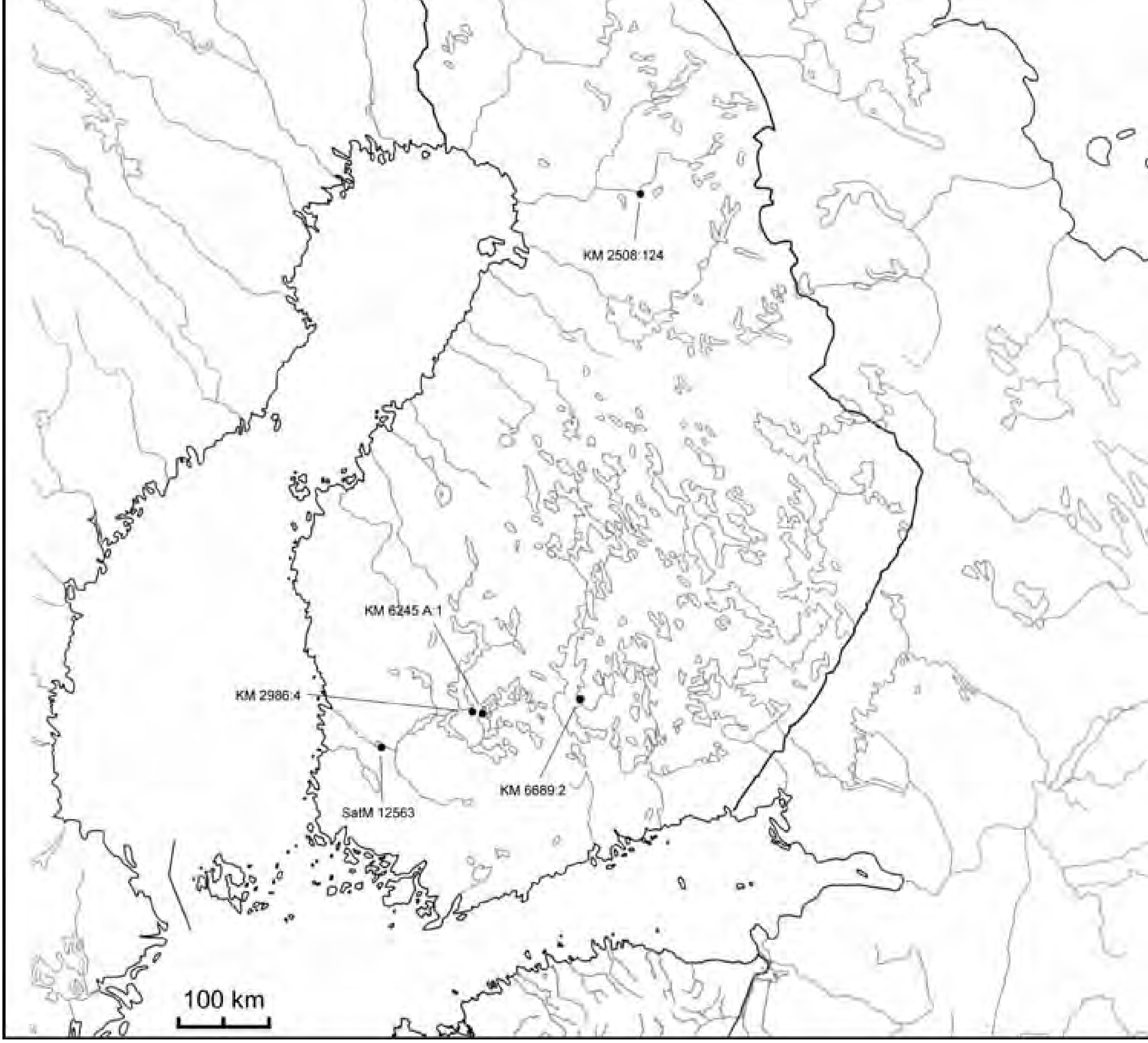
The second group consists of INGELRII inlays, again taking into consideration the geometric patterns on the other side of the blade as an aid in categorization. These inscriptions are included as their own separate group, because they are few in number, although not as numerous as the ULFBERHT inscriptions.

Four blades bearing the name INGELRII and one in the form of INGELRE have been found in the research area (Fig. 46). In two cases (KM 2508:124 from Pudasjärvi and KM 6245 A:1 from Kangasala) the letter N is reversed. Furthermore, the name is spelt as INGELRE in one sword blade from Pudasjärvi (KM 2508:124), possibly lacking the last letter D.

The geometric motifs appearing on the opposite faces of blades display much less variation than in ULFBERHT swords, because the basic composition of one central figure lined with six or more vertical lines is followed in all cases. The central motif then can be a woven lattice (KM 6689:2 from Sysmä), arrow-like inlays imitating a lattice (KM 2508:124 and KM 6245 A:1), or a figure resembling St. John's Arms (KM 2986:4 from Tampere). In one case the motif consists of altogether nine vertical lines arranged in clusters of three lines (SatM 12563 from Kokemäki).

692 *Anteins 1973: 43–44. The catalogue number of the sword is IIZ-K 85:188, with no more specific information about the collection or museum.*

693 *Geibig 1991: 122.*



When comparing both sides of the blade, only two of these swords, KM 2508:124 from Pudasjärvi and KM 6245 A:1 from Kangasala are close to being identical, both having arrow-like inlays between vertical lines, and a reversed letter N in the actual inscription. The only crucial difference is that the name is spelt differently in both cases. Thus, already in regard to the appearance and arrangement of the inlays all five examples are different from each other.

Figure 47. The geographic distribution of swords with INGELRII inlays.

The materials of the inlays are likewise variable. In two cases the inlays are of twisted pattern-welded rod, although with alternating numbers of layers. In KM 2986:4 the layer count is between nine and eleven, while in KM 6689:2 it seems to be slightly less, perhaps between seven and nine. The inlays in KM 6245 A:1 are made from straight pattern-welded rod with only three layers, one of iron and two of steel. Despite this apparently crude solution, the inlays must have been of striking striped appearance. In the case of KM 2508:124 and SatM 12563 the inlays appear to be made of plain iron. Find SatM 12563 is also exceptional in regard to its blade, with clear indications of simple pattern-welding (see Chapter 4.4.6 and Fig. 28).

The find locations of the INGELRII swords are presented in Fig. 47. Like in the case of ULFBERHT blades, the finds are concentrated beyond the provinces of Finland Proper and Satakunta. The find from Pudasjärvi (KM 2508:124) is an anomaly.

5.3.2.2. Dating and interpretations

The INGELRII blades have generally been regarded as slightly later than ULFBERHT blades. Normally the chronology is based on the hilts, which in many cases have only a pommel and a long crossguard, thus dating from the end of the Viking Age or later.[694] In the swords studied here the hilts date from the end of the Viking Age. Rudolf Wegeli has dated the INGELRII inlays similarly and broadly as contemporaneous with ULFBERHT inlays, from between 900 and 1000 AD.[695] Oakeshott dates the appearance of INGELRII swords to around 925 AD.[696] Many INGELRII blades belong to Geibig's blade types two, four and five, dating roughly from before and after 950 AD and the 11th century.[697] Many scholars consider INGELRII blades to appear in the second half of the 10th century.[698] The use of these blades has in turn been interpreted as extending to 1050 AD,[699] or even as late as 1150–1200 AD.[700]

The name INGELRII has only minor documented variations. Some blades have the name spelt as INGELRED,[701] as was possibly the case, or thus attempted as in the case of sword KM 2508:124 (see above). In one case the other side of the blade is inscribed INGELRED and the other FIT, interpreted as "FECIT".[702] Misspelt forms of this such as INGELRD and INGLRD are also known.[703] Alfred Geibig documented a form spelt as INGERIT.[704] Also INGELRILT appears in a 12th-century sword blade.[705] A sword from Hilgartsberg, Germany has the name spelt as INCERIIT with the letter T reversed, and the other side of the blade bearing the fragmentary inscription INNCIT.[706] A sword found in Myjava, Slovakia has the name spelt as INGLERII and the reverse side contains a woven lattice with vertical bars.[707] A Polish sword from an unknown locality has the name spelt as INGEELRIDI.[708] Another Polish example has the name INGEFLRICII accompanied by an X-like mark and two omegas.[709] In some cases, the text INGELRII also includes a cross, which is normally found in connection with ULFBERHT signatures. Anne Stalsberg has counted a total of 37 examples (or 32 depending on the interpretation), nine of which include a cross.[710] One fragmentary example is known from Gnezdovo with pattern-welded inlays and a Petersen type V hilt.[711]

As in the case of ULFBERHT, also INGELRII has been interpreted as the name of the maker, the smith, but possibly also a smithy. Since the datings are slightly later than in the case of ULFBERHT, INGELRII has been regarded as a younger competitor of Ulfberht.[712] The Frankish areas are generally given as the region of origin. However, the name INGELRII may be

694 *E.g. Räty 1978: 18.*
695 *Wegeli 1903–1905.*
696 *Oakeshott 2002: 8.*
697 *Geibig 1991: 154–155; Oakeshott 2002: 22–23.*
698 *E.g. Bruhn Hoffmeyer 1954: 112–113; Geibig 1991: 155; Jankuhn 1951: 226.*
699 *Geibig 1991: 155.*
700 *E.g. Bruhn Hoffmeyer 1954: 112–113; Olsen 1972: 528–529.*
701 *Bruhn Hoffmeyer 1954: 112–113; Lorange 1889: 15.*
702 *Lorange 1889: 15; Wegeli 1903–1905: 183.*
703 *Jankuhn 1951: 226.*
704 *Geibig 1991: 155.*
705 *Ellis Davidson 1962: 48.*
706 *Geibig 1991: 117, 207, 222, Taf. 12; Schmid 1918–1920: 244. The sword has the catalogue number 4716 in the National Museum in Munich. The brazil-nut pommeled hilt is of Geibig's combination type 16.1. According to the published pictures, the inlays may be of non-patterned iron, but this remains uncertain.*
707 *Głosek 1984: 103, 139, Tabl. III; Ruttkay 1971: 164–165, 253–255.*
708 *Kazakevičius 2007: 350. The sword is catalogued in the Warsaw Museum of Archaeology under catalogue number 1424. The hilt of the sword is of Petersen's type T.*
709 *Głosek & Pudło 2010.*
710 *Stalsberg 2008: 18.*
711 *Kainov 2012: 46–51. For analyses of this blade see Chapter 4.4.4.*
712 *Jankuhn 1951: 226.*

traced also to England, where the monyer of King Ethelred (978–1013 AD and 1014–1016 AD) was called Ingelri at Winceaster.[713] Later studies largely ignore this piece of written information, since the swords were considered to be Frankish in any case. The name in the form INGELRED has been paralleled with ENGELRAD, which, however, cannot be used to verify the place of manufacture due to the widespread use of the name.[714]

An interesting phenomenon not seen in any ULFBERHT blade documented so far is the existence of "fecit" and "me fecit" phrases, meaning simply "made me". This, of course, points very strongly to a single blacksmith. Following a similar line of thought in the case of ULFBERHT inlays, Anne Stalsberg maintains that the four documented INGELRII texts with "fecit" or "me fecit" may still have been manufactured for example by slaves, and INGELRII could also have been a swordmaster, merely supervising the work.[715] The best-preserved example of an +INGELRIIMEFECIT+ inscription is from Sigridsholm, Sweden.[716] A sword from Oosterhesselen, Netherlands bears the inscriptions +INGERIHFECIT and SIGBRHANI followed by lattices and half-moon figures all the way to the tip, all the marks being pattern-welded.[717] Also a sword from Gródek upon Bug, Poland has a similar kind of inscription reading +INGELIIRMEFCIT+, the other side being inscribed +INHOMEFECT+, all the crosses being cross potents.[718] The sword, dating from roughly between 1150 and 1200 AD, had inlays made of steel rods and all in the same small size as found in connection with, for example, GICELIN inscriptions.

Certainly a name or brand like INGELRII was also copied. One example from England was already mentioned in connection with the ULFBERHT swords, having the inlays +VFLBERHTCC+ and +INGEFLRII+ on opposite sides of the blade, both incorrectly written.[719] Another clearly misspelt case is from Fyrisån, Sweden, a fragmentary text in the form of "INGEELRILT", approximately, and the other side bearing complex geometric and symmetric motifs consisting of a lattice-like pattern in the middle lined by figures resembling the letters E, I and O.[720] Marian Głosek mentions a Slovakian sword with the inscription +NGEILRICENS, interpreted as a possible copy of INGELRII and dating from between 1000 and 1200 AD.[721]

Unfortunately no studies of greater detail on the inlays have been undertaken, and the variations of the geometric motifs on the opposite blade fuller remain unknown, apart from the Finnish material now, of course. To mention some variations on the same theme of a central figure lined with vertical bars, a sword from the River Thames at the Temple, London has a pattern-welded cross potent lined with vertical lines, three on each side, while the inscription is of the form INGELRII.[722] Also a sword with the inscription INGELRII accompanied by a smaller inlay on the opposite side of the blade reading HOMO DEI must be mentioned.[723] This particular blade combines the larger Viking Age inlays with the later smaller ones created during the 11th century.

713 *Lorange 1889: 16.*
714 *Bernhardt 1928: 219.*
715 *Stalsberg 2008: 21.*
716 *E.g. Anteins 1973: 46; Arbman 1936; Jankuhn 1951: 221–222, Abb. 2; Müller-Wille 1973: 81, 104; Thålin-Bergman & Kirpichnikov 1998: 498, 501, 503. The catalogue number of the sword is SHM 14471 in Swedish History Museum.*
717 *Ypey 1984: 216–219.*
718 *Kuśnierz 2006: 93–95. In the article, it is assumed that the sword originates from the Rhein region and from the smithy of INGELRII despite the nature of the inscriptions.*
719 *E.g. Müller-Wille 1970: 76, 82; Stalsberg 2008: 7.*
720 *Arbman 1936; Lorange 1889: 16; Wegeli 1903–1905: 218.*
721 *Głosek 1984: 103–104, 141, Tabl. IV. The catalogue number of the sword is III-34 with no reference to certain museum.*
722 *Lang & Ager 1989: 104–105, Fig. 7.11.; Oakeshott 1951. The sword is under catalogue number 1856 7–1 1404 in The British Museum.*
723 *E.g. Wegeli 1903–1905: 219.*

5.3.3. Other inscriptions with Latin letters

5.3.3.1. Maker's names

The third category includes all other inscriptions with clear Latin letters. This is a very diverse category, but easier to address since nearly all the other inlays with Latin letters do not display similarities. Twenty-seven blades with clear Latin letters may be distinguished in the material apart from ULFBERHT and INGELRII blades (Figs. 48 and 49). Included in this group are other proper names evident in the finds, their total being only one. Biblical phrases and religious invocations are also included here. The reason for this is that the religious phrases, especially IN NOMINE DOMINI have many spelling variants and possible abbreviated forms, making them somewhat similar to plain sequences of Latin letters with no clear meaning, also included in this group. Again, the inscriptions on the opposite sides of the blade are discussed to gain a clearer picture of the variation. The categorization itself is slightly problematic since phrases and words related to Christianity occur together with some names of smiths. One notable feature in connection with this category of motifs is the cross potent, which has been dated to occur from ca. 950 AD onwards.[724]

Other evident maker's marks can be recognized by the phrase 'me fecit', i.e. 'made me', which is written after the name. Alfred Geibig dates these me fecit inlays as occurring in general between 950 and 1030 AD and also later, 1080–1150 AD as indicated by German finds.[725] In the research material there can be found +GICELINMEFECIT+, +NZOMEFECIT+, +BENOMEFECIT, and +INNOMEFECIT+, i.e. a total of four swords. These do not have geometric motifs on the opposite side of the blade, but instead phrases related to Christianity. With regard to the above-described me fecit inlays the motifs of the opposite side are as follows: +INNOMINEDOMINI+, +INNOMNEDHI+, +INNOMIEDMI+, while the blade made by 'Inno' appears to have no inlays on the opposite side of the fuller, at least not in its present state.

These finds are discussed individually in the following. The sword from Rovaniemi (KM 3631:1) has inscriptions +GICELINMEFECIT+ and +INNOMINEDOMINI+ all correctly written along its narrow fuller. The small inlaid letters are made of steel with a higher carbon content than the surrounding fuller. At least sixteen Gicelin swords have been found in Europe, some with correctly written inscriptions like the texts from Rovaniemi, and also some incorrect versions. The find locations are as follows: three from Germany,[726] five from Latvia,[727] one from Denmark,[728] two from the Netherlands,[729] two from Russia,[730] and one from England.[731] Also from Finland is another one from Rikalanmäki in Salo (formerly Halikko) with the difference that the inlays were made of silver wire instead of ferrous material. The origin of the name GICELIN also remains obscure. According to one theory, it is a derivative of the name Gezelin, which is regarded as Continental European.[732]

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724 Geibig 1991: 155.

725 Geibig 1991: 155.

726 Głosek 1984: 105, 146, 152, Tabl. VII, X; Schwietering 1915–1917. Finds from Hamburg (catalogue number M 164), Brandenburg (catalogue number 00.196) and from an unknown locality (catalogue number 03.55).

727 Anteins 1966: 115–116, Abb. 3. Catalogue numbers LVM–V 8467:1 and LVM–V 8541:1 in the Latvian History Museum. There are two more in the collections of the State Hermitage Museum in Leningrad under collection numbers 890/1066 and 890/1087.

728 Schwietering 1915–1917: 211–214. Catalogue number D7955.

729 Ypey 1972 and Ypey 1973.

730 Drboglav 1978; Shelyapina et al. 1979: 216–218. According to the photograph published by Drboglav the inlays appear to be of steel since they have been mostly corroded away. Another one from Vyborg (Viipuri) has been published by V. A. Tyulenev (1984).

731 Oakeshott 1960: 215.

732 Bernhardt 1928: 219–220.

Catalogue number	Inlays, Side A	Inlays, Side B	Material of inlays	Blade construction	Blade type
KM 70			twisted pattern-welded (?)		Geibig 5 / Oakeshott Xa
KM 370			steel		Geibig 2 or 3 / Oakeshott X
KM 2033:1			pattern-welded or steel		Geibig 5 / Oakeshott Xa
KM 2489:280–281			steel		
KM 3316:13			twisted pattern-welded		
KM 3631:1			steel		Geibig 13 / Oakeshott XI
KM 4429:14			steel		
KM 6923			twisted pattern-welded		Geibig 3 / Oakeshott X
KM 7134:1			steel		
KM 7332			twisted pattern-welded		Geibig 3 / Oakeshott X
KM 8120:1			twisted pattern-welded (11 layers: 6 iron and 5 steel)	laminated core, separate cutting edges (Fig. 5.10)	
KM 8219			twisted pattern-welded (7 layers: 4 iron and 3 steel)		
KM 8656 H23:1			twisted pattern-welded or steel		
KM 8723:165			steel		Geibig 6 / Oakeshott XI
KM 8911:91			straight pattern-welded (3–5 layers)	steel wrap on iron core (Fig. 5.12)	
KM 9164:2			twisted pattern-welded (13 layers: 7 iron and 6 steel)	laminated (Fig. 5.8)	
KM 9419			twisted pattern-welded		Geibig 5 / Oakeshott Xa or Geibig 6 / Oakeshott XI
KM 9562:1			pattern-welded or steel		
KM 10372:1			straight pattern-welded or steel		Geibig 3 / Oakeshott X
KM 10390:5			twisted pattern-welded (7–13 layers)		
KM 11198			straight pattern-welded (3–5 layers) or iron	laminated (?)	
KM 11840			twisted pattern-welded		Geibig 5 / Oakeshott Xa
KM 12690:299			steel		
KM 13839:253			twisted pattern-welded		
KM 17208:561			iron		Geibig 5 / Oakeshott Xa
KM 17208:588			straight pattern-welded or steel		Geibig 2 / Oakeshott X
KM 17777:1			straight pattern-welded or steel		Geibig 2 or 3 / Oakeshott X

Figure 48. Features of other inscriptions with Latin letters.

Rudolf Wegeli dates the use of GICELIN blades to between 1050 and 1150 AD.[733] Ewart Oakeshott has noted that CIGELIN blades occur in type XI of his own typology, dated to between 1120 and 1200 or 1220 AD.[734] Oakeshott dates the GICELIN inscriptions to a narrower time span between 1000 and 1100 AD. The basis of this dating lies on the fact that while the GICELIN inlays are more carefully executed than their Viking Age predecessors, the inlaid marks are very similar if they are enlarged to the same size as the Viking Age ones, and thus in a technical sense the smaller inlays are a continuum from the Viking Age but only in smaller size due to the somewhat universal change in blade statistics. The dating by Oakeshott is generally regarded as correct by other researchers,[735] although GICELIN blades have been given a slightly later date, to the 13th century, much earlier.[736] With regard to the Finnish material, Leena Tomanterä dated these inlays to between 1000 and 1150 AD.[737]

Sword KM 11840 from Sastamala (formerly Tyrvää) bears the inscriptions +NZOMEFECIT+ and +INNOMNEDHI+. The latter seems to be an abbreviated form of "in nomine domini". The name NZO has been interpreted as NISO in some cases, lacking the letter I. An analogy was

733 *Wegeli 1903–05.*
734 *Oakeshott 1964: 34.*
735 *E.g. Olsen 1972: 528–529.*
736 *Bruhn Hoffmeyer 1954: 113–114.*
737 *Tomanterä 1978.*

Figure 49. The geographic distribution of swords with Latin inscriptions other than ULFBERHT and INGELRII.

probably made with a German 11th-century find with the inscription +NISOMEFET+,[738] which is considered to be a German name.[739] Another alternative interpretation is the name IIZO.[740] The height of the inlaid marks corresponds to that of the fuller, being somewhere between the large ULFBERHT and INGELRII inlays and those with the GICELIN name, for example. The material is pattern-welded and twisted and displays a very fine pattern.

Sword KM 17208:588 from Tampere has the name BENO written on the blade. The inscriptions read +BENOMEFECIT and +INNOMIEDMI+, again the latter a version of the phrase IN NOMINE DOMINI. The material of the inlays is hard to determine; it may be pattern-welded with a straight pattern, but more likely it is steel. An 11th-century sword from Stade, Germany was inlaid with the iron inscriptions +BENNOMEFECIT and +INOMINED+.[741] Also another sword from an unknown location in Germany bears an imitative version of this inscription reading approximately +BHTNOMEFECI with some letters reversed, the opposite side of the blade

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738 *Geibig 1991: 127, 209, 353, Taf. 143; Jankuhn 1951: 213, 227; Müller-Wille 1977: 53, 57, Abb. 14.2., 73. The sword is under catalogue number 2801 in the Museum of Stade. The inscriptions state +NISOMEFET+ and +NINOMINED+, crosses being cross potents. The hilt has a brazil-nut pommel of Geibig's combination type 15.3., close to Petersen's type X.*

739 *Jankuhn 1951: 218. Jankuhn compares the name to the German Nisibald, which was also in use during the 11th century.*

740 *Anteins 1973: 48.*

741 *Geibig 1991: 127, 209, 351, Taf. 141; Jankuhn 1951: 213, 227; Müller-Wille 1977: 53, 57, Abb. 14.1., 73. This sword has been found in Stade (Museum of Stade 118), and the blade is attached to a hilt with a brazil-nut pommel of Geibig's combination type 12.2.*

having a lattice weave accompanied by not only vertical but also horizontal bars.[742] The material of the inlays seems to be non-patterned.

A sword from Turku (formerly Maaria), KM 4429:14, shows a fragmentary inscription +INNOMEFECIT+ on only one side of the blade. The other side does not have any traces of inlays, although corrosion may have destroyed them. The inlays are made of steel rods. The above-mentioned sword from Gródek upon Bug, Poland with the inscriptions +INGELIIRMEFCIT+ and +INHOMEFECT+ is to some degree comparable to this find from Turku.[743] The inscription +INHOMEFECT+ has been interpreted as an abbreviation for +IN H(onestatem) OM(nipotentis) EF(f)ECT(oris)+ ("In honour of the almighty creator"), although it is more likely a misspelt version of a ME FECIT inscription, possibly intended as INNO ME FECIT.

A relatively common feature among these other maker's names and ME FECIT inlays is the presence of cross potents instead of the simpler Greek crosses that were used slightly earlier. The cross potent has been assumed to amplify the Christian background of the inscription.[744] Cross potents also occur independently or accompanied by plain vertical bars or circles. For example, finds from Drakenburg,[745] Regensburg,[746] Pullach[747] in Germany and from an unknown German locality[748] each contain one cross potent accompanied with one of the above-mentioned motifs.

5.3.3.2. Complete phrases and words related to Christianity

Among the studied finds the most common Christianity-related phrase is IN NOMINE DOMINI having many abbreviated and varied forms. As many as three of the above-mentioned four blades with maker's names also bear this inscription or a variant of it.

Sword KM 8219 from Uusikaupunki (formerly Kalanti) bears the inscriptions +INNOMNEDMN+ and +AMEN+ on both sides of the blade respectively. The inlaid letters are prominently pattern-welded from two sharply contrasting materials. The patterned rods were twisted, and they contain seven layers, four of iron and three of steel. A somewhat similar, although even more misspelt version can be found on a blade from Peene, Germany, its inscriptions reading approximately "+NIN... NINEDN" and "ONEN".[749] Possibly this again imitates a more correct version like the Finnish one.

In similar fashion to the above sword, KM 9164:2 from Eura has the inscriptions N...NEDNI and AMENI, both very carelessly executed and also containing a design resembling a cross at the beginning of inscription. Despite the blurry appearance of the inlays, they are made from a twisted pattern-welded rod containing thirteen layers, most of which are iron. In connection with the careless appearance of the inlays, the blade was not of very good workmanship (see Chapter 4.4.3).

742 *Schmid 1918–1920: 244–245.*
743 *Kuśnierz 2006: 93–95; Wołoszyn 2005: 95–96.*
744 *Prank 2011: 103–104.*
745 *Geibig 1991: 115, 208, 329, Taf. 119. It is possible that this particular blade fragment could have contained other marks than the remaining cross potent.*
746 *Geibig 1991: 115, 207, 240, Taf. 30. The cross potent can be seen on one side of the blade, while the opposite side shows three vertical lines. The hilt is of Geibig's combination type 12.2.*
747 *Geibig 1991: 115, 207, 238, Taf. 28. Here the fragmentary cross potent on one side is accompanied by a fragmented circle-like figure on the other side of the blade. The hilt is of Geibig's combination type 16.1.*
748 *Geibig 1991: 115, 207, 276, Taf. 66. On one side of the blade the cross potent is lined with six vertical bars, three on each side of the cross. The other side exhibits similar six vertical bars with a fragmentary mark in between. The pommel of this sword is of brazil-nut form.*
749 *Jankuhn 1951: Abb. 2.*

Sword KM 11198 from Lempäälä has the fragmentary inscription +INOM EDMN+ interpreted as a shortened version of IN NOMINE DOMINI. The other side of the blade has geometric patterns: a lattice weave between two B-like designs. The material of the inlays appears to be straight pattern-welded rod with three to five layers. Alternatively, the streaks may be due to corrosion, and the material is closer to plain iron. B-like figures may also be found in sword KM 8120:1 from Hattula (see Chapter 5.3.3.4 below), and also on swords from Russia,[750] Norway,[751] and Germany,[752] although the texts, letters and motifs are otherwise different. Also one INGELRII blade from Worpswede, Germany has B-like designs at the places of the first and last vertical bars lining a woven lattice.[753]

Sword KM 370 from Hämeenlinna (formerly Vanaja) bears the inscription AMEN, with the letters A, M and E reversed, and A lacking its horizontal bar. The inlays are of plain steel rod. The reverse side of the blade contains obscure marks resembling an ULFBERHT inscription, and this is presented also below. In addition, the blade is much shorter than average (see Chapter 4.8).

5.3.3.3. Letter sequences possibly referring to Christian phrases

A number of letter sequences can be interpreted either as abbreviated forms of Christian sentences, viz. IN NOMINE DOMINI, or misspelt forms. There are two interesting and almost identical cases. KM 70 from Eura and KM 9562:1 from Lieto both contain inscriptions +INVEOENI+ and +INbMPNC+ on opposite sides of the blade, the crosses being cross potents. While the latter is harder to interpret, the first-mentioned letter sequence could have been intended as a possible copy of an IN NOMINE DOMINI inscription. Donat Drboglav has interpreted the texts as +INAEOENI+ and +INPMPNC+, and suggests that these are abbreviations of the Latin sentences "I(n) n(omine) ae(terni). O(mnipotentis) n(omine) i(n)" and "I(n) n(omine) p(atris) M(ater) p(atris) n(ostri) C(hristi)" respectively.[754] The sentences are translated as "In the name of the eternal. In the name of the almighty" and "In the name of the father and mother of our Christ". The suggested dating is 11th century.

In both blades the inlays were made either from pattern-welded material or plain steel, and more accurate definitions could not be made. No identical ones have so far been found anywhere in Europe. A sword from Pasilciems, Latvia is quite close though, with the inscriptions +INIOINI+ and +INSOLNI+, and with similar cross potents, all made from iron or steel.[755] Also Marian Głosek lists two fragmentary examples having INIOINI inscriptions with cross potents, dating from between 1150 and 1210 AD.[756]

Sword KM 2489:280–281 from Kaukola, ceded Karelia, contains at least the letters INNO, followed by fragmentary marks and crosses, all inlaid in plain steel. This may possibly be another version of IN NOMINE DOMINI. In similar fashion, KM 8656 H23:1 from Masku has the legible letters OMINE, surrounded by fragmentary inlaid marks. Although the inlays are small, they may be of pattern-welded material with a very fine, twisted pattern, which is also very rare in blades of this date.

750 *Kirpichnikov 1968: 55, Abb. 7; Müller-Wille 1970: 75, 80; Stalsberg 1989: 17, 21, Fig. 11.*
751 *Lorange 1889: Tab. II.*
752 *Müller-Wille 1977: 57, Abb. 14.3., 74. Sword under catalogue number 1911:627 in the Museum für Hamburgische Geschichte. No precise find location is known. The hilt has a brazil-nut shaped pommel. Another one is known from Leer with only geometric figures lined by B-like designs (Geibig 1991: 115, 208, 335, Taf. 125).*
753 *Geibig 1991: 117, 209, 356, Taf. 146.*
754 *Drboglav 1984: 120.*
755 *Anteins 1966: 115–116, Abb. 3.*
756 *Głosek 1984: 106–107, 134, 167, Tabl. XII, XV.*

Another sword from the territory of ceded Karelia is known to have an inscription relating to the phrase IN NOMINE DOMINI. Sword KM 6923 from Sakkola bears inscriptions INXMIDNI and INOMENI, both lined with cross crosslets, and the latter is perhaps a variation of the theme. The inlays are again pattern-welded from twisted bars. Drboglav dates the inscriptions of this sword to between 1000 and 1100 AD.[757] He also suggests that both words are abbreviations of Christian phrases written in Latin. INXMIDNI meaning "I(n) n(omine) X(pisti), M(ater) I(esu), D(omini) n(omine) i(n)", and INOMENI meaning "I(n) n(omine) o(mnipotentis). M(ater). E(terni) n(omine) i(n)". These can be translated as "In the name of Christ, Mary, In the name of God" and "In the name of the almighty. Mother. In the name of eternity".

Sword KM 7134:1 from Hämeenlinna (formerly Hauho) contains inscriptions INNIMIDOINNI and INNIOINNEDINI, both lined with cross crosslets and executed in steel. These may again be variants of the phrase IN NOMINE DOMINI.

Also KM 8723:165 from Köyliö has letters inlaid in steel. The visible letters include "I INNDINI", followed by some fragmentary marks. This may be another attempt to copy the inscription IN NOMINE DOMINI. In similar fashion, a sword from Grzebsk, Poland, dating from between 1050 and 1110 AD, shows fragmentary inscriptions "+ NNOMNN…F" and "O…NIN…NE", as well as possible attempts to produce an IN NOMINE DOMINI inscription.[758] Another sword from Alt-Ruppin, Germany has fragmented inscriptions "+NMEMH…I" and "+IHM…I…NN…I", possibly also imitating the same phrase.[759] A 12th-century sword from Maidla, Estonia has the inscriptions IINNOMINOMNI and IINNOMINI most likely referring to the same phrase again.[760] A sword from Kemskiy, Russia bears the fragmentary inscription IIINNO.[761]

Similar kinds of fragmentary phrases can be found also on finds KM 9419 and KM 12690:299, both from Salo but from different localities. KM 9419 shows fragments of the letters N, M and O on one side, while the other side contains a fragmented phrase "IN…OME" preceded by a cross crosslet and followed by more fragmentary letters. Interestingly, the inlays on this particular blade are from fine pattern-welded material, although the inlays are small, about one centimetre in height. In a surprisingly similar fashion, sword KM 12690:299 shows the partly preserved phrase "I…INOI INI", lined by cross crosslets. These inlays seem to have been executed from plain steel rod.

Sword KM 17777:1 from Hattula (formerly Tyrväntö) contains the combinations +NIOIN+ and +NMIN+ on opposite sides of the blade. Both of them may refer to an IN NOMINE DOMINI –inscription. The inlays were made with either straight pattern-welding or plain steel. The combination NIOIN appears on a blade with non-ferrous inlays from Rheinsberg, Germany dating from the 13th century.[762]

It is clear that these Christian phrases and invocations are strictly related to the spread of Christianity, as well as the significance of religious authorities. It has been suggested that the background of the maker or the buyer of the sword was Christian, at least to some degree, possibly

757 *Drboglav 1984: 120.*
758 *Głosek 1984: 105–106, 157, Tabl. XII.*
759 *Głosek 1984: 145, Tabl. VI. The sword is under catalogue number 1001 in the Museum of Neuruppin.*
760 *Mandel 1991: 108–109, 121–122; Prank 2011: 75–76. The catalogue number of the sword is AM 580:1558, 2015 in the Historical Museum of Estonia. The sword is broken into two pieces resulting in the two catalogue numbers stated above.*
761 *Makarov 1987.*
762 *Głosek 1984: 107, 149, Tabl. VIII. The sword is under catalogue number W 1058 in the German Historical Museum.*

trying to acquire some power from God.[763] Most likely the correctly written phrases come from Christianized areas, contrasted by misspellings, which may be copies by non-Christian craftsmen. The abbreviations presented by Drboglav all rely on the presumed fact that all the blades and their inlays were made in Central Europe under strong Christian influence.[764] When these abbreviated forms are viewed as possible copies and incorrectly spelt versions of Christian invocations, they appear to be as plausible as Drboglav's theories of abbreviations.

5.3.3.4. Other letter combinations

This category includes all other inscriptions or combinations of letters that cannot be considered as clearly belonging to Christian imagery. Interpretation, however, is difficult, since the inlays are in many cases very fragmentary, and secondly, the meaning and symbolic origin of these letter sequences can no longer be known with certainty. In any case, Alfred Geibig has dated all the small, unknown letter sequences as well as inlaid anagrams to 1050–1150/1170 AD.[765]

KM 2033:1 from Padasjoki bears the inscriptions INEERIIRIEITI and INERNGEMITI, inlaid in either pattern-welded material or plain steel. The resemblance to inscription INGELRII gives reason to assume that this was an illiterate copy.

Sword KM 3316:13 from Salo (formerly Halikko) contains motifs "NX FE N+" and "III O III O III" on opposite fullers of the blade. The material of the inlays is pattern-welded. The motif with vertical bars and circles resembles a fragmentary motif on a Norwegian sword.[766]

In similar fashion as various hilt types (see Chapter 7), also blade decorations can be observed in various illustrations and manuscripts, although they are not as common as the hilts of the period. Inlaid marks on contemporaneously pictured sword blades are normally associated with disc-pommeled swords. This is the case, for example, in the illustrations of the Stuttgart Passionale (ca. 1160 AD),[767] and the Morgan Crusader's Bible (ca. 1250 AD).[768] Also pictures published by Robert Forrer show a similar phenomenon.[769] In all these cases, the represented inlays are lines and circles, in some cases also X-figures or crosses, with a striking resemblance to the inlays found on sword KM 3316:13.

KM 7332 is a hiltless sword blade with no accurate information on its find location. On one side, the blade has the inscription SHVΛIMIVΛHS, while the opposite side bears the motif "S III X III X II S", all in pattern-welded material. What is interesting is that the inscription and the motif can be viewed from both directions, while still remaining the same. A sword from Libagi, Latvia, with the iron inscription SINIXIXINIS, closely resembles this sword.[770] Drboglav has suggested that the letter combination SHVΛIMIVΛHS is an abbreviation of "S(alvator). Ih(es)u a(ltissim) i m(ater) i(missitl)a u(sehl). S(alvator)".[771] Correspondingly the two letters S on the opposite side of the blade has been interpreted as the word Salvator, "saviour", by Drboglav.

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763 Prank 2011: 100.
764 Drboglav 1984.
765 Geibig 1991: 155.
766 Lorange 1889: Tab. III. The catalogue number of the sword is 1737 in the Bergen Museum.
767 Boeckler 1923; Leppäaho 1964a: 8–9.
768 E.g. Walther & Wolf 2001: 169–171.
769 Forrer 1915-1917: 197–198; Forrer 1918–1920: 198.
770 Anteins 1966: 115–116, Abb. 3. The catalogue number of the sword is KVM-7344:10 in a museum which is not stated in the source in question.
771 Drboglav 1984: 114.

A somewhat similar case is known from Hattula (formerly Tyrväntö). Sword KM 8120:1 has the letter sequence DU repeated four times, alternately reversed so that it, too, may be read from both directions. The same applies to the geometric motif consisting of a woven lattice and two B-like figures. The letters D and U have been interpreted by Drboglav as meaning "d(eus) v(erus)", i.e. "true God".[772] All the inlays were executed in twisted pattern-welded material of eleven layers, having more layers of iron than steel. A similar kind of lattice with B-like figures was inlaid on a sword from Gnezdovo, Russia, the other side bearing the short text ИEN, often interpreted as the name ULEN.[773] On the other hand, these letters can be read from both directions, just as KM 8120:1. There is also a similar kind of design consisting of two simple lattices lined by B-like figures, all pattern-welded, in the Norwegian material.[774] Also a sword from an unknown location in Germany has B-like designs on both sides of the blade, with vertical bars and simple lattices between them.[775] A sword from Leer, Germany has four simple lattices between B-like figures on one side, and a Greek cross and circle-like designs lined by B-figures on the other side of the blade.[776] Yet another sword from Germany, from Worpswede, has an INGELRII inscription, accompanied by a woven lattice, which is lined with two vertical bars on each side and also B-like designs.[777]

KM 8911:91 from Mynämäki has the texts CONSTMIITNS and REX inscribed on the opposite sides of the blade. The material of the inlays is straight, pattern-welded material with three to five layers. This sword has been interpreted by Jorma Leppäaho as belonging to a member of the Varangian guard, the Constantinus marked on the blade being possibly Constantine VIII (976-1028 AD). The sword has been assumed to be of European origin since the texts are written in Latin. Interestingly, the blade bears the title REX meaning "king", while the correct title would have been "emperor". These facts suggest that perhaps the owner or maker of the sword wanted to make the impression that he had served in the Varangian guard.

Another sword with a version of Constantinus, namely CONSNMIINS and the reverse side with the inscription +INGERIHFECIT, was found in Norway.[778] A third sword, from Utgaarden also in Norway, has the word REX on one side and fragmentary letters such as O and N on the other.[779] The hilt of the sword is of Petersen's type T2.

KM 10372:1 from Kurkijoki, ceded Karelia, bears the unique inscription SNEWENTS and a fragmentary inscription with at least the letters B, W, N and S. Drboglav has interpreted the text as SNEMENTS, meaning "S(ancta) N(omin)e M(atris) e(nimo)n T(rinita)s", while the other side has been interpreted as SPBMBNS meaning "S(alvator) p(ater). B(eata) M(ater) b(eata). N(oster) S(alvator). Correspondingly, these may be translated as "[The] holy name of mother and trinity" and "Saviour, father. Blessed mother blessed. Our saviour". Again the material remains uncertain, it may be plain steel or pattern-welded with a straight pattern. A sword from Poland shows iron inscriptions approximately in the form SIMENHLIIS on both sides of the blade.[780]

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772 *Drboglav 1984: 114.*

773 *Kainov 2012: 56–57; Kirpichnikov 1968: 55, Abb. 7; Müller-Wille 1970: 75, 80; Stalsberg 1989: 17, 21, Fig. 11.*

774 *Lorange 1889: Tab. II.*

775 *Müller-Wille 1977: 57, Abb. 14.3., 74. Sword of catalogue number 1911:627, Museum für Hamburgische Geschichte. No precise find location is known. The hilt has a brazil-nut shaped pommel.*

776 *Geibig 1991: 115, 208, 335, Taf. 125. The hilt of the sword is of Mannheim type or Geibig's type 3, and the inlays appear to be like steel.*

777 *Geibig 1991: 117, 209, 356, Taf. 146. The hilt is of Geibig's combination type 15.3. which is close to Petersen's type X. The inlays look as if they were executed with steel rods.*

778 *Kirpichnikov & Stalsberg 1993a: 36–37; Kirpichnikov & Stalsberg 1998a: 509–510, Fig. 1. The sword is under catalogue number C28352 in the Universitetets Oldsaksamling in Oslo.*

779 *Leppäaho 1952: 148–149. The catalogue number of the sword is C1648 in the Universitetets Oldsaksamling in Oslo.*

780 *Jankuhn 1951: Abb. 2.*

The form of the letters, especially the letters S, which have short transverse bars at the ends is to be noted. One more similar case is known from Germany, with the fragmentary inscriptions SIEIIMIBIELTS and I…IN…BITIPINI, again having the crossbars in the letters S.[781]

Sword KM 17208:561 from Tampere has similar iron inlays on both sides of the blade, the letter E lined with vertical lines. No equivalents are known elsewhere. In this case, interpretation is difficult, and it is impossible to know if the letter E has any meaning as an abbreviation, Christian or not.

A total of three blades contain letters resembling an ULFBERHT inscription, but incorrectly made. One of these, KM 370 from Hämeenlinna has already been mentioned in connection with the text AMEN, which was inlaid on one side of this blade. The reverse side has a simple cross followed by letters such as P, V, E, P, N and T, implying that it is an imitation of ULFBERHT. Furthermore, the material of the inlays appears to be plain steel.

KM 10390:5 from Vesilahti has the obscure inscription +VLEHRAHLDH+, and the reverse side contains a woven lattice and four vertical lines. All the inlays were made from twisted pattern-welded material with seven layers and occasionally even thirteen layers. Aleksis Anteins has interpreted the beginning of the inscription as the name ULENR or ULEHR, although it is more plausible that the inscription is a copy of ULFBERHT.[782] Sword KM 13839:253 contains the inscription +VLEFBIIIT+, and the reverse side contains some vertical lines and a simple lattice weave. The material is twisted pattern-welded rod. This, too, may be a copy of an ULFBERHT blade.

5.3.3.5. Spatial distribution

The spatial distribution of these finds with Latin letters can be seen in Figure 49. The map shows quite evenly the areas of Late Iron Age cemeteries. In other words, no clear concentrations can be observed at the general level. However, the distribution according to the above-presented four categories indicated one interesting phenomenon. This is the clear cluster of IN NOMINE DOMINI -like letter sequences, possibly imitating this phrase, in the area of Finland Proper.

Some divisions can be seen with regard to the materials of the inlays. Motifs executed in plain steel, or in some cases iron, predominate in Finland Proper and the Tampere region, but are rare in Satakunta. Instead, pattern-welded inlays can also be found in Satakunta, in addition to the other regions, since pattern-welded inlays are more common than plain ferrous ones. Contrary to common perceptions, some smaller and thus perhaps younger inlays were made from pattern-welded material, and these few were found in the regions of Finland Proper and Satakunta.

The size of the inlays in this particular category should also be mentioned. All inlays with Latin letters other than clear ULFBERHT and INGELRII inscriptions found from the Tampere region or nearby are executed in large letters, i.e. their height being also two centimetres and equal in size to the letters used in the ULFBERHT and INGELRII swords. In contrast, all smaller-sized motifs with Latin letters come from the regions of Finland Proper and Satakunta. This may be a question of chronology, and it will be discussed later in connection with the dating of the studied swords.

781 *Wegeli 1903–1905: 219, Fig. 10.*
782 *Anteins 1973: 51–52.*

5.3.4. Letter-like marks

5.3.4.1. General observations

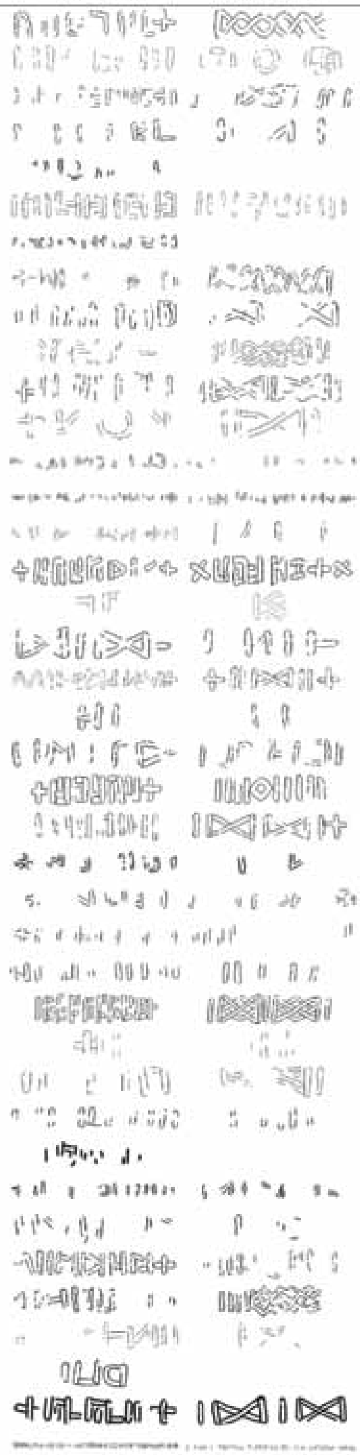
The fourth group includes all letter-like inlays, perhaps imitating Latin letters. This category is somewhat problematic, and it involves two criteria. Firstly, the inlays do not show any clear Latin letters or sequences of them, only some resemblance. Secondly, the motif or motifs are not strictly geometric or in the shape of certain symbolic marks. Common to these motifs is discontinuity at least on one side of the blade. The other side may even contain geometric motifs. In this category, however, the geometric motifs are seen only on one side of the blade, whereas the last category includes blades with such motifs on both sides (see below). Letter-like marks and figures were revealed on 33 blades (Fig. 50). Due to the highly fragmentary nature of the inlays, some of the marks classified here as letter-like may have originally been actual Latin letters. They are very hard to interpret from radiographs of badly corroded blades. The spatial distribution of these blades (Fig. 51) shows that more blades of this category have been recovered from Finland Proper and Satakunta than from other regions, although they appear also in the Tampere region.

In general, the letter-like marks seem quite unique when compared with each other. Marks are usually in random order, and in many cases they are preceded or followed by a simple cross, which can sometimes be seen at both the beginning and the end of the motif. We can surmise that these blades may be imitations of those with crosses in the Latin inscription, viz. ULFBERHT. The lattices and lines on the opposite side of the blade are also a suggestion in this direction.

Another feature consists of figures shaped like the letter L and alternately reversed. Marks of this kind can be observed in several blades. The best examples are finds KM 9778 from Kokemäki and KM 13419:2 from Turku (formerly Maaria), a few marks of a similar kind also on swords KM 6753:51 from Turku (formerly Kaarina) and KM 1120:1 from Eura. All four examples have different motifs on the reverse side of the blade. Motifs of almost a similar kind with reversed marks resembling the letter L have been found from Gnezdovo, Russia, with varying motifs on the opposite side of the blade,[783] and also from Gnista, Sweden[784] and Berg, Sweden,[785] which means that the situation is not different from Finland. The two Norwegian examples, one from Sæbø (catalogue number 1622) and one from Langve (catalogue number 3315) contain even more complex lattice weaves on their blades.[786] A sword from Malvik, Norway has similar L-shaped figures on both sides of the blade.[787]

A Petersen type C sword from Sæbø, Norway calls for special attention. In some cases, its figures have been interpreted as fragmentary runes. The inlays have been interpreted as "OH MUÞ", meaning ThormuÞ.[788] The swastika incorporated in the inscription has been seen as the symbol of Thor's hammer. Another interpretation is that the inscription is to be read "OH ÞURMUÞ" meaning literally "owns [owned by] Thurmuth".[789] The opposite side of the blade has a complex lattice weave lined by vertical bars. Despite the Runic interpretations, it seems more plausible that this blade is yet one more sample of letter-like marks instead of clear runes.

783 Anteins 1973: 52–53; Kirpichnikov 1970a: 173, Fig. 3; Kirpichnikov 1970b: 62, Fig 3. The catalogue number of the sword is GIM-195 in the State Historical Museum in Moscow.
784 Werner 1982: 17–20.
785 Thålin-Bergman & Kirpichnikov 1998: 500, 506, Abb. 5.2. The catalogue number of the find is 5237:5B in the Swedish History Museum.
786 Lorange 1889: Tab. IV.
787 Stalsberg 1994: 185, Fig. 39.
788 Wegeli 1903–1905: 181.
789 Stephens 1866–67: 407.



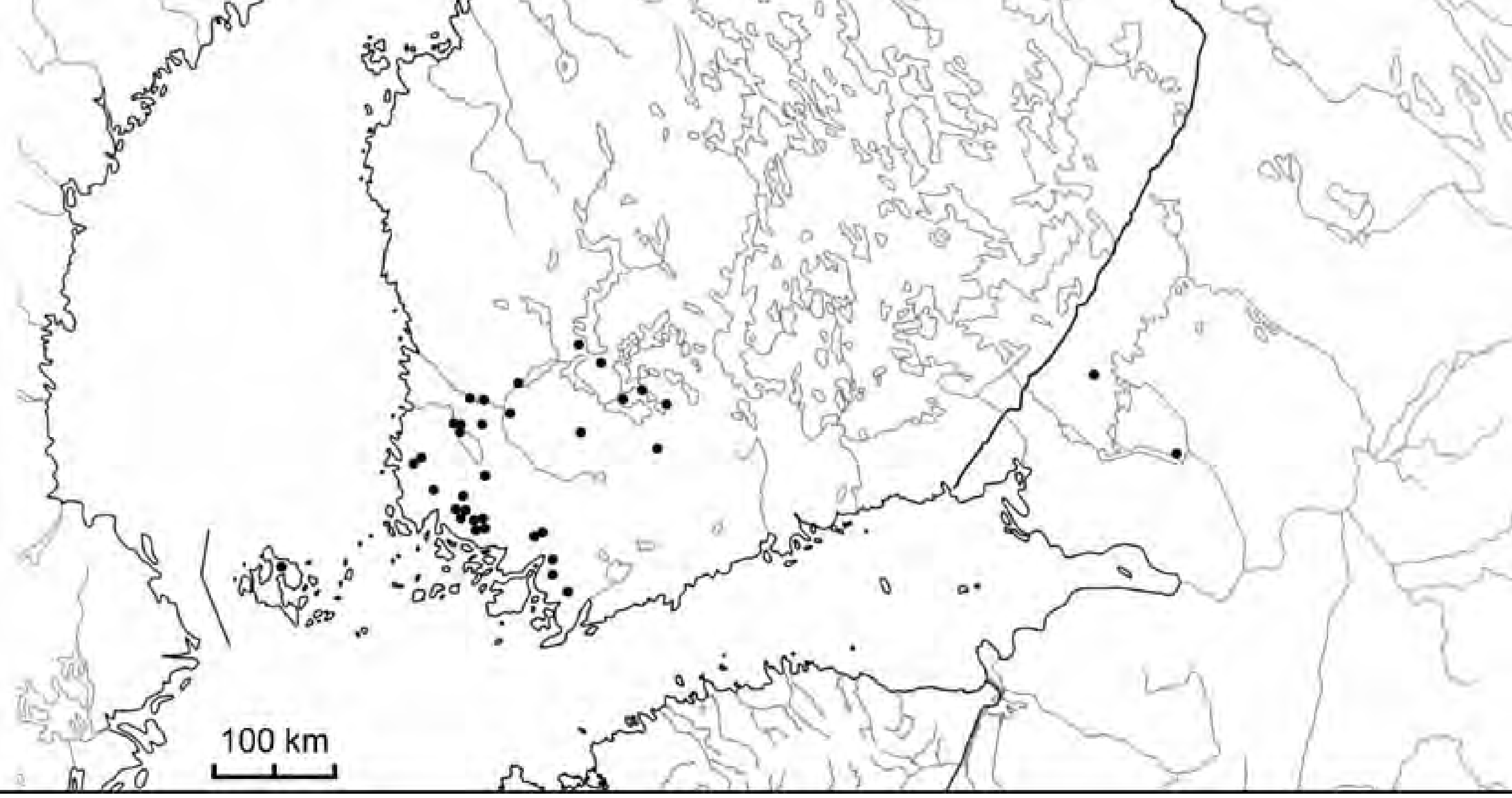
Catalogue number	Inlays, Side A	Inlays, Side B	Material of inlays	Blade construction	Blade type
KM 1120:1			twisted pattern-welded		
KM 1174:3			twisted pattern-welded		
KM 1822:1			twisted pattern-welded		
KM 1822:2			twisted pattern-welded		
KM 2489:121			steel		
KM 2548:196			twisted pattern-welded	piled from similar material (Fig. 5.6)	
KM 2939:1			twisted pattern-welded	other side of blade pattern-welded (Fig. 5.13)	
KM 3301:1			iron		
KM 3575:1			twisted pattern-welded	pattern-welded (Fig. 5.13)	Geibig 2 or 3 / Oakeshott X
KM 4633:145			twisted pattern-welded		
KM 4633:165			twisted pattern-welded		
KM 4923:1			twisted pattern-welded		
KM 5005			steel		
KM 5707:3			steel		Geibig 5 / Oakeshott Xa
KM 6227:1			twisted pattern-welded		
KM 6753:51			twisted pattern-welded (9 layers: 5 iron and 4 steel)		Geibig 2 / Oakeshott X
KM 7220:2			twisted pattern-welded		
KM 7472:2			twisted pattern-welded		
KM 7752:1			twisted pattern-welded	pattern-welded (Fig. 5.13)	Geibig 2 or 3 / Oakeshott X
KM 8602:130			iron or steel		
KM 8896:25			twisted pattern-welded		Geibig 2 or 3 / Oakeshott X
KM 9778			twisted pattern-welded (7 layers: 4 iron and 3 steel)		Geibig 2 or 3 / Oakeshott X
KM 10349:1			twisted pattern-welded (7–9 layers)		
KM 11831			steel		
KM 12033			twisted pattern-welded		
KM 12687:1			twisted pattern-welded		Geibig 5 / Oakeshott Xa or Geibig 6 / Oakeshott XI
KM 13399:3			twisted pattern-welded		
KM 13419:2			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 15467			twisted pattern-welded		
KM 16279			twisted pattern-welded		
KM 17208:375			twisted pattern-welded		
KM 18000:3880			twisted pattern-welded		
KM 19901:202			pattern-welded or steel		
KM 24740:242			twisted pattern-welded		
KM 26301			twisted pattern-welded		
KM 30985:1			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 37257			twisted pattern-welded		
ÅL 337:106			twisted pattern-welded		
ÅL 337:229			twisted pattern-welded		
Huittinen, Church			steel		Geibig 6 / Oakeshott XI

Figure 50. Features of inlays with letter-like marks.

The blades of this category commonly contain letter-like marks on one side and some geometric motifs on the other, normally various kinds of lattices. Since the letter-like marks are fragmentary and also somewhat unique when compared with each other, the geometric motifs on the opposite side of the blade have been used here as a device for grouping to make some sense on the material.

In the European context, marks of these kinds are surprisingly common, and they may have been more common than studies show since almost all of them concentrate on actual inscriptions instead of unrecognizable figures. These kinds of figures and marks have been found at least in Norway, Denmark, Russia and Estonia.[790]

790 *Anteins 1973: 52–53; Lorange 1889: Tab. III; Lønborg 1994: 10.*



5.3.4.2. Marks accompanied by lattices

Figure 51. Geographic distribution of swords with letter-like marks.

Four swords have a single lattice on the opposite fuller of the one with letter-like marks (see Fig. 52). KM 37257 from Pälkäne has a simple lattice, as well as marks resembling rotated letters T and M on the other side of the blade, all made from twisted pattern-welded material. A sword from Shifford, Great Britain, with letter-like marks as well as an almost similar hilt must be noted here.[791] KM 4923:1 from Urjala has a similar-looking lattice but lined with vertical lines, one on each side. On the opposite side, the blade has a cross and a circle-like design between two V-shaped marks, all fragmentary and made from twisted pattern-welded rods.

A more complex design also including a simple lattice may be found in KM 7752:1 from Salo (formerly Perniö). Here the lattice is lined with a cross and two vertical lines on both sides, with the motif beginning and ending in the crosses. The letter-like inlays also form a complicated motif, somewhat longer than average. The marks include figures resembling the letters V, E, D and H, among others, and the whole motif ends in a simple cross. All the inlays were made from twisted pattern-welded rods. Furthermore, the fuller of the blade is itself pattern-welded. At this point it is worth noting that pattern-welded blades with ferrous inlays are generally dated to between 750 and 800 AD.[792]

In addition, KM 7220:2 from Nousiainen has a single woven lattice, again from twisted pattern-welded rods. The other side has only a few fragmentary lines resembling the letter L reversed and rotated. KM 1822:1 from Eura displays a similar-looking pattern as commonly observed in ULFBERHT blades, i.e. a woven lattice lined with several vertical lines. Actually the marks on the opposite side resemble the letters U and E, including a cross, plausibly making it a clumsy copy of an ULFBERHT blade. The inlays are again twisted pattern-welded material. A third example of a woven lattice with vertical lines comes from Hämeenlinna (KM 16279), with highly fragmented letter-like inlays on the opposite side of the blade. It must be noted here that the

791 *Grove 1938: 255–256. See also Chapter 7.2.18.*
792 *E.g. Geibig 1991: 155. Earlier research suggests that geometric figures were inlaid in pattern-welded blades as early as the 7th century (Jankuhn 1951: 216).*

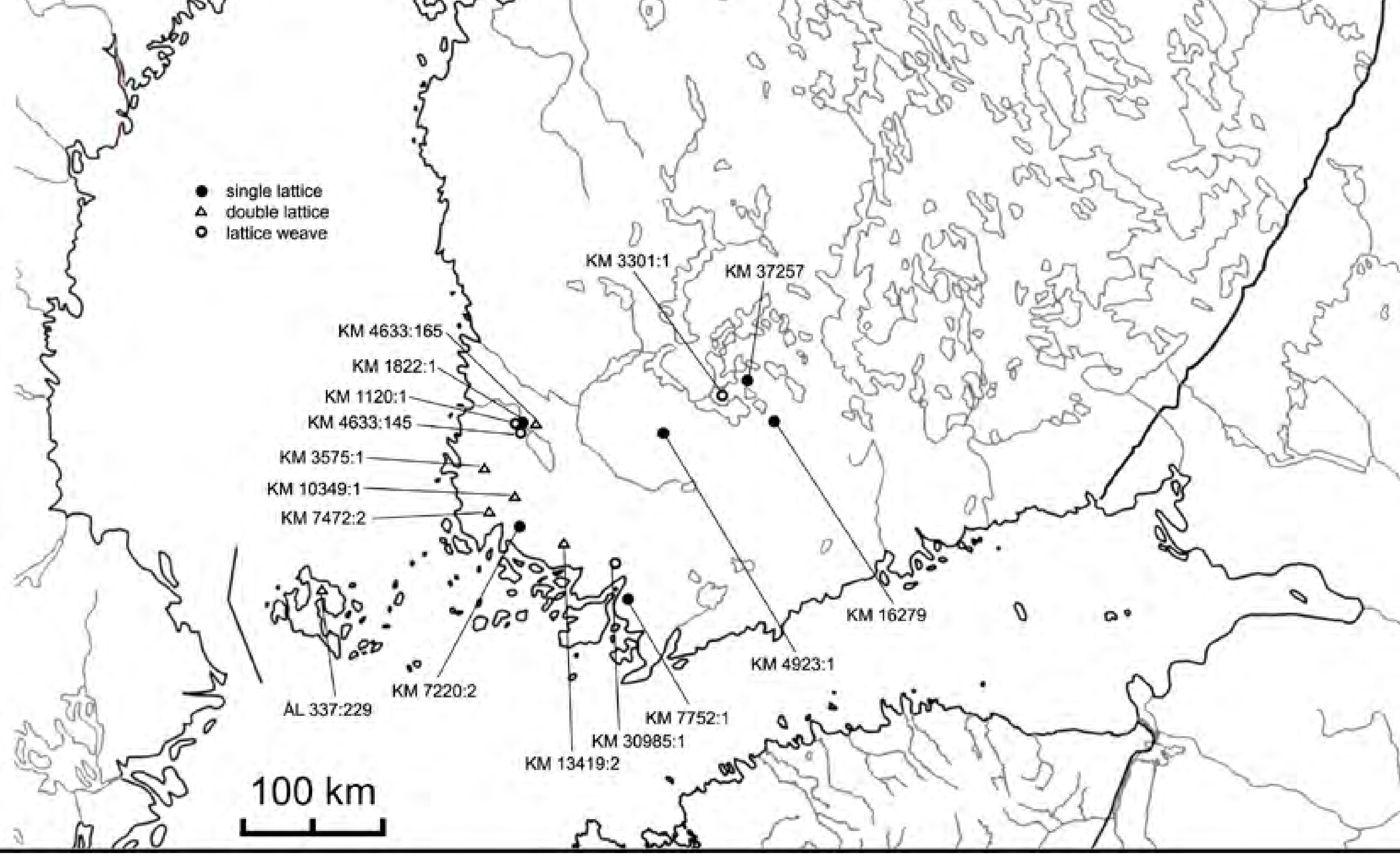


Figure 52. Letter-like marks accompanied by various lattice patterns.

interpretation of the inlays on this particular find is complicated and difficult, because the inlays extend under the lower guard and on to the tang because the breakage and re-forging of the tang in the prehistoric past.

Six blades have double lattices on one side. Sword KM 3575:1 from Laitila contains two simple lattices. The marks on the opposite side consist mainly of vertical lines and one D-shaped figure, all twisted pattern-welded material. The fuller of the blade is also pattern-welded (see Chapter 4.4.6). KM 7472:2 from Vehmaa has two lattices with a vertical line between them and a horizontal line at the end of the motif. The marks on the other side consist of vertical lines, a reversed letter N and a rotated letter T, all made from twisted pattern-welded material. KM 10349:1 from Nousiainen also has two simple lattices, but now lined with two vertical lines and ending in a simple cross. The letter-like inlays consist of I, U, E and T-shaped figures, none of them being a clear letter. The material of the inlays is twisted pattern-welded rod containing seven to nine layers. Highly similar to this is sword ÅL 337:229 from Saltvik, also with two simple lattices.

There are also simple lattices accompanied by letter-like marks on a blade from Saaremaa, Estonia,[793] and a sword from Trödje, Sweden.[794] Another Swedish find, from Arsunda, also has letter-like marks including a lattice and a cross, and a simple lattice lined with vertical bars on the opposite side of the blade.[795] Moreover, especially close to motifs on KM 3575:1 and KM 10349:1, a sword from Hjelmby, Norway has similar kinds of double lattice and letter-like figures on opposite sides of the blade.[796] Another sword from Norway has only two plain pattern-welded

793 *Anteins 1973: 53. The sword is listed under catalogue number IIZ-K 85:129 without stating the collection or museum.*

794 *Thålin-Bergman & Kirpichnikov 1998: 500, 505, Abb. 4.1. The letter-like marks begin and end with a simple cross, and the simple lattice is lined with vertical bars. The catalogue number of the sword is 9090:2 the Swedish History Museum.*

795 *Thålin-Bergman & Kirpichnikov 1998: 500, 506, Abb. 5.2. The catalogue number of the sword is 17408:2 the Swedish History Museum.*

796 *Lorange 1889: Tab. IV. The find is under catalogue number 5837 in the collections of the University of Oslo.*

lattices on one side and highly fragmentary marks on the other.[797] A sword from Oljonsbyn, Sweden, has the same phenomenon of letter-like inlays on one side of the blade and two plain lattices with a cross and other letter-like marks on the other side, all the inlays being pattern-welded, with the blade attached to a hilt of Petersen's type Q.[798]

A sword from Eura, KM 4633:165, has two woven lattices lined with single vertical lines. The marks are very fragmentary with mainly vertical columns and a cross at the beginning of the motif. All the inlays were made from twisted pattern-welded material. KM 13419:2 from Turku (formerly Maaria) also has two woven lattices lined with single vertical lines and having also one in between the lattices. The letter-like marks are well-preserved, consisting mainly of L-shaped figures with some of them reversed, the motif ending in a cross. All inlays were executed in twisted pattern-welded material. Similar kinds of motifs, though fragmentary, can be seen on the blade of a sword from Snartum, Norway.[799] Motifs that are almost identical to those on KM 13419:2 have been found on a sword from Gnista, Sweden[800] and Berg, also in Sweden.[801] Also a third sword from Sweden, more accurately from Altuna, has letter-like marks which are L-shaped and accompanied by two lattices on the opposite sides of the blade, a lattice that is more plain and a more complex woven one.[802]

A lattice weave was present in four cases among all the examined ones. KM 1120:1, a sword from Eura, has a lattice weave accompanied by U- and L-shaped marks and a cross at the end on the opposite side of the blade. The inlays are twisted pattern-welded rod. KM 3301:1 from Valkeakoski (formerly Sääksmäki) also has a lattice weave, this time made of iron. The inlays on the other side are very fragmentary, with a cross and designs resembling the letters N and I. It is possible that there was some combination of Latin letters on this blade, but this cannot be definitely stated.

Sword KM 30985:1 from Salo (formerly Halikko) has a slightly more complex lattice weave that begins with three vertical lines. The marks on the opposite fuller again include vertical lines as well as U and T-shaped figures. All the inlays were made from twisted pattern-welded rods, and because of the bending of the blade which prevented proper radiography, the lower portion of the figures and motifs cannot be defined. In principle, fragmentary figures could to some degree be comparable to the common L-shaped figures of this category of letter-like inlays.

Somewhat similar to KM 30985:1 is sword KM 4633:145 from Eura, with a complicated lattice weave lined by altogether four vertical lines. The marks on the other side are very fragmentary and only resemble letters, with a general appearance very similar to the above-mentioned sword from Salo. In foreign material, the only properly studied example is from Gnezdovo, Russia, with pattern-welded letter-like marks on one side of the blade and a lattice weave on the other.[803]

5.3.4.3. Marks accompanied by other geometric motifs

Other seemingly geometric motifs than lattices are quite rare (Fig. 53). KM 1174:3 from Kokemäki has two cross potents and a circle between them. The figures on the other side of the blade consist of vertical lines and a figure shaped like the letter E. The marks on this side are,

797 *Stalsberg 1994: 184, Fig. 38. The catalogue number of the sword is T.4004 in the Trondheim Museum.*
798 *Thålin-Bergman & Kirpichnikov 1998: 501, 506, Abb. 5.3.*
799 *Lorange 1889: Tab. III. The find is under catalogue number 8301 in the collections of the University of Oslo.*
800 *Werner 1982: 17–20.*
801 *Thålin-Bergman & Kirpichnikov 1998: 500, 506, Abb. 5.2.*
802 *Thålin-Bergman & Kirpichnikov 1998: 500–501, 505, Abb. 4.2.*
803 *Kainov 2012: 28, 30. The hilt of this sword is of Petersen's type H, and the analysis of the blade was presented in Chapter 4.4.2.*

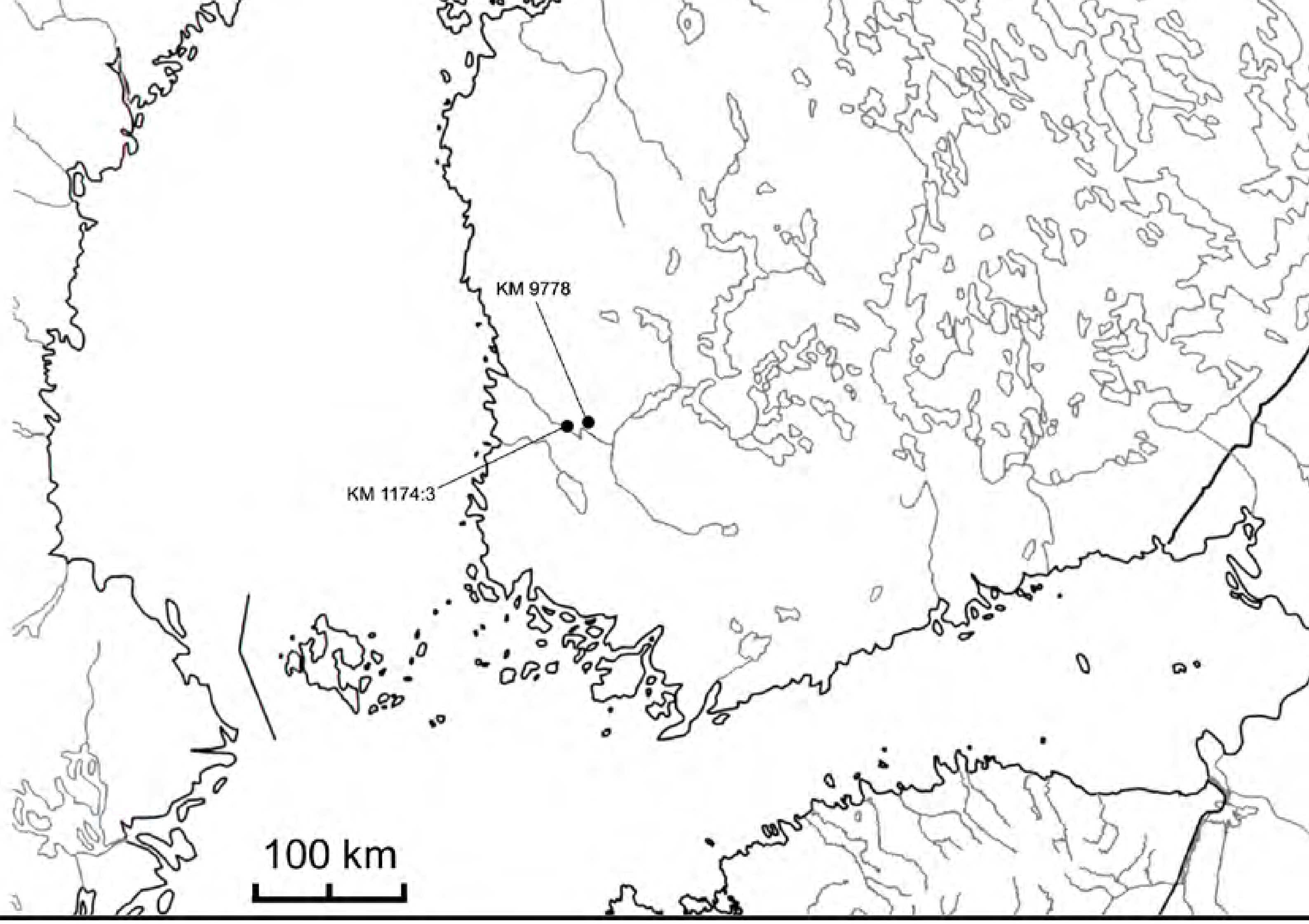


Figure 53. Letter-like marks accompanied by other geometric figures than lattices.

however, somewhat fragmentary, and their material is twisted pattern-welded rod. In similar fashion, a sword from Kurtna, Estonia has a circle between two cross potents, and the motif of a central cross potent and two circles on the opposite side of the blade.[804]

Another example is also from Kokemäki, KM 9778, which has a total of nine vertical lines and a diamond-shaped figure in the middle, perhaps imitating a lattice of some kind. The marks on the reverse side consist of L-shaped designs some of which are reversed, and the motif having a cross on both ends. All inlays are made from twisted pattern-welded material with seven layers, most of which are of iron. These marks strongly resemble those on KM 13419:2 from Turku (see above), which has two woven lattices on the opposite side of the blade, as well as marks on finds KM 1120:1 from Eura and KM 6753:51 from Turku. The motifs on the opposite side of KM 9778 resemble those found on a sword from Mainz, Rheinland-Pfalz, Germany, having a diamond-shaped design, vertical bars and V-shaped designs, also reversed.[805]

5.3.4.4. Letter-like marks on both sides of the blade

KM 1822:2 from Eura has figures resembling the letters I, R and L on one side, and highly fragmentary lines on the other, all made from twisted pattern-welded rods. KM 2548:196 from Laitila has a motif consisting of alternately reserved E and T-shaped figures, and on the other side similar kinds of figures can be seen along with vertical lines, although these are quite fragmentary.

804 *Prank 2011: 71–72. The sword is listed under catalogue number AI 2643:89 in the Institute of History in Tallinn and is dated to the 12th century.*

805 *Geibig 1991: 127, 208, 283, Taf. 73.*

All the marks are again made from twisted pattern-welded material. The only foreign finds somewhat resembling this are from Sweden.[806] KM 6227:1 from Sastamala (formerly Tyrvää) has very fragmentary V, T and H-shaped figures on one side, and some fragmentary vertical bars on the other, all pattern-welded and twisted. KM 6753:51 from Turku (formerly Kaarina) has crosses and designs resembling the letters U, D, I and H on both sides of the blade, some of the figures being reversed or rotated. The material of the inlays is twisted pattern-welded rod with nine layers, most of which are of iron. KM 8602:130 from Köyliö has marks resembling the letters H and I, made from non-patterned material, which cannot be more accurately defined from the radiographs. A sword from Tenhola, KM 8896:25, contains I, N, L and T-shaped figures, sometimes rotated, on both fullers, and again made from twisted pattern-welded material. KM 15467 from Raisio has only a few marks left, a cross and fragments of vertical lines on one side, and fragmentary lines on the other, made from twisted pattern-welded rods. This find may, of course, have also contained an actual inscription, but this can no longer be observed. Another very fragmentary example is from Eura, KM 24740:242, with fragments of vertical diagonal lines made from twisted pattern-welded material. This, too, may have originally contained an actual inscription as well. KM 26301 from Pöytyä (formerly Yläne) has figures resembling the letters V, I, F, D, H and L, implying a possible ULFBERHT imitation, except that the "letters" are reversed, rotated and only *resemble* actual letters. The other side has fragmentary vertical and diagonal bars not forming any actual geometric motif. The material of the inlays is, however, twisted pattern-welded rod. Individual parts of the motif resemble a find from Randers in Denmark.[807] Finds KM 12687:1 from Turku, KM 13399:3 from Masku and KM 17208:375 from Tampere all have remains of pattern-welded letter-like marks on one side and bare vertical lines on the other insofar as the motifs have been preserved.

This phenomenon is not unknown in foreign finds. Viking Age finds, for example, from Saaremaa in Estonia and Liškiava in Lithuania have letter-like fragmentary figures on both sides of their blades.[808] Also very crude ones are known from a sword found in Grof, Norway.[809] In addition, a sword from Hemmesta in Sweden has similar kinds of motifs, actually close to those on KM 6753:51.[810] Another sword from Sweden, from an unknown find location in Middle Sweden, has letter-like marks including some lattice-like, clumsy patterns in the middle on both sides of the blade.[811] A brazil-nut pommeled sword from Stade, Germany has long motifs on both sides of the blade consisting of marks resembling the reversed letters V, N and I.[812] Another sword from Germany, this time from Hamburg-Billwerder, has marks resembling the letters H, N, E, M, L and I, reversed in some cases and lined with cross potents on one side of the blade.[813]

Letter-like marks are also found on post-Viking Age blades with narrower fullers and smaller inlays. These normally have similar kinds of marks on both sides of the blade. An essential point is that the marks resemble actual Latin letters, but their order is very random and the marks are often reversed. These facts imply that the motifs are most likely illiterate versions of, for example, the IN NOMINE DOMINI inscription.

806 *Jankuhn 1951: Abb. 2; Thålin-Bergman & Kirpichnikov 1998: 501, 506, Abb. 5.3. The last of these has been found from Oljonsbyn (catalogue number 11097 in the Swedish History Museum), and the reverse side contains two simple lattices and a cross, along with some letter-like marks.*

807 *Lønborg 1994: 10.*

808 *Anteins 1966: 114–115, Abb. 2; Anteins 1973: 58. The catalogue numbers of the swords in question are IZA-K85:129 (Saaremaa, Estonia) and VM-1115271 (Liškiava, Lithuania); the specific collections were not stated.*

809 *Lorange 1889: Tab. IV. The catalogue number of the sword is 1069 in the Museum of Bergen.*

810 *Werner 1982: 16–19.*

811 *Thålin-Bergman & Kirpichnikov 1998: 501, 505, Abb. 4.3.*

812 *Geibig 1991: 127, 209, 354, Taf. 144; Müller-Wille 1977: 57, Abb. 14.5., 73. The catalogue number of the sword is Museum für Völkerkunde Hamburg 22:47.1. The hilt is of Geibig's combination type 15.3 and the inlays seem like iron.*

813 *Geibig 1991: 127, 210; Müller-Wille 1977: 57, Abb. 14.4., 72. The sword has a brazil-nut pommel.*

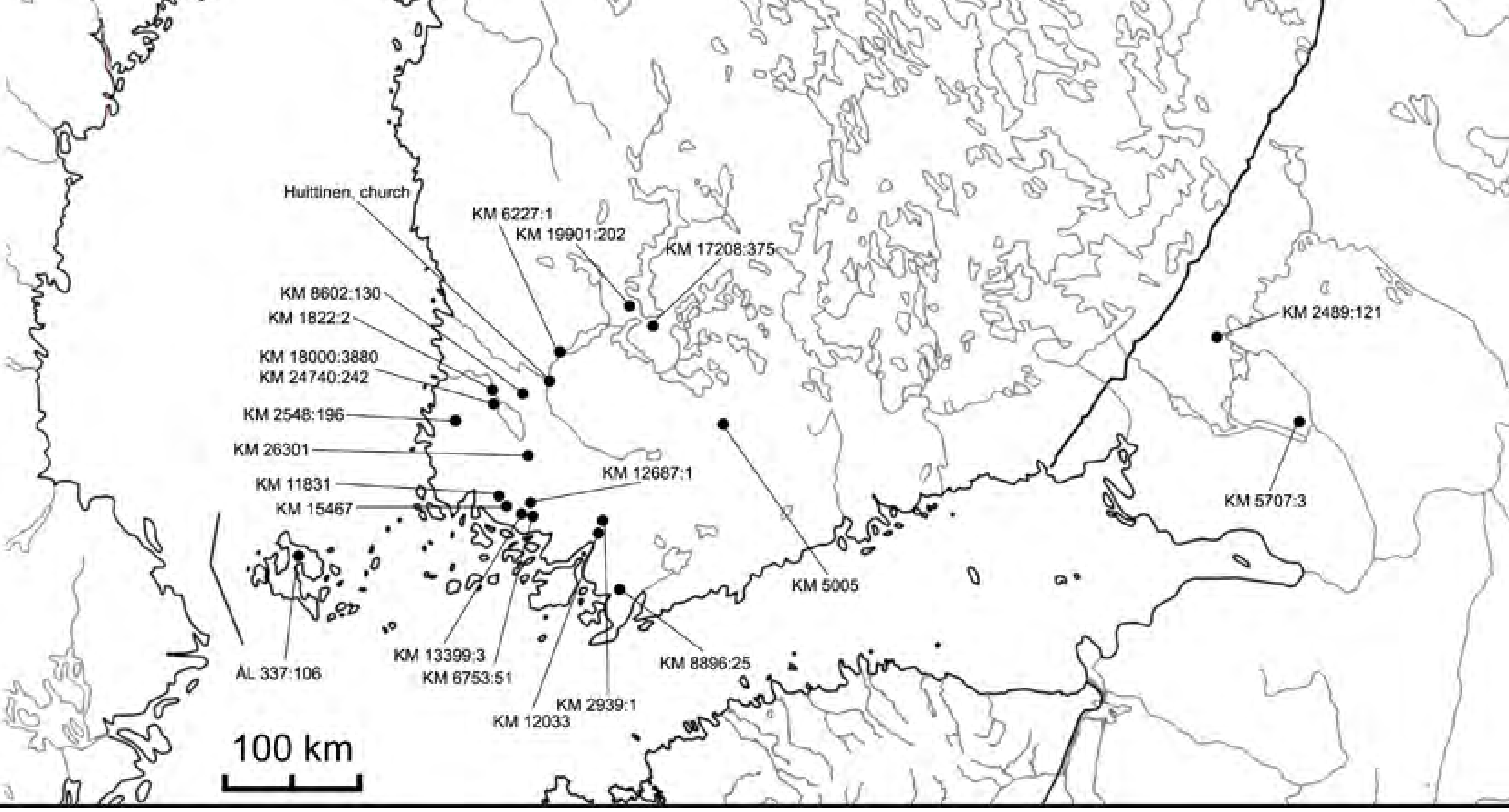


Figure 54. Letter-like marks only on one or both sides of the blade.

KM 5005 from Janakkala has steel figures resembling the letters I, N and O on both sides of the blade, the other side being much more fragmentary. KM 5707:3 from Metsäpirtti, ceded Karelia, has I, M and N-shaped figures, sometimes reversed and in random order, on both sides of the fuller. Also cross potents are present on one side, all inlays being made from non-patterned steel. Similar steel inlays although fewer in number can be found on the fuller of sword KM 11831 from Masku. Also KM 19901:202 from Ylöjärvi has I, O and N-shaped designs on both sides of the blade, being made from steel rods or even pattern-welded material. The inlays with fragmentary cross potents on KM 12033 from Salo are executed in a more confident manner with twisted pattern-welded rods. The sword from the Church of Huittinen has abnormally long motifs consisting of cross-potents and fragmentary letters resembling I, N and O, among others, all in random order and executed with steel rods. In foreign cases, a sword from Ludwigshafen am Rhein-Oggersheim, Germany has inlays in the form of CNNCINNNNMIIN+ and NI… NCNI.[814] Also German finds of swords from Kalkar-Niedermörmter[815] and from the River Rhine at Duisburg in Nordrhein-Westfalen[816] have figures resembling the letters N, M, O and I in random order.

Some blades with smaller inlays have marks only on one side of the blade, perhaps intentionally, but this may also be caused by corrosion. KM 2489:121 from Kaukola, ceded Karelia, has lines and a fragmentary O-shaped figure on one side of the blade, executed with small steel rods. KM 2939:1 from Salo (formerly Perniö) has I, O and N-shaped marks on only one side of the blade, possibly made from pattern-welded material. The other side of the blade is completely pattern-welded. These may also be found among foreign sword finds, for example from Tornimäe[817] and Lõpi[818] in Estonia. According to publications, it is hard to be sure if the blades were examined and documented well enough to state that the opposite side of the blade actually lacked any inlays.

814 *Geibig 1991: 127, 208, 279, Taf. 69. The sword has a brazil-nut pommel in the form of Geibig's combination type 15.3, and the inlays seem like steel according to the corrosion.*

815 *Geibig 1991: 127, 208, 306, Taf. 96. The brazil-nut pommeled hilt is of Geibig's combination type 12.2, and the inlays seem to be steel.*

816 *Geibig 1991: 127, 208, 302, Taf. 92. The hilt is of Geibig's combination type 15.6 with a brazil-nut pommel.*

817 *Prank 2011: 38–39. The blade fragment is under catalogue number AI 4455 89 in the Institute of History in Tallinn and the inlays are pattern-welded.*

818 *Prank 2011: 40–41. This fragmentary blade is under catalogue number AI 3139 89 in the Institute of History in Tallinn.*

The similar phenomenon of possible one-sided letter-like inlays may be observed in swords KM 18000:3880 from Eura and ÅL 337:106 from Saltvik, although neither one has been investigated with stereoradiography, thus leaving it possible that there are inlays on both sides of the fuller.

Geographically, no certain concentrations may be observed among these types of blades, apart from the fact the majority of them have been recovered from Finland Proper and Satakunta (see Fig. 54).

5.3.5. Geometric and symbolic motifs

5.3.5.1. General remarks

The fifth group consists of blades with geometric and/or symbolic motifs on both sides of the blade. These can be in the form of variable lattices, vertical lines, omegas, crosses, etc. Common to all of them is symmetry, which is not present in the previous category of letter-like marks. A large number of symbolic motifs were revealed (Fig. 55). They included various lattice patterns, plain vertical lines, circles, spirals, different crosses and omega-like designs. Altogether 48 swords contained only these kinds of marks and not any letters.

The categorization was made according to certain figures or motifs. The first group includes those with various lattices, normally appearing together with vertical lines or independently. The second group includes all motifs with omega-like shapes. The third category includes those with circles and spirals. The fourth category is small, with simple motifs consisting of plain lines that are vertical and/or horizontal. St. John's Arms and the S-shaped infinity symbol form their own groups. The seventh category includes all other motifs and their combinations.

The dating of each specific category is discussed below. In general, geometric motifs were already present in pre-Viking Age blades with pattern-welded bases. According to Alfred Geibig, geometric figures in non-patterned blades were common from 750 AD to 950 AD, after which they were in use again in the 12th century.[819] Some symbols may be interpreted as belonging to Christian imagery, thus dating from between 1100 and 1220 AD according to Geibig.[820] These observations, however, are based solely on the German finds only.

The find locations of blades with geometric and/or symbolic motifs are given in Figure 56. It may be seen straight that the finds concentrate in Finland Proper and Satakunta. Only few finds have been made elsewhere, however, it must be noted that the finds are of very broad geographic distribution, including Ostrobothnia and Central Finland. The distribution of specific motifs is presented below.

5.3.5.2. Lattices and vertical bars

This category consists of blades with only lattices on their blades, often accompanied by vertically inlaid bars. These finds are accumulated in the central parts of Finland Proper and the southern areas of the Satakunta region. There are only three finds from areas further inland, and two from the Åland Islands (see Fig. 57). In the simplest version, a lattice on only one side of the blade (KM 293) was found at Saltvik in the Åland Islands. The lattice is of iron and the blade itself is

819 Geibig 1991: 155.
820 Geibig 1991: 155.

Figure 55. Features of inlays with geometric and symbolic motifs.

Catalogue number	Inlays, Side A	Inlays, Side B	Material of inlays	Blade construction	Blade type
KM 293			iron	pattern-welded (Fig. 5.13)	Geibig 2 / Oakeshott X
KM 369			twisted and straight pattern-welded (3–5 layers)		Geibig 2 / Oakeshott X
KM 439:1			twisted pattern-welded		Geibig 5 / Oakeshott Xa
KM 1996:73			twisted and straight pattern-welded (9 layers: 5 iron and 4 steel)		
KM 2022:1			twisted and straight pattern-welded (7 layers: 4 iron and 3 steel)	pattern-welded (Fig. 5.15)	Geibig 1
KM 2345:1			twisted pattern-welded		
KM 2886:10			twisted pattern-welded		
KM 2979:8			iron	laminated (Fig. 5.8)	
KM 3336:31			straight pattern-welded (7 layers: 4 iron and 3 steel)	pattern-welded (Fig. 5.13)	Geibig 2 or 3 / Oakeshott X
KM 3383:2			steel (?)		
KM 3699:3			twisted pattern-welded		
KM 4254			twisted and straight pattern-welded (3–5 layers)		Geibig 2 / Oakeshott X
KM 4566:12			twisted and straight pattern-welded (3 layers: 1 iron and 2 steel)		
KM 5215			iron		
KM 5334:1			twisted pattern-welded		
KM 5395:1			iron		
KM 5865:1			twisted pattern-welded		
KM 5890:1			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 6482			straight pattern-welded	pattern-welded (Fig. 5.13)	
KM 6746:49			iron	pattern-welded (Fig. 5.13)	Geibig 2 / Oakeshott X
KM 7703:2			straight pattern-welded	pattern-welded (Fig. 5.13)	Geibig 2 / Oakeshott X
KM 7961:1			twisted pattern-welded		
KM 8602 A:116			twisted pattern-welded (?)		
KM 9142:8			iron	laminated (Fig. 5.8)	
KM 9243:1			twisted and straight pattern-welded		Geibig 2 / Oakeshott X
KM 9389:1			twisted pattern-welded		
KM 9832			twisted pattern-welded	piled from similar material (Fig. 5.6)	
KM 10369:3			straight pattern-welded (11 layers: 5 iron and 6 steel)	pattern-welded (Fig. 5.13)	Geibig 2 / Oakeshott X
KM 10390:3			steel	laminated?	
KM 10906:1			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 11063:283			straight pattern-welded (5 layers: 3 iron and 2 steel)	pattern-welded (Fig. 5.13)	Geibig 2 or 3 / Oakeshott X
KM 11242			steel (?)		
KM 11859:1			iron (?)		
KM 13419:1			straight pattern-welded	pattern-welded (Fig. 5.13)	Geibig 3 / Oakeshott Xa
KM 13962:322			twisted pattern-welded		
KM 14196:69			twisted pattern-welded		Geibig 5 / Oakeshott Xa
KM 18000:3170			iron or steel		
KM 22964:3			straight pattern-welded (7 layers: 4 iron and 3 steel)	pattern-welded (Fig. 5.13)	Geibig 2 / Oakeshott X
KM 23607:490			twisted pattern-welded		Geibig 2 / Oakeshott X
KM 31017:1			twisted pattern-welded	laminated (?)	
HM 3047			twisted and straight pattern-welded (7–14 layers: 4 iron and 3 steel)		Geibig 2 or 3 / Oakeshott X
LiuM 26			twisted pattern-welded		
SatM 10330			steel		
TMM 13393			twisted pattern-welded or steel		Geibig 5 / Oakeshott Xa
TMM 14105			twisted pattern-welded		
ÅL 336:292			twisted pattern-welded		
ÅL 337:528			straight pattern-welded	pattern-welded (Fig. 5.13)	
ÅL 345:113			straight pattern-welded	pattern-welded (Fig. 5.13)	

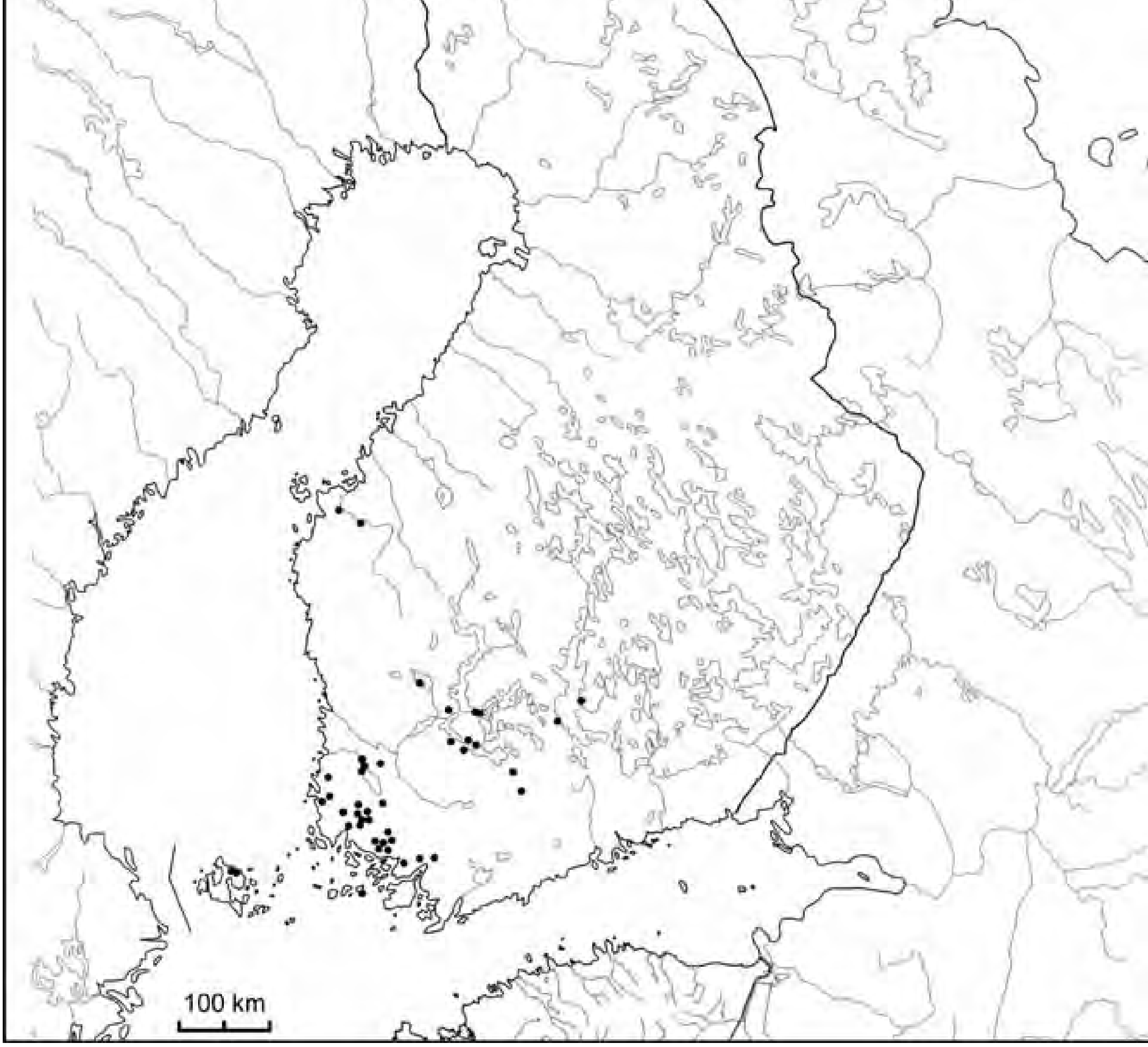


Figure 56. Geographic distribution of swords with geometric and symbolic motifs.

pattern-welded (see Chapter 4.4.6). A slightly similar find comes from Elbe, Germany, showing one lattice or more like hourglass-shaped figure on one side of the blade, which was pattern-welded to display two twisted bars on each side.[821]

KM 13962:322 from Pöytyä (formerly Yläne) has a fragmentary lattice or lattice weave made from twisted pattern-welded material, and only on one side of the blade. There is a similar kind of example from Saltvik (ÅL 336:292). KM 23607:490 from Eura has a fragmentary woven lattice and fragments of vertical lines on only one side of the blade, all marks having been made from twisted pattern-welded material. A similar kind of solution can be found on blade of KM 31017:1 from Sysmä.

KM 7961:1 from Mynämäki has a woven lattice and fragmentary vertical lines, in similar fashion to the ULFBERHT swords, made from twisted pattern-welding. No inlays were observed on the opposite side of the blade. KM 8602 A:116 shows a fragmentary lattice, and some vertical lines on both sides of the blade. The inlays are very hard to distinguish, and their material may be pattern-welded rod, but also something else.

Sword TMM 14105 from Salo has two woven lattices, one on each side of the blade. On one side the lattice is followed by a cross, and on the other by a D-shaped design. The material of the inlays is twisted pattern-welded rod.

821 *Müller-Wille 1977: 55, Abb. 12.7., 73. The catalogue number of the sword at the Museum für Hamburgische Geschichte is 1923:48. The resemblance of the hilt with Petersen's type E and some early special types dates the sword to the early Viking Age.*

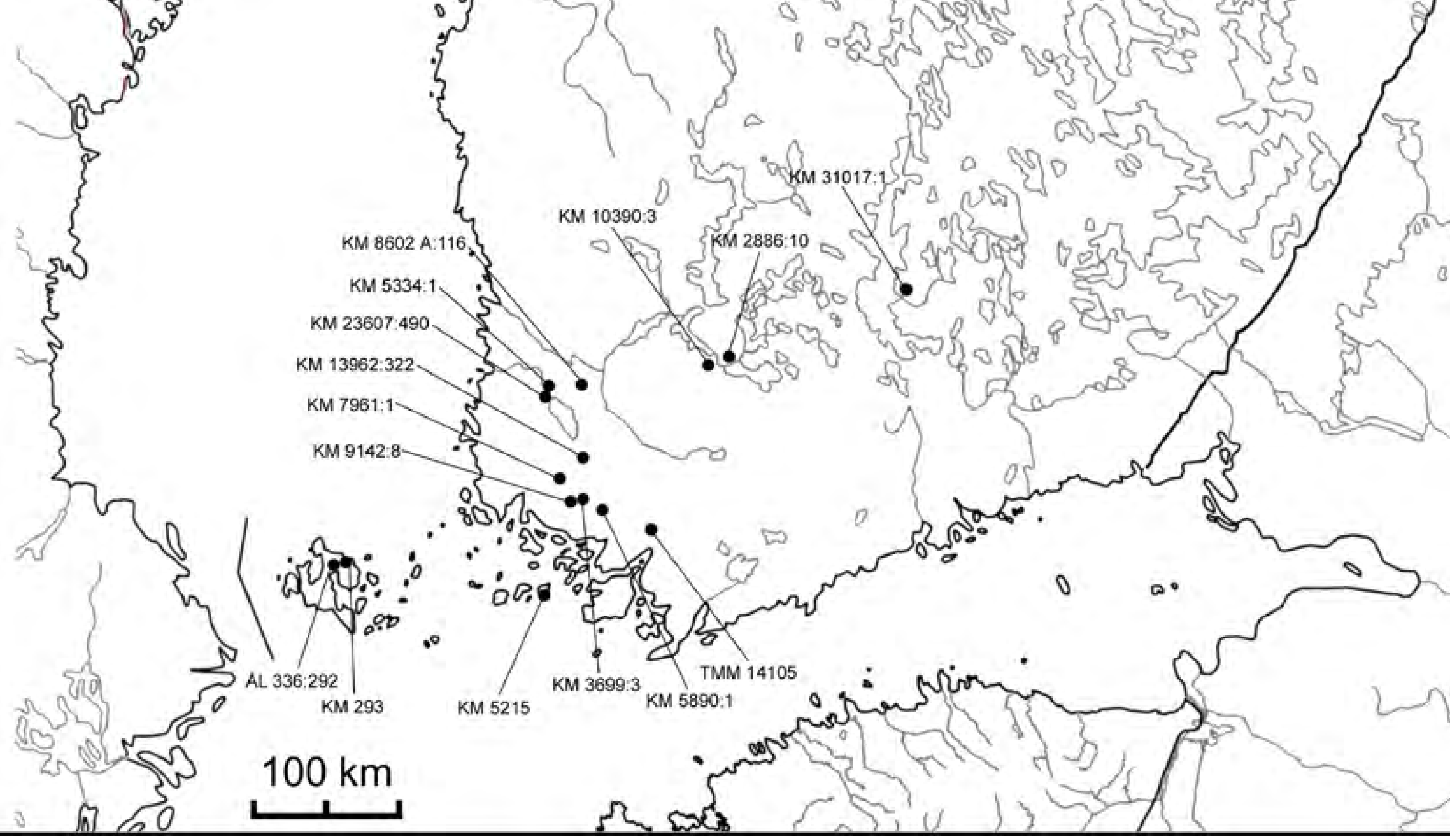


Figure 57. Find locations of blades with lattices sometimes accompanied by vertical bars.

Lattice weaves on both sides of the blade appear in a total of five examples. KM 3699:3 from Nousiainen shows twisted pattern-welded lattice weaves on both sides of the blade, lined with vertical lines on one side. Close to this find is also KM 2886:10 from Valkeakoski, although the motifs seem to be done somewhat sloppy. KM 5890:1 from Lieto has similar kinds of lattice weaves on both sides, again from twisted pattern-welded material, but without the additional vertical bars. KM 5334:1 from Eura shows a long, fragmentary lattice weave on both sides of the blade, continuing all the way to the broken part of the blade. The inlays are pattern-welded and twisted. A similar kind of lattice weave can be found on a find from an unknown locality in Germany.[822]

KM 9142:8 from Nousiainen also has a long lattice weave made of iron, this time beginning with a cross potent. The other side also exhibits a lattice-like pattern consisting of consecutive diamond figures, again preceded by a cross potent. An identical blade, at least with regard to the iron inlays, has been found in Kiviloo, Estonia.[823] Also a sword from Bederkesa, Germany has a similar cross-lined long lattice on one side of the blade.[824] KM 5215 from Parainen (formerly Nauvo) also has a narrow, long lattice weave made of iron on one side of the blade.

Several lattices could have been inlaid successively to achieve a similar kind of effect. KM 10390:3 from Vesilahti has three consecutive simple lattices on one side, and a fragmentary lattice on the other, all possibly made of steel. Similar motifs of three joined lattices can be found on a sword from Dorestad in the Netherlands, having a pattern-welded base consisting of two twisted bars on each side.[825]

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822 *Geibig 1991: 115, 207, 261, Taf. 51. The hilt of the sword is of Petersen's type B or Geibig's combination type 1.6.*
823 *Anteins 1966: 114–115, Abb. 3. The catalogue number of the sword is IZA-3904 with no specific information on the collection.*
824 *Geibig 1991: 115, 208, 326, Taf. 116. The hilt is of Geibig's combination type 16.1.*
825 *Ypey 1984: 224, Abb. 7.D. The sword is under catalogue number RMO f 1936/11.1 in the Dutch National Museum of Antiquities.*

Also some foreign finds exhibit only lattices. A sword from Kiev, Ukraine has two woven lattices and a complex lattice weave on its blade, all pattern-welded.[826] A sword from Östveda in Sweden shows two woven lattices lined by vertical lines on one side, and two simple lattices lined with vertical bars on the other.[827] This sword, however, is somewhat exceptional since the publication documents the blade as having two narrow fullers instead of one. A sword from Fedderingen, Germany has three consecutive simple lattices on one side of its blade.[828] Another sword from Germany, from Ludwigshafen am Rhein-Oppau, has three consecutive simple lattices, although more flattened ones than in the previous example, more like those on find KM 10390:3.[829]

5.3.5.3. Omega-like designs

Included in this category are all blades with one or two omega-like figures. These blades are divided more evenly between the southwestern parts of Finland and the Tampere region and Tavastia proper (Fig. 58). In addition, the omegas were attached to a pattern-welded blade in four cases.

Sword KM 3336:31 from Uusikaupunki (former Kalanti), with a pattern-welded mid-section, also has two omegas lined with vertical bars on one side. The marks are pattern-welded and were left untwisted, perhaps to distinguish them more easily from the patterned fuller below. The pattern-welding of the actual inlays has seven layers, four of which are iron. Also two swords with omegas from Saltvik have pattern-welded mid-sections, both showing two rods on one flat, which are twisted in opposite directions. While ÅL 337:528 has only one omega-like figure, ÅL 345:113 displays two, executed with possibly straight pattern-welding in both finds, the figures and the patterns being strikingly similar to each other.

In four swords, a lattice may be found on the side opposite to the omega figures. Sword KM 369 from Hämeenlinna (former Vanaja) has on one side two omegas with two vertical bars in between them, and one line as the last mark. The other side has a simple woven lattice with vertical bars, one on each side. The material is both twisted and straight pattern-welded rod with three to five layers. The straight pattern-welding was used only in the omegas. KM 4254 from Lempäälä contains a cross potent between two omegas, and a simple woven lattice lined by vertical lines. All the inlays are pattern-welded in such a manner that the patterns on the omegas are straight, while on other inlays the patterns are twisted. The pattern-welded inlaid rod contains three to five layers. There are almost similar motifs on a Petersen type H sword from Lepna-Taaravainu, Estonia, with a Greek cross between the omegas, and the lattice pattern that is fragmentary but still strikingly similar, also in pattern-welding.[830] A sword from Maas bei Wessem in the Netherlands also has a similar kind of lattice, the opposite side showing two possible omegas or C-letters with a spiral in between.[831]

KM 4566:12 from Turku (formerly Maaria) has two omegas between two vertical bars on each side. In addition, there are two more bars between the omegas. The other side of the blade has a simple lattice with two vertical lines on each side of it. The patterns are again twisted, except in the case of the omegas. The layer count of the inlaid rod is three, with one layer of iron and two

826 *Anteins 1973: 57.*

827 *Thålin-Bergman & Kirpichnikov 1998: 500, 504, Abb. 3.2. The sword is under catalogue number 11422:1 in the Swedish History Museum.*

828 *Geibig 1991: 115, 209; Müller-Wille 1977: 55, Abb. 12.6., 67. The catalogue number of the sword is Museum of Heide A 575, and the hilt is of Petersen's type H.*

829 *Geibig 1991: 115, 208, 281, Taf. 71. The hilt of the sword is of Petersen's type Y or Geibig's combination type 13.1.*

830 *Prank 2011: 36–37. The sword is under catalogue number RM 3110/A73 in the Estonian National Museum.*

831 *Willems & Ypey 1985.*

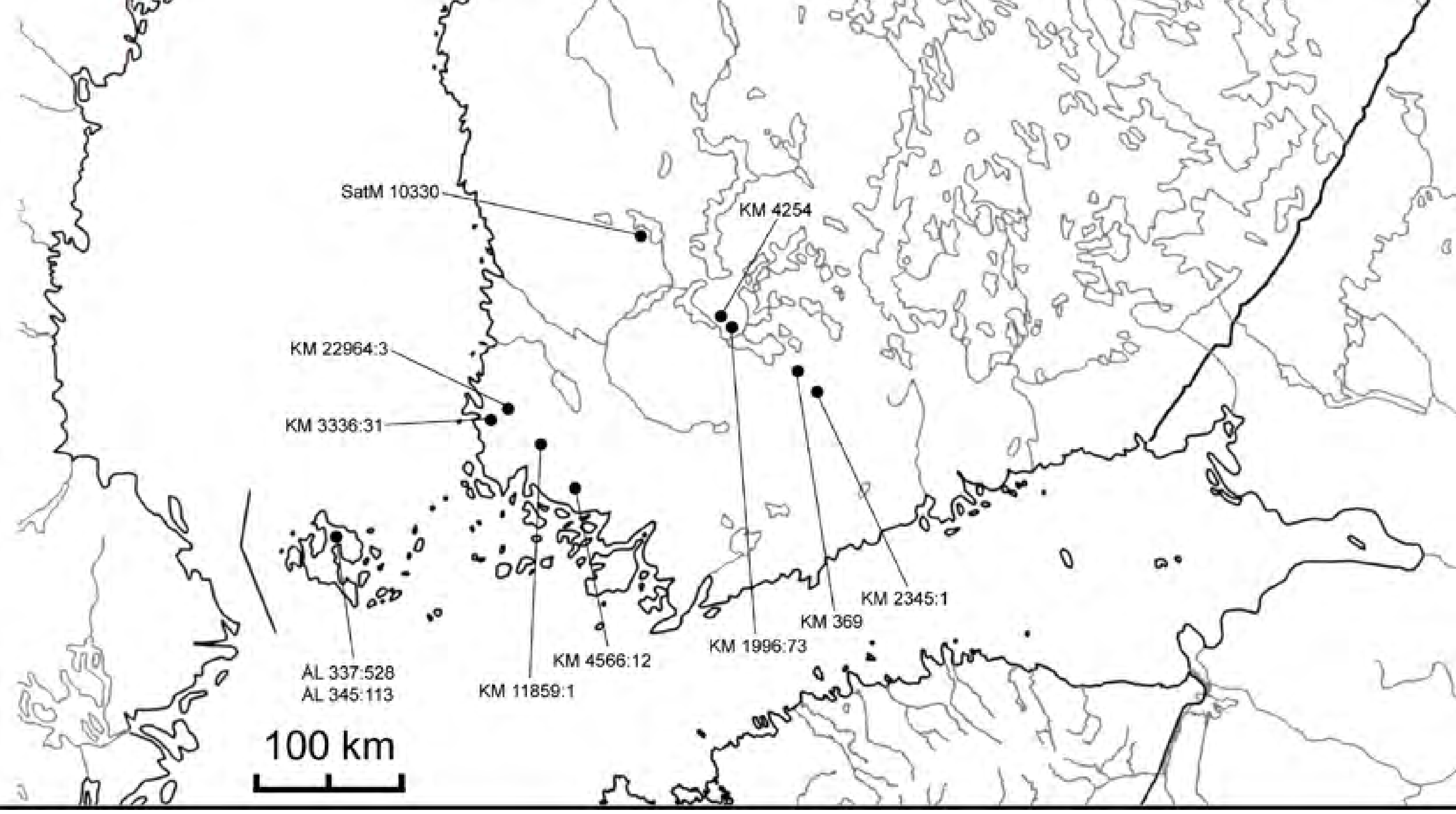


Figure 58. Find locations of blades with omega-like figures.

layers of steel. KM 11859:1 from Mynämäki is similar to the above, except that the inlays seem to be made of iron, but they may also be of pattern-welded material, since some slag streaks are diagonal instead of longitudinal on the surface of the marks.

To present some comparative material, a sword from Trondheim, Norway has a possible plain cross lined by omegas, which are again lined by vertical lines, the other side of the blade having two consecutive simple lattices lined by vertical bars.[832] A sword from Brekendorf, Germany has only two omegas on one side of the blade,[833] whereas a fragmentary sword from Gnezdovo has only one non-patterned omega figure.[834] A more similar equivalent for the finds KM 4566:12 and KM 11859:1 has been found in Kaersoo, Estonia, having three vertical bars between two omegas, and a simple lattice pattern on the other side, consisting of three X-like marks and vertical bars lining them.[835] Another one is known from Gnezdovo, Russia.[836] A sword from Bayern bei Deggendorf, Germany has a motif of two omegas with accompanying vertical bars repeated two times consecutively, meaning that the motif consists of alternating five vertical lines and four omega figures.[837]

In two cases, the contents of the motifs are similar. KM 1996:73 from Lempäälä shows a cross potent lined with omegas on one side, and a spiral lined with cross potents on the other side. Again the material is pattern-welded, now having nine layers, most of which are of iron. The patterns are twisted except in omega figures and in the spiral design. Sword SatM 10330 is similar in motifs, but the material of the inlays seems to be steel. This, however, cannot be definitely stated, so the material may be pattern-welded as well. In regard to foreign finds, a sword from Gnezdovo, Russia shows similar spiral lined with cross potents, although the reverse side is different showing

832 *Kirpichnikov & Stalsberg 1998b: 211–212.*
833 *Müller-Wille 1977: 56, Abb. 13.5., 70. The sword is listed under catalogue number 19657 of the Museum of Copenhagen, and has a hilt of Petersen's later type X.*
834 *Kainov 2012: 25, 29. The preserved lower guard of this sword is of Petersen's type E.*
835 *Prank 2011: 47–49. The sword is under catalogue number AI 4802 in the Institute of History in Tallinn and has a hilt of Petersen's later type X. The inlays are pattern-welded.*
836 *Arendt 1933: 160.*
837 *Geibig 1991: 115, 207, 212, Taf. 2. The hilt of the sword is of Petersen's type B or Geibig's combination type 1.3.*

a human-like figure arranged from pieces of pattern-welded rods.[838] Another sword from Kurtna, Estonia has a circle between two cross potents, and an opposite motif on the other side of the blade.[839]

KM 2345:1 from Loppi also has a cross potent lined with two omega figures, but now the omegas are also lined with vertical bars, three on each side. Similarly, the other side shows a circle lined with two simple crosses and three vertical lines on each side. The material of the inlays is pattern-welded and twisted. Almost similar motifs may be found on a sword blade from Lough Gur, Ireland, where the only difference is that the crosses are not simple but cross potents.[840]

Sword KM 22964:3 from Laitila has inlays on one side of the blade, with altogether four omega-like designs together with N-shaped figures, all pattern-welded from non-twisted rods. The blade is pattern-welded is such a manner that the number of rods is different on the respective blade flats (see Fig. 47). A somewhat similar blade has been found in Tarnobrzeg in Poland.[841] This specimen also has four omega-like figures, but the N-like designs resemble squares more in this sword, assuming the drawing in the article was made correctly. According to the photograph in the article, the figures may have been made from straight pattern-welded material as also in the case of the Laitila sword. Also the blade of the Tarnobrzeg sword is pattern-welded, although apparently more simply since the Polish blade has only two twisted rods in the blade fuller. The hilt of the Tarnobrzeg sword is of the Mannheim-Speyer type, with a similar dating as the Mannheim type hilt of the Laitila sword.

In foreign finds, the motifs display slightly more variation. For example in British finds a case is known where the spiral is between the omega figures, and also another blade where the cross between the omegas is a plain 'Greek' version and not a cross potent.[842]

To mention an interesting analogy, the ULFBERHT blade from Valkeakoski (KM 2767) does not have a lattice as a geometric motif, but instead two omega-like designs with a cross between them.

The interpretation of omegas has been normally Christian, i.e. meaning the Holy Spirit.[843] Unto Salo has connected the symbol to the first and last letters of the Greek alphabet, the alpha and the omega, the connotation here being Christian.[844]

5.3.5.4. Circles and spirals

In addition to omega figure motifs, circles and spirals occur also independently. These have a distribution similar to blades with omega-like figures (Fig. 59). KM 3383:2 from Padasjoki has two steel spirals, one on each side. A sword from Mynämäki, KM 5395:1, has similar kinds of spirals, but of iron. There are also iron spirals on opposite sides of the blade in KM 6746:49 from Turku (formerly Kaarina), only in this case the mid-section of the blade is pattern-welded.

838 *Anteins 1973: 56; Kainov 2012: 24–25; Kirpichnikov 1970a: 173, Fig. 3; Kirpichnikov 1970b: 62, Fig. 3; Stalsberg 1989: 16, Fig. 10. The hilt of this sword is of Petersen's type E.*
839 *Prank 2011: 71–72. The sword is under catalogue number AI 2643:89 in the Institute of History in Tallinn and is dated to the 12th century.*
840 *Lang & Ager 1989: 104–105, Fig. 7.11. The catalogue number of the sword is 1864 1-27 3 in the British Museum.*
841 *Rauhut et al. 1968.*
842 *Lang & Ager 1989: 102–104.*
843 *Prank 2011: 104.*
844 *Salo 2005b: 88, 257.*

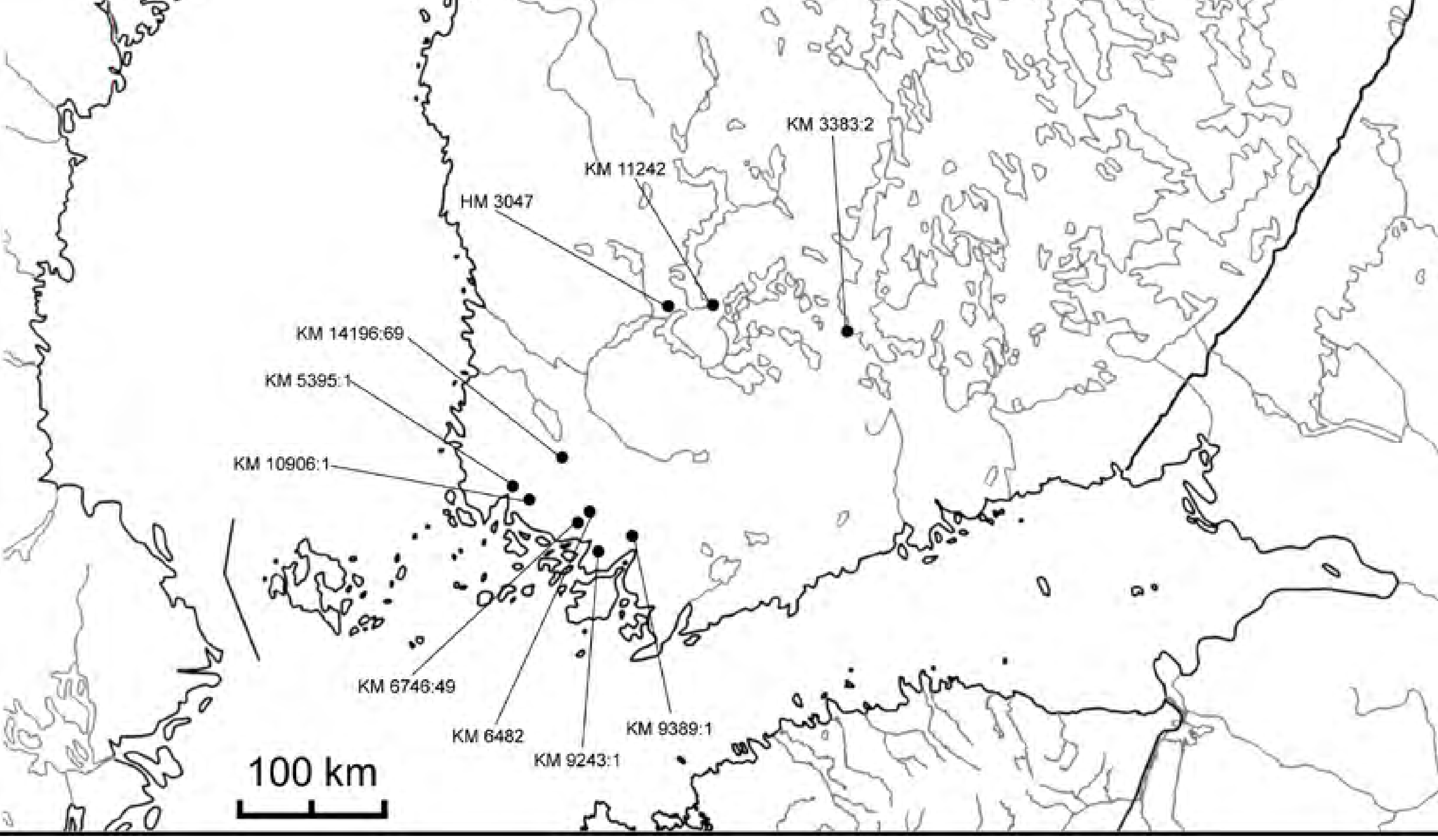


Figure 59. Find locations of blades with inlaid circles and/or spirals.

KM 6482 from Turku (formerly Maaria) has two circle-like designs but only on one side of the blade. The circles are pattern-welded with a straight pattern, and the blade is also pattern-welded on its fuller. Circles on a pattern-welded base are also found on a sword from Rimstad, Norway, along with other patterns.[845] The pattern-welding of these two blades is different, since the Finnish blade has three pattern-welded ribbons on one flat, and the Norwegian blade only two. A Petersen type K sword from Elst (U.) in the Netherlands has similarly two circle-like designs, this time inlaid on a non-patterned blade.[846] Also a sword from Dietachdorf-Kerschberg, Austria has two circle-like designs on a non-patterned blade.[847]

A sword from Sauvo, KM 9243:1, has a straight pattern-welded spiral next to a horizontal line made from twisted pattern-welding. Sword blade fragment KM 9389:1 from Salo has a circle on one side of the blade and the remains of a lattice and a vertical beam mark on the other. The lattice is fragmentary because of corrosion, and the motif may thus have been originally longer.

KM 14196:69 has a circle on one side of the blade with some additional bars inside it. Since there are also some obscure fragmentary marks on the precisely opposite side of the blade, it remains somewhat uncertain, which marks lay inside the circle and which on the opposite fuller. The material of all the inlays is twisted pattern-welded rod. This may have been an attempt to make a wheel cross design, found for example on a 12th-century blade from Lithuania.[848] Another example comes from an unknown locality in Germany, showing a cross potent on one side of the blade, and a wheel cross on the other.[849] The use of the wheel cross also continues in non-ferrous inlays.[850]

845 *Kirpichnikov & Stalsberg 1998a: 511–512, Fig. 2. The catalogue number of the sword is C.12009 in the Universitetets Oldsaksamling in Oslo.*
846 *Ypey 1982a.*
847 *Vinski 1983b: 497, Abb. 20.*
848 *Anteins 1966: 115–116, Abb. 3. The find is under catalogue number VM-850 (collection not stated).*
849 *Müller-Wille 1977: 58, Abb. 15.1., 74. The brazil-nut pommeled sword is catalogued in the Museum für Hamburgische Geschichte under number 1925:50.*
850 *E.g. a sword from Bayern bei Neu-Ulm, Germany with a hilt of Geibig's type 16.1. (Geibig 1991: 131, 207, 233, Taf. 23).*

Two circles can also be found on the blade of HM 3047 from Nokia. Both of them have a vertical beam in the middle. This kind of figure exists independently on one side of the blade, while on the other side this kind of similar design is lined by simple lattices, one on each side. The material is pattern-welded, having seven to fourteen layers, the number of iron layers being greater. In practice the original layer count was most likely seven, but for some inlays the pack was folded in two to double the layer count and to achieve a finer pattern. Otherwise the patterns are twisted, but the arcs of the circles remain straight. A similar kind of circle can be seen on a sword from Borge, Norway, along with other figures such as vertical lines and letter-like marks on the other side of the blade.[851] Also a sword from Älvkarleby, Sweden has motifs consisting of a circle on one side of the blade and two simple lattices lined by vertical bars on the other, all pattern-welded.[852] The hilt of the last example is also of Petersen's type I.

The blade of KM 10906:1 from Nousiainen also has two circles, this time connected to each other by a simple cross in between them. The other side consists of two simple consecutive lattices lined by a vertical line on both ends. All the figures are pattern-welded.

Spirals and circles can also be found in foreign material. For example, an 11th-century sword from Siraičiai, Lithuania has an iron spiral on one side and three vertical lines on the other.[853] A sword from Marcelháza, Slovakia has been documented as having one spiral on only one side of the blade, the hilt being of Petersen's type Y.[854] Somewhat similar is a Petersen type H sword from Gnezdovo, with one spiral on one blade flat and a fragmented, L-like mark on the other.[855] A sword from Stade, Germany, has spirals on the opposite sides of the blade in similar fashion to finds KM 3383:2, KM 5395:1 and KM 6746:49, and the blade is not pattern-welded.[856] Geibig has dated ferrous spirals between 850 and 950 AD.[857]

In sword KM 11242 from Kangasala, the circle, or more precisely a spiral, is accompanied by a clear cross potent on exactly the opposite side of the blade, all the figures being possibly made of steel. An almost identical blade also with non-patterned inlays is known from Gnezdovo, Russia, and is combined with a Petersen type D hilt.[858] Plain circles are quite commonly known in connection with cross potents, for example in a 9th-century sword from Paluküla, Estonia, with a cross potent between two circles on one side, and a circle between cross potents on the other, all executed in non-patterned iron or steel.[859] Also a sword from Ulvik, Norway has a pattern-welded cross-potent between two circles.[860] Two finds from the Netherlands also have similar kinds of motifs. A sword from Byland bei Millingen has a circle on the top of a pattern-welded base consisting of two twisted rods on one flat, whereas a sword from Tjaard bei Wirdum has a spiral design again on top of pattern-welding, this time with three continuously twisted rods on each side of the blade.[861] A sword from an unknown locality in Germany has a simple cross lined

851 *Kirpichnikov & Stalsberg 1993a: 36–37; Kirpichnikov & Stalsberg 1998a: 511–512, Fig. 2. The catalogue number of the sword is T.15018 in the Museum of Trondheim.*

852 *Thålin-Bergman & Kirpichnikov 1998: 500, 504, Abb. 3.1. The catalogue number of the sword is 1189 in the Swedish History Museum.*

853 *Anteins 1966: 115–116, Abb. 3. The sword is listed under catalogue number VM-17:40 without more specific mention of the museum collection.*

854 *Kovács 1995: 157, Abb. 3.1.*

855 *Kainov 2012: 28, 31, 33.*

856 *Müller-Wille 1977: 57, Abb. 14.6., 73. The sword is under catalogue number 785 of the Museum of Stade, and the hilt is of Petersen's later type X.*

857 *Geibig 1991: 155.*

858 *Kainov 2012: 16–17; Kirpichnikov & Kainov 2001.*

859 *Anteins 1966: 115–116, Abb. 3. The catalogue number of the sword is IZA-2483:57 without more specific mention of the museum collection.*

860 *Lorange 1889: Tab. III. The find is under catalogue number 2799.*

861 *Ypey 1984: 213–215, Abb. 1.*

with circles on both sides of the blade.[862] Circles can be seen on later blades as well, executed from non-ferrous materials. Marian Głosek lists few, dating possibly as far as 1200 AD and with non-ferrous inlays.[863] One of the earliest circles, on the other hand, may be found on a Merovingian blade apparently even without a fuller, found in Germany.[864] The circle is accompanied by a rotated S-like figure, both with straight pattern-welding, while the blade itself is not patterned.

The plain circle can have any meaning whatsoever. As Unto Salo has stated, a circle alone cannot be connected to Christianity unless it is accompanied by other Christian symbols.[865] The wheel cross, on the other hand, is used as a symbol of God; the Christian cross placed inside a circle symbolizes eternity.[866] As Salo has noted, the wheel cross is a symbol that also existed in the Stone and Bronze Ages, possible representing the sun.[867]

5.3.5.5. Vertical and horizontal bars

Some geometric motifs consist solely of vertically and horizontally inlaid lines. KM 5865:1 from Vähäkyrö has eight vertical lines on one side, and three on the other, all with twisted pattern-welding. Such simple motifs are somewhat rare, and usually there are also some other figures among, before or after the vertical line sequences. For example a 9th-century sword from Lejasbiteni, Latvia has letter-like marks at the beginning and end of a long line sequence made of pattern-welded rods.[868]

Plain vertical and horizontal bars are rare in foreign material, as they are also among Finnish finds (see Fig. 60). Two swords from Germany have motifs consisting of only vertical lines. A sword from Göppingen has eight lines on one side and six on the other, all in groups of two.[869] A sword from an unknown locality in Germany has fragmentary vertical bars on both sides of the blade, apparently in groups of three.[870] Geibig has dated these groups of iron bars, according to German material, broadly to 950–1200 AD.[871]

5.3.5.6. St. John's Arms

Designs resembling St. John's Arms were found on three blades (see Fig. 60). Sword KM 2979:8 from Mynämäki has figures resembling St John's Arms alternating with groups of three vertical lines. The other side contains a lattice weave pattern. All the inlays appear to be iron.

Another somewhat similar case is sword TMM 13393 from Turku (formerly Maaria). On the blade of this sword a short portion of these designs can be distinguished, consisting of similar

862 *Müller-Wille 1977: 57, Abb. 14.7., 74. The find is only a blade fragment without a hilt and is catalogued in the collections of the Museum für Hamburgische Geschichte under number M 1228.*
863 *See e.g. Głosek 1984: 140, Tabl. IV for a sword from the Czech Republic (catalogue number H-641 in the Museum of Bojnice) having a sun-shaped symbol between two circles on one side, and a vertical bar between crosses on the other.*
864 *Schmid 1921.*
865 *Salo 2005b: 48, 252.*
866 *E.g. Salo 2005b: 50.*
867 *Salo 2005b: 56, 253.*
868 *Anteins 1966: 115–116, Abb. 3; Anteins 1973: 55. The catalogue number of the sword is LVM-1963/VII in the Latvian History Museum.*
869 *Geibig 1991: 115, 207, 265, Taf. 55. The hilt is of Geibig's combination type 16.1.*
870 *Geibig 1991: 115, 209, 360, Taf. 150. The hilt is of Geibig's combination type 15.3. close to Petersen's type X.*
871 *Geibig 1991: 155.*

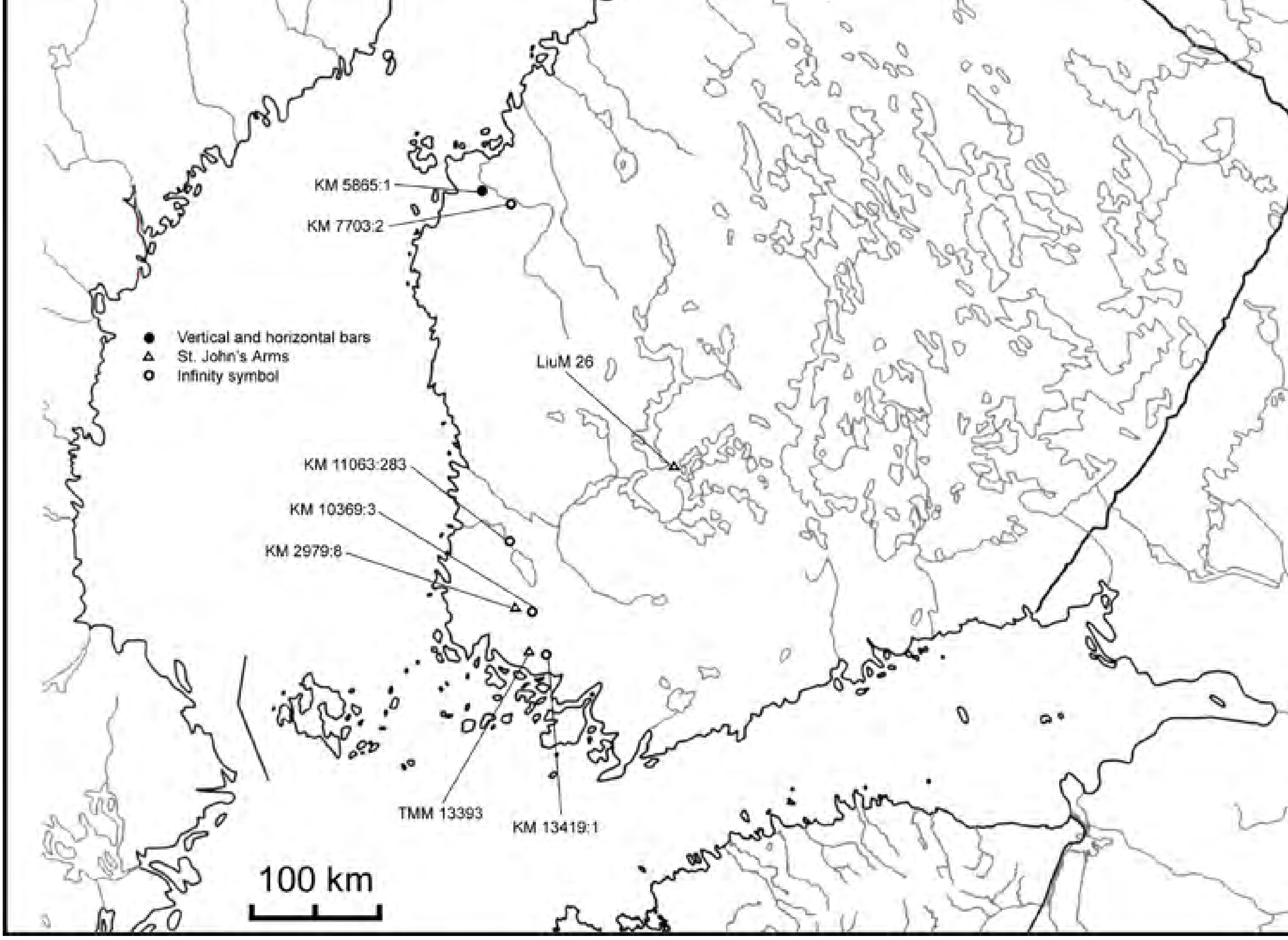


Figure 60. Find locations of blades with vertical and horizontal bars, St. John's Arms, and the infinity symbol.

figures resembling St. John's Arms alternating with groups of three vertical bars. The material appears to be either steel or pattern-welded.

The third sword is from Kangasala (LiuM 26), with a fragmentary St. John's Arms design on one side of the blade and a circular design on the other. This particular find was not examined by myself, and therefore these interpretations rely on previous publications.[872]

St. John's Arms are also quite rare in foreign material. An 11th-century sword from Altruppin, Germany has a somewhat similar motif compared to the Finnish example, although it is not identical.[873] The motifs on this German blade consist of similar D-shaped designs and St. John's Arms, with figures resembling the letter H between them. The reverse side lacks the D-shaped figures, but has instead the letter S at the beginning and end of the inlaid motif. Somewhat similar D-shaped or arrow-shaped designs are also found on a slightly later blade, although the motifs lack the actual St. John's Arms figures.[874]

Salo has interpreted St. John's Arms as purely Christian, possibly symbolizing baptism, since it is associated with the feast day of Saint John the Baptist.[875]

872 *Namely Leppäaho 1964b: 22–23.*
873 *Głosek 1984: 145, Tabl. VI; Wegeli 1903–1905: 219. The sword is under catalogue number W 5899 in the German Historical Museum.*
874 *Głosek 1984: 173, Tabl. XVIII.*
875 *Salo 2005b: 110–116, 260–261.*

5.3.5.7. The infinity symbol

There are four blades with a rotated S-shaped figure, the so-called infinity symbol (Fig. 60). In KM 11063:283 from Eura the symbol is independently on top of a pattern-welded fuller. The symbol itself was made from straight pattern-welded rod of five layers, three of which are iron and two are steel. Almost similar to this is sword KM 7703:2 from Isokyrö, with the S figure slightly tilted on top of a pattern-welded base. There is a third similar case from Nousiainen (KM 10369:3), also with also a patterned blade. The symbols on all three blades were made from straight pattern-welded material, whereas the pattern-welding of the blades varies (see Fig. 25).

There is a more complex motif on sword KM 13419:1 from Turku (formerly Maaria), in which the fuller is also pattern-welded as in the above case. Again, the inlays are concentrated on only one side of the blade. The infinity symbol is between vertical lines, one on each side. In addition, the symbol is accompanied by a simple lattice. The material of the marks is non-twisted pattern-welded material.

Considering the situation abroad, it seems that these figure-eight loops are quite common. A Merovingian Period blade from Germany has an S-shaped, rotated figure accompanied by a circle, executed with straight pattern-welding.[876] A sword from Camphill, North Yorkshire, England has similar figures on almost opposite sides of the blade.[877] This blade has been interpreted as an Anglo-Saxon attempt at copying a Continental European motif.[878] Somewhat similar to the above-mentioned two Finnish finds with pattern-welded fullers is a Merovingian Period sword from Nordendorf, Germany, with a similar infinity symbol on the top of a pattern-welded fuller consisting of three interruptedly twisted pattern-welded rods on one side of the blade.[879] The same symbol appears as rotated, looking more like the letter S, on a sword recovered from the River Witham, England, with the inscription +LEUTLRIT.[880]

Also a sword from Barlingbo, Sweden has two S-shaped figures on the blade, which is pattern-welded in the fuller below the figures.[881] Again, two similar figures may be seen on a blade from Vatku, Estonia, with vertical bars between them and on their sides, the other side of the blade having inlay in the form of "I[+II".[882] Two consecutive figure-eight symbols have also been found on a blade from Oberndorf, Germany.[883]

A somewhat similar symbol, resembling more an hourglass, was found on a sword blade from Dorestad, Netherlands.[884] The blade of this sword is pattern-welded, showing two twisted pattern-welded rods on both sides. The sword is dated to between 775 and 850 AD, and it has a hilt of Petersen's special type number two.

876 *Schmid 1921.*
877 *Lang & Ager 1989: 104–105, Fig. 7.10. The catalogue number of the sword is 1875 4-3 169 in the British Museum.*
878 *Ibid.*
879 *Böhne & Dannheimer 1961: 108, Beilage V, Tafel 19. The find is listed under catalogue number NM 3773 in the National Museum of Germany.*
880 *E.g. Maryon 1950.*
881 *Thålin-Bergman 1983b: 271, Fig. 11. The catalogue number of the sword is SHM 12773 in the Swedish History Museum.*
882 *Prank 2011: 34–35, 90–91. The catalogue number of the sword is RM 2397/A41 A73 in the Estonian National Museum. The hilt is of Petersen's type I.*
883 *Geibig 1991: 115, 207, 235, Taf. 25. The hilt of the sword is of Petersen's type B or Geibig's combination type 1.1.*
884 *Ypey 1980. The catalogue number of the sword is 372.4.11 in the Museum of Dorestad.*

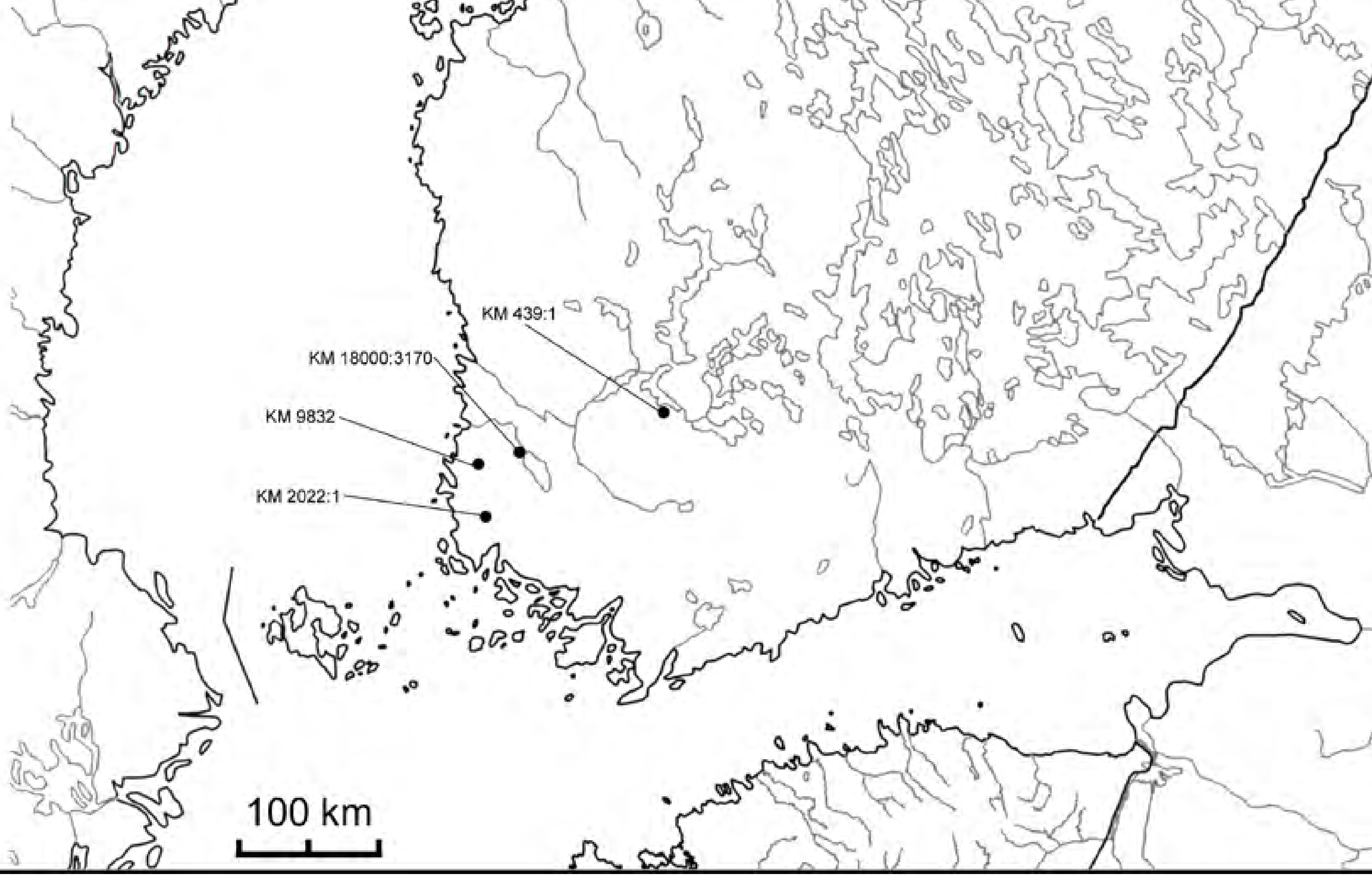


Figure 61. Find locations of blades with other geometric motifs.

The symbol has been suggested to be of Christian origin, especially in those cases where there are two symbols. In the case of the Estonian find mentioned above, the S-shaped figures have been interpreted as marks of the blacksmith[885] or as only decorations.[886] Raivo Prank has suggested that the two figures can mean Spiritus Sanctus (i.e. Holy Spirit), since the inlays "I[+II" on the opposite side of the blade may be interpreted as an abbreviation of "Iesus Christus in jure".[887] In this case the Greek cross has been interpreted as having a Christian meaning, although in general the cross may have fulfilled a decorative purpose due to its simplicity and because it was easy to make.[888]

5.3.5.8. Other motifs and their combinations

In four cases the geometric motifs were unique and not classifiable in any of the above-described categories (Fig. 61). KM 439:1 from Vesilahti has inlays on only one side of the blade. This motif consists of an X-shaped figure lined with rotated T-shaped marks. The inlays were made of twisted pattern-welded material. In this case, they are very small compared to the height of the fuller. The letter X was used as the symbol for Christ according to the Greek spelling,[889] or the diagonal cross may be interpreted as a St Andrew's cross.[890]

A fragmented sword from Laitila, KM 9832, has only a cross on one side, and a vertical line on the other. No further marks can be detected because of the breakage of the blade this near the hilt. In practice, the motifs on this blade could have been of any kind, for example ULFBERHT

885 Lääne & Selirand 1979: 59.
886 Drboglav 1984: 28.
887 Prank 2011: 90–91.
888 Prank 2011: 103.
889 Salo 2005b: 83–84, 256–257.
890 E.g. Salo 2005b: 104–105, 259.

or some of its copies. Or even something else. The reason why this find is included here is that the only marks that are left are "geometric".

KM 18000:3170, a sword from Eura, has two fragmentary cross potents on one side, and a highly fragmented figure, perhaps a lattice, on the other. Since the material of these inlays is iron or steel, i.e. non-patterned, they are very hard to distinguish from the radiographs, which makes the interpretation difficult.

A unique case is the motif found on the richly pattern-welded blade KM 2022:1 from Vehmaa (see Chapter 4.4.6). The inlays seem to consist of a circle-like design lined with vertical and diagonal bars. Most likely the reason for creating this "inlaid" motif was the lack of pattern-welded material for the fuller. The inlays are situated on only one side of the fuller, and in a place between two different kinds of pattern-welded panels made for the mid-section of the blade. Furthermore, the inlaid material seems to be the same that was also used in the patterns of the blade, having seven layers, four of which are iron. The inlaid marks display both twisted and straight patterns.

5.4. Summary and conclusions on inlaid motifs

To continue the discussion on the use of the inlaid swords begun at the end of the previous chapter, the position of inlays is a notable feature. Inlays under the lower guard and in one case on the tang tell of repairs and the use of swords in battle. Normally, the position of the inlays is always in the upper third of the blade, while there are longer motifs further along the blade.

The materials of inlays can be roughly divided into plain, non-patterned inlays made with iron or steel wires, and pattern-welded inlays with either a twisted pattern, a straight pattern, or even both. This rather simple division could be made more accurate with elemental analyses, but these could be done only to the blades analysed for this study (see previous chapter). Here, iron means that the carbon content of the inlay is lower than the surface of the fuller, making the inlays appear to be brighter and less corroded than the surrounding blade. Iron inlays could also have a higher phosphorus content to achieve the same effect. In contrast, steel inlays have higher carbon content than the fuller, making them to appear more corroded than the blade surface.

Even though the material of the inlays could not be reliably determined in all cases, it is clear that the majority of them were made from pattern-welded rods, which in most cases were twisted. Colour differences and corrosion rates permitted layer counts from some of these examples. All in all, the layer counts were between seven and thirteen, the former being more common and the latter being the result of folding a seven-layer pack in two. These numbers correspond to some degree to previously analysed pattern-welding in swords and other edged weapons in Europe. It seems that a similar tradition of pattern-welding had prevailed from the Middle Iron Age to the Viking Age and even until the 11th century in some cases. The patterns of the inlaid rods were crude enough to be clearly seen, as were those made for constructing the mid-sections of complete blades before inlays were introduced. The composition of the layers evident in inlays was analysed from six Finnish finds, showing that phosphorus-rich iron had been used together with carbon steel to create a contrast between various layers. Similar observations are known also from previous analyses, which are very few.

While the original idea was to trace different manufacturing traditions by observing the details of the inlays, this proved to be very difficult. The reason behind this is again the variation of the find material. It was difficult to find any patterns of correspondence between the size of the inlays, the materials and especially the pattern-welding technique of the rods, and the appearance of the inlaid rods and their surroundings. This task was further complicated by the visibility of inlays only in radiographs, making the definition of some variables impossible. Especially the layer counts could very rarely be determined from radiographic images.

According to their contents, the inscriptions and motifs are divided into five categories: ULFBERHT inscriptions, INGELRII inscriptions, other inscriptions with Latin letters, letter-like marks, and geometric and symbolic motifs. Of the thirty-one examined ULFBERHT blades, twenty-two displayed two clear variants where the place of the second cross was different. The geometric motifs on the other side of these blades were more varied. In spite of this, the most common combination was the variant +VLFBERH+T occurring with a woven lattice lined by altogether six vertical lines. Even these differ from each other in technical details such as the materials and the arrangement of the inlaid rods, and thus no identical cases exist among the finds presented here. Some foreign counterparts are known but only according to the contents, since there was no possibility to examine the details in the foreign material. In some cases reversed and joined marks occur, which may be interpreted as misspellings by various makers or pure accidents when manufacturing the blades. ULFBERHT blades are known from almost all areas of Viking Age settlement in Finland, with more finds from the Tampere region than the southwestern parts of the country.

The INGELRII group consists of five Finnish examples, which also have geometric motifs on the opposite side of the blade, i.e. a central motif lined by six vertical lines. Taking all the features into consideration, none of these are identical to each other. Again the finds do not originate from Finland Proper or Satakunta regions but their geographical distribution is like ULFBERHT blades. The foreign INGELRII finds are also varied.

The other inscriptions with Latin letters may be divided into subtypes. Firstly, maker's names other than ULFBERHT and INGELRII, often recognized from the words ME FECIT and the phrase IN NOMINE DOMINI or its variation on the other blade flat, are known in four different examples in the Finnish material, all relatively late as they date mainly from the 11th century or even later. Secondly, overlapping with the first category, are blades with complete phrases and words related to Christianity. Similarly, these too are quite late. An interesting item is the sword with misspelt ULFBERHT text and the word AMEN. Thirdly, there are a number of letter sequences possibly referring to Christian phrases, namely IN NOMINE DOMINI. Some of them may be deliberately abbreviated forms, while some may be illiterate copies of correctly written sentences. Fourthly, there are some other letter combinations, which may be illiterate work or have some other meaning that has been lost and can no longer be traced today. Taking all these four categories into consideration, pattern-welded inlays seem to predominate in the Tampere region, and the plain iron and steel inlays elsewhere. This may also be a chronological matter.

Letter-like marks were found in 33 blades. These marks do not contain any actual Latin letters, nor do they have any geometric pattern or sequence. The definition itself is problematic, because some finds were so poorly preserved that only parts of inlaid marks remained. In other words, some of the motifs included in this category may have actually been something else, such as correctly written words, but they are no longer discernible. Like correctly written inscriptions, letter-like motifs are often accompanied by lattices, while other geometric motifs are quite rare. In many cases the marks themselves resemble the letter L in various positions, and sometimes it may be suspected that some of the motifs imitate actual inscriptions because of the resemblance of some marks to letters. These kinds of inlays are also found in smaller blades after the Viking Age. It is interesting that letter-like marks have been found more in the regions of Finland Proper and Satakunta, while the actual inscriptions concentrate in the Tampere region.

Almost one third of all the examined blades contained geometric motifs and symbols. These were divided into seven subcategories. Firstly, some blades contain various kinds of lattices on only one side of the blade or on both sides. Omega-like figures come second, appearing not only with lattices and vertical lines, but also on structurally pattern-welded blades, which dates these figures older than the Viking Age. Interestingly, the shape of the figure has been emphasized by leaving the pattern straight instead of twisted. Thirdly, circles and spirals also occur on both pattern-welded and non-patterned blades, normally independently or accompanied by a cross. Fourthly, plain vertical and horizontal bars seem to be the simplest of all motifs, occurring in one blade among the studied finds. Fifthly, St. John's Arms or a similar design are known from three swords. Sixth is the infinity symbol in the form of a rotated number eight, appearing in only pattern-welded blades and normally independently. Other motifs with single examples are included in the seventh category. The finds with geometric designs concentrate in Finland Proper and Satakunta.

Comparisons with foreign finds proved to be difficult. Numerous publications had to be consulted to get a picture of the foreign inlaid motifs, and furthermore the documentation was not as detailed as it should be to be able for reliable comparisons of finds. Despite these deficiencies some quite close correspondences were found with regard to the contents of the inlaid motifs.

The ULFBERHT motifs are very widespread, and there are thus numerous parallels to the Finnish finds. Unfortunately not many of the foreign ones have been accurately drawn, which makes comparisons difficult. A few close parallels have been found in the territories of modern-day Russia, Germany, Latvia, Netherlands, Sweden and Norway. In the case of INGELRII swords no definite parallels were found, although the finds are distributed throughout various parts of Europe. With regard to other Latin inscriptions, GICELIN swords have been found in various localities, whereas possible parallels with other maker's names and religious words are known from Germany. Letter sequences possibly referring to Christian phrases are known from not only Germany but also the Baltic countries, whereas other letter combinations are known also from Russia and Norway.

Letter-like marks as a whole seem to be characteristic of Scandinavia, the Baltic countries and Russia, the majority of them being from Sweden, Norway, and according to this study, also Finland. Various geometric and symbolic motifs are in general known from the territories of Germany, Estonia, Sweden, Norway and the Netherlands, and some from Russia, Poland and the British Isles. Noteworthy features are plain vertical and horizontal bars as well as St. John's Arms, which are known only from Germany besides Finland.

It must of course be realized that due to the unsystematic nature of research of blade inlays, the observations presented here reflect only the situation as studied so far. Thus it remains somewhat speculative to draw any conclusions on the origin of the blades on these grounds. Nonetheless, it may be stated that letter-like marks and imitative and obscure motifs have been found more in northern areas – Scandinavia, Baltic countries and Russia – than other parts of Europe. This clearly implies that imitative motifs were manufactured in the north, and that according to the study of details and materials, the manufacturing was carried out by several makers. This may have been the case even within the Frankish realm, as directly indicated by various makers' names.

6. AN EXPERIMENTAL VIEW OF INLAYING

The next step in this thesis is to examine the manufacture of iron inlays through practical work. This includes the making of inlaid blades to find out what kinds of methods and resources are needed. Moreover, experiments are required to explain some of the features and details observed in the finds.

The inlaying process required a total of thirteen experiments. The first seven s were documented for my MA thesis,[891] and six more experiments were conducted after this to answer some of the questions that arose during the experimental work for the MA thesis. The results of all my inlaying experiments have been published previously in a brief article.[892] All the results are discussed here, including information on observations during the experiments. The theory behind experimental archaeology and the selection of materials, tools and methods will also be briefly explained.

Before explaining the experiments, theories on making iron inlays are discussed, as well as previous experiments on the subject. To complement the picture, archaeological finds are referred to, mainly those included in the find material of this work.

6.1. The manufacture of iron inlays in earlier studies

6.1.1. Earlier hypotheses

Earlier theories about making inscriptions are often very speculative and without any real knowledge of the materials and techniques that were used. The most primitive assumption may arise from the technique of making inlays from non-ferrous metals. In this technique, the non-ferrous metal wires are hammered cold in pre-cut grooves. This technique has been suggested for iron inlays by e.g. Tylecote and Gilmour, who claim that the grooves were undercut to make them wider at the bottom.[893] The iron letters and marks were then hammered cold into the grooves without forge welding.[894] Also Ada Bruhn Hoffmeyer speculated that the letters were of three millimetre-thick iron wire, and hammered into grooves, which could have been either cut but also punched.[895]

891 Moilanen 2006.
892 Moilanen 2009b.
893 Tylecote & Gilmour 1986: 276.
894 On technical matters see Chapter 3.1.
895 Bruhn Hoffmeyer 1954: 110.

Notes on the manufacture of inlays were made during the conservation and study of a Petersen type S sword found at Chertsey.[896] It was speculated that a chisel-like tool was used to force red-hot iron rods into their pre-cut grooves, and these tool marks could be seen as diagonal cavities on the surface of the inlays.[897] It is highly likely that the inlays were pattern-welded, and the higher-carbon material had corroded partly away, leaving diagonal streaks visible on the surface of the inlays. Thus, it may have been that the pattern-welded inlaid material was not recognized, since the material of the inlays is referred to as 'iron',[898] and therefore the corroded streaks were misinterpreted as tool marks.

A clear majority of researchers claim that the inlays were attached to the blade by welding. These researchers can be placed in two schools: those who claim carved grooves for the inlays, and those who do not. Some researchers think that there were pre-cut grooves where the inlays have been welded.[899] Also Ewart Oakeshott is of the same opinion, speculating that the welding took place at a temperature of 1300 °C.[900] Herbert Maryon suggests that the chiselled cuts were quite shallow, only marking the place of the inlay, and the letters were struck deeper into the grooves while the letter was still cold and the blade was heated to be white-hot.[901] According to Maryon, the blade was then re-heated and the welding took place at a temperature of perhaps 1300°C.

Anatoly Kirpichnikov is of the opinion that the inlaying was done whilst the inlaid wire or rod was red-hot.[902] Kirpichnikov does not take any kind of stand on the technique, for example, whether or not the hammering or welding was done in pre-manufactured grooves. With regard to an ULFBERHT sword studied by him in the Museum of Bergen, Alan Williams stated that the inlays of this sword must have been attached hot during forging instead of as cold afterwards, since the material of the inlays was very large-grained ferrite.[903]

Some researchers think that there were no pre-cut grooves, and the inlays were instead welded directly on the surface of the blade.[904] Also Kasper Andresen's experiment refers to this technique.[905] This experiment is discussed below in more detail. Andresen's experiment was based on the observation that the structure of the blade had been bent under the inlay, which could not have been possible if there had been pre-cut grooves. Herbert Maryon has also noted this, claiming that in some cases the material of the blade is sharply bent under the inlay.[906] In the case of welding the letters without pre-cut grooves, some kind of punch or iron rod must have been in use to move the inlays into their correct positions.[907]

An interesting theory has been proposed by the American bladesmith Jim Hrisoulas.[908] He suggested that the letters were not actually inlays, but they were constructed as mosaics of a kind of.[909] First two contrasting materials were selected and prepared as small square rods or rectangular and square rods. The rods were then piled in such a manner that the cross-section of

896 East et al. 1985.
897 East et al. 1985: 6.
898 East et al. 1985: 6.
899 E.g. Tylecote 1987: 276; Ypey 1980: 203.
900 Oakeshott 1960: 143–144.
901 Maryon 1950: 177–178; 1960: 36.
902 Kirpichnikov 1970b: 58.
903 Williams 2009: 126, 150. Sword listed under catalogue number 882 in the Historical Museum of Bergen.
904 E.g. Jones 1997; Kirpichnikov & Stalsberg 1998a: 507.
905 Andresen 1993.
906 Maryon 1950: 177.
907 Thompson 2004: 117.
908 Hrisoulas 1991: 248–250; 1994: 53–54.
909 This technique is called as 'mosaic damascus' among modern bladesmiths. For pictures and variations of this technique see e.g. Sachse 1989: 50–51, 131–133.

the rod displays a certain letter or mark, after which the whole pack was welded solid. To create an inscription, several solid rods should be made, all of which have different letters. Then small slices of these packs were cut, assembled to form words or other patterns, and then welded together to create a blade or its mid-section. This suggested technique is not attested by archaeological finds, and it is also very laborious, time-consuming and more prone to errors and poor results. In addition, round and convex shapes are much harder to produce with this method.

The making of the inscription is connected to the end result of the sword-making process: what have the inscriptions looked like on a completed blade? Researchers have mixed opinions about the etching of the blade and the resulting final appearance. Ewart Oakeshott assumes that the blade was mirror-polished and was then left unetched, while the inlays could be faintly seen on the surface of the blade.[910] The majority of researchers agree that the inlays were etched with some medium to make them more clearly visible.[911] The process of etching created contrasts between materials with different carbon or phosphorus contents, i.e. it created colour differences between the blade and the inlays.[912] Also differences of scaling during quench-hardening may have made the inlays clearly visible without etching.

A note should also be made about the ULFBERHT sword which has a blade pattern-welded in its mid-section, and the text ULFBERHT etched on the surface of the blade, recovered from the cemetery of Biskupija-Crkvina in Yugoslavia.[913] Since no picture was available, it is hard to say anything about the accuracy of this interpretation. In my personal opinion, it may be that the inlays corroded away leaving shallow depressions on the blade, and the striated structure caused by the nature of the material and forging of the blade could have been interpreted as pattern-welding. No analogous cases are known from elsewhere in Europe.

6.1.2. Experimental studies

6.1.2.1. Andresen's experiment

There are two published experiments in making inscriptions, apart from the ones carried out by the present author. In the earlier experiment conducted by a Norwegian blacksmith Kasper Andresen, some steel letters were welded on an iron plate by hammering the letters at a temperature of 1200 °C.[914] As a result, some letters were successfully welded and made visible by etching with mild acid. The iron plate remained light in colour, while the steel letters were darker after the etching. The most crucial point in the experiment was that the letter to be welded was placed cold on the iron plate, which was heated to red heat. After this, the whole package was covered with borax to prevent oxidation, and heated to welding temperature. In this way the colder letter sank slightly into the iron plate and was welded at the same time. A three millimetre-thick rod was used to create letters 6–7 millimetres wide. According to Andresen, the inscription could have been attached quickly, because no grooves were needed. The letter was only positioned in its place and then heated and hammered. In this way attaching the inscription was only routine and a stage in the overall manufacturing process of a whole sword. The attachment of one letter took approximately 12–15 minutes.[915]

910 *Oakeshott 1960: 143–144.*
911 *E.g. Kirpichnikov & Stalsberg 1998a: 507.*
912 *E.g. Leppäaho 1957: 628–629.*
913 *Geibig 1991: 122–123; Vinski 1966: 301; Vinski 1983b: 500. See also Chapter 5.3.1.1.*
914 *Andresen 1993.*
915 *Andresen 1994: 199.*

According to the principles of experimental archaeology, Andresen based his experiment on the examination of an archaeological find, although the experiment itself was greatly simplified and the materials that were used did not correspond to the majority of analysed finds from the Viking Age. It is noteworthy that in the experiment the material of the inlays was not pattern-welded, although this does not necessarily have any meaning. Furthermore, Andresen did not explain the phase of the blade forging where the inlays were welded.

In a technical sense, Andresen's experiment was not authentic, because the letters were not attached on a whole sword blade.[916] In this case, Andresen's method would not necessarily work, because the inscriptions should be attached to both, opposite, sides of the sword blade. The method works excellently when attaching only a few inlays on one side of a blade, but the relatively high welding temperature would most likely cause problems when welding letters to a complete sword blade. According to Andresen, the width of the inlaid letter was twice that of the rod before welding, so the depth of the inlay was not very deep because the rod had mainly flattened. This, in turn, would cause problems, because forging and welding will also oxidize the blade as well as the readily attached inlays, which in turn could destroy parts of the inlays. Also the claim that the steel rod would be cooler on top of the heated iron plate is somewhat obscure, since both of them were heated in the forge for welding at the same time. The flattening of the inlaid letter suggests that both the letter and the plate were at the same temperature.

6.1.2.2. Hansen's experiment

The second experiment, which was conducted by another Norwegian blacksmith, Hans-Johnny Hansen,[917] was more complete than the Kasper Andresen's experiment. Hansen made a complete sword with the inscription +VLFBERHT+ on one side and some kind of geometric motif on the other. Hansen ruined fourteen blades before he managed to create one with intact inscriptions.[918] The forging of the successful blade was done as follows.

First the letters were made of twisted pattern-welded rod with 58 layers. The pattern-welded packs were forged to round rods with a diameter of circa 4.5 millimetres. Then the rods were twisted so that there were 10–12 twists per centimetre. A total of 75 centimetres of this rod were used to bend and cut the letters and marks. The letters with multiple parts were filed so that the rods on top of each other were held in place by small cavities.

The inlays were attached to a blade blank without fullers or bevels. First the blade was heated to red heat and the letters were struck cold one by one against the hot blade causing the letters to sink a few tenths of a millimetre into the blade. Each letter on the first side of the blade was first welded in place at a low welding temperature. After this was done, the welding was done at higher temperature. For example, the inscription +VLFBERHT+ required five welding heats at a higher temperature; two letters being welded with one heat. The heating to the higher welding temperature was done with a slow blow of air and as slowly as possible to avoid the oxidation of the blade or the letters, and to prevent the thin layer of quartz sand (used as a welding flux) from being blown away.

The inlays on the other side of the blade were attached in the same manner. This time overheating was to be avoided even more than when welding the letters on the first side of the blade. Overheating

916 See also Hansen 2007: 55.
917 Hansen 2007: 52–55.
918 Hansen 2007: 55.

can easily destroy the inlays on the first attached side. After all the inlays were welded, the surface of the blade was hammered flat. The fullers were then forged with some special tool.

The depth of the inlays on the completed, polished and etched blade was ca. 0.7 millimetres. If the inlay appeared on the bevel of the blade, it had been placed wrong before the welding, or then it was too big to be fitted in the fuller. Hansen noted that if the welding temperature is too low, dark cavities will be left around the inlays, i.e. the welding has not been successful and the material of the inlay has not been fused together with the material of the blade. Hansen concluded that he is not satisfied with the results because the inlays should be much smaller in comparison with archaeological finds, but in this case the work would become more difficult to carry out.[919]

Hansen's experiment seems to be much more authentic than Andresen's experiment. It would have been useful to publish the procedures of the earlier thirteen experiments. Their omission could be due to the popular nature of his publication. In addition, Hansen does not tell what materials he used for the blade. Also the material of the pattern-welding for the letters was too fine, i.e. it contained too many layers when compared with archaeological sources, although it must be noted that the number of layers does not matter when trying to solve the technique of attaching inlays.

What could be noted about Hansen's experiment is that in some way the inlaid letters should be smaller and more sharp-edged. Also the depth of the inlays should be greater. A close-up view of the inlaid letters shows that he did not forge the inlaid rods even after twisting, thus causing the edges of the letters be slightly undulating.[920] It should nonetheless be noted that inlays with the same kind of appearance as produced by Hansen do exist, although they are not the most common ones.

6.1.3. Observations of commercial products

Not many blacksmiths – or more accurately bladesmiths – forge iron inlaid blades any more. The reason for this may just be the lack of knowledge of how that kind of blade is best made. However, some bladesmiths have made, or at least have tried to make, iron inlaid sword blades.

In this work no names of individual bladesmiths are mentioned when commercial products are considered. Iron inlays have been produced in modern blades in at least the Czech Republic and Slovakia. Email correspondence with these various bladesmiths showed that their inlaying technique is different from the above-mentioned published experiments. Modern-day bladesmiths chisel grooves, into which the inlays are fitted and welded. This method makes it easier to get the marks and letters straight and neat. The inlays are attached to the blade blank, into which the fuller and bevels are then forged. The inlays are made visible by heavy etching.

Despite this different kind of method, the appearance of commercial inlays corresponds to that of inlays visible in archaeological finds. Some inlays are considerably flattened and widened, while others are very narrow and neat. In other words, this single technique permits the production of different-looking inlays, depending on the depth of the pre-carved grooves and the amount of hammering of the fuller. In some cases, both sides of the blade are inlaid. Commercially produced inlays also show a wide range of materials from iron wire to straight and twisted pattern-welded rods.

919 Hansen 2007: 55.
920 Hansen 2007: 54.

The Finnish bladesmith J.-T. Pälikkö has made pattern-welded inlays on both sides of the blade with a method similar to the one used by Hans-Johnny Hansen.[921] This time the inlaying was done with an 'apprentice'. The bladesmith set the cold inlay in its right position on a hot blade, after which the apprentice placed a long-shafted, large-faced hammer to rest on the rod, and the bladesmith hit the large hammer with another one. This procedure allowed the inlays to be evenly sunk into the blade blank. It must be noted here that Hansen's experiment was published at the same time as I was conducting my last experiment.[922] Despite this, our results were in principle the same. This last-mentioned Finnish work was carried out after my publication in 2009, and thus it did not have any effect on my experiments.

The American blacksmith Michael Pikula has also managed to produce pattern-welded inlays on a complete ULFBERHT blade through many trials and errors.[923] His methods include both inlaying in carved grooves and also sinking the letters without any grooves. Also his problem lies in the depth of the inlays, since they are easily ground away if they are left too shallow. Throughout his experimental series he tried to sink all the inlays at once, instead of inlaying one letter or mark at a time.

Jeff Pringle made an INGELRII-inscribed sword, of which a picture has been published.[924] He also carved the grooves for letters with a chisel, after which he welded the letters in the blade. It is not known in which phase of the sword forging he attached the inlays. His inlays, however, are quite slender and neat, corresponding well to archaeological finds, although his technique does not. The same can be said about Richard Furrer, who forged a crucible steel blade with an ULFBERHT inscription, again sinking the inlays in chiselled grooves.[925]

Also the German blacksmith Manfred Sachse has made a copy of a ceremonial sword kept in the Cathedral of Essen. This blade was inlaid with a pattern-welded lattice pattern,[926] but the technique with which Sachse made the reproduction has not been described. Also pictured in Sachse's book is a sword made by another German blacksmith, Paul Müller, having an iron inlaid swastika in the pommel, and a pattern-welded one in the crossguard, unfortunately with no description of the manufacturing technique.[927]

6.1.4. Indications of manufacturing techniques in archaeological find material

6.1.4.1. Observations from previous studies and analyses

In some rare cases, a cross-sectional analysis has been made in the middle of the attached inlay. In the Finnish material, a case like this is a sword from Hattula (KM 8120:1). In Jorma Leppäaho's posthumously published work there is a picture of the cross-section of the sword and a close-up view of the cross-section of the inlaid letter.[928] The interpretations of the picture are not discussed

921 *This information was obtained from the MyArmoury.com discussion forum, where the bladesmith in question created a topic on his work on 26.5.2010.*
922 *The results of my experiments were published briefly in Moilanen 2009b.*
923 *Topic in the MyArmoury.com forum, posted 27.4.2011.*
924 *Short 2009: 118–120.*
925 *This was done in a documentary entitled Secrets of the Viking Sword (2012), based on the results obtained by Alan Williams in his studies and analyses.*
926 *See Sachse 1989: 12.*
927 *Sachse 1989: 169, Abb. 285.*
928 *Leppäaho 1964b: 9.*

here, because the analysis of the cross-section of the sword is presented below in connection with the material studied for this work.

An ULFBERHT sword from Öland, Sweden (catalogue number SHM 3104, the Swedish History Museum) was analysed by Lena Thålin-Bergman and Birgit Arrhenius.[929] The letters were welded on the blade in a way that makes the bottom of the letter convex. The letters were sunk ca. 0.6 millimetres, but it is likely that the depth had originally been much greater, because the blade had been badly corroded. There is also a third case, again from Sweden (catalogue number SHM 907 in the Swedish History Museum), analysed by Mille Törnblom.[930] Again, the letter was welded to the blade. The letter had sunk ca. one millimetre as measured from the picture. In addition, the structure of the blade seems to have bent under the inlay indicating that there were no pre-cut grooves. It should be mentioned that all above-mentioned three cross-sections were made in a place where only one inlaid rod was attached. The depth would be much greater if the cuts had been made in a place where two rods were welded on top of each other. This can be seen from radiographs: some parts of the inlaid letters are placed on top of each other.[931]

According to Aleksis Anteins, the inlays were attached to the blade by welding, probably in a groove.[932] The depth of the examined inlays was between one and one-and-a-half millimetres. This considerable depth of the inlays probably led Anteins to deduce that some grooves were made for the inlays beforehand, instead that the inlaid rods were welded straight or sunk by hammering.

A sword with +ING…IT inlaid in the blade was analysed by B. A. Kolchin.[933] A cross-sectional analysis was made of the inlaid portion of the blade. No detailed measurements were taken from the depth of the pattern-welded inlays, but according to Kolchin's drawing the ferritic core evident elsewhere in the blade had flattened under the inlays, which show as panels on both sides of the fuller. The depth of the pattern-welding of inlays is about one third of the thickness of the blade in the fullered part.

Above was mentioned that in the cross-sections the blade structure seems bent under the inlaid rod. Some blades dating to the beginning of the Viking Age or even earlier have pattern-welded central portion of the blade, which also has some inlays. Presumably the technique – or techniques – of attaching inlays was the same in these cases, as also in the blades that are laminated and appear to be homogeneous. The patterns of the pattern-welded fuller portion could tell something about the manufacturing phase of the blade when the inlays were attached.

A sword in the National Museum of Copenhagen (catalogue number C6374) has a figure-eight shaped inlay on top of two twisted pattern-welded bars.[934] The fuller beneath the inlay has a semi-circular pattern representing the mid-section of a twisted rod. This could tell that the fuller had been ground to its full depth before attaching the inlays. On the other hand, perhaps some grinding and polishing of the forged fuller and its inlay took place, revealing the semi-circular pattern, leaving the deeply sunk inlay still intact. It is also possible that the grinding of the fuller was left at a minimum, and only slight polishing has revealed the central portion of a twisted, but greatly flattened and thin pattern-welded panel.

929 *Thålin-Bergman & Arrhenius 2005: 100–101.*
930 *Törnblom 1982.*
931 *Maryon 1950: 178.*
932 *Anteins 1973: 43.*
933 *Kolchin 1953: 133–134, 242. See also Chapters 4.4.4 and 5.3.2 for details.*
934 *Peirce 2002: 150.*

Another example comes from Gotland, Sweden (catalogue number SHM 16905 in the Swedish History Museum).[935] The fuller of this blade is constructed of two pattern-welded bars, with an S-shaped inlay on top of them. The semi-circular pattern is evident in the fuller, except under the inlay, in which the pattern is seen only as diagonal streaks or 'herringbone'. In this case the diagonal streaks in the pattern-welded bars of the blade indicate either the actual surface of the bars or their bottom. In the first case the fuller was forged either before attaching the inlay or while hammering the inlay in place. Considering these two alternatives, the fuller had not been ground very much on the inlaid spot. In the latter case the fuller was ground considerably either before or after inlaying, or then the pattern-welded bars are again extremely thin and had easily been even ground away. It is also possible that the fuller was ground to its final depth before attaching the inlay, and the final grinding of the blade produced the pattern.

A sword from Dorestad in the Netherlands has an inlaid mark on top of two pattern-welded bars. The notable feature here is that the inlaid mark is not in the centre line of the two pattern-welded rods. This may be due to the fact that the pattern-welding of the blade was not visible when the inlay was attached.[936] Sometimes the twisted pattern can be seen at high temperatures while welding and forging the blade, though not always, as this depends on the materials of the blade. This low visibility enables the swordsmith to forge the fuller and the bevels so that the patterns remain inside the fuller. Perhaps the inlay in the Dorestad sword was welded before the blade was shaped, in the blade blank welded from separate pieces, in this case from pattern-welded rods and steel edges.

6.1.4.2. The find material of this work

The locations of the inlays are quite similar in all the swords. As a rule, the inlays were attached to the upper third of the blade, near the hilt. In some cases even straight below the lower guard. This seems natural because the blade's thickest part is its upper third, and is therefore the easiest and safest part to weld the inscription.

Normally the blades have inlays on both, opposite sides of the blade. In most cases the inlays of both sides were centred so that their central points are in the same position along the length of the blade. For example, ULFBERHT and INGELRII blades have geometric motifs on the other side of the blade, and the centre of these motifs corresponds to the centre of the inlaid text on the opposite side of the blade. This means that while welding the inlays, almost the same locations on the blade were repeatedly heated to welding temperature, which in turn slowly destroys the material of the blade – and inlays – through oxidation and possibly through burning as well. Considering these facts, the blade blank before welding the inscriptions must have been considerably thicker than the resulting blade. In addition, in order to centre the inlays of both sides of the blade, the side welded first should be somewhat visible.

Attention was also focused on the placing of the letters and marks. For example in inlaid texts the letters are not always straight and they can be placed partially on top of each other. It is noteworthy that the different parts of the same letter seem to be attached on top of each other. The patterns of the lower part appear to continue underneath the topmost one (Fig. 62). This indicates that the topmost part is welded straight on top of the lower one. This kind of placing of inlays leads to assume that there were no grooves for the inlaid rods. If grooves were made, the lower rod should have been made from two separate pieces, which do not have continuous-

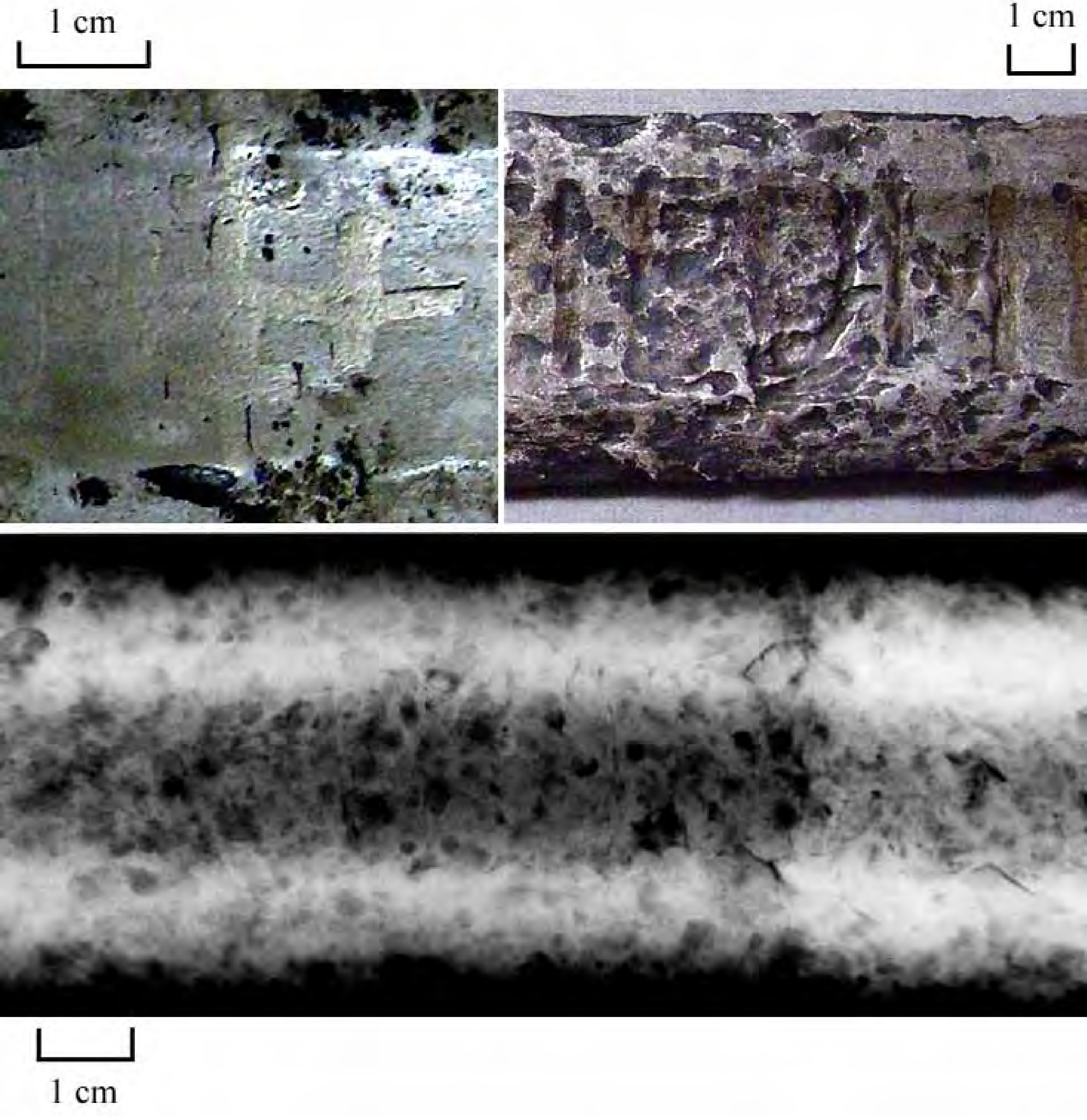
935 *The sword in question was in the permanent section of the exhibition in 2005 when I visited the museum.*
936 *Ypey 1980: 203.*

Figure 62. Two rods inlaid in such a manner that the upper inlay overlaps the lower one, while the patterns of the lower rod seem to continue under the upper one (find HM 3047).

looking patterns. Discontinuous patterns can, however, be observed in some finds (e.g. KM 2767 from Valkeakoski).

In some finds, the inlaid rods are not only limited to the fuller, but parts of them also extend over the ridge of the fuller to the blade bevel (e.g. in finds KM 2767 from Valkeakoski and KM 13419:2 from Turku) (Fig. 63). In these cases the inlaid rods must have sunk very deep whether they were attached before or after the making of the fuller – more likely before. The ridge of the fuller is a place that in some cases must be ground considerably to make it sharp and straight. It is also interesting that some well-preserved swords have a slightly wider fuller in the part with the inscriptions. This wide fuller could have been made while attaching inlays into a completed fuller or then while hammer-welding the inlays into the blade blank and forging the fuller at the same time or after the welding procedure. In any case, it seems that the fuller had to be made slightly wider to fit the inlays inside it.

Some well-preserved blades have only a very shallow fuller in the part for the inscription (e.g. KM 1174:2 from Kokemäki and KM 2508:124 from Pudasjärvi). This could indicate that the inlays were attached to a fuller, which extended only partly to its intended depth. Alternatively, the fuller was forged while attaching the inlays, or after it. The grinding of the forged fuller in the inlaid portion was left to a minimum to guarantee the preservation of inlays. If the inlays were attached to a completed fuller of full depth, the fuller would most likely be even deeper than elsewhere in the blade.



The general appearance of the inlays is relatively neat in the majority of finds. All the convex and circular shapes in the inlays are neatly executed, which could have been very hard if there were pre-cut grooves for the inlays. There are, however, exceptions. The inlays of the same blade are not always of equal width, which is probably due to a large number of hammer strikes. The edges of the inlays are in most cases relatively even, which means that the prepared rods for the inlays were also quite even. In nearly all pattern-welded inlays, the rods are twisted, which means that their sides must have been levelled to avoid undulating edges, which, however, appear in some cases (Fig. 64).

Figure 63.
Examples of inlays that do not fit in the fuller, but also extend to the blade bevel. Finds KM 2767, top left, and KM 17208:588 ,top right. The same phenomenon can be seen in the lower picture, which is a radiograph of find KM 30985:1 (radiograph no. 2424). In the radiograph, the fuller is shown as a darker streak in the middle of the blade, from which some inlays clearly extend to the blade bevel.

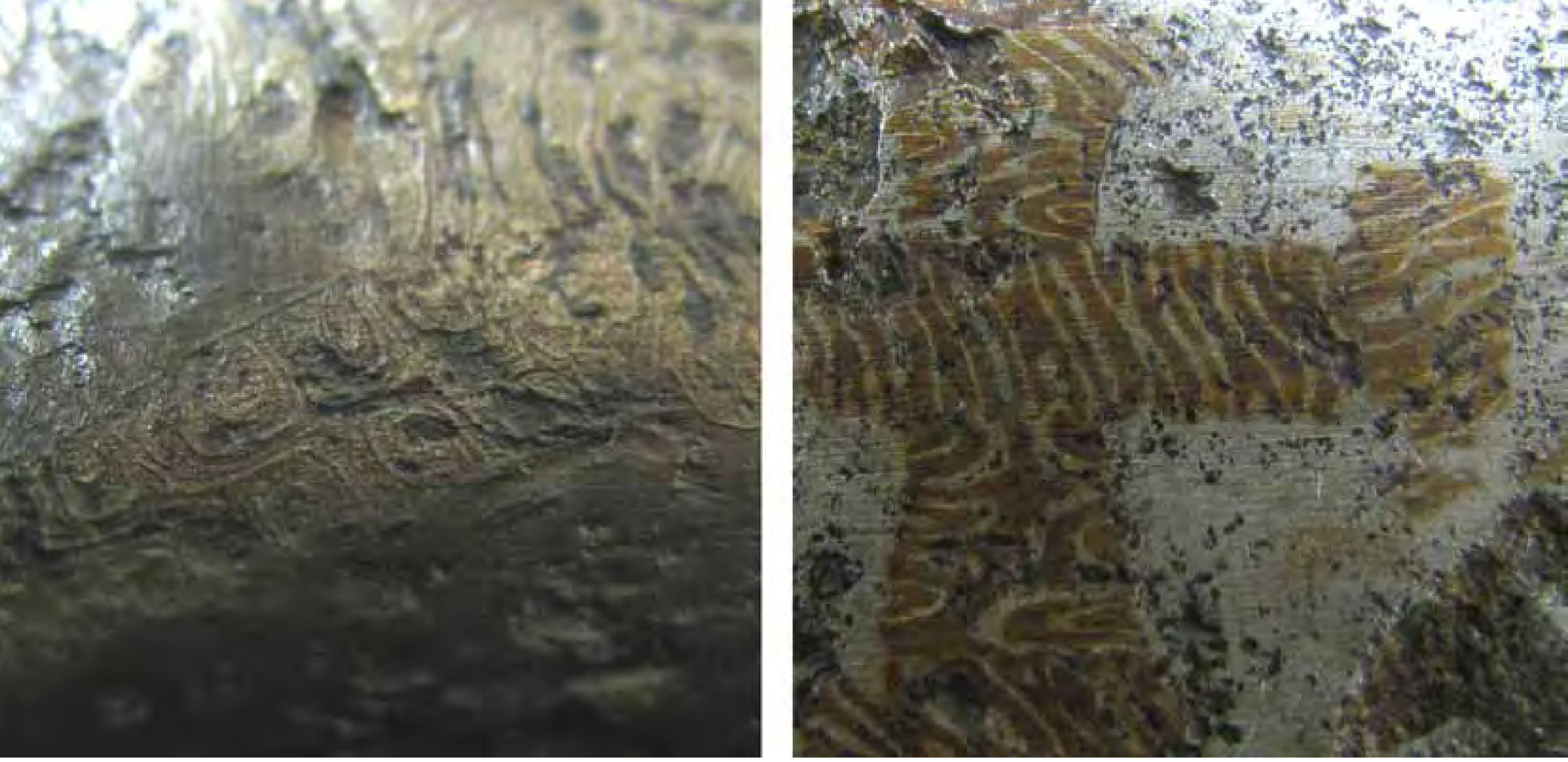


Figure 64. Edges of inlaid marks. On the left are inlays with even edges; inlays of KM 8120:1 from Hattula in the upper photograph, and on the right are inlays with slightly undulating edges (KM 1996:73 from Lempäälä).

This in turn could have been done either by hammering or by grinding or filing.[937] Because the twists and edges of inlays are relatively even, it is obvious that the rods were welded solid before they were attached to the blade or even twisted along their axis. If the rods were only twisted without welding, they would most likely have broken into pieces when it was attempted to weld them into the blade by hammering.

The edges of the inlays are not only even, but in many cases they blend very smoothly into the surrounding blade. There are no clearly visible, bright seams around the inlays, but the inlays seem to be of the same material as the blade, excluding of course the colour differences. This kind of clean, almost invisible seam can only be achieved through forge welding. In addition, the corrosion would have revealed the sharp edges of the inlays if they were attached without welding. Also, corrosion would be much stronger on the edges of the inlays, if there were no welding seams.

If the inlays were flattened during hammering, then they narrowed considerably during grinding and polishing, presuming that the bottom of the inlay is convex and tapers towards the bottom. When the inlays are flattened considerably, the semi-circular pattern of the mid-section of the twisted pattern-welded rod soon becomes visible after only slight grinding. However, it must be noted here that almost all the blades showing inlays as colour differences, have been mechanically cleansed and etched at some stage. This rather crude operation could have wiped out a considerable number of the inlaid rods, leaving the pattern that is now visible not necessarily even close to the one that could be seen originally. Also, inlays made visible by strong corrosion may look different than when new. As corrosion gets deeper, the surface layer of the inlay disappears, leaving a different kind of pattern visible as a corroded relief.

Some inlays have dark impurities on their edges (in e.g. KM 1174:2 from Kokemäki and KM 2767 from Valkeakoski) (Fig. 65). These impurities may be slag trapped under and beside the inlay during heating, welding and forging. Alternatively, these dark streaks may be welding flux, e.g. quartz sand, trapped under the inlay during welding. In either case, these dark streaks were most likely unintended, but they remained visible after the final polishing of the blade, and they

937 *Jaap Ypey (1980: 200) has noted this same phenomenon in his studies of pattern-welded swords. If the edges of the pattern-welded bars are not evened, the resulting welding seam will be undulating. This could in turn have been done by hammering, which may distort the patterns. According to Ypey, one possible way to get rid of sharp spiral ridges of the twisted bar is to forge the bar round before twisting.*

represent in any case an imperfect welding seam. The dark impurities also left a small cavity between the blade and the inlay, and thus they can only be removed by grinding off the surface of the blade and its inlays. It is likely that the dark streaks remained on the edges of the inlays while striking the inlays very hard against the even surface of the blade or fuller. The blade has bent sharply under the inlay creating a small cavity for the impurities. Optionally, the inlays may have been sunk and welded into grooves, which have been a little too wide for the inlaid rods, or the rods were not welded in their exact positions.

***Figure 65.* Dark streaks on edges of inlays. From left to right: KM 1174:2, KM 2767 and KM 370 (as seen in radiograph no. 547).**

Earlier research methods can give hints about the depth of the inlays. An examination of the mechanically cleansed swords shows that the inlays are in most cases still intact and clear. In the worst cases the find has first corroded and then about a millimetre could have been ground away, but there are still inlays. As a conclusion, the inlays in these swords have sunk at least a millimetre deep, most likely even more. One sword from Tampere (KM 6066:1) was ground slightly too much: the majority of inlays have disappeared and there are no clear edges of inlays. The inscriptions can be seen only as colour differences, which are mainly a kind of transition of carbon contents while welding the inlays. There are no actual inlaid rods present, only a kind of 'shadow' of them (Fig. 66). The blade is in fair condition, and thus it is also possible that the inlays were not quite deep even originally.

***Figure 66.* Geometric patterns of a possible ULFBERHT sword from Messukylä, Finland (KM 6066:1). No actual inlaid rods are intact. There are only differences in carbon content caused by the welding of the inlays.**

Sometimes the inlays have not been welded properly. For example, a sword from Mynämäki (KM 8911:91) has the inscription REX on one side of the blade, and the tip of the letter X has come

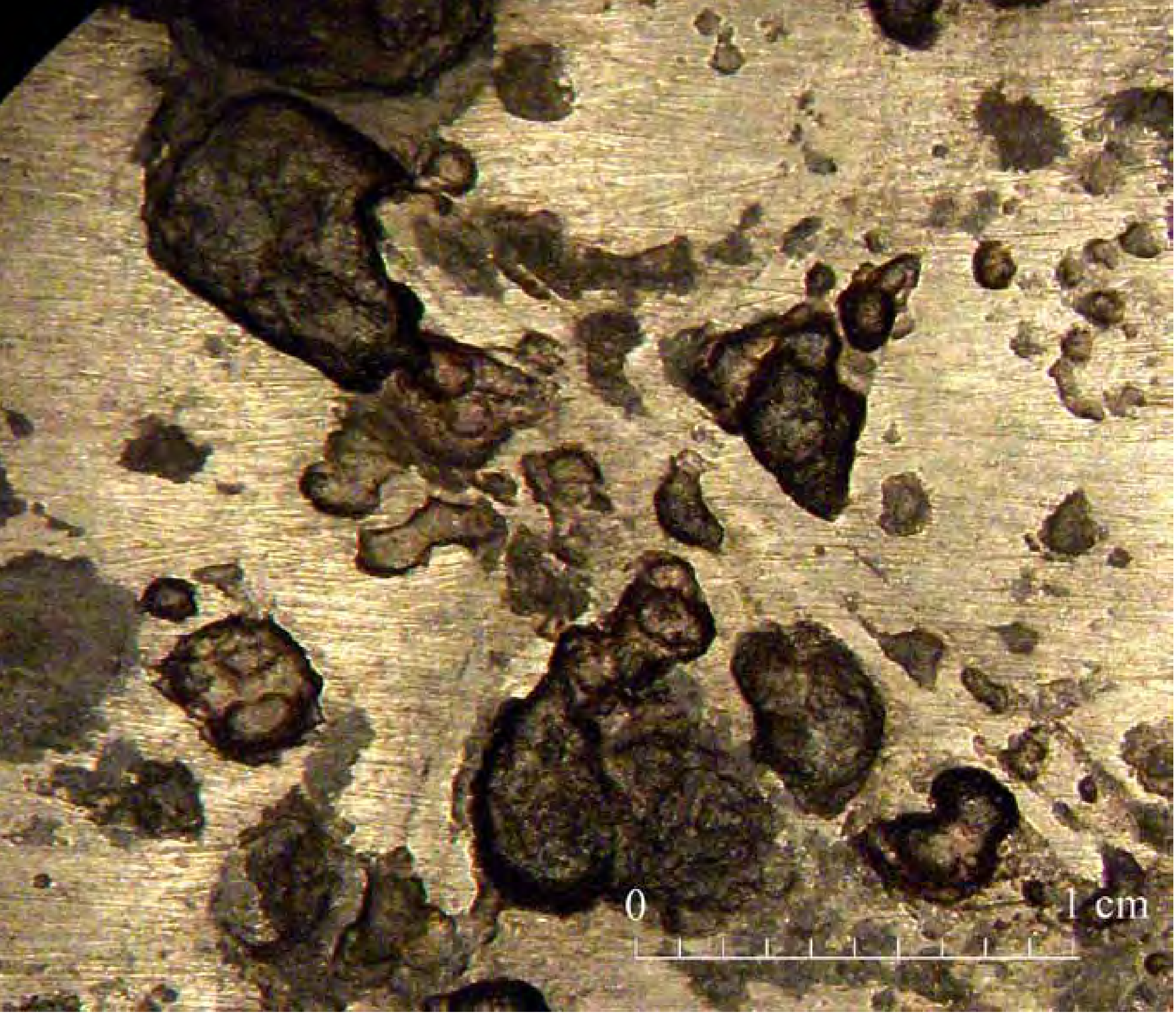


Figure 67. Close-up view of the letter X in a sword from Mynämäki (KM 8911:91), showing the place where an inlaid rod has come off.

off, leaving only a convex pit ca. one millimetre deep (Fig. 67). Once again, there is nothing that refers to carved grooves. Sometimes this same phenomenon can also be seen in radiographs. For example, a sword from Pöytyä (KM 26301) has inlays invisible to the unaided eye, but in the radiograph it can be seen that under the corrosion layer are inlays, one of which has a missing end similar to the one in KM 8911:91.

Convex pits of the same kind can be observed if the inlays are corroded very deeply (e.g. KM 9562:1 from Lieto, KM 17208:588 from Tampere, and KM 17777:1 from Hattula) (Fig. 68). In some cases, parts of the inlays have corroded away completely, leaving a pit about one millimetre deep. Since the blade is also corroded, the original depth of the inlays must have been slightly more than one millimetre. Of course, this feature of corroded inlays can also be seen in radiographs as a darker area where the inlay has been.

More accurate measurements of the depth of inlays are provided by the cross-section analyses conducted by the present author, in which the depths of inlays of altogether eight swords could be measured.[938] In the large pattern-welded inlays, the depth varied between 0.5 and 1.6 millimetres. In three cases (swords KM 3423 from Vesilahti, KM 5960:3 from Hämeenlinna and KM 8120:1 from Hattula) the depth was under one millimetre, 0.5–0.8 millimetres to be precise. Swords KM 2548:277 and KM 9832, both from Laitila, had inlays ca. 1–1.1 millimetres deep (Fig. 69). The inlays of sword KM 2548:196 again from Laitila were as deep as 1.4–1.6 millimetres, which may be due to the soft ferritic material of the blade. The inlay of KM 2979:8 from Mynämäki was ca. 0.4 millimetres deep, but it was not pattern-welded and not as large as the pattern-welded ones. Sword KM 9142:8 from Nousiainen was of later date, having narrower iron inlays only 0.3

938 *See Chapter 4.*

***Figure 68.* Close-up views of corroded inlays showing their depth. From left to right: KM 9562:1 (close-up of letter O), KM 17208:588 (close-up of letter D), and corroded letters of KM 370, as seen in radiograph no. 547.**

millimetres deep. All the measurements were taken from a cross-section of a single inlay, instead of having two rods welded on top of each other.

In the find material of this work, the blade structure can sometimes be seen as fibrous longitudinal streaks, though normally only in radiographs. Also alterations in the pattern-welded structures of the blades containing inlays were noticed in the finds examined in this work. In some finds the pattern-welded mid-section of the blade is bent towards the edges in the inlaid portion of the blade (e.g. KM 11063:283 from Eura), while in some finds the pattern-welding remains perfectly straight under and around the inlays (e.g. KM 3336:31 from Uusikaupunki) (Fig. 70). The same bending of blade structure is seen also in non-pattern-welded blades. This can best be observed in radiographs. The fibrous structure is visible as darker and lighter streaks, which in some cases seem to bend away from the inlaid mark or letter.[939] Again, sometimes the structure does not seem to be bent at all.

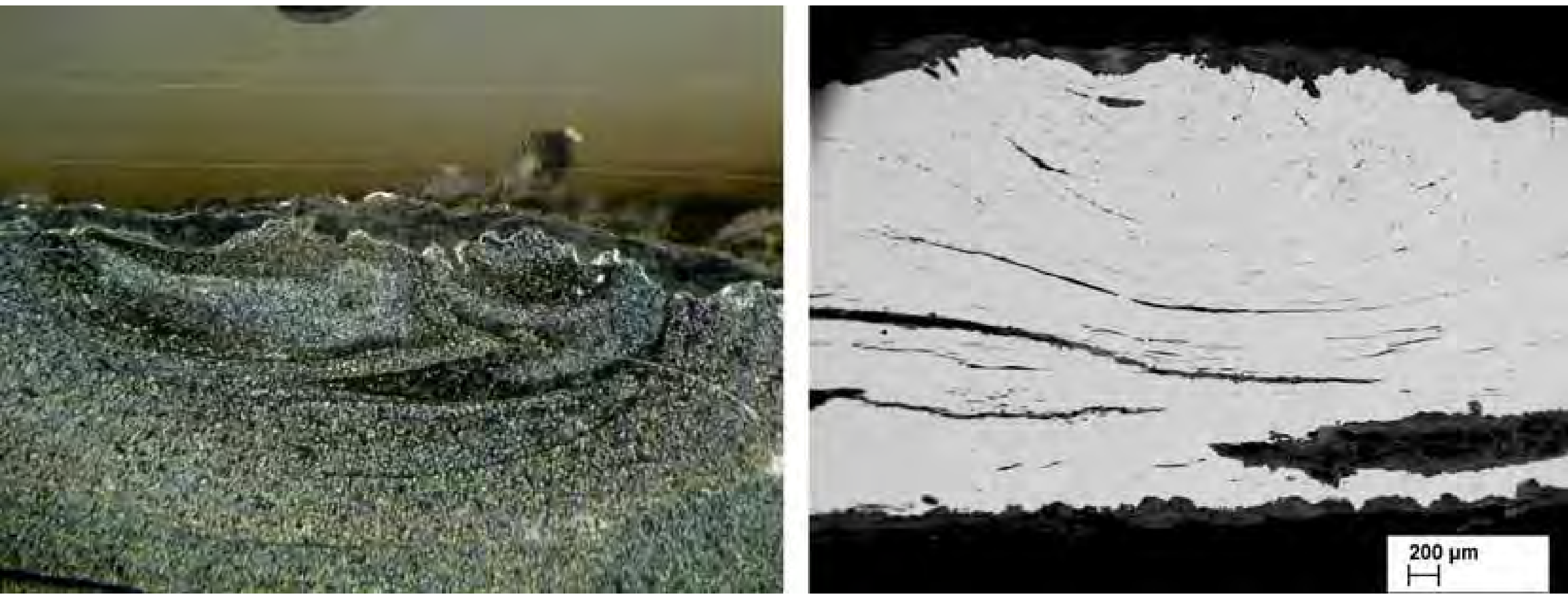


***Figure 69.* Close-up view of the inlay in find KM 9832 from Laitila. The picture on the right was taken with a scanning electron microscope (SEM). Both images also illustrate the bent blade structure under the inlay.**

One last note can be made about the welding flux used in making inscribed swords. The previously mentioned ULFBERHT sword from Öland, Sweden had quartz silicates in the welding seams, which indicates the use of quartz sand as a flux.[940] The same observation applies to the analysed blades, which had large amounts of silica in the welding seams. Sand was commonly used in the welding of other artefacts as well.[941]

939 *A similar phenomenon has been observed in some Early Bronze Age swords, in which cavities for gold inlays were struck in the copper mid-section of the sword blade (Berger et al. 2013: 41–42, Fig. 15).*
940 *Thålin-Bergman & Arrhenius 2005: 100.*
941 *E.g. Thålin-Bergman & Arrhenius 2005: 73, 90.*

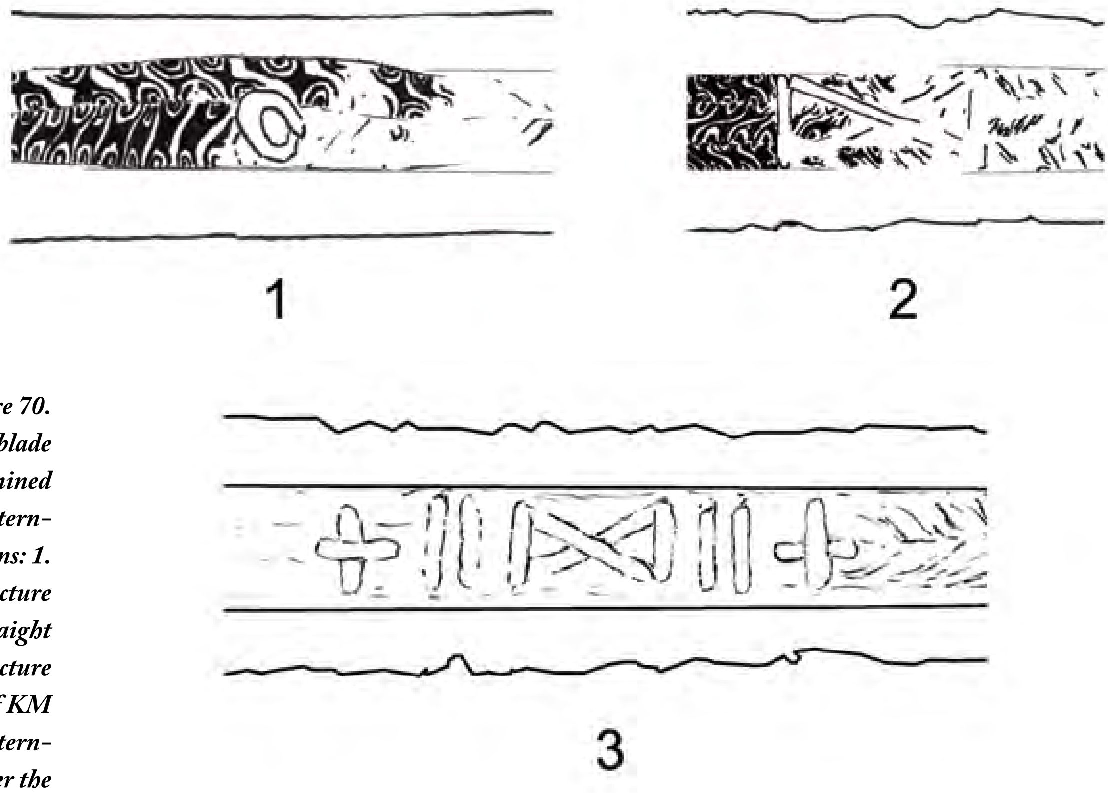


Figure 70. Drawings of blade structures on examined inlaid blades with pattern-welded mid-sections: 1. Outwardly bent structure of KM 6746:49, 2. Straight pattern-welded structure under the inlays of KM 293, 3. Straight pattern-welded structure under the inlays of KM 7752:1.

6.1.5. Hints of technology in written and pictorial sources

The only written source concerning the making of inlays on knives or other blades is by Theophilus Presbyter and dates from the 12th century.[942] According to Theophilus, the grooves are engraved first. Then the inlaid motifs and letters are formed from thick silver wire with small tweezers or pliers. Finally, the formed letters are hammered into the pre-cut grooves using a small hammer.

This depiction concerns the making of non-ferrous inlays. They were normally done by chiselling small grooves, usually wider at the bottom, in which the non-ferrous mark or letter was hammered cold. The non-ferrous material – silver, gold, or a copper alloy – is much softer than iron to be used in inlays, and can thus be hammered cold into the grooves of the blade. Of course they may be carefully heated after the initial hammering to soften the metal more, thus making the end result smoother. Moreover, non-ferrous inlays cannot be attached by welding, which means that the carving method was practically the only one that was used.

The pictorial sources, i.e. early medieval and medieval art, can mainly answer the question of whether or not the inlays were visible. Many illustrations containing swords show different kinds of patterns drawn on the centreline of the blade, sometimes even on a clearly discernible fuller.[943] Parallels to these often geometric patterns can be found among archaeological finds, in both pattern-welded and inlaid blades from the Late Iron Age and the Early Middle Ages. The main point here is that since patterns were drawn on blades in illustrations, these patterns must have been clearly visible in contemporary blades with the help of etching or some other means described above.

942 *Theophilus Presbyter 1979: 186.*
943 *This subject has been studied by Jorma Leppäaho, whose article on pattern-welding and inlays on sword blades in period art was posthumously published in 1964 (Leppäaho 1964a).*

There are examples of possible pattern-welding along the whole length of the fuller. These are found from e.g. the Stuttgart Psalter and the Canterbury Psalter, both dating roughly from the 9th century.[944] Serpentine fullers, possibly indicating some kind of pattern-welding, are also found in considerably later manuscripts, for example in the medieval German World Chronicle, ca. 1310.[945]

Representations of blade inlays can be found in several sources. Depictions on the portable altar of the Bishop of Paderborn (ca. 1120 AD) and in manuscripts such as the Stuttgart Passionale (ca. 1160 AD) and the Prudentius manuscript of St. Albans Abbey (1119–1146 AD) show lines, circles and crosses pictured near the hilt, in the portion that is normally inlaid.[946] Inlay-like figures can also be seen in later illustrations, for example in the Morgan Crusader's Bible (ca. 1250 AD).[947] Of special interest is a manuscript entitled *The Life, Passion and Miracles of St. Edmund*, in which Ingvar of the army of Danes is pictured with a sword showing inlay-looking marks with slight colour differences, possibly depicting pattern-welded inlays.[948]

A problem in the interpretation of these period illuminations is that one cannot know for sure if the artist depicted the blade or only the decoration or straps of the scabbard.[949] Also the relatively late date of the illustrations makes it impossible to know whether the depicted inlays were made of iron or some non-ferrous metal. It seems, however, certain that artists tried to depict the sword blades as close to reality as possible, and, having no accurate knowledge of weapons, the pictured inlays and patterns are not necessarily connected to certain swords, patterns or inlaid motifs.[950] For this reason, the only thing that can be definitely stated is that the patterns and inlays must have been originally very clearly visible.

6.2. The theory of experimental archaeology and its applications

Before the description of the course of the experiments and their results, it is necessary to briefly summarize what is experimental archaeology and discuss its nature and limitations. The definition of experimental archaeology itself appears to be somewhat complicated, since there seem to be many definitions depending on the scholar in question.[951] While comparing different definitions it can be claimed that experimental archaeology explores the behaviour and/or technology of past peoples under controlled circumstances, i.e. through experiments. The result of experimental archaeology is always a reconstruction, for example, of an ancient artefact or its processes of production and manufacture. Experimental research can concentrate on any stage of the course of life of archaeological finds or sites. Not only a branch of science or a sub-field of archaeology, experimental archaeology can also be considered to be a tool in aid of research, since an archaeological experiment can be included in any stage of the research process to minimize the number of erroneous interpretations and hypotheses.[952]

944 *Leppäaho 1964a: 12–13.*
945 *E.g. Walther & Wolf 2001: 193–195.*
946 *Leppäaho 1964a: 8–9.*
947 *E.g. Walther & Wolf 2001: 169–171.*
948 *Pierpont Morgan MS M.736. The manuscript is dated to ca. 1130 AD.*
949 *Leppäaho 1964a: 7–8.*
950 *Leppäaho 1964a: 15–16.*
951 *E.g. Bahn 1992: 165; Champion 1980: 45; Coles 1973: 13; Ingersoll & MacDonald 1977: xii; Skibo 2000: 199.*
952 *Malina 1983: 71.*

The most crucial part of experimental archaeology is the experiment itself, in which researchers observe how certain selected variables affect each other.[953] Since experimental work in most cases includes traditional handicrafts, such experiments cannot be conducted in strictly controlled laboratory environments. For the sake of the representativity of the results of the experiments, they should be executed in authentic conditions outside laboratories, where the control of any 'variables' becomes almost impossible and often unnecessary due to different objectifying techniques such as statistics. The aim of experimental archaeology is to produce scientifically valid results, which in practice means that the experimental process must be validated and authenticated to provide valid hypotheses suitable for different kinds of applications in the archaeological field of research.

Despite its practical nature, experimental archaeology also has its problems. Without a doubt the greatest problem of experimental archaeology is the lack of any generally accepted theoretical basis,[954] which leads to the fact that experiments and their results have no general applicability to archaeological hypotheses. The second, growing problem appears to be that concepts such as experiment, experience and education have been confused,[955] which in turn has led the term 'experimental archaeology' to be simplified for the public to mean only ancient technology or re-enactment, which in turn influences the credibility of experimental studies in scholarly circles. Similarly, the result of experimental archaeology, a reconstruction, has at present a very simplified meaning. Peter Reynolds suggests, that the term 'construct' should be used in most cases, because 'reconstruction' refers to something quite accurate and authentic.[956] Still it must be remembered that a mere reconstruction or replication of e.g. an artefact, regardless of how authentic it is, is not 'experimental archaeology', but the process behind it.[957]

Experimental archaeology has also many practical problems. Normally the conducting of experiments involves considerable expenses, which may include items such as materials, tools, documentation devices, and the staff of the experiments. Experimental research is also very time-consuming and requires a lot of devotion and organizational capability to be executed properly. In addition to this, experimental research usually requires researchers from many different fields of study. In particular, experts in material technology are quite few, but usually needed. The experiments usually deal with some craft or handiwork, and experts of these areas should also be present at the experiments, if not doing the experiments itself while the archaeologist acts as an observer, critic and interpreter.[958]

Last but not the least is the problem of the researcher's own attitude and personality. His or her preconceptions may affect the results of the experiments already in the planning stage. Archaeologists often make erroneous assumptions about the knowledge of ancient craftsmen,[959] which may be reflected already in planning of experiments. The results should therefore be examined very critically. The fact that practical experiments are often carried out outside laboratories in more authentic conditions inevitably introduces human factors in the experiments. Also human errors and pure chance may have an effect on the final results. Reynolds claims that the human element should always be dismissed to avoid erroneous experiments.[960] This view can produce very accurate experiments at the level of material technology, but it should also be remembered that the human element was always present in prehistoric times, and it should thus also be included in

953 Schiffer 1976: 6.

954 Practically the only clear theoretical basis is defined by John Coles (1973 and 1979). It consists of different guidelines to help the experiments become more 'scientific' and closer to authenticity.

955 Reynolds 1999: 156.

956 Reynolds 1999: 159.

957 E.g. Linderholm & Gustafsson 1991: 111.

958 E.g. Broadbent & Knutsson 1980: 5–6.

959 Schiffer & Skibo 1987: 596.

960 Reynolds 1999: 158.

the experiments. The validity of experiments must then be tested with statistical analysis and by repeating the same experiments so many times that they can be trustworthy.

From a methodological point of view, scientific experimental archaeology is always a process of many different stages.[961] Some authors have even schematized the phases of experimental archaeology to clarify the whole process of research.[962] The starting point and the foundation for the whole experimental process is to define a clear research question.[963] The next step is to gather the required background information – the more, the better.[964] The latest research of the subject in question should always be taken into account.[965] The researcher should strive to minimize possible errors already while making the required preparations for the experiments, and during the experiments. The results should also be checked for errors through necessary criticism.[966] The last stage of an experimental project is to publish it,[967] preferably in a scholarly forum.[968] The aim of publishing is also to make experiments repeatable for other researchers.

Because of its methodical diversity, experimental archaeology has sometimes been seen as a distinct field of research.[969] Because the experiments normally deal with nature's own materials, and sometimes even nature's own processes, the natural sciences should be used within experimental research, especially archaeometry – the application of methods of physics and chemistry to archaeological research.[970] An understanding of the materials that are used, as well as knowledge of tradition or long-term experimentation are both required to carry out the experiments properly. It can also be claimed that experiments should be acceptable for both archaeologists and representatives of technological disciplines,[971] which may turn out to be very difficult or even impossible. The researcher performing the experiments must have experience in dealing with the materials in question. Optimally, the researcher must take advantage of other professionals capable to work with used materials and tools.

Ethnographic data may also be used to answer different questions concerning the technology that is applied.[972] The drawback here is that ethnographic data cannot give definite answers, because knowledge of certain technologies may have disappeared,[973] or in most cases it has been transformed. Richard Gould has stated that ethnographic analogies can only offer alternative explanations for archaeological source material instead of direct information.[974] Analogies have often been forgotten precisely because they have been seen as erroneous, purely speculative and ethnocentric.[975]

John Coles has defined eight rules by which errors in the experimental research can be minimized and even eliminated.[976] These rules are more like recommendations, which should be followed according to the research question at hand. Their aim is to provide results that are as reliable as

961 *E.g. Ascher 1961: 810–811; Coles 1973: 14–15; Fansa 1990: 13; Linderholm & Gustafsson 1991: 109.*
962 *E.g. Fansa 1990: 13; Kyllönen 2005: 34.*
963 *E.g. Kyllönen 2005: 35.*
964 *Kyllönen 2005: 35.*
965 *E.g. Näsman 1986: 36.*
966 *Kyllönen 2005: 35.*
967 *Kyllönen 2005: 36.*
968 *Coates & McGrail 1995: 299.*
969 *Malina 1983: 75.*
970 *Dunnell 2000: 47–48.*
971 *Reynolds 1999: 157.*
972 *E.g. Coles 1979: 39; Ingersoll & Macdonald 1977: xv–xvi; Kyllönen 2005: 36.*
973 *Schiffer 1976: 6–7.*
974 *Gould 1989: 20.*
975 *See e.g. Hodder 1982: 30; Wylie 2002: 138–139.*
976 *Coles 1979: 46–48.*

possible, and in any kind of experimental research. These recommendations are the most widely used in different kinds of experimental projects, and briefly they are as follows.[977] The materials used in the experiments should correspond to those used during the period of the subject of research. Correspondingly, the manufacturing methods should be as close as possible to the original ones. Modern methods of analysis should be used both before and after experiments to establish the similarities between the original object and the one created in the experiments. The scale of the experiment should be the same as that of the original. For example, an artefact should be reconstructed to its exact size, not as a scale model. The experiment should also be repeated to recognize possible errors. The experiment should aim at answering a specific research question. Moreover, new questions may arise during the experiments, and they should also be answered. The result of the experiment is not an exact answer, but a possible option, since hypothetical experimentation cannot produce exact answers. After the experiment, the results must be observed with criticism regarding the questions considered and the materials and techniques that were used. In addition, the preconceptions and characteristics of the experimenter should be taken into consideration. All these above-mentioned rules and points of view must be weighted according to the research question and the materials and techniques in question.

The results of the experiments can often be seen as 'negative', because they can more likely explain what did not function or occur.[978] Hypotheses to be tested through experiments cannot be verified; they can only be proved wrong, as in many other archaeological fields of study.[979] The undeniable fact that the results of the experiments cannot say anything positively sure, may be seen as reflecting the unsystematic nature of experimental archaeology,[980] and this fact surely is among the main causes for its criticism.

In this work it is necessary to study the manufacturing process of iron inlays in practice if the purpose is to seek traces of manufacturing techniques from the archaeological finds. To be able to distinguish possible traces of different techniques, one should know what to look for. The inlays may have been executed in different ways than defined in previously presented hypotheses, and each way could have left some characteristic features from which to recognize the technique that was used. The experimental approach is best suited here. Moreover, it needs to be proved experimentally that it could have been possible to produce imitations of inscribed swords. The techniques of inlaying iron are not extensively practised and known today, which has probably led to the conclusion that the technique of inscribing swords was generally been connected only to Frankish, high-quality smithies.[981]

The discussion of the experimental theory that is presented here is based on my article dealing with the theoretical basis for iron-working experiments.[982] The research question was defined first (Fig. 71) and in this case the question was how were iron inlaid inscriptions made in sword blades. In other words, how were inscriptions attached to both opposite sides of a sword blade? The aims of the experiments were to find a "forgotten" technique and to create an inscribed sword blade with the most authentic methods possible. This main question created instantly a group of additional questions. Before complete inscriptions can be attached to a complete blade, the technique for attaching one inlaid mark must first be established. Is it then possible to attach many letters or marks at the same time? Will the technique of attaching one letter work for a complete

977 *Coles 1979: 46–48.*
978 *E.g. Plew 1996: 235.*
979 *Malina 1983: 77.*
980 *Schiffer 1976: 4–5.*
981 *Opposite opinions are given in e.g. Andresen 1994, Geibig 1991, Müller-Wille 1970, Stalsberg 2008, on the grounds of the great number of inlaid blades and their variation. The statement that inscriptions were copied has also found its way into a popular publication introducing the Vikings and their culture (Hall 2007: 70).*
982 *Moilanen 2007a.*

sword blade? What was the phase of manufacture of the blade when inscriptions were attached? What did the inscriptions look like on a completed polished sword? Will the material of the blade and/or the inlays affect the technique that is used? Most importantly, could there have been several different techniques for producing an inscription?

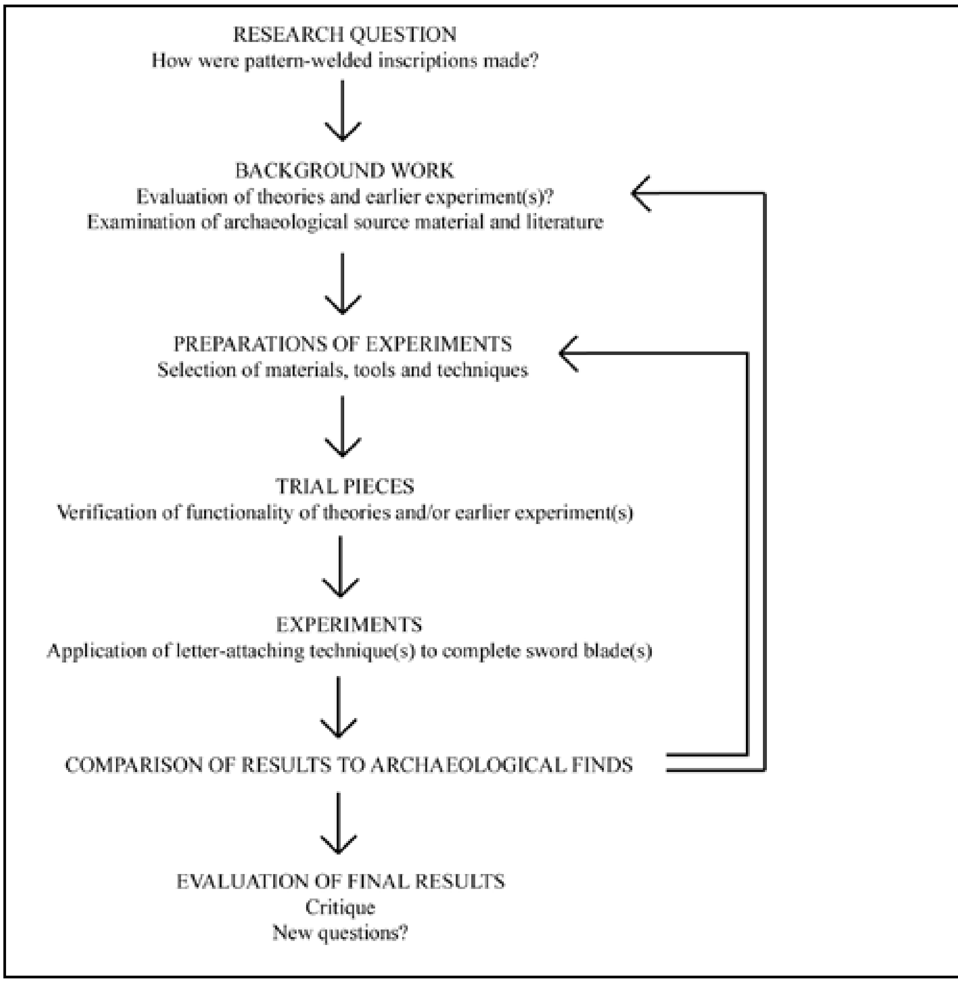


Figure 71. Diagram presenting the stages of the experiments conducted in this thesis.

Before conducting any experiments, all earlier studies concerning iron inlaid inscriptions must be studied. There are many different theories about the manufacture of inscriptions (see Chapter 6.1 above). Some of these theories may be disproved by simply examining the archaeological finds, but some of them must be tested through practical experiments to be able to prove them true or false. It is likely that there could have been several functional techniques for making inscriptions instead of just one. Earlier experiments must also be studied. Archaeological find material and research literature must be examined to select the materials used in the experiments. In these experiments it is very important that the used materials correspond as closely as possible to those used in the prehistoric past. The most important factor in selecting materials is the carbon content of the iron/steel. In theory it affects both the attachment technique of the inscriptions and the final appearance of the blade and the inscription.

To be able to clarify the manufacturing process of inscriptions, the most authentic tools possible were used. Archaeological finds of blacksmithing tools and sites including smithies provided enough information for this. The experiments then aimed at finding out what tools were actually needed for the work. Furthermore, the reconstruction of a whole smithy was not needed. Even the forge could be of modern construction. Only the fuel for the forge should correspond to that used in prehistory, which means that the metal should be heated using charcoal. In addition to archaeological data, also ethnological material could tell something about the used tools and techniques.

After the background work, it was necessary to plan the practical part well. First the aim was to find a functional technique for attaching one letter on a small trial piece simulating a sword blade. When such a technique was found, it was applied to attaching complete inscriptions on a whole sword blade. It was reasonable to test earlier hypotheses in small trial pieces first, and only after that the working ones were applied to complete blades to create whole inscriptions. The practical part then consisted of not only one experiment but several. The whole process was further complicated by the question of the actual phase of producing the blade in which the inscriptions were attached. Once again potential alternatives were experimented with. Because the making of inscriptions is tied on the manufacturing process of the whole sword blade, it was necessary to consider the making of the complete blade with authentic methods and tools. Still, it should be noted that it was not necessary to produce the whole blade with authentic methods.

The results of the experiments were then compared with archaeological finds. This naturally raised new questions during the experiments, which in turn created a new experiment, and so on. Because the series of experiments aimed at finding a 'lost' technique, the results of all the experiments must be considered as 'possible' or 'impossible', not 'certain'. To be precise, the technique has not actually been lost, but it is only an application of the techniques of the blacksmith and the knowledge of the used materials. The technique can be considered 'lost', since the tradition of iron inscriptions ceased to exist at the end of the early medieval period. The aim was then to reconstruct a Late Iron Age technology, which consists of materials, tools and techniques.[983]

6.3. The selection of materials and tools for the experiments

In the light of the archaeological finds, the majority of the inscribed sword blades were laminated, and the composition of the material used for the surface of the blades seems to have varied a great deal. With regard to the experiments the carbon content of the surface of the blade is of crucial importance: the welding temperature of the material rises with lower carbon content. Furthermore, the material of the surface of the blade has an effect on the final appearance of the blade: the inscription was most likely etched with an acid to make it more clearly visible, and the lower the carbon content, the lighter the colour when etched.

The surface of the fuller of the blade is in most cases steel, with carbon content varying between 0.2–0.8 % in different blades, sometimes being even higher. 0.2 % carbon steel will be etched somewhat darker than pure iron, but will require a slightly lower welding temperature than iron. In some cases the surface of the fuller had carbon content near zero, which means that the material could be classified as iron. Iron, on the other hand, requires a much higher welding temperature. Considering the final appearance of the blade, only minor variations in carbon content have an effect, for example steel with a carbon content less than 0.4 %, which is not hardenable, will etch considerably darker than pure iron.

In selecting the materials the most crucial factor was the carbon content. In the experiments I decided to use old steel springs with a carbon content varying between 0.5–0.8 %, and with some alloying elements. There were only small amounts of pure iron, which were used in the construction of only one blade in one experiment, excluding, of course, the inscriptions. Besides these, old carburized iron from the 18th century was also used, but only in two experiments, since it was scarcely available only when the series of experiments was under way. This material has greater resemblance to Iron Age steel. Modern materials are too homogeneous and alloyed to be accurately compared with prehistoric iron and steel, which was observed during the experiments.

In the experiments it was necessary to use materials corresponding to the surface of the fuller. The lamination of the blades was not needed. Therefore, the blade blanks in the experiments were of homogeneous steel to prevent the process from becoming too laborious and time-consuming. In some cases the blades were laminated, because they had to be made of several smaller pieces,

983 Schiffer & Skibo 1987: 595.

still with the same carbon content. Unfortunately no hypereutectoid steel[984] was available for the experiments, and thus no blades with carbon contents over 0.8 % were forged.

The material of the inlays should be pattern-welded steel with differing layer counts. The layers in pattern-welded rods were in most experiments non-carbon iron and steel with carbon content between 0.4–0.5 %. The production of the twisted pattern was also tried using iron and steel wires twisted together, but only in the first two experiments. In one experiment, it was attempted to increase the contrast between the layers of pattern-welded rods by using different kinds of steel and iron. The carbon content of the steel used for this was ca. 0.8 %, while the other material was old, non-carbon iron. This iron had small amounts of phosphorus in it, which was used to create a brighter result after the etching. Otherwise, no phosphorus-rich iron was available, and the sharp contrast originally seen on the surface of inlaid blades could not be achieved. Again it should be noted that the first seven experiments were done for my master's thesis, and they could have been executed in another, more authentic manner.

The blacksmithing tradition has remained somewhat unchanged since the Roman Iron Age.[985] The best evidence for this consists of archaeological finds of tools, which are in principle the same as those used today. In ethnographic perspective, both the techniques and the tools have survived in the form of tradition until modern times. It is noteworthy that blacksmith's tools are relatively rare in archaeological find material. There are two reasons for this: large tools have been preserved well and they can be reused as tools or scrap metal, or tools have been found but the value of the finds has not been recognized because of the universal forms of the tools.[986] Correspondingly the dating of blacksmith's tools is complicated by similarity between ancient and modern tools.[987]

The most important material for blacksmith's tools in Scandinavia is the Mästermyr find from Gotland consisting of a wooden tool chest containing a set of tools, both for metal-working and wood-working along with some raw iron and reused scrap iron. It is generally assumed that the Mästermyr find dates from the late Viking Age according to some tool forms, although it could just as well be later.[988] In addition to Mästermyr, an important grave find is from Bygland, Telemark, Norway. The tools in this grave are very heavy, indicating specialization in iron-working.[989]

The basic tools include hammers, tongs, the anvil and the forge. These basic tools have not changed radically since the Iron Age, and they come in various sizes and forms.[990] Early medieval hammers look quite the same as those used in modern times.[991] Early medieval tongs vary quite a lot in size and shape, as they also do today.[992] These kinds of tongs can also be seen in various pictorial sources, for example, on an 8th-century picture stone from Gotland,[993] 11th-century petroglyphs at Ramsundsberget, Södermanland,[994] 8th-century funerary stone from Ardre, Gotland,[995] and in the so-called Franks Casket from the 8th century.[996]

984 *See Chapter 4.5.1.*
985 *E.g. Gaitzsch 1980: 256. See also Pleiner 2006: 71–108 on the development of smithing tools.*
986 *Peets 2003: 159.*
987 *Peets 2003: 160.*
988 *Arwidsson & Berg 1983: 37; Christensen 1998; Lund 2006; Lønborg 1996.*
989 *Blindheim 1963: 36.*
990 *See e.g. Theophilus Presbyter 1979: 84–87.*
991 *See e.g. Arwidsson & Berg 1983: Pl. 6, 20–21; Ohlhaver 1939: 9, 13, 16–18, 24, 38; Oldeberg 1966: Fig. 325–329, 370–374; Peets 2003: 164; Uino 1989: 216.*
992 *See e.g. Arwidsson & Berg 1983: Pl. 7, 22; Blindheim 1963: 57; Grieg 1922: 44–45; Kolchin 1959: 22; Leppäaho 1949: 54; Petersen 1951: 87; Uino 1989: 216.*
993 *E.g. Holmqvist 1979: 43, 46.*
994 *E.g. Brate & Wessén 1924–36; Serning 1979: 86, Fig. 31.*
995 *E.g. Thålin-Bergman 1979: 105, Fig. 3.*
996 *E.g. Vandersall 1972. In the scene carved in whalebone, smith Wayland is forging.*

Late Iron Age anvils were much smaller than most common modern-day anvils, and they are also of different shape. At present the most common anvil is the one called the 'London type', which became common in the 1700s. This anvil has, besides a flat part, a round horn and two holes (so-called hardie and pritchel holes) for removable extra tools. Common early medieval anvils are small and square so-called stake anvils, which were often attached to a wooden log.[997] No additional tools could be attached to the anvil; sometimes there was a small hole for making nails only. In some cases Iron Age anvils had one or more spiked horns.[998] It is assumed that larger pieces were forged on large flat stones.

Blacksmith's forges are relatively rare among archaeological finds. There are several plausible construction methods for a forge. In its primitive alternative, a forge could have been just a pit in the ground, lined with stones, or it could have been a tower-like structure with even wooden frames.[999] A raised forge is illustrated, for example, in the Utrecht Psalter (ca. 820–840 AD).[1000] Theophilus Presbyter describes a forge with a clay lining.[1001] The pit-forges were very common throughout the Iron Age.[1002] The forges could have also been portable field-forges.[1003] The fuel of the forge was probably charcoal, in addition to plain wood. Especially charcoal made of hardwood is capable of raising the temperature up to 1500 °C, close to the melting temperature of iron (ca. 1538 °C). The heat is maximized by blowing air into the glowing coals. This was traditionally arranged with bellows made of wood and leather. There are no preserved bellows, but they are illustrated in rock-carvings from Södermanland[1004] and in 12th-century church paintings at Hylestad and Vegusdal in Norway.[1005] During the Late Iron Age, bellows were isolated from the coals with so-called forge-stones, which have a small hole in the centre for the tuyere.[1006] Forge-stones, usually made of soapstone, seem to have been used especially in pit-forges.[1007] The tuyere was normally of iron, clay or soapstone,[1008] but a wooden one has also been found.[1009] It is to be noted that side-draft forges were used even during the Middle Ages,[1010] whereas modern forges are normally blown from below.

For cutting iron there were hacksaws, which were quite similar to modern saws, but with coarser teeth.[1011] Alternatively, iron could be cut both hot and cold with chisels, which also were the same in shape in early medieval times and modern times.[1012] Besides cutting, chisels could also have been used for engraving, for which there were special hilted engraving tools.[1013] Thin pieces could

997 *For example, in the Junius or Caedmon Manuscript from the late 10th to early 11th century (Oxford, Bodleian Library, MS Junius 11) (Krapp 1931) there is a picture of a blacksmith forging on a small block-like anvil, which is attached to a square block, possibly of wood. The above-mentioned petroglyph from Södermanland, Sweden, also illustrates a stake anvil.*

998 *Møllerop 1960; Ohlhaver 1939; Petersen 1951.*

999 *See Moilanen 2011; Pleiner 2006: 123–128.*

1000 *E.g. De Wald 1932; Walther & Wolf 2001: 90. Utrecht, University Library, MS 32. This image also appears in later copies of the Utrecht Psalter, such as the Harley Psalter (London, British Library, Harley MS 603, ca. 1010–1030 AD), the Eadwine Psalter (Cambridge, Trinity College Library, MS R.17.1, ca. 1155–1170 AD), and the Anglo-Catalan Psalter (Paris, Bibliothèque nationale de France, ms. lat. 8846, ca. 1180–1200 AD).*

1001 *Theophilus Presbyter 1979: 81–83.*

1002 *Gömöri 1984: figs. 3, 5, 6.*

1003 *Taavitsainen 1990: 198.*

1004 *See Brate & Wessén 1924–36; Serning 1979: 86, Fig. 31. The carving shows a forge-stone and two small bellows next to each other. A continuous air supply can be provided by pumping two bellows in turns.*

1005 *E.g. Hauglid 1973; Thålin-Bergman 1979: 103, Fig. 2.*

1006 *See e.g. Grieg 1922: 66; Peets 2003: 175–177.*

1007 *Peets 2003: 175.*

1008 *Brinch Madsen 1981: 95.*

1009 *Rosenberg 1937.*

1010 *Peets 2003: 175.*

1011 *E.g. Arwidsson & Berg 1983: Pl. 7, 22; Kolchin 1959: 19.*

1012 *E.g. Grieg 1922: 59; Ohlhaver 1939: Tf. 10–11; Oldeberg 1966: Fig. 375, 382–384; Pleiner 1962: 173; Uino 1989: 216.*

1013 *E.g. Theophilus Presbyter 1979: 91.*

be cut with plate shears.[1014] After forging, the product was further refined by filing. Files and rasps were coarser in early medieval times.[1015] Early medieval files were made by striking the teeth with a special hammer, while today files are made by machinery. Different kinds of stones were probably used for finer grinding and polishing.[1016] Grinding wheel was also utilized, although they cannot be found in Iron Age archaeological find material, only in illustrations.

Considering the selection of tools, the aim was to conduct the forging experiments with as few and simple tools as possible. These tools included an anvil, a hammer, tongs and a forge. The hammers were industrial blacksmith's hammers. Tongs were made by the author from mild steel, except for the industrial pliers and plate shears. Also the chisels were made by the author from medium-carbon steel. The material of the tools did not matter at all; only the function, and to some degree form, was considered. In the case of hammers, the form and size of the hammer face (i.e. the wide striking surface) was to be same as in the finds. The tongs and pliers do not need to be exactly of the same form, only their function matters.

At first a London-type anvil was used in the experiments (experiments one to four), but only using its flat part. During the experiments a small stake anvil was made to resemble archaeological finds (experiments five to nine). It should be noted that while forging the fuller on sword blades, an iron underlay, i.e. a swage, had to be used to shape the fullers. The smaller stake anvil had rounded edges, which functioned as underlay for making the fullers. Fullers were also forged quite successfully without any underlay. In this connection it must be noted that swages are quite rare in archaeological material throughout Europe, not to mention this particular type of swage.[1017]

The forge used in the experiments was a stone-lined pit in sandy ground. The lining had two openings on opposite sides to enable the heating of a long sword blade. The fuel was charcoal made of birch, and the air-blowing was arranged with small bellows. Considering the aims of the experiments, modern solutions could also have been used. The main point to be considered is that while forging a sword blade, it should be possible to stab the blade through the forge and to be able to heat any part of the long blade. This, in turn, may be done with numerous construction alternatives, even with portable field-forges.

6.4. Possible techniques for attaching a single letter

In the light of archaeological sources, it is evident that the inlays were attached to the blade by welding. The cross-section cuts of inlays, in particular, indicate hammer-welding. A certain phase of blade manufacture, however, cannot be observed in the archaeological finds. In theory, inlays could have been attached at different stages of forging the blade. There are no direct indications of pre-cut grooves for the inlays. Instead, the inlays seem to have been attached without any grooves. The impurities and the cavities on the edges of the inlays on some blades could indicate grooves of some kind. According to the finds, grooves were not cut, but were instead rather struck on the surface of the red-hot blade, or the inlays were struck directly on the surface of the hot blade.

1014 *E.g. Arwidsson & Berg 1983: Pl. 6, 22; Grieg 1922: 49; Munksgaard 1984: 85; Oldeberg 1966: Fig. 336–337; Peets 2003: 173; Petersen 1951: 87; Thålin-Bergman 1983a: 198; Uino 1989: 216.*

1015 *E.g. Arwidsson & Berg 1983: Pl. 7, 22; Ohlhaver 1939: Tf. 9, 18, 27, 41–42; Oldeberg 1966: Fig. 376; Pleiner 1962: 173; Thålin-Bergman 1983a: 204.*

1016 *E.g. Holmqvist 1983: 99.*

1017 *See Pleiner 2006: 97 for types of discovered swages in Europe.*

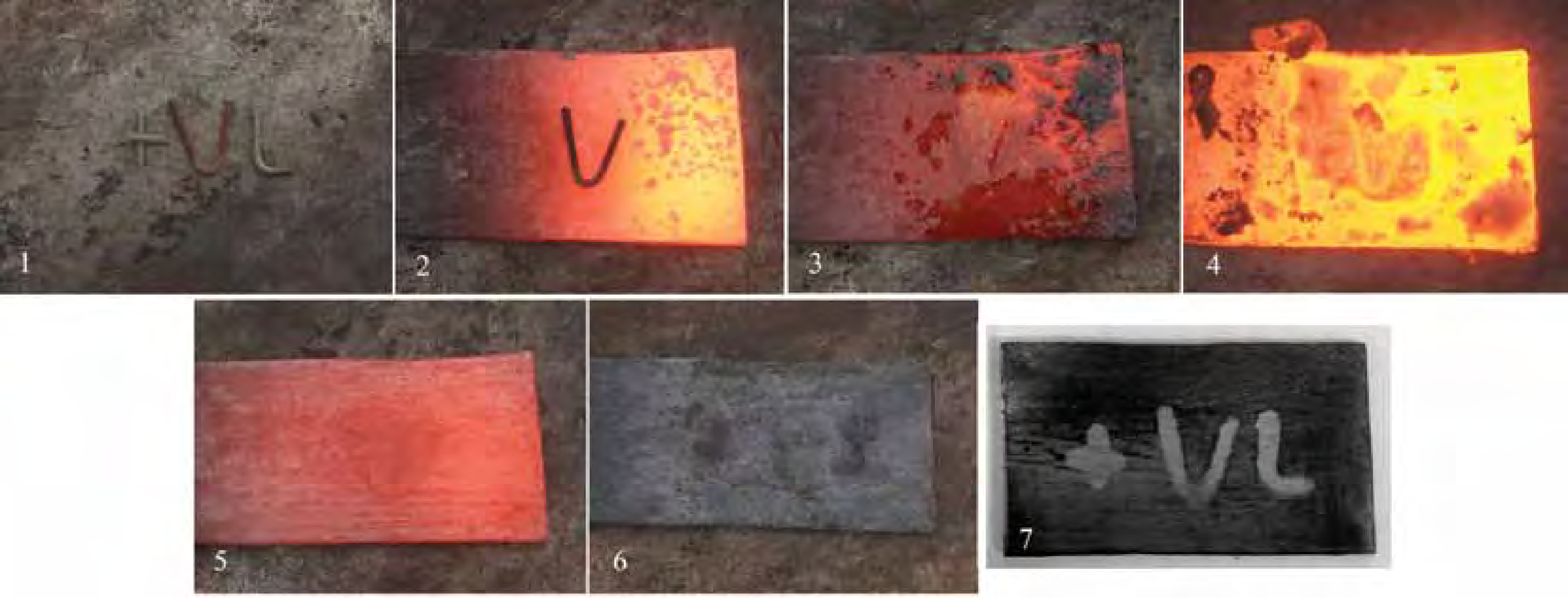


Figure 72. Making of the first trial piece: 1. The letters +VL bent from iron wire, 2. A cold letter placed on top of a steel plate imitating a sword blade, 3. Borax sprinkled on top of the letter and the plate, 4. Both the letter and the plate heated to a welding temperature, 5. The letter V hammer-welded on the plate, 6. All the +VL inlays welded on the plate, 7. Roughly ground and etched iron letters appearing bright against the darker steel plate. Photographs: Ulla Moilanen.

Before a complete inscription was attached to a whole blade, it was first necessary to discover a technique for attaching one inlaid letter or mark. In analyses of archaeological finds no indications for carved grooves were found, but it is still a plausible technique since some bladesmiths used it successfully. On the other hand, a technique creating a bent blade structure beneath an inlay must be found.

My starting point was Kasper Andresen's experiment.[1018] In his technique, the letters were forge-welded directly on the surface of the blade, because this is the easiest and quickest way, and it does not break the structure of the blade as carving some grooves would do. To test this technique I took a steel plate with a carbon content of 0.5%, on which I welded some letters bent out of iron wire.[1019] I used a slightly lower welding temperature than Andresen did. It was necessary to keep the welding temperature as low as possible for two reasons. First, the surface of the heated piece will oxidize every time it is heated. Considering that almost same parts of blade are repeatedly heated to welding temperature, the material loss through oxidation is great. Secondly, oxidation causes steel to lose carbon, which in turn causes the blade edges to turn into lower-carbon steel and eventually into iron. In this case, the edges do not necessarily harden during the heat treatments.

The majority of the inspected inscribed blades had a steel surface. In theory, this makes the attaching of inlays easier, because low welding temperatures can be used. The more carbon steel has, the lower is its melting point and correspondingly its welding temperature. In this way mere choice of materials may be used to minimize the risk of burning or oxidation of the blade. Originally it may have been that the steel surface was made with functionality in mind, because in this way the whole surface of the blade can be hardened while the iron core of the sword remains flexible.

To summarize briefly, the trial piece was made in the following way. First the letters were bent with small pliers from an iron wire one-and-a-half millimetres in diameter (Fig. 72). The ready-made letters included V and L, as well as two short pieces to be welded on top of each other to form a simple cross. The attaching was done one letter or piece of rod at a time. The cold mark was placed on a red-hot (ca. 800 °C) steel plate, after which some borax was sprinkled on top of the mark. Borax is a modern alternative for quartz sand and works in the same manner, except that the melting temperature of borax is slightly lower than that of sand.[1020] The steel was then placed again in the forge and the location of the inlay was heated to a welding temperature of ca. 1000 °C. Finally, as this temperature was reached, the mark was welded with quick hammer strokes on an anvil. As a result, the letter both sank into the plate and widened on the surface.

1018 Andresen 1993.
1019 See Chapter 6.1.2.1 above.
1020 E.g. Bergland 1990: 140. Borax already melts at 741 °C.

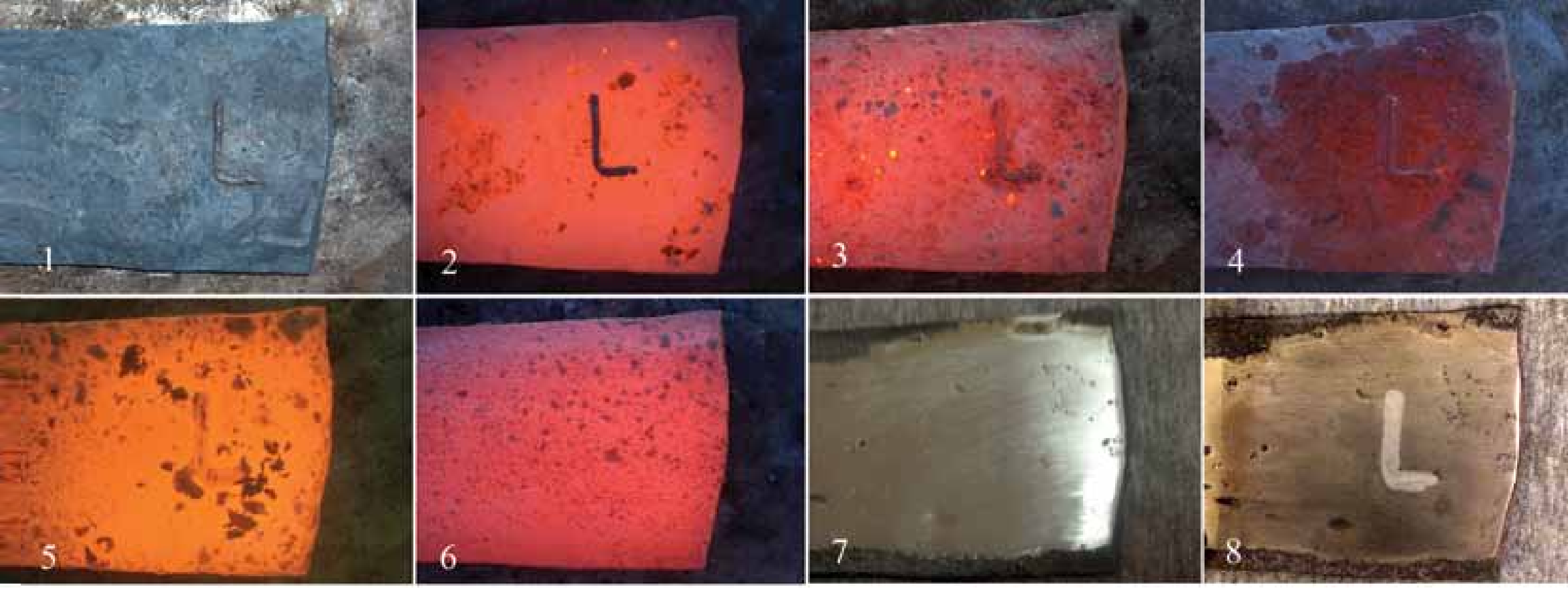


Figure 73.
The second trial piece made by striking the inlay deeper before welding: 1. A pattern-welded letter L and a steel plate simulating a sword blade, 2. A heated steel plate with the cold letter placed on top of it, 3. The letter has been struck against the hot plate causing the letter to sink slightly, 4. The letter is covered with borax, 5. The letter and the plate are heated to a low welding temperature, 6. The letter L hammer-welded, 7. The ground and slightly polished plate showing the dim shape of a letter, 8. Etched trial piece. Photographs: Ulla Moilanen.

While welding adjacent letters, one heating is skipped, because after welding the first letter, the blade is still red-hot, and the next letter with borax can be placed in its location straight away. Also the cross was welded in the same way. First I welded the horizontal bar, and then the vertical one, right on top of the horizontal one, without any problems. The first welded horizontal bar was flattened to the same level as the steel plate, and thus the second bar was easy to place and weld on top of the first one.

It was necessary to use an approximately twenty centimetre-long iron rod to adjust the letters to their right places on the hot steel plate. Since the letters were flattened during the hammering, it was also difficult to judge where the previous letter was welded. In addition, the molten borax makes inlays even harder to locate. Borax, when melted and cooled, turns into a black, thick layer. When hammer-welding a small letter, only little borax sprinkles away, because the hammer strokes are concentrated in a fairly small area, and the strokes cannot be executed too forcefully.

After all the marks were welded, the surface of the plate was forged more even, causing the inlays to flatten and widen even more. After this the surface of the plate was ground and polished with grinding stones, and finally etched with diluted nitric acid, which caused to inlays to be distinguished as white against the dark grey background of the steel plate. During the grinding and polishing, the inlays narrowed slightly, but still they were all welded successfully. Finally the steel plate was cut in two with a hacksaw, and the cross-section was polished and etched, which showed that the letters V and L were approximately half a millimetre deep, while the cross had sunk ca. one millimetre, because it had two rods welded on top of each other.

An alternative solution could be to hammer the letters deeper into the blade before the welding heat. This, too, was tested on a trial piece. I made a letter L from pattern-welded rod and welded it into a steel plate with this method (Fig. 73). The welding of the letter was done in the same way as in all the previous experiments, but before sprinkling the borax on the letter, I struck it cold few times against the hot steel plate, which caused the letter to sink slightly and helped the letter remain in place during the welding heat. I cut this trial piece in two and polished and etched its cross-section. This showed that with this technique the letter had been sunk twice as deep as in the previous experiments, i.e. to about one millimetre.

A third option was to punch grooves for inlays. For this technique chisel-like punches of two different sizes were used. The thickness of the ends of both punches was 2.5 millimetres, while the widths of the ends of the punches were one centimetre and half a centimetre respectively. The narrower punch was used to strike grooves for the curved inlays, a short bit at a time. In practice, the cold punches were struck against the blade with a hammer, while the blade was lying on the anvil. During one heat it was possible to strike ca. one millimetre deep grooves for two letters.

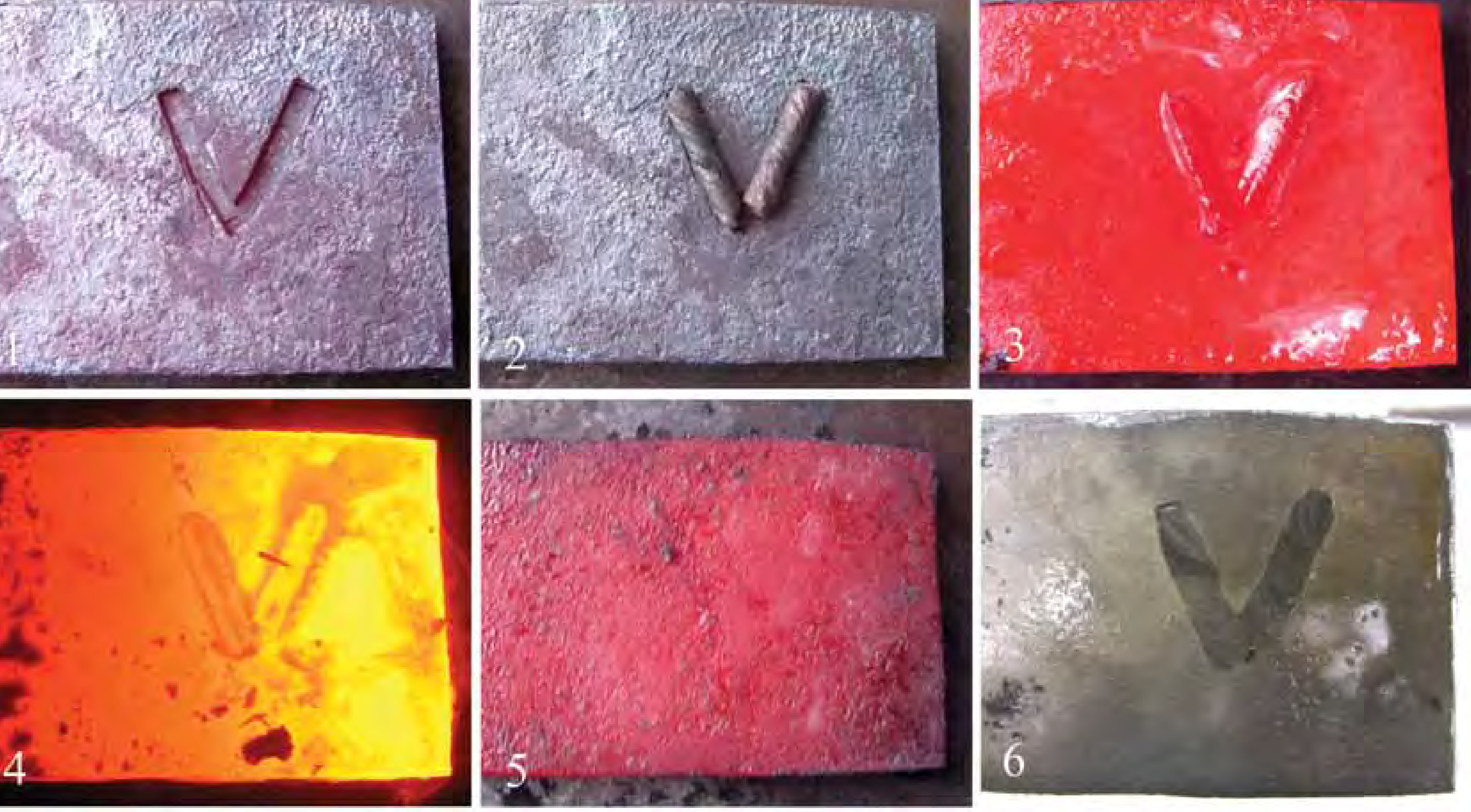


Figure 74. A trial piece showing the welding of inlay in a punched groove: 1. A punched groove for the letter V, 2. Pattern-welded rods placed in the punched groove, 3. Borax sprinkled on top of the letter and the plate, 4. Both the letter and the plate heated to a welding temperature, 5. The welded and flattened letter, 6. The ground, polished and etched plate.

These grooves only bent the structure of the blade but did not break it. The inlays had to be formed only after the grooves for them had been struck on the blade. In this way, the inlays can be fitted for the grooves (Fig. 74). After the inlays were fitted, the blade was heated, flux added, and the inlays were welded. With this method it was possible to weld both two inlays with the same heat.

Since the first technique that was tried proved to work, it was decided to be applied for complete sword blades. According to archaeological finds, the alternative techniques may also have been in use, and they were eventually tested as the series of experiments progressed. First the main concern was in the stage of forging the blade. In what stages was it possible to attach complete inscriptions on both sides of the blade with these techniques?

6.5. Applying the techniques to a complete sword blade

6.5.1. The process of making a complete blade

Attaching inscriptions is firmly connected to the manufacturing process of the whole blade. The making of the inscriptions can be considered as distinct stage in making the sword. The stages of manufacture of a whole sword may vary according to the swordsmith's own conceptions.[1021] The following is a short list of most common stages of making a sword:

1. Drawing out the blade blank to correspond roughly to the blade size
2. Shaping and centring the tip
3. Making the shoulders of the tang

1021 *See e.g. Pelsmaeker 2010 on the experimental making of a pattern-welded blade.*

4. Drawing out the tang and cutting it to its correct length

5. The forging or cutting of fullers

6. Forging blade edges from the tip to the shoulders (or backwards)

7. Heat treatments

    A. Annealing to relieve stresses

    B. Annealing to soften the blade; rough grinding to the final shape

    C. Hardening (i.e. quenching)

    D. Tempering

8. Final grinding and polishing; etching if the blade is pattern-welded

9. Making the hilt and assembling the sword

The above stages are the ones that I have used most (see Fig. 75). If the attaching of inscriptions is included in the above process, it should be placed before or after number five. In other words, the inscription can be best attached before making the fuller or then to the completed fuller. In theory, the inscription can also be attached after stage number six, i.e. the blade without heat treatments. In this case the inscription will no doubt end up straight and properly aligned. However, it is safest to attach the inscriptions already to the blade blank, if at all possible. The further the forging of the blade proceeds the greater is the risk of losing precious material through burning and oxidation.

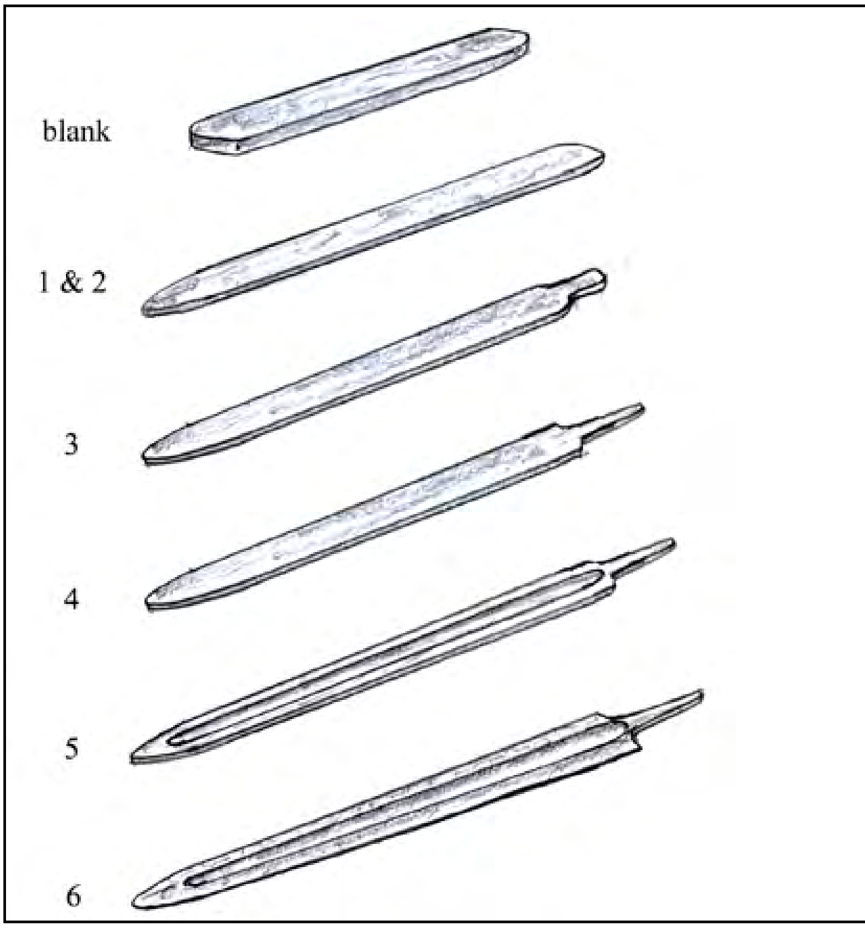


Figure 75. The stages of sword forging.

6.5.2. The different techniques of sword forging

6.5.2.1. Constructing the blade blank

The term blade blank is used to refer to a bar of iron or steel of suitable size to start the process of forging a sword blade. The blank itself can be assembled from different parts in numerous different ways. The most primitive way is to forge-weld several pieces of the same iron or steel together to form a blank big enough for a sword blade.

Figure 76. Example of the stages of forge-welding a pattern-welded blade to one piece: 1. Four partially twisted rods tied together with thin iron wire, 2. Twisted rods welded together, 3. The steel for the cutting edges tied to the pattern-welded core, 4. The completely welded blade which has been hand-forged to sword shape.

Another way is to laminate the blade. First the parts of the blade are assembled in the correct order, after which they are tied together and welded into a single solid piece. This laminated piece will then be forged into blade shape. In laminating, the pieces to be welded can be of any shape or size. The laminated blank can be a long, flat bar, or it can resemble a rectangular box. In any case, it will be forged into the shape of a blade. A box-like blank is of course more laborious to forge. In lamination, the blank must be welded from pieces large enough to allow for the loss of material during welding and forging. If the pieces are too small, a blade large enough cannot be properly forged from it.

The pattern-welded blade is constructed in much the same way as the laminated one (Fig. 76). Normally the pattern-welded section consists of two or more pattern-welded bars, and the bevels of the blade are of more homogeneous steel, and in some cases laminated. In making a blank for a pattern-welded blade, the pattern-welded rods are constructed and twisted first – according to the desired pattern. In cases where multiple rods, perhaps more than four, are used, the pattern-welded core is first assembled by welding it into one piece. In the same manner, if the cutting edges are laminated, they are made first. Finally, the whole blank is assembled and welded solid: the cutting edges are tied to the core and the pack is welded into one piece.[1022] In doing a pattern-welded blade, the blank will always be a long and slender one. Normally the core consists of twisted pattern-welded rods, the patterns of which will be distorted and lengthened if they are forged too much. For this reason, the pieces from which the pattern-welded blade is welded must be of almost the same length as the completed blade.

1022 See e.g. Moilanen 2007b and 2008a.

6.5.2.2. Shaping the blade

There are two alternative methods for producing a blade: forging and stock removal. At present, the stock removal method is widely used because of the ease and speed permitted by electrical grinding tools. In stock removal material is removed from the blank to achieve the desired shape. If the sword is forged, loss of material through oxidation must be taken into consideration. During every heat ca.0.5 % of the blank disappears, and the grinding of the bevels and fuller will remove one fourth of the weight of the forged blade.[1023]

In forging a sword, a blade blank should first be forged by drawing and thinning. This blank should be little shorter than the desired blade. While drawing the blank to its correct length, the material glides under the hammer in the desired direction. Usually heavy sledgehammers are used in this coarse work. To guarantee the even packing of crystals in steel, however, light hammers should be used in forging.[1024] Perhaps for this reason large sledgehammers are rare among archaeological finds.[1025] The next step is to make the tang and the fuller. Between the tang and the cutting edges come shoulders. They can be forged with the ridged end of hammer, or then against the edge of the anvil. After the shoulders are forged, the tang is drawn out and hammered into shape. If necessary, a tang that is too long may be cut to correct length for example with a chisel or a hacksaw.

A fuller can be manufactured in two ways: forging or grinding.[1026] No matter how the fuller was made, it will function in a manner of an I-beam or H-beam making the blade tougher.[1027] A modern solution is to use a kind of fuller tool attached to the anvil. This tool consists of a U-shaped springy part, which has two opposite swages in its inside edge. A small part of blade is heated and placed between the swages, after which the wedges are hammered together. This creates a fuller on both opposite sides of the blade. Anvil tools of these kinds probably did not exist in the Iron Age. At any rate, not a single one can be identified in the archaeological find material. A fuller can also be forged with a normal, convex-faced hammer on an anvil. One way is to put a fuller-shaped convex swage or underlay under the blade and then hammer the opposite fuller. First the fuller may be forged on the other side of the blade. Then the blade is turned over, the swage is put in the ready fuller, and the second fuller is forged. In this way the swage prevents the flattening of the first forged fuller. The swage does not need to be a separate tool; for example the convex edge of an anvil may be used for this purpose.

The simplest way is to forge the fullers on the flat of the anvil without any swages. Also in this case the fuller is first forged on the other side of the blade. Now this fuller needs to be much deeper than the result should be. Then the blade is turned over and the fuller of the other side of the blade is forged, this time with slightly lighter hammer blows to prevent the first fuller from being completely flattened. Also the blade should be heated to a relatively high temperature to be worked more easily with lighter blows. With this method it is very difficult to create sharp ridges for the fuller, for which it is wise to forge the edge bevels after the fuller is forged.

The fuller may also be ground to the blade, either before or after the forging of the bevels. In early medieval times the fuller may have been ground with a grinding wheel, although this would have been a slow process. Before heat treatments fullers may be cut into the blade with a scraper, a drawknife or a cold chisel. This is a relatively neat way, although especially drawknives and

1023 Hansen 2007: 42.
1024 Andresen 1994: 197.
1025 Andresen 1994: 197.
1026 E.g. Lang 2007: 93–94.
1027 E.g. Andresen 1994: 193–194; Hansen 2007: 48.

scrapers for this purpose are not encountered in archaeological finds. However, a convex cold chisel is also a good alternative. In archaeological finds, the depth of the fuller varies, which may be due to different manufacturing techniques. Ground fullers are sometimes observed in archaeological finds. For example a Viking Age sword from Sweden (catalogue number SHM 8974) was cut, and the section revealed that the grain structure of the blade was broken in the part of the fuller.[1028]

The Utrecht psalter (ca. 820–840 AD) has an illustration of a man sitting on a long bench and working on a sword fuller with a long-handled, convex tool.[1029] This could be a scraper to grind in the fuller, or then it could be a polishing tool. It is strange that the sword is shown as hilted, which may have been done only to illustrate that the worked object is actually a sword. It would be easy to polish the fuller by making a convex tool, for example, from iron or leather-covered wood, with which to rub some abrasive agent against the fuller.

The edge bevels are forged next. The forging of the bevels may be started from the tip or the tang. The author is used to starting from the tip, although the blade length may be adjusted more easily if the bevels are forged from the tang to the tip. The forging is done by striking alternately on both sides of the blade to create two bevels ca. one millimetre thick. Leaving the edge this thick prevents the carbon migration while the blade is heated, and it also leaves some spare material in the blade bevels for the grinding and sharpening phase. While forging the bevels the blade naturally widens and grows slightly longer. The hammer blows must be focused on alternate bevels to prevent the blade from bending and twisting. If the fuller was made before the bevels, the sharp ridges can also be created for the fullers by sliding the material of the bevels towards the centre of the blade.

As Kasper Andresen has noted, tongs are not needed in the forging of a sword blade.[1030] The blank can be held by hand, because it is long enough not to heat up along its whole length. First one half of the blade can be forged, and then the blade can be cooled and turned over, for shaping the other half.

6.5.2.3. Heat treatments

After the forging, the heat treatments may take place. The ideal heat treatments include normalising to relieve stresses, annealing to soften the blade, hardening, and tempering (see Chapter 3.1.4). In the case of Late Iron Age sword blades, not all these treatments were done on the same blade, and in many cases the blades were not heat-treated at all.

First the blade could be annealed and softened. The blade is heated evenly to the critical temperature and then cooled in air to relieve the stresses caused by forging. In softening, the blade is again heated to the critical temperature, and is then cooled slowly, for example, among wood ashes. This will make the steel softer, and the blade can be straightened by cold-hammering, filing and grinding. The coarse grinding can be done with a grinding wheel and grinding stones. If the fuller is to be cut cold in the blade, this is easiest to do at this stage.

The hardening or quenching will harden the blade hard and make it cut well. The whole blade or only the cutting edges are heated to quenching temperature, after which they are quickly quenched in a quenching medium, for example water or oil. When the desired parts of the blade are at

1028 Thålin-Bergman & Arrhenius 2005: 92–94.
1029 Walther & Wolf 2001: 90.
1030 Andresen 1994: 193.

quenching temperature, the blade is taken out of the forge and plunged quickly in the quenching medium, with the tip of the blade pointing downward. The vertical position of the blade prevents it from being bent by the rapid change in temperature. It is essential that the temperature is even along the whole length of the blade, which can be achieved by a long bed of coals.[1031] Janet Lang does not exclude the possibility that the central part of the sword was covered with clay to prevent it from hardening.[1032]

After proper quenching the blade is too fragile, depending of course on the quality of the steel. The fourth step in heat treatments is tempering, which removes the stresses caused by hardening, and makes the blade more flexible. The blade is heated to a low temperature, which is judged by the colour of the metal. Tempering can be done with several methods, because the low temperature can be reached with alternative solutions. Probably the best way is to use warmed sand into which the blade is plunged.[1033]

It is also possible for the cutting edge to be hardened by cold forging.[1034] This can be done best when the material of the blade, including the edges, is not hardenable but of iron or low-carbon steel. Also one way to harden the edges is to make iron absorb nitrogen.[1035] Nitrogen could have been obtained, for example, from bird droppings.[1036]

6.5.2.4. Finishing the blade

The completed, hardened and tempered blade can be ground further using a grinding wheel and grinding stones. For this, a bench may have been used into which the blade was fastened, and with which the correct grinding angles could have been adjusted.[1037] Water should be used between the blade and the grinding stone, because this creates a kind of abrasive mud from water and stone powder, and in addition, keeps the blade cool during the grinding.

An illustration in the Utrecht Psalter (ca. 820–840 AD) shows a large grinding wheel with which a sword is being ground.[1038] This image proves that grinding wheels were in use. The clumsy construction of the grinding wheel support may be due to the ignorance of the artist. The above-mentioned obscure image of the working of the fuller may also mean grinding or polishing, and the hilts of both these swords may have been included to show that namely a sword is being made. Grinding wheels were in use in medieval times. For example, the Luttrell Psalter from 1325–1335 shows another grinding wheel, with two men turning the wheel and one grinding or sharpening a knife.[1039]

The polishing may be done with fine-grained stones, or for example with fine sand rubbed against the blade with a piece of leather. It has been suggested that this work was done more easily and quickly, if the blade is pushed up and down in a box filled with wet sand or clay,[1040] although this may round off the sharp lines of the blade. Wet wood ashes are also a good polishing medium.

1031 E.g. Hansen 2007: 49.
1032 Lang 2007: 77. This technique has been used in Japan to create the final curvature of the blade and to emphasize the border between the hardened and non-hardened parts of the blade.
1033 Hansen 2007: 50.
1034 Andresen 1994: 197.
1035 Emmerling 1972: 292–296.
1036 Ellis Davidson 1962: 160.
1037 Hansen 2007: 49.
1038 De Wald 1932; Walther & Wolf 2001: 90. Again, these images appear also in later copies of the Utrecht Psalter.
1039 Backhouse 1997: 113.
1040 Hansen 2007: 50.

Number of experiment	Type of inlay	Type of blade	Phase of blade forging where inlays were attached	Blade thickness before attaching inlays (mm)	Technique of inlaying
1	twisted wires	homogeneous, 0.6 % C	finished with fuller and bevels	6	welded on surface
2	twisted wires	laminated: edges 0.6 % C, core 0–0.1 % C	half-finished, fuller and no bevels	6	welded on surface
3	pattern-welded (13 layers)	homogeneous, 0.7 % C	half-finished, fuller and no bevels	7	welded on surface
4	pattern-welded (7 layers)	homogeneous, 0.7 % C	blank	7	welded on surface
5	pattern-welded (7 layers)	homogeneous, 0.7 % C	half-finished, shallow fuller and no bevels	8	struck cold before welding
6	pattern-welded (7 layers)	homogeneous, 0.8 % C	finished with fuller and bevels	6	welding in punched grooves
7	pattern-welded (7 layers)	homogeneous, 0.8 % C	half-finished, shallow fuller and no bevels	8	welded on surface
8	pattern-welded (13 layers)	homogeneous, 0.8 % C	blank	7	welded on surface
9	pattern-welded (7 layers)	homogeneous, 0.8 % C	half-finished, shallow fuller and no bevels	7	struck cold before welding
10	pattern-welded (7 layers)	old steel, 0.5–0.6 % C	half-finished, shallow fuller and no bevels	8	welded on surface
11	pattern-welded (7 layers)	old steel, 0.5–0.6 % C	blank	8	struck cold before welding
12	iron	homogeneous, 0.4 % C	half-finished, shallow fuller and no bevels	7	welded on surface
13	steel	homogeneous, 0.4 % C	blank	8	struck cold before welding

6.6. Attaching inscriptions on blades – a summary of 13 experiments

Figure 77. Table showing the variables of each inlaying experiment.

The experiments themselves are discussed briefly, since their complete documentation would require a vast number of pages. The variables of each of the thirteen experiments are presented in Figure 77. During the experiments the properties and the forging stage of the blade varied, as well as the applied inlaying technique. The table provides a brief overview of this.

To begin with, the first experiment was a direct application of Andresen's technique of welding the marks straight on the surface of the blade. It was first tested whether this technique work on a blade forged into shape, including the bevels and the fuller. The marks were welded individually, keeping a convex swage underneath the completed fuller to prevent it from flattening against the anvil. Some letters required multiple heatings, since only one bit of metal rod could be welded at once. After grinding and polishing the resulting inlays were in most parts lost, since they were at a depth that was too shallow. The first inlaid side, the inscription, was oxidized much more, which is probably the reason for disappeared inlays. Furthermore, the multiple heating of the same spot of the blade slowly destroyed the ready-forged, relatively thin cutting edges.

The second experiment was conducted in similar fashion as the first one, except now the blade was only half-finished so that it lacked the edge bevels, having the fuller again at its intended depth. The primary aim was now to prevent the oxidation of the inscribed part by leaving this part thicker at the bevels, which were forged only after the inlays were completed. The monosteel blade like in the first experiment will be etched dark even in the fuller around the inlays. In the second experiment the blade was laminated, having an iron mid-section that will remain almost bright after etching. It was also attempted to weld multiple inlays, since the blade retains its welding temperature for a few seconds. In practice this meant that all rods of one letter were welded in the same heating.

As a result of the second experiment, the actual inlay was present in most of the letters, but still large parts of the inlays were ground away leaving a 'shadow', because the inlays were not deep enough. The welding of multiple inlays with one heating was successful, except that during the hammering some wires moved and became slanted. On the other hand, inlays are often also slanted in the finds. Because the fuller was made of iron and the welding temperature was slightly too low, not all the inlays were successfully welded. This time the blade edge did not oxidize, while the ridges of the fuller did, which can be seen as small dark pits.

At this point a note must be made about the inlaid materials. In the first two experiments the inlaid rod was composed of two wires – iron and carbon steel – twisted together. This creates a diagonal pattern on the surface, but it is not comparable to proper pattern-welding, which was used in other experiments, except for the last two, in which smaller post-Viking Age style inlays were produced. The pattern-welded inlays used here were piled from seven alternating layers of non-carbon iron and medium-carbon steel (0.5 % C). There were four iron layers and three steel layers (Fig. 78). The pack was tied together with iron wire, hammer-welded solid from one end to the other using borax as a flux and a welding temperature of ca. 1200 °C. To create more layers (experiments three and eight), the solid pack was struck almost in half, folded and welded again to create a total of fourteen layers. The completed pack shows only thirteen of them because two white iron layers were welded against each other in the middle of the pack. Finally the pack was forged to a plate approximately two millimetres thick, from which thin, about two millimetre-wide strips were cut with a chisel while hot. These strips were then twisted along their own axis with two pliers, and then their edges were flattened by careful hammering (Fig. 79). Both the twisting and hammering had to be done at forging temperature. Multi-layered and twisted pattern-welded rod is too tough to be shaped while cold.

In the third experiment, the blade was again homogeneous steel and semi-finished just as in the previous experiment, although the blade was now thicker to prevent oxidation from thinning it. The welding of the inlays was done as in the previous experiment, as was the grinding and polishing of the blade. The bevels were forged right after the inlays were attached. The patterns on the inlays appeared to be very irregular due to the great amount of grinding and the levelling of the edges of the rods by hammering. The hammering of twisted pattern-welded rods straightens the rod and makes the twists appear looser. In addition, most of the inlays were ground away again, especially on the side of the blade where they were first attached. The blade, too was oxidized, now even more than in the previous experiment, because the successful welding of the letters seems to require a temperature well over 1000 °C. One problem in this experiment was the fuller, which was at its full depth in all these first three experiments. When hammer-welding the inlays, the bottom of the fuller changes its shape and oxidizes, which in turn causes the final fuller to be too deep and its ridges, as well as its bottom, will end up broken and pitted.

In the fourth experiment the pattern-welded rod for the inlays was left coarser and had seven layers. The pack was drawn out with a hammer into a three millimetre-thick rod, instead of forging it flat. The rod was almost square in diameter, and it was again twisted with two pliers at a forging temperature. The sides of the rods were not flattened by hammering, but instead filed. In this way, the rods narrowed slightly but still their twists remained tight compared to the third experiment. The inlays were attached to a blank blade with no bevels or fullers. The idea here was

Figure 78.
The making of a pattern-welded pack: 1. A pack made from alternating sheets of iron and steel, bound together with iron wire, 2. Forge-welding the pack by hammering, 3. A completely welded and solid pack.

that welding the inlays directly onto the blank and then forging the blade only after this procedure will prevent the blade from oxidizing and thinning as was evident in the previous experiments. The welding of the inlays was carried out as in the previous experiments. It was only after the welding process that fullers were forged with a convex-faced hammer, using a swage under the blade to help shape them. As a result the ready blade now looked more intact and trimmer without any major traces of oxidation. Instead the inscriptions had almost completely oxidized away. Apparently the hard forging flattens the inlays paper-thin, and heating during the forging of the fuller causes the inlays to oxidize very easily. In addition, the hard forging distorts the inlays, causing the edges to be twisted and blurred. Correspondingly, the patterns of the inlays also become distorted.

The blade in the fifth experiment had fullers but no bevels before the inlaying process. In addition, the fuller was forged to only half of its intended depth. The blade was now also thicker, and the rod for the inlays was seven-layered pattern-welded material. The previous experiment showed that it is much easier and quicker to forge the pattern-welded pack into a flat plate from which strips are cut with a saw or chisel, instead of drawing it out into a thin rod. In the previous experiments one problem was that the inlaid rod does not sink as deep as needed, and therefore large parts of them are ground off during the finishing of the blade. As a solution, all inlays were now attached to the blade by striking them deeper before being heated for welding. In this experiment, as in the following ones, a small stake anvil was used for forging and welding. The shaping of the fuller, like the hammering of the letters, was done against the round corner of the anvil and without any separate swage.

The resulting blade appeared to be quite intact and neat. The patterns of the inlays started to resemble the archaeological finds, and some inlays even displayed a semi-circular pattern characteristic of pattern-welded rods. Still, the inlays did not sink deep enough, and on the first welded side small parts of letters vanished during the grinding. The greatest problem was that the inlays tended to move while hammering them deeper into the blade before the heating for the welding. The inlay could remain still during one or two hammer blows, but then it usually jumped out of its place, and the next hammer blow created a new hole for the same letter or mark. Naturally these must be ground away, which also causes the inlays

Figure 79a.
Making rods for inlays from a pattern-welded pack: 1. Flattening the pack by hammering, 2. The pack is flattened into a thin sheet, 3. Cutting a strip with a chisel, 4. Twisting a strip with the help of tongs, 5. Forming the letters and marks by hot-forging, 6. A pattern-welded rod almost halfway in the process of being ground, polished and etched, showing its patterns.

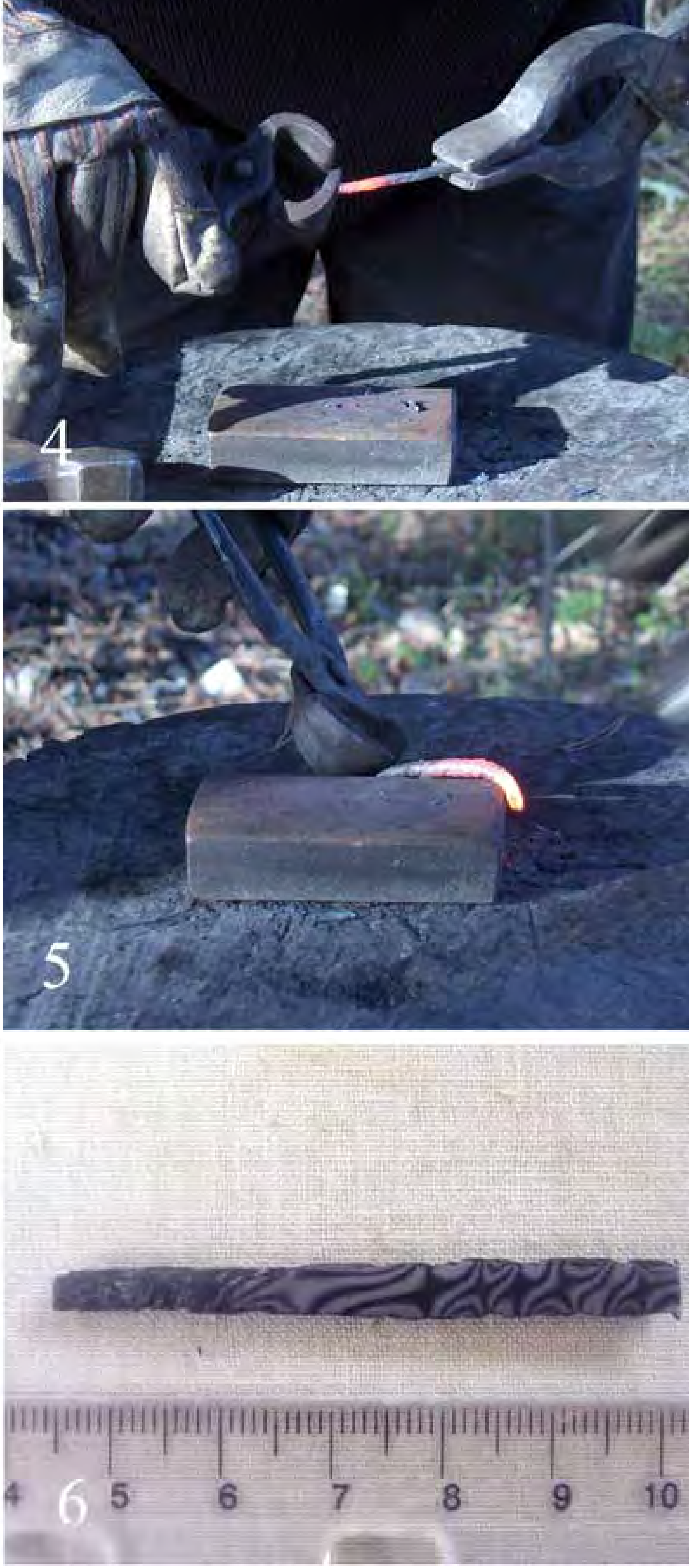


Figure 79b.

to be ground more. It was also hard to strike the inlays so deep that they would not move at all in the forge during the heating for the welding. As a consequence, shallow, dark depressions were left in the blade, which had inlays welded on their edges.

If the inlays are to be sunk deeper into the blade, they must either be struck harder at a higher welding temperature, or some grooves must be done beforehand for the inlays. One way to achieve such grooves is to strike them into the hot blade with chisel-like punches. Also, by striking the grooves, the depth of the inlays can be easily adjusted. In the sixth experiment a complete blade was first made, as in experiment number one. After this, two punches were made, which were used to strike grooves for the inscription and the geometric motifs on both sides of the blade. After forming the inlays, the marks of the inscription side were fit into their places, after which the whole inscribed part was welded with only two welding heats. After the inscription the geometric motifs were welded on the other side of the blade in the same manner and with only two welding heats. All the inlays required a total of only four welding heats, after which the fuller was evened by heating and forging. The resulting blade looked otherwise neat, except that the inlays have some dark lines and grooves on their edges due to grooves that are too wide and inlays that are too narrow. Moreover, the inlays had moved slightly during the welding heat, and therefore some of them are not exactly on the grooves where they were intended to be. Still, the fullers and inlays had enough material for additional grinding, because the inlays displayed the semi-circular pattern characteristic of the mid-section of the pattern-welded rod. This means that about half of the inlaid rods were still intact in the blade.

If the inlays are sunk either by making grooves for them or by striking the inlays deeper before the welding, it is possible to execute the inlays with at least some accuracy. However, the simplest method used in the first four experiments needed further testing. It was attempted to prevent the excessive oxidation of the blade by using considerably larger amounts of flux, so that a continuous layer of molten borax or sand covered the whole inscribed section. In this way the welding temperature could be raised, which in turn would help the inlays sink deeper when they are welded directly on the surface of the blade. Moreover, it was considered as the safest alternative to weld the inlays to a thick, half-finished blade with no bevels and only a shallow fuller. While conducting the seventh experiment, the inscribed section of the blade was continuously fed with borax, and the welding temperature was raised to 1050–1100 °C. As a

Figure 80. Close-up view of the inlaid letters of the seventh experiment. The lower right tip of the letter H has not been properly welded, but the letter still remains intact in the blade.

result, the inlays were successfully welded, clearly visible, and their patterns corresponded to the originals. Only one end of the letter H of the inscription +VLFBERHT+ did not weld properly, but the letter did not come off the blade (Fig. 80). The depth of the inlays, though, was apparently not as great as in archaeological finds, since some parts of them were lost. The thick layer of borax prevented oxidation to a considerable degree, but on the other hand the grinding and polishing of blade destroyed parts of the inlays again.

The eighth experiment was a modification of experiment number four, in which the inlays were welded straight on the surface of the blade blank, after which fuller was forged. In the eighth experiment the same technique and manufacturing stage of the blade were used, with only the forging of the fuller carried out differently. The fuller was forged at the same time as the inlays were welded, a short section at a time. While forging the fuller on the second side of the blade, a convex underlay was used in order to avoid flattening the fuller on the opposite side of the blade. The bevels were hammered after forging the fullers. Now the result was much better than in the fourth experiment, though the first welded side was oxidized and partly destroyed during grinding and polishing. The depth of the inlays was not more than in the fourth experiment, and the inlays were widened considerably, causing them to overlap and making the patterns distorted. Forging the fuller at the same time reduces the number of heatings and helps preserve the inlays at least to some degree, but the results were not satisfactory.

The ninth experiment was a small modification and renewed attempt of the fifth experiment. In the fifth experiment inlays were not welded directly on the surface of the blade but were first struck deeper into the blade, one by one, and then welded. In the ninth experiment the blade was otherwise a blank, except it had an almost finished fuller. This was done to reduce the amount of grinding after attaching the inlays. The difference in the used technique when compared to the fifth experiment was that all inlays on one side were first sunk in the blade, and only after that the welding took place. This was tried in order to reduce the number of heatings during the welding. However, the material of the blade was so tough that it was impossible to sink the rods deeper than about half a millimetre, after which the inlays began to flatten because they were warmed very quickly against the orange-hot blade. The major problem was that the sunken inlays came off their grooves when new inlays were being hammered into the blade. Moreover, while hammer-welding the first sunken inlays, others were coming off their grooves, and they were very hard to assemble back into their places.

The resulting inlays of the ninth experiment were clearly dislodged in most parts, so the inlays should be much deeper to avoid them being shifted during hammering and welding. The material

Figure 81.
The polished and etched cross-section of the blade made in the ninth experiment. The carbon steel blade has become etched dark grey, while the inlays are visible as darker and brighter lines at the top surface of the cut blade. The cut inlay, the cross, sank ca. 1.4 millimetres in its centre, while a single inlaid rod sank about 0.7 millimetres.

of the blade, however, was simply too tough to permit this. Otherwise the blade was oxidized to a surprisingly small degree, considering that the fuller was almost at its full depth. Because the inlays were adversely affected in such a way, the blade was cut all the way through to see how deep the inlays were. This was done at the middle of the second cross of the text +VLFBERHT+, because this inlay was quite well welded in its intended place and thus intact. It was found that a single inlaid rod was at a depth of ca. 0.7 millimetres, while the middle section of the cross was at a depth of 1.4 millimetres (Fig. 81). This centre of the cross had two rods welded on top of each other.

All previous experiments led to speculate if the relatively modern materials used in the experiments were too tough, since they also contained other alloying elements than carbon. In the tenth experiment, old steel from the 18th century was obtained. These were old rims of cartwheels, made of probably bog iron and carbonized to some degree, although quite unevenly, the carbon content being somewhere between 0.5–0.6 %, as estimated by spark showers generated by a grinding wheel. This material had only natural alloying elements. In addition, the folded and welded structure was clearly seen on the surface of the material, along with some slag inclusions. In all aspects, this material is much closer to Iron Age materials than any used in the previous experiments.

Besides the selection of materials, the tenth experiment went in a similar manner to the ninth one. Instead of borax, quartz sand was used as a flux, requiring a temperature of over 1000 ˚C to allow the sand to melt. The welding temperature was raised to ca. 1100 ˚C or slightly higher as estimated by the colour of the heated blade. With this old blade material, it was found that the letters and marks sank deeper into the blade than when using modern materials. Some of the inlays were slightly too large for the fuller, and therefore they had to be welded also on the ridge of the fuller. Parts of them still remained after grinding and polishing (Fig. 82). Still, all the inlays were not deep enough to avoid destroying parts of them by grinding. It seems that the problem was the fuller. The inlays would otherwise have remained completely intact, but the oxidation of the bottom of the half-forged fuller required some grinding to be done. This in turn wiped off some of the inlays, although only very small parts of them.

In the experiment number eleven, the same 18th-century steel was used. Now the aim was to get the inlays even deeper to allow all parts of them to remain intact in the final blade. This was attempted by using the technique described in experiment five. In this technique, cold inlays are hammered against the hot blade, and welded only after that. In experiment eleven the blade was left as a blank into which inlays were attached. During the process, the rods sank almost completely into the blade when struck in a yellow heat. This temperature also allowed the sinking of multiple inlays with only one heat. The thick blade blank cooled relatively slowly, which means that there was enough time to adjust many inlays into their correct places, normally three of them. Marks with overlapping parts were no problem. After one part was struck into the blade, it became heated very quickly due to the surrounding hot blade. Then the overlapping rod could

Figure 82. A finished, polished and etched blade showing pattern-welded inlays and the fibrous, longitudinal structure of the steel produced in the tenth experiment.

be struck just on top of the bottom one. The depth of the inlays turned out to be approximately the same as the diameter of the inlaid rod, in this case three millimetres. Only after few marks, it became evident that it is best to strike the inlaid mark as fast and as hard as possible to make them sink straight without any widening. Moreover, all sunken marks on one side of the blade could be welded with only few heats.

After all the letters and marks were inlaid and welded, the blade was forged into shape. First, the fullers were forged, again with a convex hammer and a swage, and then the bevels and tang were forged. While forging the fuller, it was noticed that some small cavities remained on the edges of some inlays, which was caused by the sharp bending of the structure of the blade (Fig. 83). Furthermore, after the fuller was forged, some of these were still visible, although not as wide as before the forging of the fuller. The cavities also seemed to be full of welding flux, i.e. molten quartz sand. This time the fuller was polished before quench-hardening. As a consequence, the hardening makes the inlays clearly visible through the surface topography caused by differences of oxidation, and thus etching was not needed. Only a slight polishing of the fuller was enough. Otherwise the bevels were polished only after hardening.

Now that various methods were tested to attach large, pattern-welded inlays, smaller plain iron and steel rods were inlaid in the twelfth and thirteenth experiments. The aim was to test the technique of attaching larger, Viking Age-style inlays and for attaching later and smaller inlays commonly present in sword blades of the Crusade Period. In the twelfth experiment the inlays were bent from iron wire, while the blade was low-carbon steel with a carbon content of ca. 0.4 %. Though industrial, this steel has very few alloying elements, which makes its properties very close to prehistoric steel, at least in toughness and malleability.

In the twelfth experiment the blade was semi-forged, having no bevels and a fuller in its half depth. The inlays were attached as in the tenth experiment. Again, quartz sand was used as a flux. As expected in the light of the tenth experiment, the inlaid rods did not sink deep enough and instead parts of them were lost during grinding and polishing. In addition, black spots remained around the inlaid letters and all over the bottom of the fuller. They could be ground away, but then the inlays would

Figure 83.
The stages of the eleventh experiment: 1. Letters and marks formed from pattern-welded rods, 2. The same inlays welded into a blade blank. The inlays have not been considerably flattened, but only sunk into the blade, 3. A completed, polished and etched blade.

Figure 84. The thirteenth experiment. The blade is polished and etched to show the steel inlays.

be lost. Due to the small proportions of the inlaid rods, they were more easily oxidized and ground away than those bigger ones created in all previous experiments. Furthermore, the small parts of the inlays had moved during heating, and they were thus not exactly in their intended places when the welding heat was reached. One more problem was posed by the etching of the inlays. Because the inlays were of non-carbon iron, they were etched less than the blade, causing the blade to be eaten away while the inlays remained elevated from the bottom of the etched fuller. This is where the problem was faced. If the bottom of the fuller (i.e. the surface of the blade) was polished after etching, the contrast between the blade and the inlays was lost. Only the edges of the inlays, or the welding seams, were etched slightly more, which revealed the letters.

The thirteenth experiment was similar to the eleventh one. The inlays were first hammered cold into the hot blade blank, after which they were welded. The blade was forged to its shape after both sides were welded one by one. In scale, both the blade and the inlays were the same as in the twelfth experiment, but the inlays were made from steel with carbon content of about 0.8 %. As a result, the inlays were quite easily hammered all the way into the hot blade blank, although great speed was needed, because the small pieces of wire heated very rapidly on the surface of the hot blade. There was approximately two or three seconds time to hammer one inlay in place before the inlay was heated too much. If the inlay reached red heat before it was hammered, it would not sink deep enough but only widen when hammered. Owing to the great number of inlaid letters, the corresponding large number of heats and obligatory eight welding heats oxidized the blade considerably. The etching was easier, because the steel inlays were etched darker and deeper than the blade, allowing them to be seen from the re-polished surface of the fuller (Fig. 84). All the inlays were preserved and clearly visible.

One notable feature was that the inlaid letters were tilted and the resulting texts were neither neat nor straight. This was caused by the fact that the inlays must be hammered in the blade within two or three seconds, which is not enough time to adjust them into their correct places. This could be prevented by making small grooves or cavities for the inlays before hammering them in. In this way every inlaid rod would fall into place when placed on top of the heated blade. These cavities would be only some tenths of a millimetre deep, and could thus be made quite easily and fast, and they would not be observable in finds. Of course these small guiding grooves could also have been used in the case of bigger, pattern-welded inlays.

6.7. Observations of the experiments

6.7.1. Criticism

The aim was to apply the principles of experimental archaeology as guidelines in the planning and execution of the experiments. Some concessions had to be made according to the limits of the resources. The methods cannot be proved to be strictly of the Late Iron Age, but they function with the same kind of equipment and knowledge transmitted by tradition, and are therefore possible. The tools were mainly modern and made of industrial steel, but this was not considered as a drawback. Because this research is concerned with discovering the manufacturing technique of inscriptions, the tools that were used only had to correspond in their form and function to those of the Late Iron Age.

The main point of criticism concerns the materials chosen for the blades in the first nine experiments. The series showed that modern steel is slightly tougher and harder than, for example, iron or steel made in a primitive furnace.[1041] If the materials of the blades were as authentic as in experiments ten and eleven, the series would most likely have been shorter, giving the same results with fewer individual experiments. This situation was partially created by the lack of primitive iron during the experiments of the early stage of the work.

The difference between modern and old materials can best be seen when comparing the results of the fifth and eleventh experiments. The technique was the same, but the inlays sank in a very different way into blades of different materials. The appearance of the blade produced in the fifth experiment was considerably different from that of the finds. This was primarily caused by the modern material used for the blade. The inlays slightly missed the grooves for which they were intended. The depth of the inlays was somewhat better than in the experiments from one to four, but due to the attempt to grind off the pits where inlays were intended, some of the inlaid rods were lost. It must be noted here that Late Iron Age smelted iron is much easier to forge and weld than any modern industrial steel.[1042]

It must also be taken into consideration that blacksmithing is always based on experience and it reflects personal differences. Because of this, the first experiments may include errors because I had no experience of making the inscriptions. By conducting more experiments, I gained some experience of welding and hammering the inlays. The lack of experience during the first experiments can be seen from a comparison of the first and seventh experiments. While the method was in principle the same in both experiments, the results were considerably different. Increased experience can also be seen in the fact that the time required for attaching the inscriptions grew increasingly less after each experiment. The making of the inlaid marks and letters, excluding their attachment, took between five and six hours at its fastest when the material was pattern-welded. Plain iron and steel rods can be cut and bent into letters in less than half of this time. The welding of all marks on one blade took between one and three hours depending on their number and the length and complexity of the inscriptions.

In experimental blacksmithing it should be remembered that the working of iron by hammering is solely based on an evaluation of the material. Whatever the desired result, the blacksmith must be able to imagine the result and to evaluate how much material he would need for it. The blacksmith must also be aware of his skills. A skilful blacksmith can forge an artefact almost to its

1041 This has also been pointed out by Kasper Andresen (1994: 191, 193).
1042 E.g. Andresen 1994: 191, 193.

desired shape, while a less skilful one will forge only to a small extent and do the rest of the work by grinding or stock removal. The evaluated amount of material will most likely vary slightly, even if the desired artefacts are imagined to be identical. In practice, a blacksmith may seek to produce identical artefacts but would still end up with slightly different products. This means that the same swordsmith may create with the same technique many inscriptions similar in content, but all of them slightly different in appearance and details.

The time consumed in the inlaying process would change radically if there were many people working at the forge, as most likely was the case during the Late Iron Age. Blacksmiths may have had helpers or apprentices, just as they had during historical times. The inlaying would have been faster and somewhat easier if one person used the hammer, one operated the bellows, moved the blade between the forge and the anvil, and perhaps one more adjusted the inlaid marks. Of course the number of persons depends on the technique that is used, but in any case many hands make things different than when working alone.

6.7.2. Methods of inlaying iron according to the experiments

According to the experiments, there are many things to consider when making an iron inlaid sword blade. Firstly, the blade must be thick and wide enough not to end up too thin after the oxidation caused by multiple heats. This is best controlled by welding the inlays in such a stage of manufacture that there is still enough material to be worked with. Secondly, the oxidation of the blade must be controlled by the number of heats, which should be kept as few as possible, for example, by welding multiple letters or parts of them with a single heating. In the experiments the number of heats depended on the length of the inscriptions and the degree of complexity of inlaid marks, but I still managed to decrease the number of heats successfully during the experiments. Thirdly, keeping the welding temperature as low as possible conserves both the material of the blade and the inlays. Still the welding temperature must be high enough to weld the inlays securely in the blade. Fourthly, the sinking of inlays and their welding by hammering must be conducted with precision, speed and the necessary force.

The series of experiments suggests that there have been many slightly different techniques to produce iron inlaid marks on sword blades. The attaching of inlays is affected by two different factors: the technique of attaching a single inlaid mark or letter, and the stage of making the blade in which the inlays are attached (Fig. 85). All the methods tested in the experiments are combinations of these two. A certain technique for inlaying one mark works in certain stages of manufacture.

The fastest and also the most secure way to attach an iron inlay is to strike it cold through the surface of the hot blade and then to hammer-weld it. This technique was also used by the Norwegian

blacksmith Hans-Johnny Hansen.[1043] It produces traces comparable to archaeological finds, for example the bent structure of the blade under and around the inlays. The inlays were most likely welded directly on the surface of the blade blank, which was first shaped to resemble a sword blade. Both the fuller and the bevels of the cutting edge were left undone, and the blank should be roughly two millimetres thicker than the ready blade would be. It makes no difference if the tang is forged or not, for it could also be made as the last step in the forging process. It is only certain that a completed, polished and sharpened blade cannot be inscribed by welding. The blade will oxidize to some degree, causing it to lose its thickness and also the sharpened edges. In the worst case, after the welding of the inlays, a five millimetre-thick and six centimetre-wide blade could end up less than four millimetres thick and less than five centimetres wide in the inscribed section.

Figure 85. Illustration of different techniques of inlaying iron. From left to right: an inlay struck cold through a hot surface, an inlay welded directly on the surface, an inlay in a struck groove, and an inlay in a carved groove. Inlays were attached to pattern-welded sheets to illustrate the alterations in blade structures caused by different methods of inlaying. Also the depth of the inlays is illustrated by their cross-section. To summarize, the inlay struck straight on the surface remains very shallow, the inlays struck through the surface and welded on a struck groove are impossible to distinguish from each other, and the inlay with carved groove shows a broken blade structure underneath.

The process could have been as follows. Pattern-welded inlays were made beforehand. First, a pack made from iron and steel layers was welded solid and hammered to a flat plate. Narrow strips were then cut from the plate with a hacksaw or a chisel. These strips were forged round and twisted hot with two pliers, after which the edges of the twisted rods were evened out with very careful hammering. The filing or grinding of twisted rods results in a lowered layer count in the rods, although filing does not lengthen the twists as hammering does. When the rods were prepared, they were bent with pliers or by forging, most likely at forging temperature.

In experiments 1–10 and 12 I made the inlaid rod always of the same thickness, about 1.5–2 millimetres, the cross-section varying from rectangular to round. In the eleventh and thirteenth experiments the rod was ca. three millimetres (experiment 11) and 1.5 millimetres (experiment 13) thick. A round surface will naturally sink deeper when hammered than a flat, rectangular surface. The width of the completed inlays varied according to the manufacturing technique. With the technique of experiments 1–4, 7–8, 10 and 12 the completed inlay was approximately twice as wide as the rod, for example a two millimetre-wide rod produced a four millimetre-wide inlay. With the technique used in experiment five, the inlays did not become so wide because the inlays sank deeper. A 1.5 millimetre-wide rod produced a 2.5 millimetre-wide inlay. In experiments six, nine, eleven and thirteen, the inlays did not widen at all; the rod sank into the blade and widened only little during welding and the following forging. In this way the width of the inlays as completed could indicate a certain manufacturing technique, but unfortunately this cannot be applied to an examination of archaeological finds. In the finds, the width of the inlaid rods varies greatly, but most likely the diameter of the rod has also varied, and corrosion has destroyed the original surface of the blade.

1043 *Hansen 2007. As a further note, it is not known whether the materials Hansen used were modern, but he did not sink the inlays completely in the blade. As a conclusion, he stated that the depth of the letters in a finished blade was a few tenths of a millimetre, which is less than in archaeological finds. In the ninth experiment in this study the depth of the inlaid letters and marks could in some places be more than one millimetre.*

In the case of small, non-patterned inlays there could have been some very shallow grooves, in which the small rods would be easy to place before hammering them into the blade. Without grooves there is not enough time to adjust small inlays into their correct places. Small guiding grooves could have been used also in the case of larger pattern-welded inlays, although they are not necessary because of the greater diameter of the inlaid rod.

The inscription of one side of the blade was welded first, then the other one. First the inlaid rods were struck into the blade one by one, and then they were attached by welding. First the place for the first inlays was heated to a yellow heat. Then, cold inlay was placed on its location and struck quickly and forcefully with a hammer to sink the inlay entirely into the blade. In this manner even three marks or letters could be sunk with the same heat, after which some flux was sprinkled on the inlays to prevent their oxidation. It is also economical to sink multiple inlays with same heat, since heating tends to reduce the carbon content of the blade. After all the inlays of one side were sunk into the blade, they were welded with few heats, maybe from two to four. The other side of the blade was prepared in the same manner. Some flux had to be added every once in a while on both sides of the blade to minimize oxidation caused by the repeated heating of the same places on the blade.

The bevels of the edges are forged after the inscriptions are welded and the fuller is forged. The inlays will flatten slightly during the forging of the fuller. While forging the bevels, it is crucial to keep the fuller straight. The fuller may also be deepened slightly by forging the material from the bevels towards the centre of the blade. Finally, the blade is heat-treated, after which the surface of the blade is ground and polished.

Another technique to produce marks similar to those described above is the one used in experiment number six. In this technique, grooves are struck for the inlays, after which the welding is carried out. Although the result in the experiment was rather crude and unsuccessful, the technique may, with careful work, produce an inscription that cannot be distinguished from the result of, for example, the eleventh experiment. The grooves for the inlays could be formed so that the inlays could be struck tight in them. In this way, it could be possible to weld the inlays of both sides by only hammering the other side of the blade, and of course with a smaller number of heats, perhaps only two. The result would still be similar compared to the result of experiment number six.

The depth of the inlays may be adjusted by striking the grooves for them first. In this way, they can be sunk even several millimetres if desired. Of course, the rod to be inlaid must be adjusted to the grooves. In theory, when inlays are to be sunk very deep, this can be done at any stage of preparing the blade. Inlays could be sunk already in the blade blank. After forging, they will be flattened to some degree, but still they are deep enough not to be ground away. In contrast, inlays may be sunk into a completed, forged blade with bevels and fullers. The small number of welding heats allows this. With perhaps only four welding heats, the blade will not be oxidized, and thus thinned too much. Of course, as stated above, even this technique does not allow inlays to be attached to a completed, sharpened and polished blade.

Third technique is the one that Kasper Andresen experimented with.[1044] In this technique the inlays were welded directly on the surface of the blade. As shown by experiments seven and eight, this technique can be used, although with some caution not to burn or grind away the inlaid marks. The experiments show that the inlays may be welded straight on the surface of the blade, if the blade is only a blank, or then only a very shallow fuller of half of its intended depth is forged, without the edge bevels of course. The contradictory result of this in experiment number four was most likely caused by the modern, tough material used in the blade, preventing the inlays from sinking deep

1044 Andresen 1993.

enough into the blade. Care must be taken, because the inlays tend to flatten a lot, because they do not sink very deep. Also large amounts of flux must be used to prevent the oxidation of both the blade and the ready-made inlays.

Andresen's method does not work if the blade bevels are forged before welding the inlays. Also, if the fuller is forged to its final depth, the result will not be of pleasant appearance. Because of the large number of welding heats on the same parts of the blade, there is considerable oxidation, causing the inlays to oxidize along with the surface of the blade. As a result, the surface of the blade, and the fuller, will be covered with small dark spots caused by the oxidation and forging. Of course they can be ground away, but the inlays will then be at least partially lost.

As a fourth alternative, grooves could be carved for the inlays, with pieces of inlaid rods then set into them and welded. This technique would work in the same manner as that described in experiment number six, where grooves were struck into the blade. This method of carving is mentioned last here, since it was not experimented with due to its functionality as proved by works of modern-day professional bladesmiths. Even though this method is functional, it is not straightforwardly supported by any examined archaeological finds. This, however, does not diminish the possibility that this technique, too, was used in the Late Iron Age. In theory, the channels could be carved wider at the bottom, whereby all the inlays could be cold inlaid first and then welded. For example, inlays of both sides of the blade could be cold inlaid first, after which inlays of opposite sides could be welded with one heat.

To summarize, there are four different methods for producing an iron inlaid sword blade. First, the inlays may be struck cold against the hot blade, a technique which works well into a blade blank or a blade with only a shallow fuller to be forged. Second, grooves may be struck for the inlays, allowing the inlays to be welded to a blade blank, a blade with a fuller, or a ready-forged blade without sharpening or polishing. Third, grooves may also be carved, but this is not supported by any analysed finds. Fourth, the inlays can be welded directly on the surface of a blade blank or a blade with a shallow fuller but no bevels. The last-mentioned technique requires much more accuracy than the previous ones, and has a greater risk of unsuccessful inlays.

As a general remark regarding all the above-mentioned methods, one way to lightly weld the inlays is to tap them gently while still heating them in a forge. Especially when inlaying in grooves and directly on the surface of the blade, it would make things easier to lightly hammer the inlays of both sides so that they stick in the blade. In this way it might be possible to weld both sides of the blade with the same heats. This is just an afterthought to the experiments, since this was not attempted in practice.

6.7.3. The appearance of the inlays

According to the archaeological finds, the blades were ground and polished, both the fuller and the bevels. The degree of the original polishing cannot be ascertained. The blades could have been mirror-polished by e.g. rubbing a mixture of water and ashes on the blade with a piece of leather. The degree of grinding and polishing does not, however, matter if the inlays are etched with some kind of acid. On the other hand, if the blade is mirror-polished, the inlays may be distinguished from the surface of the blade even without etching, as was the case in all the experiments done in this work (Fig. 86). Prolonged use may well have produced a contrast between the inlays and the blade even if the blade was not originally etched. Iron is of slightly darker appearance than steel on a plain polished surface.

Figure 86. The inscription INGELRII made in the fifth experiment. In this photograph the text is faintly visible on a polished blade without any etching. The borders of the letters are visible, while the patterns in the letters are not.

The acids used in the etching process do not differ from each other. Some acids will etch faster and some more slowly. A very light etch is achieved by a mild etchant, and in this case the patterns will become visible slowly and with light colours. If a darker result and greater contrast are wanted, a stronger acid can be used. These also etch much faster and produce some topography on the inlays by corroding the higher-carbon material. During the Late Iron Age such strong acids probably did not exist. The alternatives have all been relatively mild acids, which probably all correspond very closely to etching with vinegar. The reaction may be enhanced to some degree by heating the acid or the blade. Water may also be used to reveal the patterns.[1045] It creates a contrast between different irons and steels like acids do, but achieving the contrast may take a considerably long time, and the result will be a very light etch. If topography of the surface is wanted, a good way to do it is the one used in the eleventh experiment, i.e. to polish the fuller before hardening and to harden also the inlaid portion of the blade.

A completely separate question is the appearance of the blade after it had been in use for some time. The blade had to be cleaned, re-sharpened and perhaps re-polished. According to Jorma Leppäaho, re-etching by the user of the sword was highly unlikely because the etching methods were probably unknown outside the big sword smithies.[1046] There are, however, several ways to etch a blade, and the inlays could have been only slightly visible. Still, if inlaid inscriptions and motifs were copied in smaller smithies, the designs of the originals must have been clearly visible, being etched or made visible through heat treatments. If the last-mentioned method was used, the topography of the inlays would have allowed some degree of re-polishing, while still showing the inlays clearly. If etched with mild acid, the colour differences would disappear quickly even because of the cleaning of the blade.

The successfully inlaid motifs in the experiments correspond very closely to archaeological finds. Their general appearance is quite similar to most of the finds. The inlays are of quite equal width. Moreover, their edges are clear, sometimes having dark streaks due to the impurities trapped in the sharply bent cavity between the inlay and the material of the blade. Sometimes this is caused by steep curves in the inlaid rods, and sometimes cavities are created during the forging process of the blade, which lengthens the blade and thus causes stresses on the welding seams between the inlays and the blade. The structure of the steel in the blade is bent towards the cutting edge in the inlaid portion of the blade, which can also be observed in the finds. The depth of the inlays seems to correspond very closely to that of the finds according to the patterns of the inlaid marks and letters.

It is noteworthy that in the technique of welding the inlays directly on the surface of the blade, the inlays will most likely be tilted and even very close to each other. The blade must remain immobile and horizontal in the forge while heating it to the welding temperature, for otherwise

1045 See e.g. Leppäaho 1957: 629–630.
1046 Leppäaho 1957: 629–630.

the inlays will slide on the blade along with the molten flux. In addition, pieces of charcoal may move the inlays in the forge. In the experiments, small bits of charcoal were not placed on top of the welded inlays, but instead a larger piece of wood to prevent the loss of heat. When the welding temperature is reached, the inlay will not move on the blade but it will slightly stick in place. Still, the blade has to be taken carefully from the forge before the inlays are hammer-welded securely.

In many cases, the inlays in the archaeological finds are slightly tilted and the inscriptions look like they were carelessly executed. While this may be the actual reason in some cases, the techniques themselves may also be blamed. For example, if the blacksmith works alone, he may not necessarily have enough time to take the blade out of the forge, place the cold inlay in its correct position, and hammer the inlay in the blade before the inlay becomes too hot to be sunk. If the inlays are to be welded directly on the surface of the blade, they may move slightly while heating the blade with its inlay in the forge. After the welding temperature is reached, the inlay must be welded in place because it will be hard to take loose. The blade should be cooled, the tilted inlay struck loose, and then heated again. Furthermore, already welded inlays are not very well distinguishable from the surface of the blade or blank but only faintly when the iron is red hot.[1047]

Besides tilting, it became evident that it is very hard to create sharp-cornered marks, since the inlays tend to flatten during welding and forging, creating a somewhat 'softened' appearance. This is the opposite of non-ferrous inlays that are sunk into the completed blade into carved grooves. Because no welding is executed, the inlays can be created very accurately and sharply. Iron inlays, even if they are sunk into carved channels, must be welded, which flattens and deforms the inlaid rods.

6.8. Summary and conclusions

To begin with, there are many theories about the actual technique of inlaying iron on sword blades; some are based on the inspection of archaeological finds while others are purely hypothetical. To balance the matter, some experimental work has also been done during the 1990s and later, with results of varying quality. Especially the work done of non-academics and commercial blacksmiths usually lacks the basis of archaeological knowledge.

When carefully examined, the archaeological finds may shed light on the actual technique of inlaying. Earlier publications contain some cross-sections of inlaid marks, making the deduction of the inlaying technique possible by looking at the depth and form of the inlay as well as the structure of the blade beneath it. Similarly, inlays on a pattern-welded blade base are useful, since the pattern-welded base may give indications of the stage of blade forging when the inlays were attached. More help was obtained from the Finnish finds studied for this work, indicating possibly several techniques comprising both the way to attach the inlay and the stage of blade forging.

Combining the information of all the above-mentioned observations as well as suggestions from written and pictorial sources, a series of experiments was conducted. Although the experiments were begun at a very early stage, new information required new experiments to be conducted and further criticized to gain the most reliable results possible. It was also sought to guarantee the authenticity of experiments through an excursion into experimental theory and its applications.

1047 E.g. Ypey 1980: 201.

The materials and tools were selected against this background, leading first to solve archaeologically valid techniques of attaching an individual mark and then applying these techniques to blades with different stages of forging, again dictated by the examined finds.

The resulting methods all combine two variable factors: the method of sinking the inlay and the stage of manufacture of the blade itself. One technique seems to be fastest and appears to produce the result that is closest to the majority of the archaeological finds. In this method cold inlays are first sunk into the hot blade blank by mere hammering, after which they are welded one blade flat at a time. Alternately, inlaid wires could have been sunk by carefully punching grooves for them, since no archaeological find supports carved grooves, although this cannot be ruled out due to the very small number of finds analysed in sufficient detail. With these means also post-Viking Age smaller inlays could be produced relatively easily. Larger inlays could also have been made by welding the rods directly on the surface of the blade, but this requires more skill and accuracy, as well as shorter inlaid motifs to succeed. Pattern-welding on the inlays was also experimented with and found to be relatively easy and similar to that used earlier to construct mid-sections of sword blades, only in smaller scale. This stage, too, may be carried out with different methods and tools, while the principle of pattern-welding remains the same.

To conclude, the results of the experiments support the line of thought that inlays were produced by a number of smithies and makers. The inlaying process may have been carried out with slightly different methods and it could also have been in various stages of sword manufacture. These facts make it plausible that various blacksmiths could have deduced some of these above-mentioned combinations of techniques to produce their own versions of inlaid blades after they had seen a completed inlaid sword.

7. THE HILTS OF THE STUDIED SWORDS

This chapter concentrates on the hilts of the iron-inlaid swords. The studied hilts are fewer than all the examined swords, because not all finds had their hilts still attached. The chapter begins with the presentation of various typologies and their backgrounds, followed by a catalogue-like part listing all hilts attached to iron-inlaid blades examined in this work. The listing proceeds in basically chronological order from the earliest Petersen types of the Late Merovingian period, all the way to types appearing at the onset of the medieval period, according to the Finnish chronology.

In addition to traditional viewpoints, also the technical aspects of hilts are examined, such as their method of construction and forging, as well as techniques and motifs of decoration, as far as the examination of these details is possible. The aim here is to examine the hilts first through 'types' defined by other scholars, and secondly, by combining the variability evidenced by other factors such as construction, decoration and detailed shapes, to trace the various makers or traditions of these hilts. The aim is not to create new types or even sub-types to further complicate the picture, but rather to examine variability within certain typological forms and their meaning.

In addition to the above, aspects of use, such as acts of repair and reuse of hilt parts are recorded, as well as remains of grips. These help to create a more accurate picture not only of the finds, but also of their use. The chronology of the hilts is discussed here but only according to previous studies and other authors. The chronological issues regarding the swords studied in this work are dealt with in the next chapter.

7.1. Hilt typologies: traditional classification and the dating of swords

7.1.1. The background of typologies

Typologies are modern systems in aid of research and for arranging the finds in some order. Not only tools for relative dating, typologies are also of great help in tracing for example stylistic, technological or even social changes throughout time.[1048] The chronology is always relative, only being able to represent the order in which things gradually changed. There are several works discussing the theory and applications of typologies in the study of archaeological find material.[1049]

Typologies may concentrate on different characteristics, which are used as the principles for the classification. Chris Caple has separated four distinct groups of such characteristics.[1050] The first of

1048 E.g. Creutz 2003: 28.
1049 In chronological order: Müller 1884, Montelius 1900, Malmer 1963, Almgren 1967, Gräslund 1974, Klejn 1982, Solberg 1986 and Stig Sørensen 1997, just to mention a few.
1050 Caple 2006: 49.

these are functional attributes, i.e. similar function leads to a similar shape of the artefact. Second are shape attributes, including the dimensions. In the case of sword typologies, these attributes appear to dominate the classification. Third are surface attributes such as colour, decoration and finish. Fourth are technological attributes, which include the materials and techniques of manufacture. Essential for a typology is that the attributes are presented so clearly that other researchers are able to define the types from a different material.

In an ideal situation it would be most fruitful to take all these attributes into consideration. In practice, however, this has proven to be almost impossible. Including all the attributes would most certainly make the typology chaotic, offering even many different lines of development. The research question has normally dictated the attributes that are sought in various typological systems.

It has to be borne in mind that typologies are the creations of archaeologists, who decide the attributes for generating them. The selection of these attributes is thus somewhat subjective and dictated by the problems that the typology should try to solve. For this reason, there are no 'correct' types, and also for this reason different typological systems will be taken into consideration while examining the finds in this work.

7.1.2. Petersen's typology

Traditionally, Late Iron Age swords, as well as medieval ones, are arranged chronologically with the help of hilt typologies. The most commonly used typology for Viking Age sword hilts is the one created by the Norwegian scholar Jan Petersen and published in 1919 together with typologies for Viking Age spearheads, axes and rangles. Petersen classified a total of 26 main types of hilts (A–Æ) and 20 so-called special types (1–20), which he interpreted as rare local variants of the main types. The typology is based on 2,027 Norwegian sword finds, 1,062 of which could be classified according to their hilts.

The main purpose was to create a typology of the phases of development of sword hilts, and at the same time to establish relative dates from different hilt types. The dating was done to the nearest half century. Petersen also tried to define the possible origin and places of manufacture of different kinds of hilts. Partly the purpose was to create a continuum from the Merovingian Period to the Viking Age, since Petersen took granted that some hilt types were older than the Viking Age.

Petersen's chronology has been sometimes criticized. Petersen based his relative dating on find combinations. The actual problem lies in the fact that only few of these combinations were strictly closed ones. The majority of Petersen's 'combinations' were found separately, for example, in the same cemetery. There is no evidence that the finds were deposited at the same time creating a closed find combination. Despite this perception, the typology has survived all criticism surprisingly well, and the relative dates are still regarded as quite reliable also outside Norway.

The typology is not entirely applicable in different parts of Europe, because the classified finds were all from Norway, thus also reflecting local traditions. The twenty special types are interpreted as being manufactured locally in Norway, since Petersen did not know of any similarities elsewhere. At present they are also known from other countries, which places Petersen's definitions under question. Apart from Petersen's types, local hilt types are evident for example in Finland and the Baltic countries. A good example is a silvered hilt with an iron grip, which occurs in Sweden, Finland, Estonia and Russia, but not in Norway.[1051]

1051 *This type of hilt is here referred to as 'silver-plated'. See also Chapter 7.2.20 below.*

As stated before, Petersen classified only hilts, not blades. Different hilt types may occur in both one-edged and two-edged blades. Only blades bearing the name ULFBERHT were noted, and they were – along with their hilts – dated to the second half of the Viking Age.[1052] Furthermore, Petersen regarded a type as consisting of certain kinds of hilt parts. In practice hilts with parts from different Petersen's types occur, and they are hard to classify or date with this typology. After all, the time of use of some hilts or their parts may well exceed that claimed by Petersen.

Normally, the classification is made according to the form of the hilt or its parts. In some cases, for example in types O and T, sub-types have been defined according to decoration. Otherwise in most cases the decoration is left unnoticed, even though different kinds of decoration occur in hilts of the same type. Also the construction technique of hilts is mostly ignored, at least in the classification itself. This is odd, since Petersen also tried to separate different manufacturing traditions from each other. For example, type H has a triangular, somewhat pyramid-shaped pommel, which is attached to the upper guard with two small rivets. Since this type is the most common one throughout Europe, it includes a great number of different forging alternatives and also decoration techniques and materials. Typically, the hilt is inlaid with vertical strips from copper-alloy and silver wires, with changing geometric motifs of course. Because the thickness of the inlaid wire and the grooves vary it is likely that same hilt form was imitated in different places with varying decoration.

Petersen's typology is a good way to classify hilts and in this way it is an aid for research and cataloguing. However, the typology ignores some important points, which are rarely considered in other typologies. They are, among others, independent innovation in different areas, influences spread by trade, the recycling of materials, long periods of use or preservation of certain forms or types, post-depositional factors, and the imprecise recording of finds. Good examples of the latter in the list are the 'errors' in cataloguing of the find combinations, presuming that they even were closed finds. In the case of swords, the dating becomes very problematic considering that the hilt and the blade could have been made in different places. In many cases, it seems likely that a new blade was given a much older hilt, or the other way round. Briefly put, Petersen's typology does not seem to reach the cultural level, but remains a tool for the researcher.

Petersen's typology is still widely used throughout Europe. Very often complete swords are dated according to the hilt as Petersen saw it. Also, it is not rare that this dating is used for the whole find combination. The above-mentioned facts, especially those connected with the time of use and reuse of sword parts, connected with the dating of the blade can give different alternatives. Sometimes the dating of the hilt does not match the dating of the blade, if that can be stated. Petersen's typology has been useful also with regard to later typologies, since almost all of them are more or less based on Petersen's classifications.

7.1.3. Other typologies of the hilt

Petersen's typology was initially considered to be somewhat complicated, since it had a total of 46 different types, and some of these having even sub-types. Sir Mortimer Wheeler drew up a simplified version of Petersen's typology in 1927, reducing the number of different types to seven.[1053] Whereas Petersen based his typology on Norwegian finds, Wheeler created his version

1052 Back then, the dating of ULFBERHT swords was generally accepted as the 10th century, and Petersen took also this for granted using it as the basis for dating for the types bearing the inscription in question (Petersen 1919: 101, 141, 148, 152; Stalsberg 2008: 8).

1053 Wheeler 1927.

by studying the British finds. This classification was further revisited nearly eighty years later by Logan Thompson.[1054] Thompson stated that Wheeler's type I, corresponding to Petersen's type M, should be dated similarly to Wheeler's type III. Furthermore, Wheeler's type III, i.e. Petersen's type L, is not actually 'Viking' but 'Anglo-Saxon'.

After examining the Finnish material, Carl Axel Nordman added a further type to Petersen's typology.[1055] This type was the one with silver-plated hilt parts, including the grip made of a hollow iron pipe, and traditionally considered to be of East Scandinavian origin. This type mostly resembles Petersen's types S and T, and Nordman called this type T:2, a variation of type T.[1056] In my opinion, this kind of hilt is a type of its own, perhaps imitating Petersen's types S and T (see Chapter 7.2.20).

Anatoly Kirpichnikov made additions to Petersen's typology with local Russian types.[1057] Kirpichnikov also criticized the datings given by Petersen, noting that in Russia various sword types were much longer in use and thus datable much younger than Petersen presented.[1058] Vytautas Kazakevičius did the same with swords from the Baltic countries.[1059] Considering the find material of this work, a variant of Petersen's special types 1 and 2 noted by Holger Arbman is important.[1060] Later Herbert Jankuhn defined this same type as 'the Mannheim type'.[1061] There is also the so-called Mannheim-Speyer type, resembling special types 1 and 2 and also the Mannheim type.[1062]

Ada Bruhn Hoffmeyer created an extremely simple version of Petersen's typology by reducing the types to three.[1063] She did not take into account Petersen's twenty special types, but only the 26 main types. It must be noted that Bruhn Hoffmeyer tried to establish type definitions also for medieval swords, and perhaps it was only practical to classify Viking types in only three categories, since diverse medieval types were more numerous in her classification.

While developing a more complicated typology for medieval sword hilts, Ewart Oakeshott[1064] also contributed to Viking Age typology by adding two more types to those defined by Wheeler,[1065] thereby creating a simple typology of nine types. Oakeshott further refined his own typology in 1964 and 1991, creating independent classifications of both pommel forms and lower guards. Although his material extended throughout the Middle Ages, the earliest types can also be found in the finds from the research area of the present study.

The noteworthy pommel forms considering this work are types A, B, B1, C, G, H and I. Type A is the classic brazil-nut pommel (ca. late 10th century – 1150 AD), while type B is a bulkier and rounder form (ca. 1050–1150 AD).[1066] Type B1 resembles Petersen's type X, having a 'mushroom' or 'tea-cosy' form with a straight lower face and rounded upper face.[1067] Type C is a

1054 *Thompson 2004: 92–95.*
1055 *Nordman 1943.*
1056 *Nordman 1943: 53.*
1057 *Kirpichnikov 1966.*
1058 *Kirpichnikov 1966: 27.*
1059 *Kazakevičius 1996.*
1060 *Arbman 1937: 218.*
1061 *Jankuhn 1939: 155.*
1062 *See e.g. Geibig 1991: 141–142; Menghin 1980: 268; Müller-Wille 1982.*
1063 *Bruhn Hoffmeyer 1954.*
1064 *Oakeshott 1960.*
1065 *Wheeler 1927.*
1066 *Oakeshott 1964: 93.*
1067 *Oakeshott 1964: 94.*

one-part successor of Petersen's type Y, dating as far back as ca. 1150 AD.[1068] Types G, H and I are all disc-pommel forms dating very roughly between the late 10th century and as far as the 15th century.[1069] In connection with disc-pommeled swords, Leena Tomanterä's classification (types A, B and C, see Chapter 7.2.22) should not be forgotten, although she dates all her types to 1000 AD and onwards.[1070]

Like pommels, the types of crossguards defined by Oakeshott are numerous. Styles 1, 1A, 2, 3 and 7 can be connected to the studied finds. 1 and 1A are long and slender bars, style 1 (10th century onwards) tapering towards the ends and style 1A (11th century onwards) being of equal width.[1071] The crossguard of style 2 is widened at the ends,[1072] while in style 3 (ca. 1150–1250 AD and perhaps later) it is a short and stout, rectangular bar.[1073] In style 7 it is a simple downwardly curved and slightly tapering guard.[1074]

Using Oakeshott's typologies as a basis, Marian Głosek has classified and dated the sword finds of central Europe between 900 and 1500 AD, including finds from contemporary East Germany, Poland, Czechoslovakia and Hungary, about five hundred in number.[1075] He sought to demonstrate a chronology for the hilt types as well as blade decorations. His hilt datings are mainly the same as those defined by Oakeshott, with only small modifications based on local chronologies. Głosek added seven local sub-types of pommels to those defined by Oakeshott, and similarly, two sub-types and one completely new type of lower guard. The local chronology of hilts of both Oakeshott and Głosek are, however, similar in the case of the forms important for this work. One detail worth mentioning is Głosek's guard of type 6a, dated to ca. 1100–1500, bearing a similar form to Petersen's type Æ.

With regard to the local types, the work of Vytautas Kazakevičius on Baltic swords of the 9th – 13th centuries is also of some importance.[1076] Although Kazakevičius applied Petersen's typology and its chronology, he also defined some local types typical of the Baltic countries. Clearly unique in this respect are the antennal sword and the so-called Desiukiškės type. In addition, Kazakevičius classified a unique kind of Curonian hilt as a sub-type of Petersen's type T. His work includes Baltic datings for rhomboidal, oval, and spherical pommels, which do not differ greatly from the generally accepted ones.

Of more importance is the work of Anatoly Kirpichnikov.[1077] His work has been used here as a basis for eastern, Russian chronology for some of Petersen's hilt types. These datings differ slightly from the conventional Norwegian ones, and must be considered very important since some of the finds originated very close to the Finnish areas studied here. The main trend is that the sword types are dated at least half a century later than by Petersen, and sometimes even more. Furthermore, Kirpichnikov includes some local variations in his classification, for example special variants of Petersen's types T1, U and Z, as well as a local type A, of which there are also examples in the Finnish material. A unique 'Scandinavian' type has been found in the territory of modern-day Ukraine. Kirpichnikov created his own typology for post-Viking Age sword hilts dating from the 11th century to the 15th century (types I–VII). Examples of some of these are also found in

1068 *Oakeshott 1964: 93.*
1069 *Oakeshott 1964: 95–96.*
1070 *Tomanterä 1978: 23.*
1071 *Oakeshott 1964: 113.*
1072 *Oakeshott 1964: 114.*
1073 *Oakeshott 1964: 114.*
1074 *Oakeshott 1964: 116.*
1075 *Głosek 1984.*
1076 *Kazakevičius 1996.*
1077 *Kirpichnikov 1966.*

the Finnish material, and therefore the dating established by Kirpichnikov is also used here to some degree.

Jouko Räty presented some of the hilt types appearing from the Late Viking Age to the Crusade Period as so-called transitional types in his MA thesis.[1078] In practice, these types include all that do not straight fall into any of Petersen's categories, including some types presented by Kirpichnikov, and the brazil-nut forms. Räty used Roman numerals from I to V to classify the hilts. Type I has a semi-circular pommel with its even surface upwards, corresponding to Kirpichnikov's type III. Type II is the bronze-hilted sword from Hattula (KM 17777:1), resembling Petersen's type Æ. Type III has two subtypes; IIIA is the silver-plated type, and IIIB corresponds to Kirpichnikov's type II with acanthus motifs. Common to the both variants of Räty's type III is the three-lobed pommel, the overall form of the type being close to Petersen's types T, S and Z. Räty's type IV also has two variants, both with hilt parts cast in bronze or some other copper alloy. IVA is acanthus-ornamented type with a three-lobed pommel, similar to Kirpichnikov's local A type. IVB is a more rounded variant of the same form, defined by Räty as having similar decoration to oval tortoise brooches with crayfish ornaments. This type corresponds to Kirpichnikov's type IIA. Räty's type V includes the brazil-nut pommeled hilts, the first variant having smaller pommel than the second. Correspondingly, these two forms are similar to Oakeshott's pommel types B and A. To conclude, Räty classified all the above-mentioned types as transitional, since their form is to some degree based on the Viking Age forms, unlike the disc pommel, which Räty did not include in his work on these grounds.

There has also been an attempt to classify swords through statistical methods according to both hilt and blade, by using only 109 well-preserved swords from Norway as a basis for the classification.[1079] In this work, Marc Maure categorized both the pommels and the guards independently. The division of the pommels was based on the shape of the lower face: 'straight' pommels (types A–I), 'convex' pommels (types J–P), and concave pommels (type Q).[1080] Guards were categorized as straight (types A–G), concave-convex (types H–M), and concave (type N).[1081] All the classifications were based on the measurements of length and height of the hilt parts in question. Maure further created combinations of pommel and guard classifications, which correspond closely to Petersen's types.[1082] While the work offers one possible way to classify hilts, it seems rather clumsy, one-sided and inapplicable and unable to answer chronological questions.

Mikael Jakobsson created a slightly different way to classify sword hilts.[1083] He defined six design principles as an aid in their classification. These are triangular pommel, three-part pommel, five or multi-part pommel, the absence of a pommel (only upper guard), bent lower guard, and absence of upper guard (only pommel-like piece). According to Jakobsson, it is essential that these principles result from strategies of reproduction, i.e. some symbolic value is attached to a certain physical form, which was widely copied for this reason.[1084] Thus the principles cannot be explained in chronological, chorological or functional terms, in other words, they do not reflect different time periods, they do not differ in distribution, and they are not connected to any technological development.[1085] Jakobsson's ideas have been further discussed and criticized.[1086]

1078 *Räty 1983: 88–89.*
1079 *Maure 1977.*
1080 *Maure 1977: 102–107.*
1081 *Maure 1977: 107–109.*
1082 *See Maure 1977: 114, fig. 39.*
1083 *Jakobsson 1992.*
1084 *Jakobsson 1992: 77–78.*
1085 *Jakobsson 1992: 76.*
1086 *See Magnusson Staaf 1994.*

Jakobsson's classification is not actually a typology, in which a certain artefact can be included in only one type. Jakobsson's design principles allow one sword find to be classified according to several of his principles. After all, Jakobsson's primary idea was to discuss matters concerning warrior-ideology, the division of power, and maintenance or alteration of social hierarchies in Viking Age societies, not to create a new typology for swords. This can also be seen from the fact that Jakobsson's classification and chronology are almost entirely based on Petersen's typology with only slight modifications.[1087] Although Jakobsson managed to create some chronologies on different design principles,[1088] these are not strictly applicable in terms of 'types' as defined by e.g. Petersen.

The work of the German scholar Alfred Geibig also presents a typology which is based on different combinations of pommels and upper and lower guards.[1089] The time-span of the swords was from the beginning of the 8th century to the end of the 12th century. Geibig's classifications are not based on morphology, but metrical distinctions. The find material used by Geibig in his work is also of local nature. All 347 swords were found in modern-day Germany or its vicinity, ancient East Francia. This limited geographical area may affect the applicability of the typology elsewhere in Europe.

Geibig's system is more complicated than others, which does not make it any less applicable or any further from the truth. Geibig defined nineteen distinct combination types, each consisting of a pommel and a lower guard, both of which may vary slightly within the same type. To clarify the distinctive forms and possibly their different datings within a certain type, Geibig separated 'variants' within some combination types. The types of pommels and guards bear, of course, resemblance to the types defined by Petersen and Oakeshott. Geibig's chronological considerations are very detailed and well-argued, having utilized numerous other typologies and single type-definitions to be able to establish an universal dating for each type and its variant.[1090]

Ian Peirce's book *Swords of the Viking Age* includes a kind of updated version of Petersen's typology created by Lee A. Jones.[1091] The datings established by Petersen are revised by looking at the results of Alfred Geibig[1092] and Mikael Jakobsson.[1093] Only the twenty main types and one sub-type are presented, because these are considered as the most common ones throughout Europe. Whereas Petersen dated the types in the precision of half a century, Jones suggests datings with an accuracy of up to a quarter-century. This seems somewhat odd, when considering previously mentioned factors such as reuse, independent innovation, post-depositional factors etc.

The latest contribution to the typology of swords dating from the second half of the Iron Age is the work by Anne Nørgård Jørgensen.[1094] She examined Scandinavian weapon graves from Bornholm, Gotland and southern Norway from 520/30–900 AD, creating her own typological definitions, once again relying on Petersen's types whenever possible. Instead of type definitions,

1087 *As a side note, Petersen's types F, G and N, and also special types 4, 9 and 20 are not included in Jakobsson's work, simply because they do not fit into any of his design principles (Jakobsson 1992: 58–60). Special types 10, 11 and 12 have also been left out since they were not illustrated by Petersen (1919).*

1088 *Jakobsson 1992: 72, tabell 10.*

1089 *Geibig 1991. The typology is briefly presented also in Geibig 1989, but the publication of 1991 is referred to here as it is more comprehensive.*

1090 *Geibig used the following works to establish the datings: Petersen 1919, Wheeler 1927, Jankuhn 1939, von zur Mühlen 1975, Nordman 1943, Bruhn Hoffmeyer 1954, Nadolski 1954, Oakeshott 1960 and 1964, Dunning & Evison 1961, Seitz 1965, Stein 1967, Ruttkay 1976, Menghin 1980, Müller-Wille 1982, Vinski 1983a and Głosek 1984.*

1091 *Jones 2002b.*

1092 *Geibig 1991.*

1093 *Jakobsson 1992.*

1094 *Nørgård Jørgensen 1999.*

one of her goals was to create a more accurate chronology for different types in various parts of Scandinavia. Nørgård Jørgensen's sword hilt types are stated with the numbers 2-11, number one consisting of hiltless and thus 'unclassifiable' blades. Of these types, numbers five to eleven are also connected with the present work, i.e. iron hilts datable from the Late Merovingian Period to the middle of the Viking Age. Type five corresponds to Petersen's type B, type seven to Petersen's type A, type eight to Petersen's type H, type nine to Petersen's special type two, type ten to Petersen's special type five, and type eleven to Petersen's type F. According to Nørgård Jørgensen, her type number six corresponds to Petersen's type D, but in reality they are not the same. Her examples of type six are similar to cast-bronze hilts of Elis Behmer's type VI or Helmer Salmo's type B I dated to the Late Merovingian period.

7.1.4. Sword hilts in art of the period

Among other weapons, swords are illustrated in early medieval and medieval artworks, especially in manuscripts dating from the Carolingian era. Although the themes and models often emerge from the Roman periods, the details are usually made according to the period of the artist in question. This is not always easy to state, but at least the weapons seem to have parallels in actual artefacts from the early medieval or medieval era. Perhaps the most noticeable in regard of typologies are the shapes of illustrated hilts, which have sometimes been used to aid in archaeological dating.[1095] A variety of hilts are represented in early medieval and medieval artwork, but only those comparable to the finds studied in this work are examined here.

In many cases there are three clearly separate parts representing the lower and upper guards and the pommel. Moreover, the pommel has often been pictured as three-lobed, resembling most like Petersen's special type 2 or type S. These kinds of hilts equipped with a three-lobed pommel can be found from, for example, the Stuttgart Psalter (ca. 820–830 AD),[1096] the Vivian Bible (ca. 846 AD),[1097] and the Lothar Gospels (ca. 849–851 AD).[1098] The upper and lower guards of these illustrations are of even height, best corresponding to Petersen's special type 2 or the so-called Mannheim or Mannheim-Speyer types. The dates of these sword types would fit in the dating of the manuscripts mentioned above. In connection with pictures of these hilts there are sometimes patterned mid-sections of blades, possibly indicating pattern-welding, which was also common at the time.

In the Liber Vitae of New Minster dating ca. 1031 AD, is an image of king Cnut holding a sword with a three-lobed pommel.[1099] This time the guards resemble more like Petersen's type S, or maybe type Z. Again, the dates established to these types correspond to that of the manuscript. Rock carvings from Södermanland, Sweden illustrate a sword resembling Petersen's type Z or even Æ.[1100] The carving dates from the 11th century.

Some manuscripts have pictures of clear brazil-nut pommels together with long and slender lower guards. For example the Gospels of Otto III (ca. 997 AD or shortly after),[1101] the Stammheim

1095 E.g. Androshchuk 2010.

1096 E.g. De Wald 1930. Württembergischen Landesbibliothek, Stuttgart, bibl. fol. 23.

1097 E.g. Walther & Wolf 2001: 97. Paris, Bibliothèque nationale de France, Ms. lat. 1. This manuscript is also known as the First Bible of Charles the Bald.

1098 E.g. Walther & Wolf 2001: 460. Paris, Bibliothèque nationale de France, Ms. lat. 266.

1099 E.g. Karkov 2003: 151. London, British Library, MS. Stowe 944.

1100 See e.g. Brate & Wessén 1924–36. The sword is pictured in the hands of Sigurd, who is slaying the dragon Fafnir.

1101 E.g. Walther & Wolf 2001: 114–117. Munich, Bayerische Staatsbibliothek, Clm 4453.

Missal (ca. 1160–1180 AD),[1102] the World Chronicle from the German Middle Ages (ca. 1300),[1103] and the Codex Manesse (ca. 1310–1340 AD)[1104] illustrate these kinds of hilts. The type has also been depicted in other works of art. A portable altar showing St. Simplicius (ca. 1100 AD)[1105] and a copper-gilt altar from ca. 1120 AD[1106] display hilts of these kinds. Brazil-nut pommels can also be seen in the 11th-century bronze doors of the Cathedral of St. Zeno in Verona[1107] and in the effigy of Count Dedo von Wettin in Wechsenburg Cathedral, dating from ca. 1230 AD,[1108] just to mention a few. The dates of the earliest of these depictions match to the datings given to the brazil-nut type. The later ones could well reflect the long-lived popularity of this type, or then some other medieval type resembling the form of the brazil nut, such as Oakeshott's types C (resembling Petersen's type Y), D or E, all dating roughly between 1050 and 1275 AD.[1109]

In Bamberg Cathedral there is a figure of Archangel Michael, holding a sword with a pommel resembling Petersen's type X or Oakeshott's type B1. This figure is dated to ca. 1220, and is thus interestingly late when compared with the dates normally presented for both of the above-mentioned types. This, however, is one possible example of the 'artistic impression'; the maker is not referring to any certain existing sword type, but something close to period pieces.

Disc-pommeled swords are otherwise very common in medieval art. This is not surprising since the form is very common throughout the medieval period. Some of the earliest examples can be mentioned here. One rarely cited example is from Valthjofsstadir, Iceland, the rune-inscribed church door from Iceland, dated to ca. 1150–1190 AD.[1110] In a scene interpreted as King Theodoric slaying a dragon, there is a simple representation of a disc-pommeled sword. Another, much more famous example comes from Hylestad, Norway. There are as many as four depictions of swords having disc-shaped pommels, in the wooden panels originally from the entrance to the now demolished stave church of Hylestad.[1111] The carved panels are dated ca. 1175–1200 AD.[1112] Disc-pommeled swords are also very common in medieval art outside Scandinavia. For example, a portable altar at Stavelot (ca. 1120)[1113] and the Apocalypse of St. John preserved in the British Museum (ca. 1300–1310 AD)[1114] illustrate a simple, non-faceted disc-pommel. Faceted pommels on the other hand can be seen, for example, in a statue of Count Ekkehard (ca. 1250 AD)[1115] and an image of St. Peter of the same date[1116] in Naumburg, and in the Tenison Psalter (before 1284),[1117] the canopy of the tomb of Edmund, Earl of Lancaster in Westminster Abbey (1296 AD),[1118] the tomb effigy of Robert d'Artois in St. Denis (1317 AD),[1119] and in the roof bosses of

1102 E.g. Walther & Wolf 2001: 463. Los Angeles, J. Paul Getty Museum, Ms. 64.

1103 E.g. Walther & Wolf 2001: 193–195. St. Gall, Kantonsbibliothek Vadiana, Ms. 302 Vad. and Berlin, Staatsbibliothek Preussischer Kulturbesitz, Ms. germ. fol. 623.

1104 E.g. Walther & Wolf 2001: 197–198. Heidelberg, Universitätsbibliothek Codex Pal. Germ. 848.

1105 Oakeshott 1964: 31. Altar is in the collection of Victoria and Albert Museum in London.

1106 See Oakeshott 1964: 85.

1107 Oakeshott 1964: 36–37.

1108 Oakeshott 1964: 87.

1109 Oakeshott 1964: 93–94.

1110 E.g. Stephens 1874.

1111 Swords are depicted in the following scenes telling the tale of Sigurd the dragon-slayer: Sigurd testing the strength of a sword by striking it against an anvil, Sigurd killing the dragon Fafnir, Sigurd roasting the heart of the dragon (Regin crouching nearby with a sword), and Sigurd killing Regin with a sword.

1112 E.g. Blindheim 1965: 52, 198.

1113 Oakeshott 1964: 31.

1114 Oakeshott 1964: 45–46. British Museum Library MS. Roy. 19. B.XV.

1115 Oakeshott 1964: 40–41.

1116 Oakeshott 1964: 40, 42.

1117 Oakeshott 1964: 45. British Museum Library MS. Add. 24636.

1118 Oakeshott 1964: 46.

1119 Oakeshott 1964: 55.

Lincoln Cathedral (ca. 1280 AD)[1120] and Exeter Cathedral (ca. 1308–1328 AD).[1121] As can well be seen, the forms of disc pommels are quite widespread and were in use for a very long period of time.

One last note can be made about coin finds. Some coins have depictions of swords, but unfortunately definitions of type are impossible due to the lack of details and accurate representation. Worth mentioning are, for example, the coins of Erik Bloodaxe (died 954 AD) and King Sitric (York, ca. 921–927 AD), both of which have images of large-pommeled swords that were typical during the Viking Age.[1122]

7.2. Types, decoration and chronology

To proceed by period, the Viking Age hilts are presented first. The types are mainly defined according to the Petersen typology.[1123] Other typologies include some of the same forms as Petersen's system,[1124] but it is clearer to use Petersen's classifications due to their firm foothold among sword studies. In sixteen blades there were no parts of hilt to be classified. Two hilts that could not be classified need to be noted here. Swords KM 3383:2 from Padasjoki and KM 14684 from Hämeenkoski have undecorated iron hilts, which could not be classified to any specific type according to their form. The documented hilts are presented in Figure 87, listing also the attributes of all the studied hilts.

The construction method of the hilt is also noted. A peened tang means that the upper end of the tang was flattened against the upper face of the pommel. In this method the tang goes all the way through all the parts of the hilt. Sometimes the upper guard is almost hollow and the tang was flattened inside the guard, possibly with the help of punches of some kind. Viking Age upper hilts, in particular, have two separate parts – the upper guard and the pommel – which are attached to each other with either two rivets or one curved rivet. In this case the tang has been peened on the upper guard. In the case of a curved rivet, it may have either been soldered into the hollow pommel, or then attached with some organic glue-like substance, such as cutler's resin.[1125] It must be noted that not all massive hilts could be radiographed, and thus the method of attaching the pommel remains unclear in several cases. The parts are simply too massive for x-rays to penetrate them, at least with the device that was used.

According to the observations and x-ray examinations conducted by Alfred Geibig, the methods of construction of iron hilts, namely the attachment of the pommel have evolved over time. Construction type one was used during the Late Merovingian Period and in the beginning of the Viking Age, when the tang was drawn all the way through both the upper guard and the pommel, being flattened on the top of the pommel. During the Viking Age, it was a common practice to

1120 Oakeshott 1964: 51.

1121 Oakeshott 1964: 62.

1122 See Lorange 1889: 17–18.

1123 Petersen 1919. Main types A–Æ and special types 1–20.

1124 Alfred Geibig (1991: 13–19) has listed different type names by other researchers, which correspond to his own combination types and their variations. These include also some Petersen's (1919) types, but also following: Wheeler 1927, Jankuhn 1939, von zur Mühlen 1975, Nordman 1943, Bruhn Hoffmeyer 1954, Nadolski 1954, Oakeshott 1960 and 1964, Dunning & Evison 1961, Seitz 1965, Stein 1967, Ruttkay 1976, Menghin 1980, Müller-Wille 1982, Vinski 1983a and Głosek 1984.

1125 In its simplest form, cutler's resin was normally a compound of pine pitch, beeswax and sawdust (in modern times brick dust), mixed in certain proportions. It has been used e.g. to attaching of handles to blades in historically documented times.

Figure 87.
Table showing the properties of hilts in the examined iron-inlaid swords.

Catalogue number	Type of hilt	Hilt decoration	Pommel attachment	Comments
KM 70	Oakeshott B / Geibig 14		peened tang	
KM 287	H	vertical silver wires (16 / 1 cm)		upper guard and pommel missing, hole in lower guard oversizec
KM 293	I	vertical silver wires (22 / 1 cm)	?	
KM 369	Y		peened tang	holes on pommel and lower guard slightly loose
KM 370	V	vertical silver wires (35 / 1 cm)	?	lower guard wedged with iron wedge, hole in lower guarc oversized
KM 439:1	Oakeshott B / Geibig 15.5		peened tang	
KM 708	V		?	lower guard missing
KM 1120:1	H			pommel missing
KM 1174:2	S	traces of silver plating on hatched surface (grooves 26 / 1 cm, hatched in two directions)		upper guard and pommel missing
KM 1174:3	Z	traces of silver plating	peened tang and curved rivet	
KM 1822:1	I			pommel missing, hole in lower guard oversized
KM 1822:2	Oakeshott 7 / Geibig 12 or 16.1			pommel missing, long and slender lower guard
KM 1996:73	close to L or Z	vertical silver wires (22 / 1 cm)	?	lower guard wedged with iron wedge, hole in lower guarc oversized
KM 2033:1	Oakeshott B / Geibig 15.5		peened tang	
KM 2345:1	E	round holes (diameter 2-3 mm)		upper guard and pommel missing, lower guard wedged with iror wedge, hole in lower guard oversized
KM 2361	N		peened tang	hole in lower guard oversized
KM 2489:121	Tomanterä A / Oakeshott G		peened tang	remains of iron grip
KM 2489:280–281	Tomanterä A / Oakeshott G	silver wires on hatched surface (grooves 24 / 1 cm, hatched in three directions)	peened tang	silver decoration also on iron grip
KM 2508:124	Y		peened tang	holes on pommel and lower guard slightly loose
KM 2548:196	Q		peened tang	holes in pommel and lower guard oversized
KM 2548:277	H	vertical silver and copper-alloy wires (4 silver and 5 coppei wires alternating) (23 / 1 cm)	?	hole in lower guard oversized
KM 2767	silver-plated	engraved silver plating (grooves 32 / 1 cm, hatched in two directions)		upper guard and pommel missing, tang possibly re-shaped
KM 2939:1	Tomanterä B / Oakeshott H		peened tang	lower guard missing, hole in pommel oversized
KM 2979:8	Z (pommel and upper guard)	traces of silver plating	peened tang and curved rivet	lower guard is of undefined, rounded type, hole in upper guarc oversized
KM 3052:2	R	traces of silver plating (grooves 28 / 1 cm, hatched in one direction)		pommel missing
KM 3131:6	X / Geibig 8 or 12.1			pommel and possible upper guard missing, tang broken
KM 3301:1	V	vertical silver and copper-alloy wires (22 / 1 cm)		pommel missing
KM 3316:13	Tomanterä A / Oakeshott G		peened tang	remains of wooden grip
KM 3336:31	B			upper guard and pommel missing
KM 3383:2	undefined			upper guard and pommel missing, hole in lower guard oversizec
KM 3423	H	vertical wires (22 / 1 cm)		upper guard and pommel missing, lower guard wedged with iror wedge, hole in lower guard oversized
KM 3575:1	B		?	
KM 3631:1	Tomanterä B / Oakeshott H		peened tang	holes in pommel and lower guard oversized
KM 3899:3	T2	vertical silver and copper-alloy wires (29 / 1 cm)	?	hole in lower guard oversized
KM 4524	S	hatched surface (grooves 25 / 1 cm, hatched in three directions)		upper guard and pommel missing
KM 4429:14	Oakeshott A / Geibig 16.1		peened tang	lower guard missing
KM 4566:12	Y		peened tang	holes on pommel and lower guard slightly loose
KM 4633:145	V (?)		peened tang (?)	pommel is loose and hollow and no rivets are intact
KM 4633:165	H	vertical wires (16 / 1 cm)	?	
KM 4923:1	X (later)		peened tang	holes in pommel and lower guard oversized
KM 5005	Tomanterä A / Oakeshott G		peened tang	hole in pommel oversized

KM 5215	Tomanterä B / Oakeshott H		peened tang	
KM 5334:1	Mannheim-Speyer / Geibig 4	vertical copper-alloy wires (12 / 1 cm)	peened tang	holes in both guards slightly loose
KM 5395:1	H	vertical silver wires (16 / 1 cm)	?	
KM 5707:3	Oakeshott A / Geibig 16.1		peened tang	holes on pommel and lower guard slightly loose
KM 5865:1	B		peened tang	
KM 5868:80	I			
KM 5890:1	Y		peened tang	holes on pommel and lower guard slightly loose
KM 6196:1	E	vertical silver wires (22 / 1 cm) and round holes (diameter 3 mm)		upper guard missing, pommel is find KM 6196:20
KM 6227:1	Z	traces of silver plating	?	iron grip
KM 6245 A:1	V	vertical silver and copper-alloy wires in diamond patterns (26 / 1 cm)		pommel missing
KM 6482	B			upper guard and pommel missing
KM 6746:49	Special type 1	vertical copper-allow and/or silver wires (9 / 1 cm), relief decorated vertical copper-alloy panels	peened tang	hole in lower guard oversized
KM 6753:51	H	vertical silver wires (12 / 1 cm)	?	holes in both guards oversized
KM 6923	Oakeshott A / Geibig 16.1		peened tang	
KM 7011	X (later)		peened tang	hole in pommel is slightly oversized
KM 7134:1	Oakeshott B / Geibig 15		peened tang	
KM 7220:2	B		peened tang	holes in pommel and lower guard oversized
KM 7472:2	H	vertical copper-alloy wires (14 / 1 cm)	?	hole in lower guard oversized
KM 7703:2	Behmer VI / Salmo's Late Merovingian			pommel missing, parts of hilt are hollow cast bronze
KM 7752:1	E	vertical copper-allow and/or silver wires (6 / 1 cm), vertical and horizontal elongated oval pits	peened tang	holes on both guards slightly loose
KM 7961:1	V (?)	vertical silver wires (26 / 1 cm)		upper guard and pommel missing
KM 8120:1	X (later)		peened tang	lower guard wedged with iron wedge, holes in pommel and lower guard oversized
KM 8602:130	T2	vertical silver and two different copper-alloy wires in diamond patterns (23 / 1 cm, hatched in two directions)	?	grip covered with wood, textile and leather
KM 8602 A:116	disc-pommel (?)		peened tang	remains of wooden grip
KM 8656 H23:1	Oakeshott E / Geibig 19		peened tang	remains of wooden grip
KM 8723:165	Tomanterä A / Oakeshott G		peened tang	
KM 8896:25	H	vertical copper-alloy wires (13 / 1 cm) and copper-alloy plates on upper and lower faces of lower guard		pommel missing
KM 9164:2	X (later)		peened tang	holes in pommel and lower guard oversized
KM 9164:3	X (later) / R or S		peened tang	lower guard is of type R or S and pommel is of type X, hole in pommel oversized
KM 9243:1	I	vertical silver and copper-alloy wires, which are partially twisted (14 / 1 cm)	?	upper and lower guards wedged with copper-alloy wedges, hole in lower guard oversized
KM 9243:2	X (later)		peened tang	holes in pommel and lower guard oversized
KM 9419	Tomanterä A / Oakeshott G		peened tang	hole in pommel oversized
KM 9562:1	silver-plated	engraved silver plating (grooves 28 / 1 cm, hatched in one direction)	?	silver-plated iron grip
KM 9778	C		peened tang	holes in pommel and lower guard oversized
KM 9832	H		?	holes in both guards oversized
KM 10349:1	B		?	
KM 10369:3	B			pommel and upper guard missing, tang broken
KM 10390:2	Z	traces of silver plating	?	upper guard and pommel are find KM 10409:1
KM 10390:3	U		?	
KM 10390:5	V (?)			upper guard and pommel missing
KM 10413	H (?)		rivet / rivets	pommel missing, guards have been postdepositionally nailed to their places on one side
KM 10906:1	H	vertical wires (20 / 1 cm)	?	hole in lower guard oversized

KM 11063:283	N (?)			pommel missing, remains of wooden grip
KM 11198	silver-plated	traces of silver plating (grooves 28 / 1 cm, hatched in two directions)		upper guard and pommel missing, tang re-shaped
KM 11242	Z		rivet / rivets	upper guard is loose
KM 11831	Tomanterä A / Oakeshott G		peened tang	
KM 11840	Oakeshott B / Geibig 15.5		peened tang	
KM 11859:1	I (?)	vertical silver and copper-alloy wires in alternating rows (20 / 1 cm)		pommel missing, holes in both guards oversized
KM 12033	Tomanterä B / Oakeshott H		peened tang	
KM 12687:1	silver-plated	engraved silver plating (grooves 32 / 1 cm, hatched in two directions)	peened tang	silver-plated iron grip
KM 12690:299	Geibig 13.2			pommel missing
KM 13399:3	Geibig 13.2			pommel missing
KM 13419:1	E	vertical copper-alloy wires (4 / 1 cm) and round holes (diameter 2-3 mm)	?	holes in both guards oversized
KM 13419:2	H	vertical wires (22 / 1 cm)	?	
KM 13839:253	Z		?	remains of wooden grip
KM 13962:322	Special type 2 / Geibig 2		?	
KM 14196:69	X (later)		peened tang	hole in lower guard oversized
KM 14684	undefined			pommel and possible upper guard missing, tang broken, hole in lower guard oversized
KM 15175:1	V	vertical silver and copper-alloy wires in diamond patterns (28 / 1 cm)		pommel missing, hole in lower guard oversized
KM 15181:2	Z / brazil-nut		peened tang	lower guard resembles Petersen's type Z while pommel is of large brazil-nut shape
KM 15467	H	vertical copper-alloy wires (11 / 1 cm)	?	holes in both guards oversized, rivet-heads on upper guard are very large
KM 16279	H			pommel and upper guard missing, hole in lower guard oversized
KM 17208:375	Z	traces of silver and copper-alloy plating, (grooves 30 / 1 cm, hatched in three directions)	?	
KM 17208:561	silver-plated	engraved silver plating (grooves 30 / 1 cm, hatched in two directions)	peened tang	silver-plated iron grip
KM 17208:588	silver-plated	engraved silver plating (grooves 30 / 1 cm, hatched in one direction)	peened tang	silver-plated iron grip
MK 17777:1	bronze hilt, close to AE	cast animal figures in bronze	peened tang	lower guard, grip and pommel are hollow cast bronze
KM 18000:3170	X (later)		peened tang	
KM 18000:3880	X (later)		peened tang	
KM 18402:1	H	vertical silver and copper-alloy wires in chequerboard patterns (24 / 1 cm)	?	hole in lower guard oversized
KM 19901:202	Tomanterä A / Oakeshott G		peened tang	remains of wooden grip
KM 20127	X (later)		peened tang	
KM 22106:23	X (later)		peened tang	
KM 22964:3	Mannheim / Geibig 3	vertical wire inlays (14 / 1 cm), embossed horizontal, non ferrous strips on guards	peened tang	
KM 23607:490	H	vertical copper-alloy wires (14 / 1 cm)	?	remains of wooden grip
KM 24740:242	H	vertical wires (22 / 1 cm)	?	remains of wooden grip
KM 26301	H	vertical wires (18 / 1 cm)	?	
KM 27141:1	R	traces of silver plating	curved rivet	
KM 30870:1	V	vertical silver and copper-alloy wires in diamond patterns (25 / 1 cm)	?	hole in lower guard oversized
KM 30985:1	H	vertical copper-alloy wires (16 / 1 cm) and copper-alloy plates on upper and lower faces of lower guard	?	upper guard wedged with iron wedge, holes on both guards oversized
KM 31017:1	T2	vertical silver wires in diamond patterns (23 / 1 cm)	?	
KM 31550:1	V (?)	vertical silver and copper-alloy wires in diamond patterns (26 / 1 cm)		pommel missing, lower guard wedged with iron wedge, hole in lower guard oversized
KM 37257	close to Z or Kirpichnikov's local A	traces of silver plating (hatched grooves 22 / 1 cm, hatched in two directions)	?	shape of hilt close to Z or an iron version of Kirpichnikov's local type A
HM 3047	H	vertical copper-alloy wires (12 / 1 cm)	?	holes on both guards oversized
LiuM 26	E		peened tang	

SatM 10330	Y		peened tang	hole in lower guard oversized
SatM 12563	O	vertical copper-alloy wires (25 / 1 cm)		upper guard and pommel missing, hole in lower guard oversized
TMM 13393	Tomanterä A / Oakeshott G	silver wires on hatched surface (grooves 27 / 1 cm, hatched in one direction)	peened tang	
TMM 14105	H	vertical wires	?	
ÅL 336:292	B		peened tang	
ÅL 337:106	Special type 2 / Geibig 2	silver wires	peened tang	
ÅL 337:229	H	vertical copper-alloy wires		
ÅL 337:528	Special type 2 / Geibig 2		peened tang	
ÅL 345:113	Special type 2 / Geibig 2	silver wires	peeend tang	
Huittinen, Church	Tomanterä B / Oakeshott H		peened tang	lower guard broken or cut, holes in pommel and lower guard oversized

attach the pommel to the upper guard with one or two rivets (construction type two), until the upper guard vanished, leaving only a pommel, on top of which the tang was naturally peened (construction type three). Type three hilts are those from the Late Viking Age onwards.[1126]

The decoration of the hilts is quite varied. While there are 71 undecorated, plain iron hilts, 61 of all the examined hilts have some kind of decoration applied with non-ferrous metals. In some cases, the hilts were in such poor condition that no decorative elements could be distinguished. Furthermore, in two cases (KM 5868:80 and LiuM 26) decoration is most likely present, but the swords in question were not personally studied by me. Most commonly vertical wires are inlaid into the surface of iron hilt parts. Sometimes there are as many as thirty wires inlaid along a distance of one centimetre, whereas the crudest one has only four wires along this distance. Sometimes all wires of the same hilt are of the same metal – silver or some copper alloy – creating the illusion of a hilt made of something else than iron.[1127] The wires may have been flattened so that no iron is visible around them. In these cases, the visible upper and lower faces of both guards have also been plated. Some hilts have vertical inlays of different non-ferrous metals, creating geometric patterns on the finished surface.

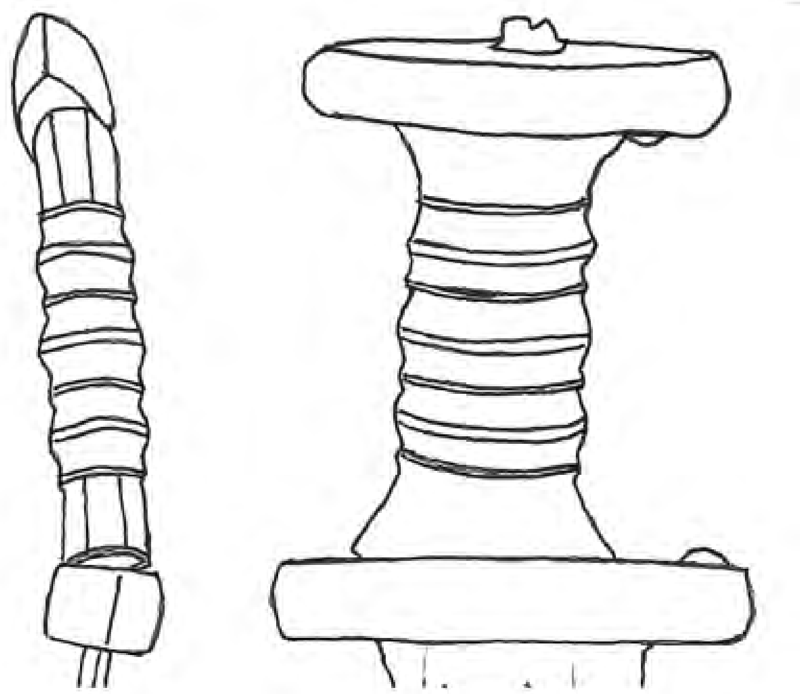
Some hilt types have a hatched or napped surface on which silver wires or plates were overlaid. The hatching is made sometimes in only one direction, but usually in two or three directions to ensure the attachment of silver overlay. As with vertical inlays, the hatching may be executed with different numbers of cuts per centimetre. In addition to non-ferrous decorations, also carved grooves and round holes occur, sometimes with accompanying wire inlays.

In the following type-specific presentation, single types as defined by Petersen and/or some other scholars, are not dealt with as single mass. Within certain types variants may occur in regard to their form, dimensions and construction. Also the decoration is of crucial importance, since the non-ferrous materials used in decoration, as well as their technique of attachment may vary within a certain 'type'. This kind of analysis may set out new ways to trace different manufacturing traditions. After all, the 'types' were quite universal and widespread during the Late Iron Age, giving reason to assume that they were forged and imitated in various places.

1126 *Geibig 1991: 90–100.*

1127 *In this work the copper alloys are classified as copper, bronze or brass according to their colour, although these determinations are not accurate. Copper is reddish in colour, while brass (an alloy of copper and zinc) is much more yellowish. Bronze (an alloy of copper and tin) falls in between these two, being orange in colour. In any case, elemental analyses would be needed to securely state the nature and composition of the inlaid metal.*

7.2.1. Behmer's type VI



Before going on to Petersen's types that clearly remained in use in the Viking Age, one earlier type must be presented. Sword KM 7703:2 from Isokyrö has a hilt cast in bronze, with the pommel missing (Fig. 88). The parts of the hilt imitate the Migration and Merovingian Period hilts having similarly fashioned upper and lower guards as well as the ribbed grip, also cast in hollow bronze. The guards have small rivet-heads in imitation of pre-Viking Age composite guards. These kinds of guards were riveted together from organic and non-ferrous plates, usually the organic plate being sandwiched between two metal plates, and the whole kept together with two rivets with decoratively large ends.

Figure 88. Sword hilt of Behmer's type VI with pommel missing (KM 7703:2).

This kind of hilt belongs to Behmer's type VI or Helmer Salmo's "Bronze-hilted Late Merovingian" type. Behmer dates similar hilts from Sweden and Finland to between 750 and 800 AD.[1128] Salmo dates these swords, as Oscar Montelius did earlier, to between 700 and 800 AD.[1129] Nørgård Jørgensen dates this type slightly later, to between 740/50 and 830/40 AD, and includes this hilt in her type six.[1130] However, this dating seems to be partially based on the subjective similarity of Petersen's type D and this bronze-hilted type, which in fact are not exactly the same. Petersen defined type D as clearly Viking Age and it is constructed differently and from different materials, and most importantly, type D no longer imitates the Merovingian forms so strongly.

7.2.2. Petersen B

Hilts of type B are exceptionally and surprisingly common among swords with ferrous inlays, being represented by a total of eight examples. Type B hilts consist of a pommel and upper and lower guards. The tang is drawn through all parts of the hilt and flattened on the top of the pommel. No separate rivets are used between the pommel and the upper guard. The pommel is flat in cross-section, sometimes somewhat widening towards its top. In profile, the pommel is triangular. Both guards are of relatively short length, and they have a central ridge. In addition, no non-ferrous decoration was applied.

1128 Behmer 1939.
1129 Montelius 1924; Salmo 1938.
1130 Nørgård Jørgensen 1999.

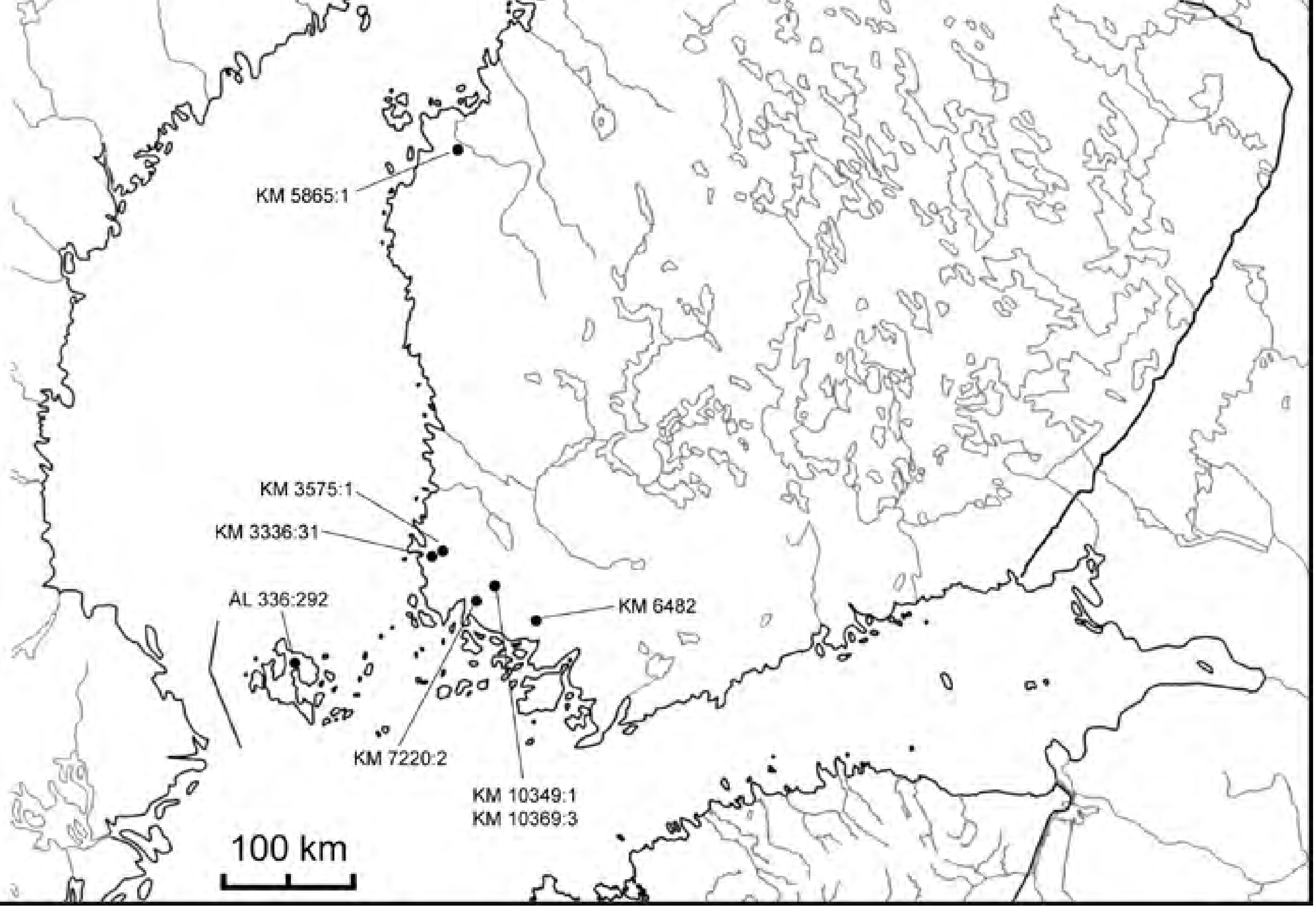


Figure 89. Hilts of Petersen's type B among the studied material.

The type is dated to 750–800 AD by Petersen,[1131] but it may have been in use during the first quarter of the 9th century.[1132] Nørgård Jørgensen dates the type even earlier, to ca. 700 AD in Sweden, ending its period of use also in the first quarter of the 9th century.[1133] This type also corresponds to Geibig's combination type one, dating roughly from 730–800 AD.[1134] Jouko Räty dates the Finnish swords with this type of hilt to between 750 and 825 AD.[1135] Helmer Salmo has dated the type to 700–925 AD.[1136] The origin of this type of hilt is hard to determine, since it is widespread in Scandinavia and Germany, with some finds also from the Baltic countries and Russia.[1137] The type has been characterized as either Frankish[1138] or Scandinavian.[1139] Jouko Räty considers type B swords to be Frankish, including the hilt and the blade, since the fit between the hilt and the tang seems properly and carefully done.[1140] Again, this is based on the assumption that all the sword blades came from Frankish smithies.

With regard to the forging techniques, in the case of sword KM 5865:1 from Vähäkyrö corrosion has revealed the welding seams indicating that the parts were each forge-welded from two plates, creating natural cavities for the tang to pass through. In each case examined here, the parts of the hilts appear to be almost solid, since the x-ray device that was used could not penetrate them.

Type B hilts joined with inlaid blades concentrate in Finland proper (Fig. 89). In the studied finds, there are no hilts of this type that are strictly identical to each other in their measurements.

1131 Petersen 1919: 62–63, 181. Also Holger Arbman (1937: 217) considers this type as dating from the second half of the 8th century.
1132 Jakobsson 1992: 35, Mandel 1991: 102 and Jones 2002b: 18–19.
1133 Nørgård Jørgensen 1999: 73, 75, 128, 134, 141–155. The early dating of the first examples has been suggested by Guttorm Gjessing (1934: 110).
1134 Geibig 1991: 151.
1135 Räty 1983: 147.
1136 Salmo 1938.
1137 See e.g. Arbman 1937: 217; Gjessing 1934: 110–111; Kazakevičius 1996: 19–20; Kirpichnikov 1966: 24–26; Mandel 1991: 102; Nerman 1929: 64; Petersen 1919: 61; Räty 1983: 20.
1138 E. g. Nordman 1943: 49.
1139 E. g. Petersen 1919: 63; Nerman 1929: 64.
1140 Räty 1983: 21.

However, variations of few millimetres cannot be taken as an indicator of, for example, different makers, since the blacksmith's work is based on evaluation and personal experience combined with skills of the hand, as well as the properties of the used tools.

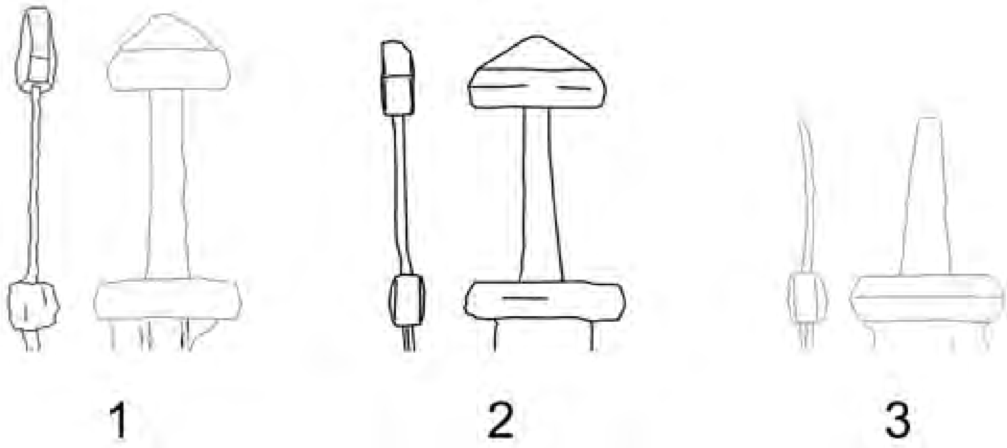


Figure 90. Variations of Petersen's type B hilts in the research material: 1. type with higher pommel (KM 3575:1), 2. type with lower pommel (KM 5865:1), 3. a possible stouter variant (KM 6482).

According to the overall proportions of the hilts, three kinds of shapes can be distinguished (Fig. 90). In the most common type (KM 3575:1 from Laitila, KM 10349:1 from Nousiainen, and possibly KM 3336:31 from Uusikaupunki and ÅL 336:292 from Saltvik) the pommel is clearly higher than the upper guard. A variation of this has a pommel of the same height or even smaller than the upper guard (KM 5865:1 from Vähäkyrö and KM 7220:2 from Nousiainen). As a possible third variant is a hilt with shorter and therefore stouter-looking lower guard (KM 6482 from Turku), possibly having originally a more robust upper guard and pommel. The lower guard of KM 10369:3 from Nousiainen is too badly corroded to be placed in any of the above categories. This division may not be of any significance, since the measurements are all slightly variable and the finds are quite badly corroded and do not show the original surface. Furthermore, hilt parts that are assembled by forge-welding and then forged into shape, will not end up identical in size.[1141]

7.2.3. Petersen's special types 1 and 2, and the Mannheim and Mannheim-Speyer types

Chronologically, the next types are Petersen's special types one and two, both of which have one example with an iron-inlaid blade. Special type one has a triangular pommel with its highest point in the centre. The cross-section of the pommel is of almost even thickness or slightly tapering towards its upper end. The guards are slightly ridged and oval in form when viewed from the top. The tang has been attached to the upper guard, which in turn is connected to the pommel with rivets. Non-ferrous wires and plates were used to decorate the hilt. Petersen dated special type one between 750 and 800 AD,[1142] while later studies suggest that it may have been use until ca. 850 AD.[1143] Iben Skibsted Klæsøe has dated this type to her early Viking Age (period no. 1), between 750/775 and 825–830 AD.[1144] According to Räty, the Finnish examples date roughly from 725–825 AD.[1145] Since the type was so rare, it has been suggested that it is of Frankish origin since its equivalents have been found from the Frankish territories,[1146] even though Petersen claimed it was

1141 Modern-day blacksmiths may create identical parts easily due to the development of machinery. Back in the Iron Age, the finishing had to be done by filing, and if for example a pommel was forged to its shape, it was probably filed only as much as was needed to bring out the shiny iron surface, after which it was polished. In other words, parts of the hilt, as well as other forged iron artefacts, most likely were not filed to be identical in measurements, since the filing was very laborious, and strictly identical measures are not useful in any way.

1142 Petersen 1919: 65, 181.

1143 Jakobsson 1992: 41; Jones 2002b: 18–19. Also Salmo (1938: 115) dates this type, as well as Petersen's special type number two, to the transition from the Merovingian to the Viking Ages.

1144 Skibsted Klæsøe 1999. Similarly, also Petersen's special type two and Mannheim type (see below) are dated to this period by her.

1145 Räty 1983: 147.

1146 E.g. Arbman 1937: 219; Gjessing 1934: 106–108; Jankuhn 1939: 156.

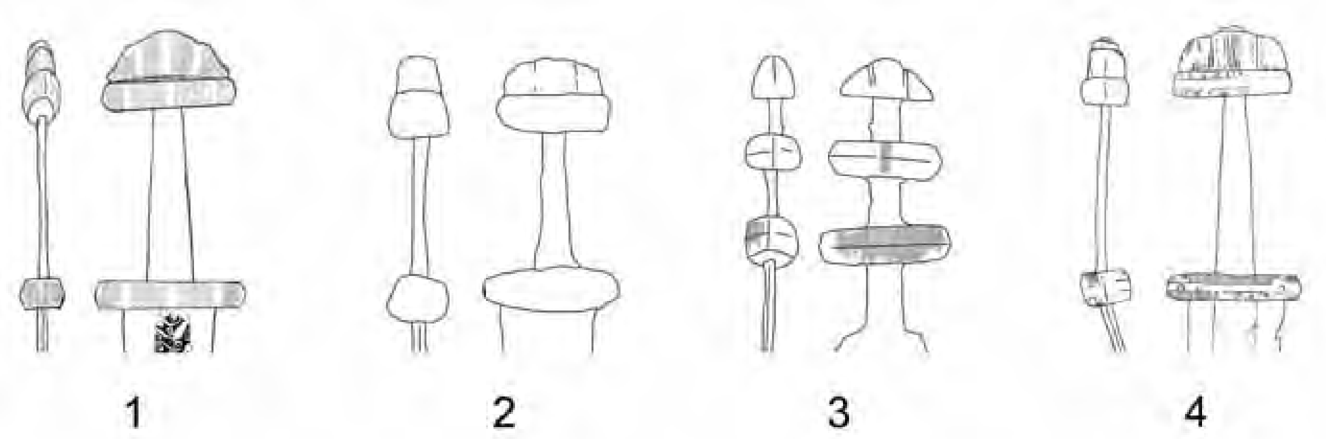


Figure 91. Early Viking Age hilts from the studied material: 1. Petersen's special type 1 (KM 6746:49), 2. Petersen's special type 2 (KM 13962:322), 3. Mannheim-Speyer type (KM 5334:1), 4. Mannheim type (KM 22964:3).

Norwegian, not knowing of any parallels.[1147] One specimen, however, is known from Estonia,[1148] and several from Scandinavia as a whole.[1149]

Sword KM 6746:49 from Turku belongs to special type one (Fig. 91). Contrary to common practice, the tang is peened on the top of the pommel as in other early iron hilt types classified by Petersen. The hilt has been decorated with bronze and silver wires and inset panels. The wires are set in grooves, numbering approximately nine per centimetre. There are three inset panels on both sides of the guards, while only one panel is situated on both sides of the pommel, in the middle. Originally the panels may have been relief-decorated with animal motifs, as has been the case with the well-preserved sword from Steinsvik, Norway (Universitetets Oldsaksamling C20317).[1150] The decoration of this Finnish equivalent has melted on the cremation pyre. Helmer Salmo, in connection with Merovingian period swords, called the whole type "sword as in Petersen's fig. 56", dating the type to 700–800 AD.[1151] In similar fashion, Jouko Räty placed this find into a kind of sub-group of special type one, calling it as type "Fig. 56", according to Petersen's illustration.[1152]

Special type number two is very close in form to special type one. The pommel is tripartite, the middle lobe being slightly wider and higher than the side lobes. The guards are quite thick and high, oval in form and tapering towards their ends when viewed from the top. Sometimes the sides of the guards have ridges. The tang has been flattened on the top of the pommel or on the upper guard. The decoration has been executed with non-ferrous wires and plates. The type is dated between 800 and 850 AD,[1153] while the type may have been born already during the second half of the 8th century.[1154] Special type two corresponds to Geibig's type two, which has been dated to 750–800 AD.[1155] Räty dates the Finnish examples between 775 and 825 AD,[1156] whereas Salmo places the type to ca. 800 AD or slightly older.[1157] The type is also similar to Evison's group number two.[1158] Spatially this type occurs in Scandinavia, the British Isles, the Netherlands, the Baltic countries, and Central Europe,[1159] in Finnish contexts occurring also on Åland islands.[1160] Petersen, knowing

1147 Petersen 1919: 65.
1148 Mandel 1991: 102.
1149 Müller-Wille 1985: 93.
1150 See pictures in Peirce 2002: Plate IV and pages 32–33.
1151 Salmo 1938.
1152 Räty 1983: 23–24.
1153 In addition to Petersen 1919: 85, see also Nørgård Jørgensen (1999: 73, 75, 128, 134, 141–155), who has categorized this type as number nine, basing the dating on the Norwegian material, as was also done by Petersen.
1154 Jakobsson 1992: 41; Jones 2002b: 18–19.
1155 Geibig 1991: 151.
1156 Räty 1983: 147.
1157 Salmo 1938.
1158 Dunning & Evison 1961: 123, 138. Dunning and Evison include the 'Mannheim' type in this group.
1159 Dunning & Evison 1961: 123, 138; Müller-Wille 1985: 93; Ypey 1980.
1160 Kivikoski 1963: 105–107.

only few examples, stated the type being of Norwegian origin,[1161] but Alfred Geibig considers it Frankish.[1162] From mainland Finland, only sword KM 13962:322 from Pöytyä can be classified to this type by its form, although corrosion has covered all probable non-ferrous decorations. Two possible examples from this type are known from Saltvik in the Åland islands – finds ÅL 337:528 and ÅL 345:113 – of which the latter still displays some traces of silver wire decoration.

In connection with these two special types, one example of the so-called Mannheim-Speyer type is known (KM 5334:1 from Eura). This type has been dated to between 780 and 800 AD.[1163] The type corresponds to Geibig's type four, which is dated to ca. 790–850 AD, i.e. slightly later as in the estimates of other researchers.[1164] Geographically, these types of hilts have been discovered from Denmark and the Frankish areas.[1165] This type is a more massive, sharply tri-lobed combination of Petersen's special type two and the so-called Mannheim type. The sword from Eura has its tang peened on the top of the pommel, and the parts of the hilt have been inlaid with brass wires, quite robustly with approximately twelve wires per centimetre.

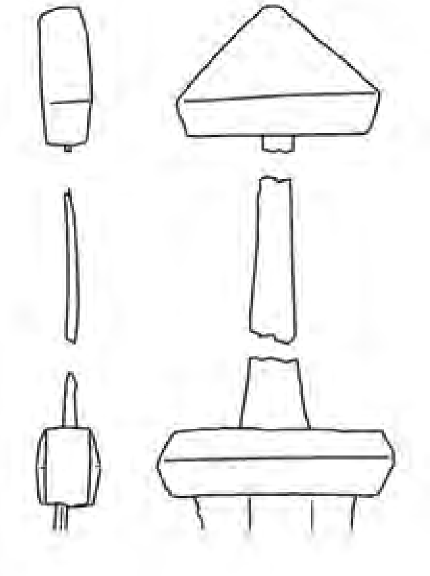


Figure 92. Sword of Petersen's type C (KM 9778).

The Mannheim type resembles Petersen's special types one and two, having embossed or engraved wide strips of copper-alloy metal in the hilt. In research literature, this type is commonly called the 'Mannheim type', since it noticeably differs from both above-mentioned special types.[1166] Also this type has been characterized as Frankish, with examples from Denmark, Central Europe and the Baltic regions.[1167] The dating of the Mannheim type is suggested to be 750–820 AD[1168] or in the middle of the 9th century.[1169] Geibig, classifying this type as his own type number three, dates it to between 750 and 810 AD, which is also done by some other scholars.[1170]

Two examples of this type can be found among the find material studied in this work. One is from Laitila (KM 22964:3), having a hilt inlaid with vertical wires and a guard with embossed non-ferrous inlaid strips. The sword is from a cremation cemetery, and thus does not have the non-ferrous metal intact any more as it has mainly melted away. The other find is from Saltvik (ÅL 337:106), with silver and possibly copper alloy decorated surfaces exhibiting curved motifs.

7.2.4. Petersen C

Type C is represented by only one find, KM 9778 from Kokemäki (Fig. 92). This type lacks the upper guard, having only a pommel, which has a ridge or a groove representing the border between the upper guard and the pommel evident in many other contemporary pommel types. In form, the solid pommel is five-sided in profile. Normally, the pommel is of even thickness or only slightly tapers either upwards or downwards. The lower guard is ridged and slightly tapering towards its ends when viewed from the top. Naturally, the tang has been peened on the top of the pommel. The parts usually have no non-ferrous decoration, except one example from Norway with a few

1161 Petersen 1919: 85.
1162 Geibig 1991: 161.
1163 Müller-Wille 1982.
1164 Geibig 1991: 141–142; Menghin 1980: 268.
1165 Müller-Wille 1985: 93.
1166 Jankuhn 1939, von zur Mühlen 1975.
1167 E.g. Jankuhn 1939: 156–161; Kazakevičius 1996: 40; von zur Mühlen 1975: 30; Müller-Wille 1985: 93; Naber 1976: 161–163.
1168 Jankuhn 1939; Von zur Mühlen 1975.
1169 E.g. Menghin 1980: 268.
1170 Geibig 1991: 161.

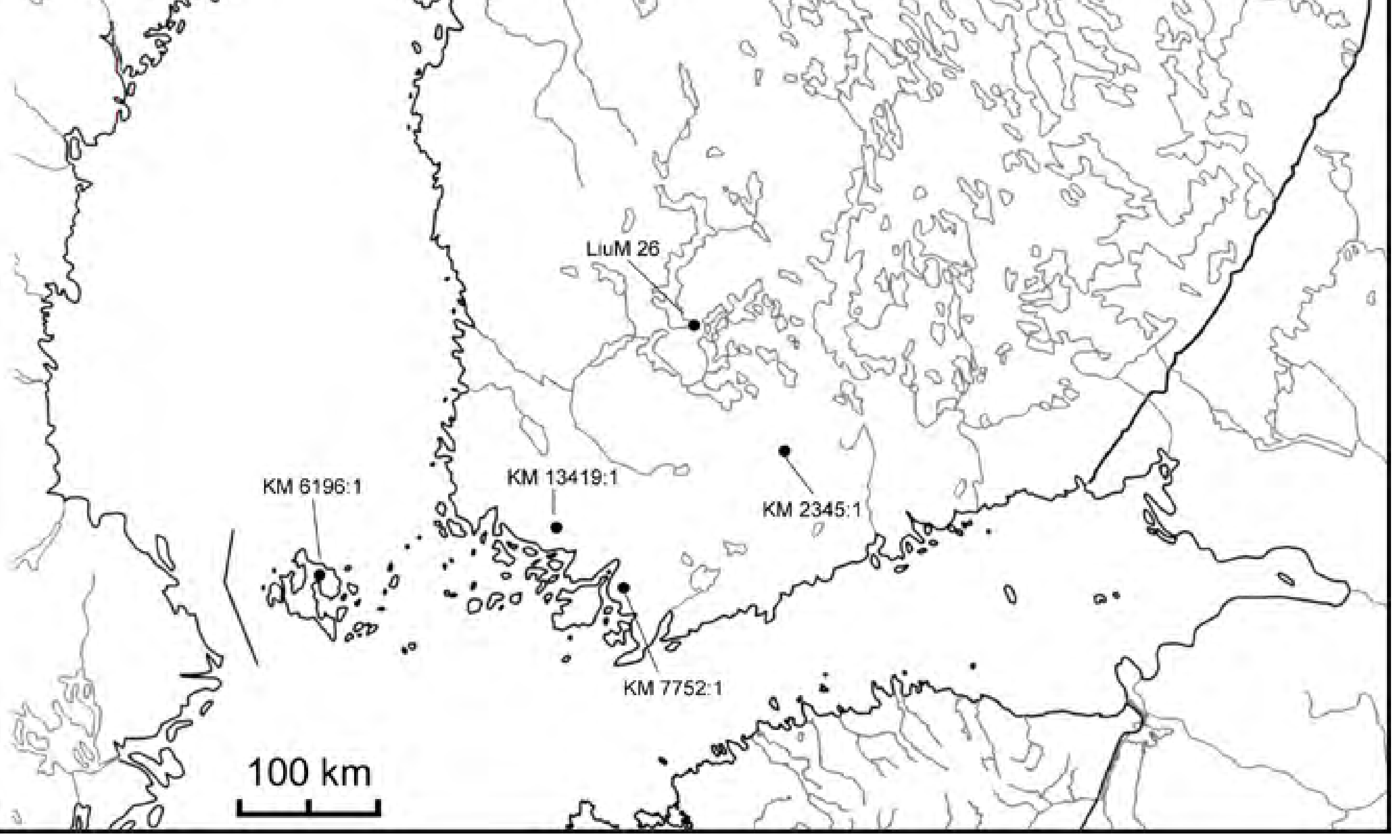


Figure 93. Hilts of Petersen's type E.

inlaid non-ferrous wires. While Petersen dates this type to 800–850 AD,[1171] it may have been in use until 900 AD.[1172] Petersen considers this simple type to have been developed in Norway, although some examples have also been found in the British Isles, Ireland and Sweden.[1173]

7.2.5. Petersen E

Type E hilts have five examples (Fig. 93). The pommel of type E is tri-lobed, the side lobes somewhat resembling animal heads, evident in some Merovingian Period artefacts. The thickness of the pommel is almost even. The guards are relatively high, oval in form when viewed from the top, and narrow and rectangular in their cross-section. The tang has been attached to the upper guard, and the pommel has been attached with rivets. In some cases also the lower guard exhibits rivet heads on its upper and lower faces. The decoration has been applied with non-ferrous wires and plates, and normally with round or elongated pits struck into the surface of the hilt parts.

This type is also quite early, dated to between 800 and 850 AD by Petersen.[1174] After Petersen, the dating of this type has been set considerably later, ca. 850–900 AD.[1175] Mati Mandel dates the Estonian examples even younger, to between 900 and 1000 AD.[1176] Räty has given the dating of 800–950 AD for the Finnish swords with type E hilts,[1177] whereas Salmo established a dating of ca. 800 AD or older,[1178] perhaps seeking to increase the number of Merovingian Period finds. Type E hilts may either be of Scandinavian origin, or they may have first been made in Continental Europe.[1179] Räty considers the type to be of Frankish origin, since the hilts were fitted well to the blades, and the blades are traditionally regarded as Frankish manufacture.[1180] In any case, the

1171 *Petersen 1919: 70, 182.*
1172 *Jakobsson 1992: 35; Jones 2002b: 18–19.*
1173 *Petersen 1919: 68; Walsh 1998: 226.*
1174 *Petersen 1919: 79, 182.*
1175 *Jakobsson 1992: 41; Jones 2002b: 18–19.*
1176 *Mandel 1991: 114–115.*
1177 *Räty 1983: 147.*
1178 *Salmo 1938.*
1179 *Von zur Mühlen 1975: 31.*
1180 *Räty 1983: 35.*

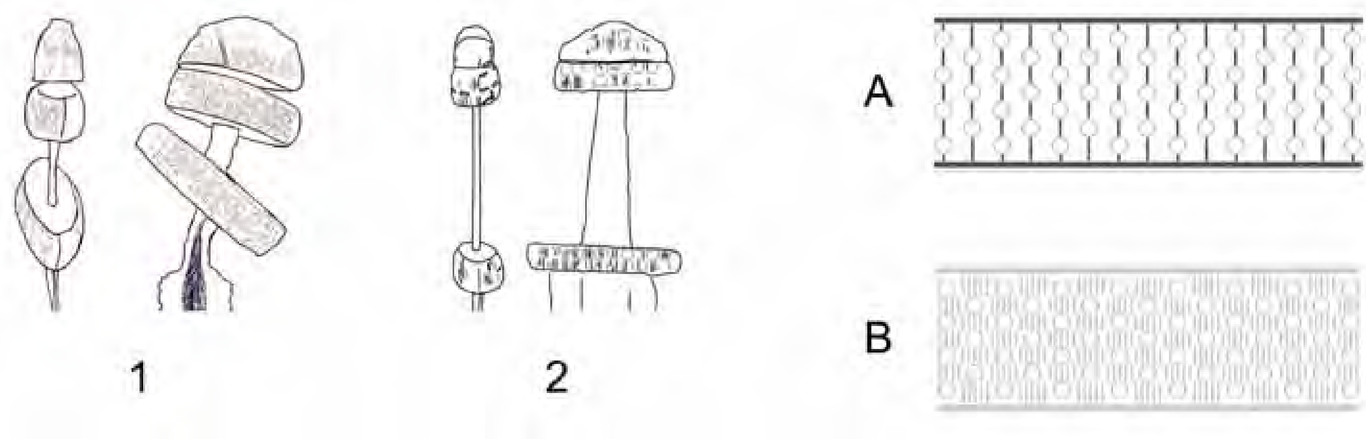


Figure 94. Variants of Petersen's type E: 1. Thick version decorated with round stamps (KM 13419:1), 2. more slender version with elongated stamps (KM 7752:1). Next to the hilts are schematic drawings of the two decoration variants evident in the type with round stamps: KM 13419:1 with copper-alloy wires (A), and KM 6196:1 with silver wires (B).

type is very widespread in Europe including Scandinavia, Russia, Ireland, the Baltic countries and Central Europe.[1181]

Three of these E types were decorated with round holes two to three millimetres in diameter. Three of these are clearly more massive – finds KM 6196:1 (Saltvik, Åland), KM 13419:1 (Turku) and LiuM 26 (Kangasala) – although their inlaid wires differ from each other (Fig. 94). The first one has only inlaid silver wires between the round holes, 22 wires per centimetre on average. The second hilt has a more robust inlay of ca. four wires per centimetre, having only brass wires instead of silver. Also, the rivet-holes observable in the lower guard may indicate an earlier type.[1182] The hilt from Loppi (KM 2345:1) with round stamps is of more slender and smaller form, and also lacking non-ferrous decoration, perhaps due to its poor condition. Sword KM 6196:1 has its hilt parts detached showing that the pommel (KM 6196:20) is completely hollow.

Sword KM 7752:1 from Salo is of slightly different form with exceptional decoration. Similarly, no rivets are observable between the pommel and the upper guard, and the hilt parts were forge-welded from two halves, including the pommel, which has a large, elongated cavity inside. The decoration consists of vertical and horizontal elongated pits, inlaid brass and/or silver wires between, roughly six wires per centimetre. Räty placed this particular find into a sub-group called E:1, while classifying all other type E finds in Finland as the E:2 type.[1183] This group also seems to be the earliest form of the type E hilt, perhaps deriving from the type D hilts with similar pit decoration in the form of crosses.

7.2.6. Petersen H

There are 23 type H hilts with blades with ferrous inlays (Fig. 95). The pommel of this type is three-sided in profile, relatively high, and sharp at its upper edge. The guards are wide and oval when viewed from the top, and their sides are rounded or ridged. In some rare cases, the pommel and the upper guard have fused into a single piece, and some hilts exhibit their tangs peened on the top of the pommel. The normal convention was for the tang to be peened on the upper guard and the pommel to be attached with one or two rivets. Non-ferrous wires and plates were used as decoration.

1181 *E.g. Arbman & Nilsson 1969: 166–168; Kazakevičius 1996: 27–28; Kirpichnikov 1966: 78–80; Mandel 1991: 114–115 ; von zur Mühlen 1975: 31; Nerman 1929: 66–68; Nordman 1943: 50; Petersen 1919: 31; Walsh 1998: 228–229.*

1182 *Petersen 1919: 72–73.*

1183 *Räty 1983: 29.*

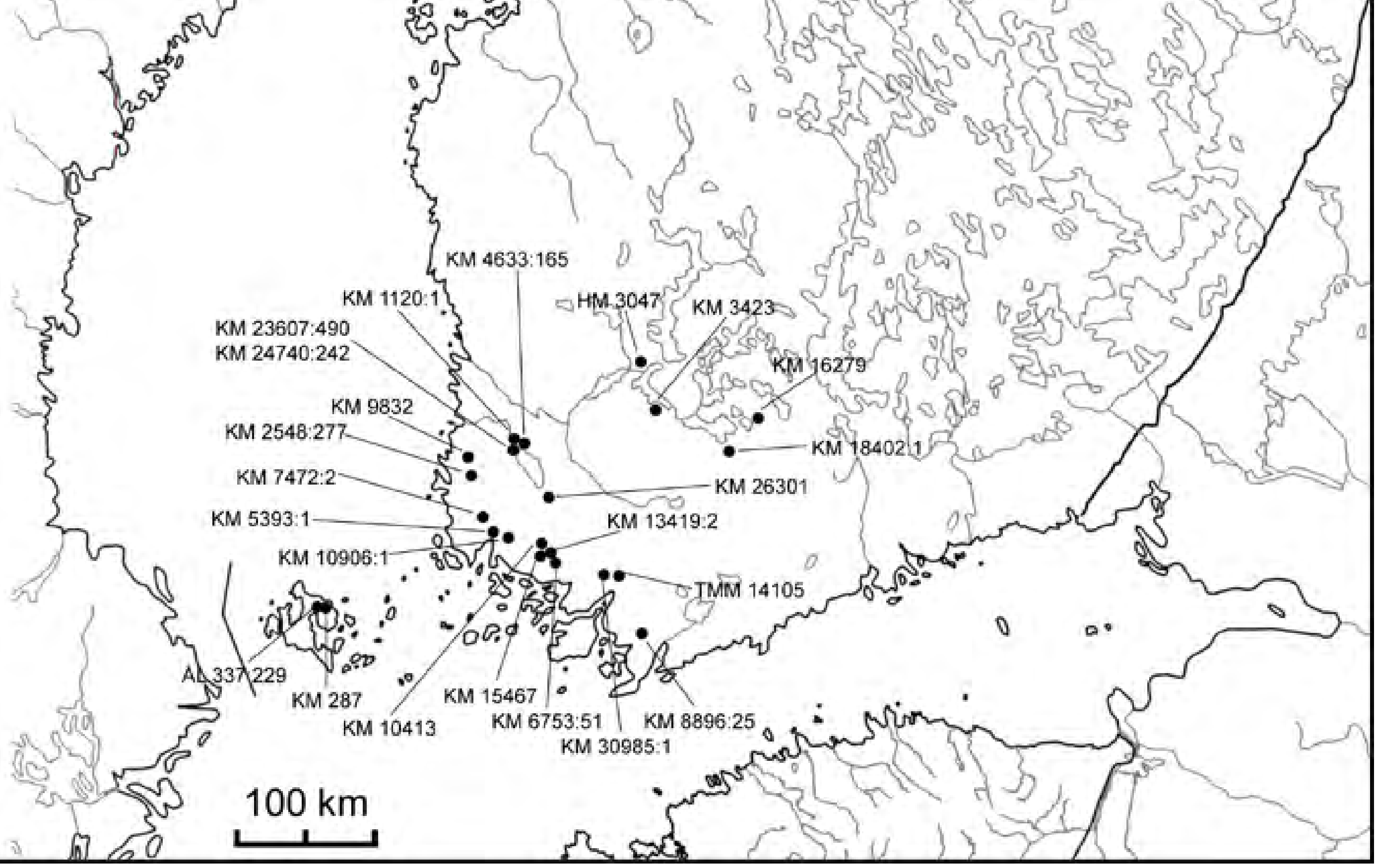


Figure 95. Hilts of Petersen's type H.

According to Petersen, the type dates roughly to between 750 and 950 AD.[1184] According to other authors, the type seems to have been created slightly later, during the last quarter of the 8th century or slightly later.[1185] Nørgård Jørgensen has included type H hilts as her own type number eight, and presented a more limited time of use for this type: ca. 830/40–900 AD according to Norwegian finds.[1186] The type corresponds to Geibig's type 5.1, dating from a. 790–970 AD.[1187] According to Räty, the Finnish material dates from between 775 and 975 AD.[1188] Helmer Salmo, in the same fashion as in the case of type E, dated H type hilts to ca. 800 AD or older.[1189] This may hold true in the case of some finds, but in general the type is much later. Types H and I may be regarded as variations of the same basic form, with type I developing from type H.[1190] The type is very widespread throughout Europe.[1191] Also in Finland, the spatial distribution of the type corresponds to the settled area of the Viking Age.[1192] The origin of this hilt type is once again under debate.[1193] It has been speculated that, for example in the Baltic countries, some versions of this hilt were made locally.[1194]

It is characteristic that all the examined hilts were assembled in such a manner that the pommel was attached to the upper guard with one or two rivets, and the tang did not extend beyond the upper guard. KM 9832 from Laitila has a loose pommel, which is completely hollow and still has one rivet. This pommel was attached to the upper guard with two rivets. The pommel of find KM 13419:2 from Turku exhibits a corroded structure indicating the forging direction. According to

1184 Petersen 1919: 99–100, 182.
1185 E.g. Jakobsson 1992: 35; Mandel 1991: 103, 114 and Jones 2002b: 18–19.
1186 Nørgård Jørgensen 1999: 75, 77, 134, 141–155.
1187 Geibig 1991: 151.
1188 Räty 1983: 147.
1189 Salmo 1938.
1190 Nordman 1943: 50; Räty 1983: 38.
1191 See e.g. Arbman 1937: 222–223; Arbman & Nilsson 1969: 168–170; Geibig 1991: 165; Kazakevičius 1996: 29–30; Kirpichnikov 1966: 27; Mandel 1991: 103, 114; von zur Mühlen 1975: 36–37; Naber 1976: 162, 164; Nerman 1929: 65; Petersen 1919: 94; Shetelig 1945: 45; Stein 1967: 80; Vinski 1983b: 473–474; Walsh 1998: 229–230.
1192 Räty 1983: 44–45.
1193 E.g. Arbman 1937: 223; Petersen 1919: 101–103; von zur Mühlen 1975: 36.
1194 Kazakevičius 1996: 33.

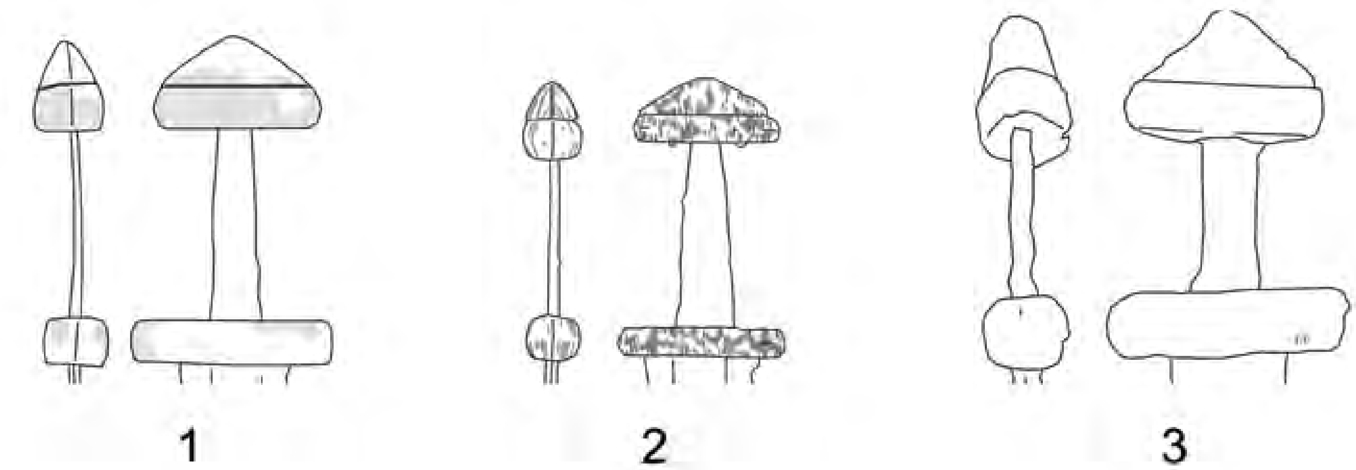


Figure 96. Variants of Petersen's type H: 1. The most common form of type H (KM 15467), 2. Type with low pommel (KM 6753:51), 3. Massive variant (KM 24740:242).

this striated pattern, the pommel has been forged into its pyramidal shape, possibly from a sheet of iron. Not many traces of welding seams can be detected in the parts of these twenty hilts. The lower guard of sword KM 3423 from Vesilahti shows a possible corroded seam at one end, indicating that the guard was made by bending a long bar around the tang or its template and welding the ends together. A similar phenomenon can be seen in the case of KM 6753:51 from Turku.

With regard to their dimensions, the hilts of type H are surprisingly similar, showing only minor variation. The only visible exceptions are as follows. Sword KM 6753:51 has similar proportions as the majority of these H type hilts, except that its pommel appears to be lower than in other examples (Fig. 96). This hilt has silver wires inlaid in it, more robustly than in the other H types studied here (twelve wires per centimetre), and also inlaid slightly tilted, while the others are vertically quite straight. Another exception is sword KM 24740:242 from Eura, with a very massive hilt about a centimetre larger in every proportion than any other hilt of type H. Nonetheless, this massive hilt was decorated with vertical wire inlays (ca. 22 grooves per centimetre).

All the other twenty type H hilts are principally of the same form, and the measurements vary only slightly. Again, the variation may be caused by the fact that every one of these hilts was created by a blacksmith, through craftsmanship that is based solely on the judgement and skills of the maker. In these hilts a number of decorative patterns and motifs were observable, all being based on vertical wire inlays. Commonly, the surface probably appeared to be covered completely with the non-ferrous metal (Fig. 97). Of these twenty type H hilts, seven have only copper-alloy wires, hammered in small grooves to cover the iron surface. Of these, two are identical in regard to the spacing of the grooves, i.e. fourteen grooves per centimetre on average, as well as in the inlaid material, which seems to be brass (finds KM 7472:2 from Vehmaa and KM 23607:490 from Eura). Three others have copper-alloy inlaid hilts with 11–13 grooves per centimetre (finds KM 15467 from Raisio, KM 8896:25 from Raasepori, and HM 3047 from Nokia), whereas the last one has ca. sixteen grooves along the same distance (KM 30985:1 from Salo). Of these, swords KM 8896:25 and KM 30985:1 had copper-alloy plates on the upper and lower surfaces of the lower guard still intact. The variation of grooves between eleven and thirteen grooves may be unimportant, since the work was done with hand tools, and is therefore variable in quality and detailed measures. It must also be noted that the materials of these hilts varied: KM 8896:25 was inlaid with copper, KM 15467 and KM 30985:1 with bronze, and HM 3047 with brass, at least according to the slight colour differences. The seventh type H hilt with copper-alloy wires (brass to be more precise) is from Saltvik (ÅL 337:229), and was not personally examined by me.

Apart from copper-alloy wires, two of the most common of type H hilts were inlaid with plain silver wire. The decoration of these two (finds KM 287 from Saltvik, Åland, and KM 5395:1

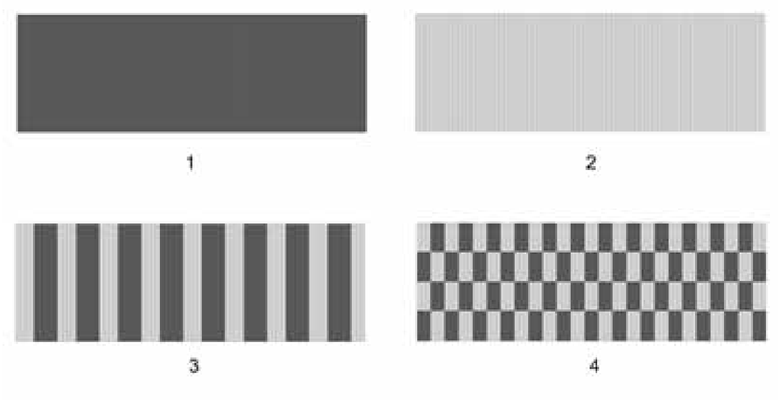


Figure 97. Schematic drawings of various decorative motifs on type H hilts, showing silver wires as lighter grey and copper-alloy wires as a darker grey shade: 1. Plain copper-alloy wires, 2. Plain silver wires, 3. Four silver and five copper-alloy wires in alternating rows (KM 2548:277), 4. Chequerboard pattern (KM 18402:1).

from Mynämäki) is identical, having sixteen grooves per centimetre.

There were also more complex designs among type H hilts in the form of alternating patterns of both silver and copper-alloy wires. A sword found in Laitila (KM 2548:277) has alternating four silver wires and five bronze wires to create wider streaks of white and yellow metals on the surface of the hilt parts. Although the resulting streaks were quite wide, the grooves were carved ca. 23 pieces per centimetre, indicating an excellent and detailed craftsman. A parallel to this hilt has been found in the Netherlands.[1195] Yet another different example is from Hämeenlinna (KM 18402:1), in which silver and copper wires have been arranged in a chequerboard pattern, ca. 24 grooves per centimetre.

Six other type H hilts clearly had grooves for vertical wire inlays, but the non-ferrous material was absent, i.e. either corroded away or melted on the cremation pyre. In one case among these, the frequency of inlaid wires per centimetre could not be counted (TMM 14105 from Salo). Of the remaining five cases, two seemed identical having 22 grooves per centimetre (finds KM 3423 from Vesilahti, and KM 13419:2 from Turku). The remaining three type H hilts had sixteen, eighteen and twenty wires per centimetre (swords KM 4633:165 from Eura and KM 26301 from Pöytyä, and KM 10906:1 from Nousiainen). Also, four more hilts can be categorized as belonging to this type, although the decoration and their grooves have corroded away (finds KM 1120:1 from Eura and KM 9832 from Laitila, KM 10413 from Lieto, and KM 16279 from Hämeenlinna).

7.2.7. Petersen I

Hilts of type I, often mixed with type H hilts because of their very small differences, number only five among the examined finds, one of these being an uncertain specimen of this type (Fig. 98). Type I is otherwise similar to type H except that the sharp upper edges of the pommel are curved inwards in profile, making the pommel look sharper at its tip. The guards are oval as in type H, but they are narrower and lower. The pommel was attached to the upper guard by means of riveting. The decoration consists of non-ferrous wires and plates. Type I is dated to between 850 and 950 AD,[1196] or even slightly later.[1197] Like type H, also type I is included in Geibig's type 5.1. And, like type H, this type too is very common in Viking Age Europe including Scandinavia, Russia, the British Isles, the Baltic countries and Central Europe.[1198] The origin of this type has usually been discussed and debated in connection with type H.

The dimensions of these type I hilts recorded in this work are almost the same, while the forms of decoration vary (Fig. 99). In only one case (KM 1822:1 from Eura) no decoration is visible any longer, having been destroyed by corrosion. A sword from Saltvik, Åland (KM 293) has plain inlaid silver wires, ca. 22 per centimetre, while sword KM 11859:1 from Mynämäki had both silver and bronze wires in alternating rows, approximately twenty wires per centimetre. The hilt of a sword found in Sauvo (KM 9243:1) is slightly stouter than the others, and has a vivid

1195 *Ypey 1986. Correspondingly, the blade of this sword as well as the find from Laitila also had an ULFBERHT inscription.*
1196 *Petersen 1919: 104–105, 182.*
1197 *Jones 2002b: 18–19.*
1198 *E.g. Kazakevičius 1996: 34; Petersen 1919: 104–105; Walsh 1998: 229–230.*

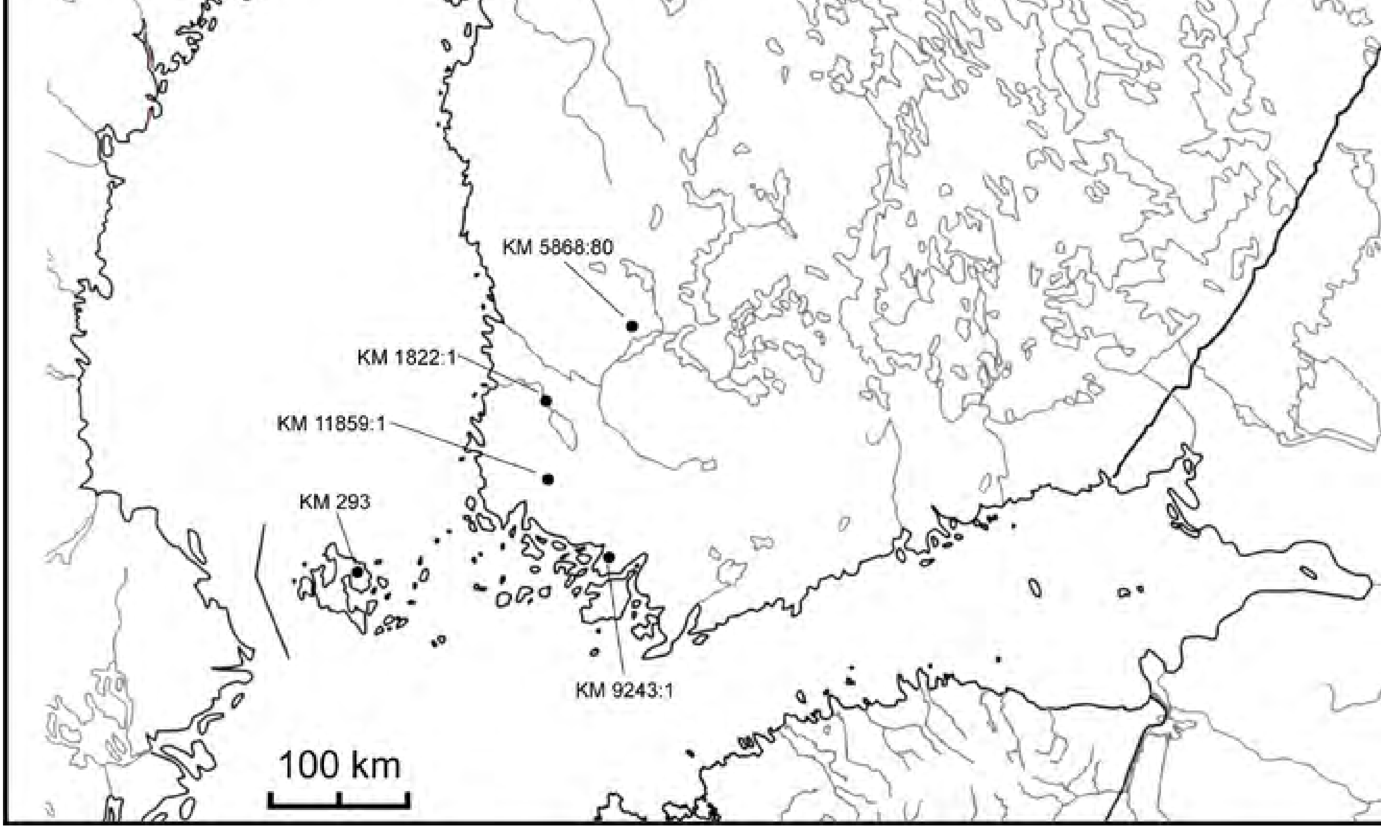


Figure 98.
Hilts of Petersen's type I.

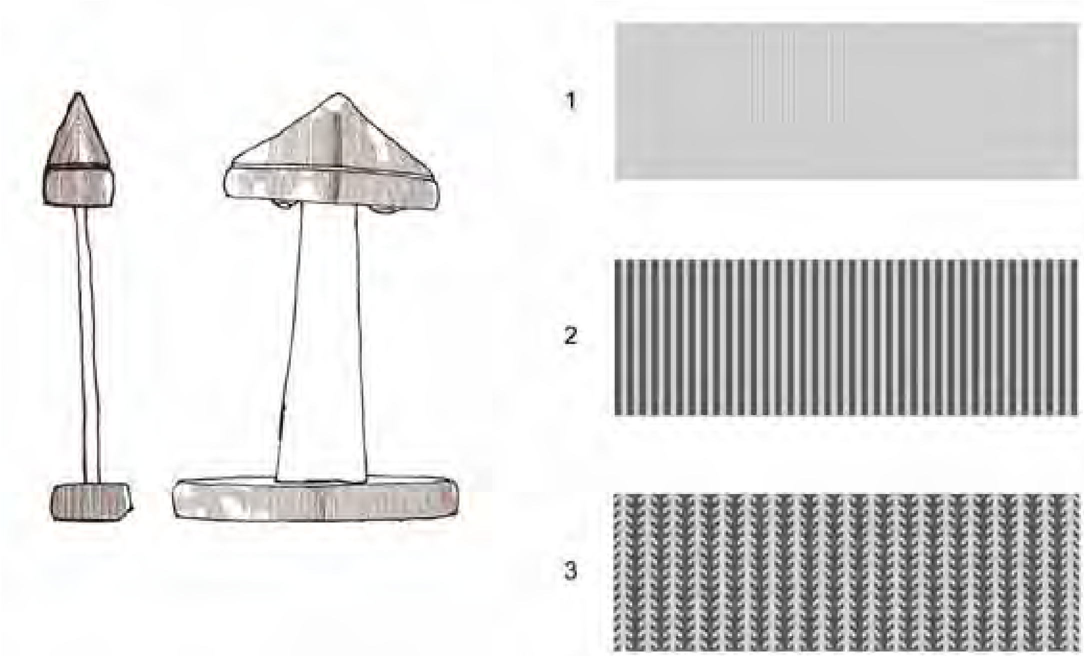


Figure 99.
Variations in the decoration of type I hilts, showing silver wires as lighter grey and copper-alloy wires as a darker grey hue: 1. Plain silver wire (KM 293), 2. Alternating copper-alloy and silver wires (KM 11859:1), 3. Herringbone motif made of copper and silver wires (KM 9243:1).

decoration motif on it. The main pattern consists of alternating straight and twisted wires (ca. fourteen per centimetre), which are arranged in the following way: a straight silver wire is lined on both sides with silver and copper wires twisted together to create a herringbone effect, and these 'herringbones' are placed side by side by having one copper-alloy wire between the motifs. There is also a strand of twisted copper wires in the groove between the pommel and the upper guard. Sword KM 5868:80 from Sastamala was not personally studied by the present author, and it is stated in previous studies as having a type I hilt.

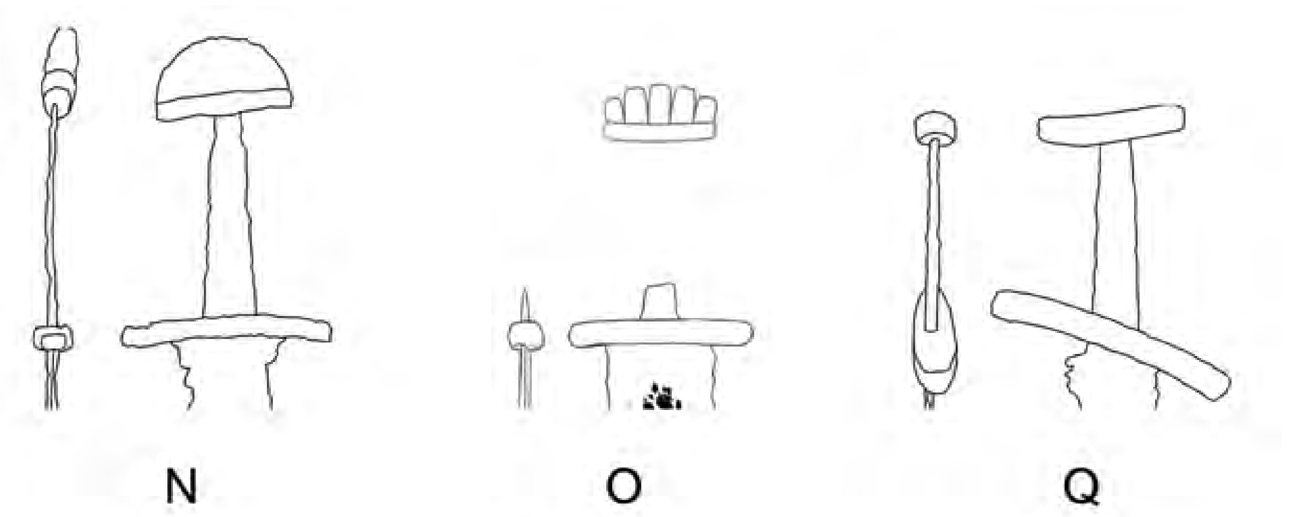


Figure 100. Petersen's types N (KM 2361), O (SatM 12563), and Q (KM 2548:196). The only example of type O in the studied material consists of a lower guard, and for this reason the normal form of the pommel of type O accompanies the drawing of the find.

7.2.8. Petersen N

Two hilts of type N have been documented, one of them being somewhat unclear. Type N has a pommel of semi-circular profile and almost even thickness. Both guards are thin and plate-like, and usually somewhat ridged along their sides. Non-ferrous decoration has not been applied. The type has been dated broadly to 850–900 AD, and it may originate from Norway or some neighbouring area.[1199] Type N is similar to Geibig's type eight, dated to between 830 and 880 AD.[1200]

The pommel and upper guard of sword KM 2361 from Eura have been attached only by the tang, which also passes through the pommel (Fig. 100). Jouko Räty has classified this find as an earlier variant of Petersen's type X.[1201] Another sword from Eura (KM 11063:283) may also be of this type, although corrosion and missing pommel make the definition very hard. The hilt parts of KM 11063:283 appear to be slightly thicker, provided that the sword really belongs to type N.

7.2.9. Petersen O

The pommel of this type is five-lobed in such a manner that the lobes are separated from each other, pointing in slightly different directions. Both guards are slightly curved in profile and of relatively equal width, with their ends also slightly rounded. The tang was peened on the upper guard, while the pommel is attached to the upper guard with rivets. According to Petersen, hilts of type O may be divided into three separate groups. The first of these consists of parts cast in bronze or some other copper-alloy metal. The second variant has iron hilt parts inlaid or overlaid with silver. The third subtype has iron parts, decorated with vertical inlays of non-ferrous wires, also having a lower pommel and straighter guards. Type O may be seen as having developed from type K, but the locality in which this occurred remains uncertain.[1202] Swords of type O has been found in Norway, Sweden, Germany, Iceland, and the British Isles, among other regions.[1203] The

1199 *Petersen 1919: 126, 182.*
1200 *Geibig 1991: 151.*
1201 *Räty 1983: 72–74.*
1202 *E.g. Arbman 1937: 226; Petersen 1919: 132. The pommel of type K is also five-lobed, but the lobes all point directly upwards, thus being attached to each other.*
1203 *E.g. Arbman 1937: 226; Eldjárn 2000: 87–91, 324–325, 560; Geibig 1991: 161; Petersen 1919: 126; Shetelig 1945: 51.*

type is dated to 900–950 AD.[1204] In Geibig's system, variations of finds of this type are included in combination type nine, also dated to between 900 and 950 AD.[1205]

There is one uncertain and single example of type O from Kokemäki (SatM 12563). It belongs to Petersen's third kind of variant of type O, which has characteristically a straight lower guard made of iron and covered with vertical wire inlays. This particular lower guard from Kokemäki is covered in bronze inlays (ca. 25 per centimetre) to hide all of the iron surface. Once again the classification of this hilt is problematic, since no pommel or upper guard has been preserved.

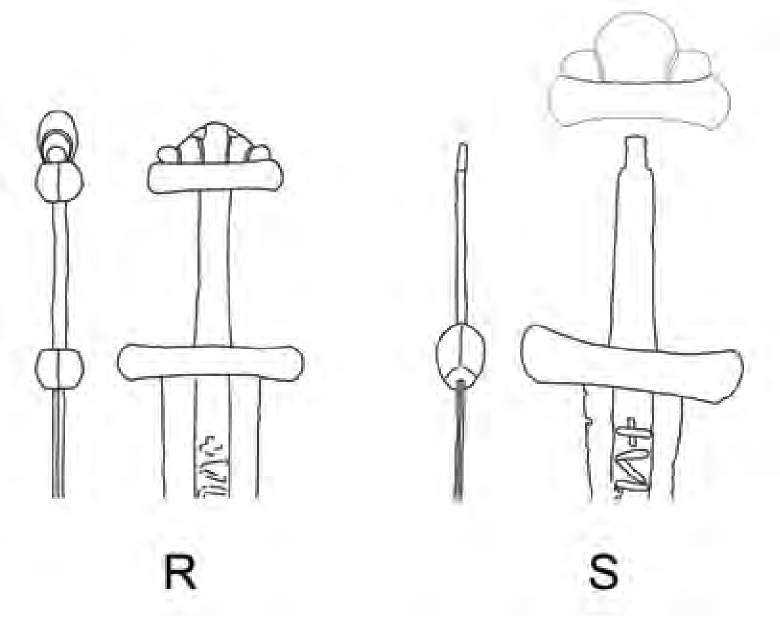
7.2.10. Petersen Q

Type Q hilts lack the pommel, consisting of only upper and lower guards. The guards are slightly curved away from the grip, at the same time widening towards their ends. When viewed from the top, the guards are relatively oval in form but still even at their ends. The tang was attached to the upper guard, since no pommel exists. Furthermore, the parts of the hilt do not display any traces of decoration. Type Q probably developed from type M in Norwegian territory.[1206] The type has been found in Scandinavia and also in Latvia and Iceland,[1207] dating from between 900 and 1000 AD according to Petersen,[1208] but it may have been in use a quarter of a century longer.[1209] An example of type Q has been found in Laitila (KM 2548:196).

7.2.11. Petersen R

There are two hilts of type R among the examined finds. The pommel of type R is three-lobed in the sense that the central lobe is the highest and thickest, and the side lobes are in the form of some kinds of animal heads. The pommel may also be interpreted as consisting of five lobes, because the large centre lobe is grooved to make it look as if it has three separate lobes itself. The guards are oval when viewed from the top, and their ends are widened when viewed in profile. Both guards are rounded at their sides. The pommel was attached to the upper guard with rivets, and the tang was peened on or inside the upper guard. The decoration is executed with non-ferrous wires and plates, attached normally to a hatched surface.

Figure 101. Petersen's types R (KM 27141:1) and S (KM 1174:2). Again, the type S hilt is without a pommel, and therefore a typical one has been drawn alongside to illustrate the complete type.



The type is dated to between 900 and 950 AD as stated by Petersen.[1210] Again, the type may have been taken into use and disappeared a quarter of a century later.[1211] Both types R and S are included in Geibig's type ten, dated to 900–1010 AD.[1212] The Finnish type R swords are dated to 975–1025 AD by Räty.[1213] The type resembles type S, but is more

1204 Petersen 1919: 129, 182.
1205 Geibig 1991: 151.
1206 Petersen 1919:121.
1207 E.g. Brøndsted 1936: 188; Eldjárn 2000: 177–184, 189, 326–328, 330, 576, 578; Nerman 1929: 73–74; Petersen 1919: 140.
1208 Petersen 1919: 139, 182.
1209 Jakobsson 1992: 49; Jones 2002b: 18–19.
1210 Petersen 1919: 141–142, 182.
1211 Jakobsson 1992: 41; Jones 2002b: 18–19.
1212 Geibig 1991: 151,
1213 Räty 1983: 147.

short-lived. This type is claimed to be Frankish or west-European.[1214] Type R swords have also been found in various parts of Europe, such as Scandinavia, France, the British Isles, Poland, Hungary, and Romania.[1215]

Find KM 3052:2 from Mynämäki lacks a pommel, and the upper guard appears to have been forged hollow. In find KM 27141:1 from Hämeenlinna also the pommel appears to be hollow, and, according to radiographic images, it was attached to the upper guard with a curved iron rivet. Both hilts are of approximately the same size. The sword from Hämeenlinna (Fig. 101) is covered by a thick layer of fire patina, but some indications of silver decoration can be observed. The sword from Mynämäki, on the other hand, bears traces of silver and also small patches of hatched surface, onto which the silver was applied. The hatching was done in this case in only one direction, with approximately 28 chisel strokes per centimetre.

7.2.12. Petersen S

There are only two examples of type S. The overall shape resembles type R. The pommel is either three- or five-lobed, having the central lobe clearly the highest and thickest. Compared to type R, the pommel is higher and plumper. The upper and lower guards are oval when viewed from the top, and their ends are widened. In addition, the guards are more curved than in type R. The construction of the hilt is, in principle, the same as in type R, as well as the techniques of decoration.

Petersen dated this type to the latter half of the Viking Age, ca. 900–1000 AD.[1216] Later, the dating was shifted by a quarter of a century younger at both ends,[1217] according to Estonian material as far as 1100 AD.[1218] Geibig dates the type to between 900 and 1010 AD with reference to German finds.[1219] Type S swords also have a wide distribution, and they have been found in Scandinavia, the British Isles, France, Germany, Poland, Hungary, Romania, Russia, the Baltic countries, and even in Iceland.[1220]

Both finds examined here (KM 1174:2 from Kokemäki and KM 4254 from Lempäälä) have only the lower guards remaining, and are of almost the same size. The sword from Kokemäki has traces of silver on its surface, and a surface hatched in two opposite directions (ca. 26 grooves per centimetre). The Lempäälä hilt has only its hatched surface left. The density of hatches is almost the same, ca. 25 grooves/centimetre, but the hatching was done in even three directions. In both cases the surface of the hilt was covered with silver, probably having copper-alloy wires to create a geometric or animal-related pattern on the surface.[1221]

1214 E.g. Petersen 1919: 141.
1215 E.g. Geibig 1991: 161; Gjessing 1931: 253; Müller-Wille 1973: 68; Räty 1983: 53.
1216 Petersen 1919: 148, 182.
1217 Jakobsson 1992: 41; Jones 2002b: 18–19.
1218 Mandel 1991: 115.
1219 Geibig 1991: 151. Like type R, also type S is included in Geibig's combination type number ten.
1220 E.g. Eldjárn 2000: 94–98, 324–326, 328–329, 560–561; Geibig 1991: 161; Kazakevičius 1996: 42–44; Mandel 1991: 115; Müller-Wille 1973: 102–107; Naber 1976: 164–165; Räty 1983: 55.
1221 See illustrations in e.g. Jones 2002b: 18–19.

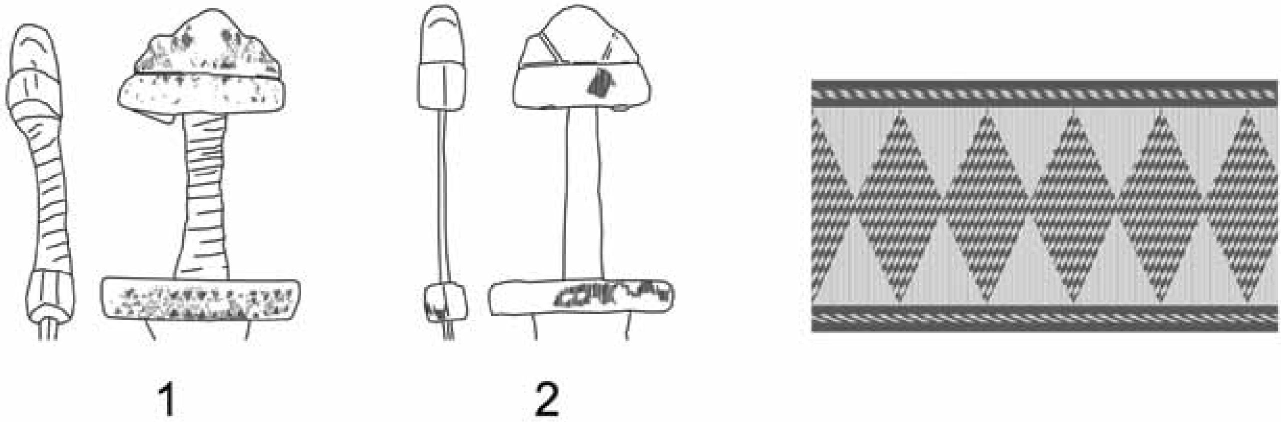


Figure 102. Variations of Petersen's type T2: 1. The common form (KM 8602:130), 2. Variant with a thicker pommel (KM 3699:3). On the right is a schematic drawing of the decoration (light = silver, dark = copper alloy) as in KM 8602:130.

7.2.13. Petersen T

Three type T finds were investigated in the present study. The pommel of type T is of three parts, the side lobes bear a slight resemblance to animal heads. The central lobe is highest, widest and thickest. The guards are almost straight-sided, rectangular in their cross-section, oval in form when viewed from the top, and sometimes slightly rounded at the sides. The ends of both guards are bent slightly away from the grip. The pommel was attached to the upper guard with rivets, the tang being flattened on the upper guard. According to Petersen, this type has two sub-groups. The first group includes hilts decorated with silver, animal ornaments and circular stamps or holes. The second group consists of hilts decorated with non-ferrous wires in the form of lozenge or rhombic motifs.

All type T hilts recorded here belong to the variant having rhombic or lozenge figures made of non-ferrous overlays, referred to here as T2. This variant of type T is dated by Petersen and other authors to 950–1000 AD, i.e. to the late Viking Age.[1222] Räty dates this type between 950 and 1025 AD.[1223] This apparently Frankish type[1224] also has a wide spatial distribution: Scandinavia, Russia, the Baltic countries and Germany.[1225] According to their spatial distribution, Jouko Räty has considered these hilts to belong to Varangians or other people exploring the east.[1226]

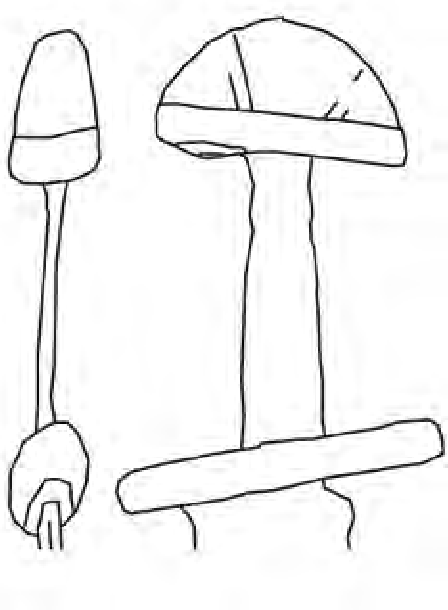


Figure 103. Sword of possibly Petersen's type U (KM 10390:3).

All three hilts studied here have their pommel attached to the upper guard by rivets. The lower guard of find KM 3699:3 from Nousiainen shows a corroded welding seam indicating that the guard was forge-welded by bending a long iron bar in twice.

In terms of form, the sword from Nousiainen looks stouter since it has a shorter pommel and upper guard than other two hilts of this type (Fig. 102). The decoration on the hilt of the sword from Nousiainen was applied in grooves ca. 29 per centimetre, and from both brass and silver wires, traces of which are faintly visible. The other two swords of this type, one from Köyliö (KM 8602:130) and one from Sysmä (KM 31017:1), have clear lozenge patterns executed from pieces of silver and

1222 Petersen 1919: 152, 183.
1223 Räty 1983: 147.
1224 Petersen 1919: 153.
1225 E.g. Kazakevičius 1996: 45–46; Kirpichnikov 1966: 78; Mandel 1991: 115–118; von zur Mühlen 1975: 33; Naber 1976: 162–163; Nerman 1929: 82; Nordman 1943: 53; Petersen 1919: 150–151; Selirand 1974: 117.
1226 Räty 1983: 62.

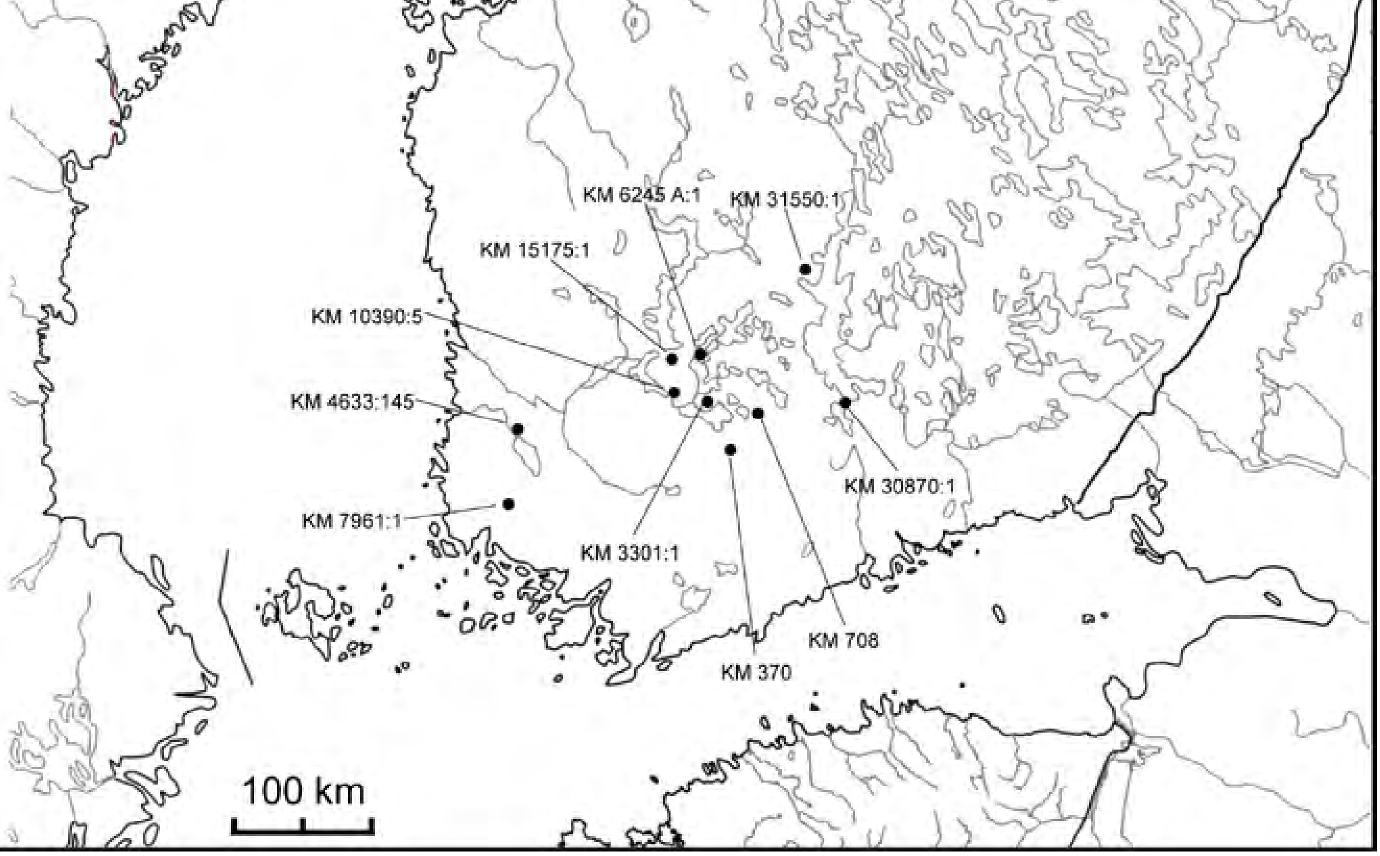


Figure 104. Hilts of Petersen's type V.

copper-alloy wires twisted together, the hilt from Köyliö displaying copper and brass in addition to silver. The spaces between were filled with triangular designs again assembled from strands of silver wire to completely cover the iron surface. Hilts of both finds, from Köyliö and Sysmä, seem identical also in the respect of the hatched surface. The hatching was executed in two directions, having 23 grooves per centimetre on average. Hilts of similar appearance have also been found in Russia.[1227]

7.2.14. Petersen U

One possible case of type U is known from Vesilahti (KM 10390:3, Fig. 103). No traces of non-ferrous decoration are visible, but they may have been lost due to corrosion, if they ever existed. The pommel of type U is of three-part appearance and somewhat low in height, the central lobe being the highest and widest. The pommel is of almost even thickness. The guards are oval when viewed from the top and low in profile. The pommel was attached to the upper guard with rivets. The decoration was applied with inlaid wires and plates. This type is dated to ca. 900–950 AD by Petersen,[1228] but other researchers give it a longer time span, between 900 and 1000 AD.[1229] Geibig has placed type U swords in his combination type eleven, which includes type W swords and is dated to 900–950 AD.[1230] The origin of this type is somewhere outside Norway according to Petersen, and the spatial distribution includes Norway, Denmark, Russia and Lithuania.[1231]

1227 Kirpichnikov 1966: 28, 78–79, 82–83.
1228 Petersen 1919: 153–154, 182.
1229 Jakobsson 1992: 41; Jones 2002b: 18–19.
1230 Geibig 1991: 151.
1231 E.g. Geibig 1991: 161; Kazakevičius 1996: 59–60; Petersen 1919: 153–154.

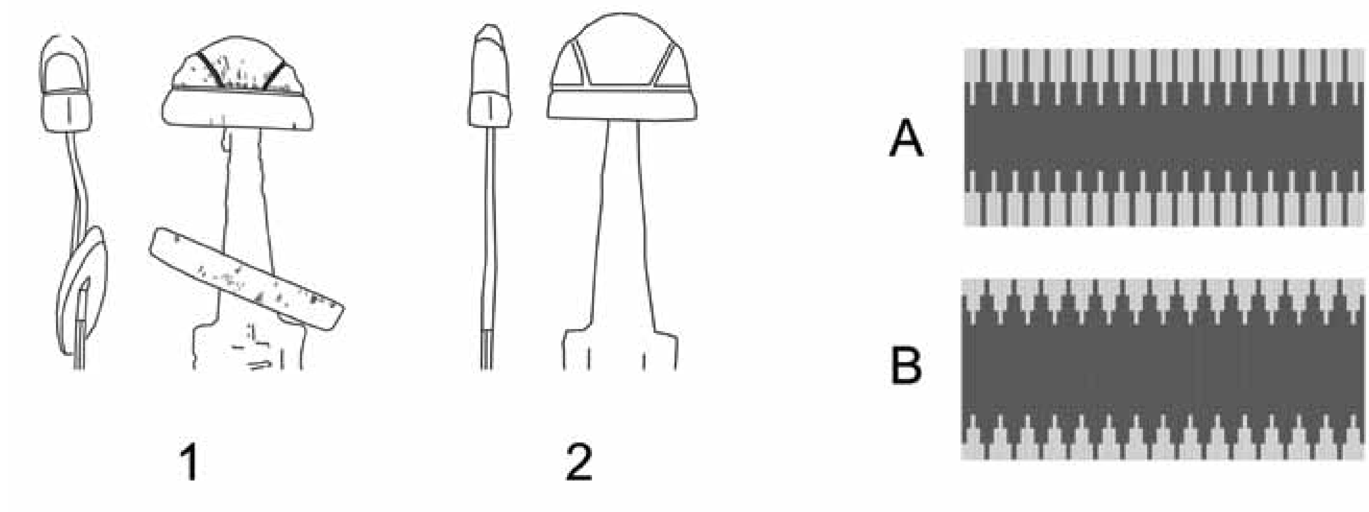


Figure 105. Two variants of Petersen's type V as observed in the studied finds: 1. The common type (KM 30870:1), 2. A variant with a higher pommel (KM 708). Next to the hilts are two variants of the decoration observable in the common type, both made from silver (lighter) and copper-alloy (darker) wires: KM 6245 A:1 (A) and KM 15175:1 (B).

7.2.15. Petersen V

Type V hilts are quite common with a total of ten examples, four of which, however, are slightly uncertain (Fig. 104). Again, the pommel is of three parts and relatively high. The lobes or parts of the pommel do not stand out markedly from each other. The pommel is also of quite even thickness. Both guards are relatively thick and oval. In profile, the corners of the guards are slightly rounded. The tang was peened on the upper guard, the pommel being then riveted to the same guard. Non-ferrous wires and plates were used as decoration. While Petersen dates this type to between 900 and 950 AD,[1232] its time of use may have been slightly later, ca. 925–1000 AD,[1233] or even as late as 1050 AD.[1234] Räty suggests a dating of ca. 950–1025 AD in the case of Finnish finds.[1235] Overall, the finds in Finland show a clear concentration in Tavastia.[1236] In Europe, hilts of this type have been found in Ireland, Scandinavia, France, Germany, Russia, Iceland, and the Baltic countries.[1237]

Type V is sometimes hard to distinguish from hilts of type T2, especially when corroded. The method of the pommel attachment is similar in both types. Find KM 3301:1 from Valkeakoski is without a pommel, at the same time revealing that the upper guard is hollow with the tang peened inside it. Also finds KM 6245 A:1 from Kangasala, KM 15175:1 from Tampere, and KM 31550:1 from Jämsä have a hollow upper guard of this kind. Both the pommel and the upper guard of sword KM 4633:145 from Eura are hollow; no rivets are intact any more, if they ever existed, and the tang extends all the way to the pommel.

The decoration was applied from non-ferrous wires, normally in the form of lozenge patterns, on which basis some of the hilts have been classified here. According to their form, the variation is almost unnoticeable. Variations of few millimetres in their measurements can be reckoned due to blacksmith's handiwork. Only the find from Hämeenlinna (KM 708) has distinctly higher pommel than other examples recorded here (Fig. 105). Due to corrosion, no decoration is visible any longer on this hilt. Another sword with only the lower guard preserved and thus questionably belonging to type V (KM 10390:5 from Vesilahti) has also a badly corroded surface, with no traces of decoration.

1232 *Petersen 1919: 155–156, 182.*
1233 *Jakobsson 1992: 41; Jones 2002b: 18–19.*
1234 *Mandel 1991: 118.*
1235 *Räty 1983: 147.*
1236 *Räty 1983: 64.*
1237 *E.g. Arbman & Nilsson 1969: 164–165; Brøndsted 1936; Eldjárn 2000: 330; Kazakevičius 1996: 61–62; Kirpichnikov 1966: 31; La Baume 1954: 85; Mandel 1991: 118; von zur Mühlen 1975: 36; Müller-Wille 1970: 71–72, 85; Petersen 1919: 155; Räty 1983: 66; Tischler 1941: 96–99.*

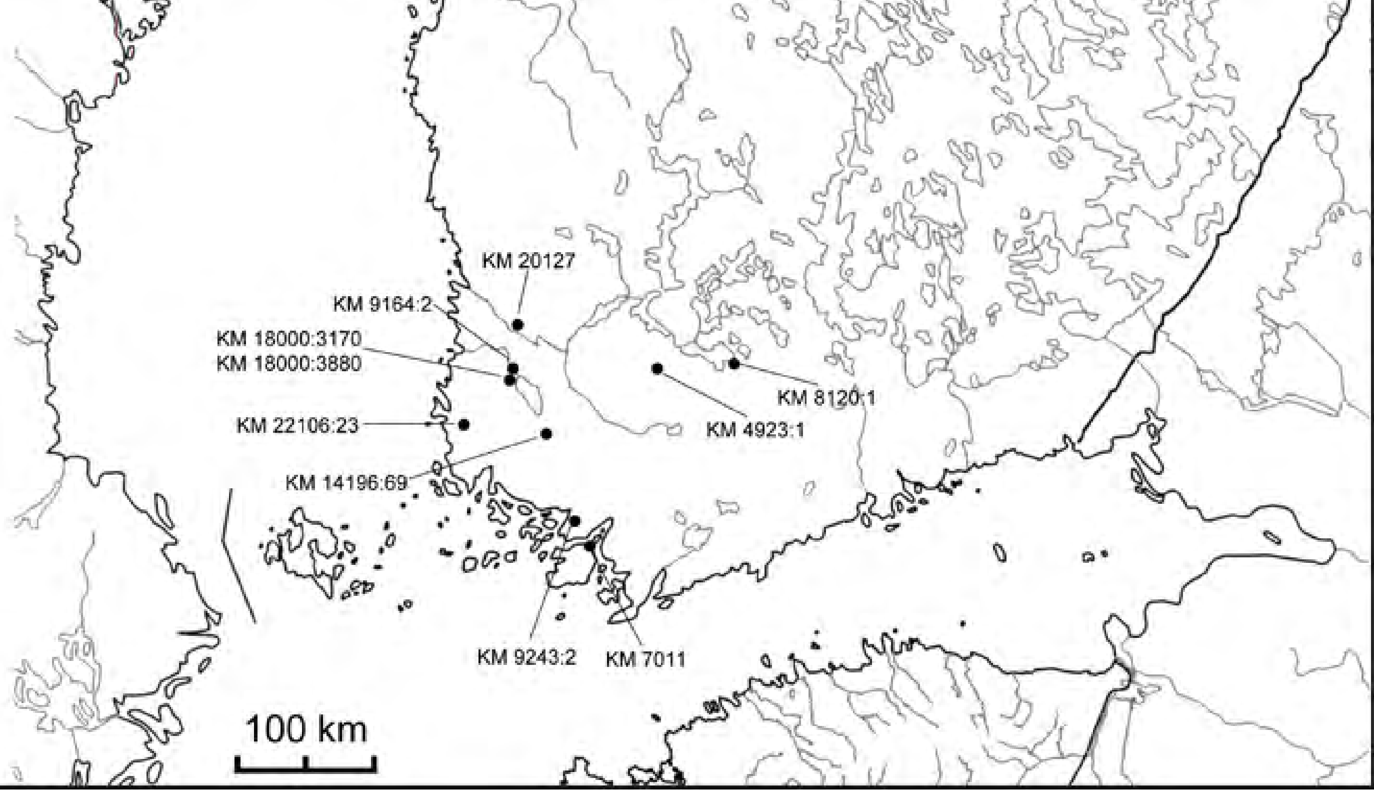


Figure 106. Hilts of Petersen's type X.

The other seven hilts of type V all have non-ferrous decoration in the form of inlaid wires. In two cases only silver could be detected (finds KM 370 from Hämeenlinna and KM 7961:1 from Mynämäki). Due to corrosion, no patterning could be observed. The number of grooves in which the wires had been inlaid varied, being 35/cm in KM 370 and 26/cm in KM 7961:1. In other words, the latter of these two was executed more robustly, having thicker wire inlaid in its surface. In addition to silver, also bronze wire could be observed in sword KM 3301:1 from Valkeakoski, with ca. 22 wires inlaid per centimetre.

In a total of four cases, lozenge patterns could be seen on the surface of the hilt parts, assembled from copper-alloy and silver wires. Two of these hilts showing clear patterns were identical in regard to the inlaid wires, since both had 26 wires per centimetre on average(finds KM 6245 A:1 from Kangasala and KM 31550:1 from Jämsä), both also having bronze wires inlaid with silver. Close to these finds and perhaps of the same origin is the hilt of sword KM 30870:1 from Asikkala, with 25 wires per centimetre, also having brass wires instead of bronze. In this hilt also twisted silver wires were partially preserved in the cavities in the pommel and between the pommel and the upper guard. Sword KM 15175:1 from Tampere had about 28 wires per centimetre, being also almost identical to the above-described three sword hilts, except in materials, which in this case looked like silver and brass. It must be noted that the patterns in finds KM 15175:1 and KM 6245 A:1 were slightly different, the latter being completed with fewer wires, thus creating a simpler-looking lozenge pattern.

7.2.16. Petersen X (later variant)

Of type X, only its later variant is known among the studied finds in a total of eleven cases, one of which is uncertain (Fig. 106). In addition, one type X pommel is attached with an R or S type lower guard (KM 9164:3 from Eura). In general, type X has no upper guard but only the pommel. Petersen regards the type as dividing into an earlier and a later variant, in which the earlier one has a groove-decorated pommel representing an upper guard and a tripartite pommel. The pommel of the later variant is lower and shorter, but correspondingly thicker and without any grooves. The lower guard of the earlier variant curves slightly downwards and tapers towards the ends when viewed from the top, resembling the lower guard of type Q. The lower guard of the later variant is longer and more slender, and rectangular in cross-section. The tang was flattened on the top

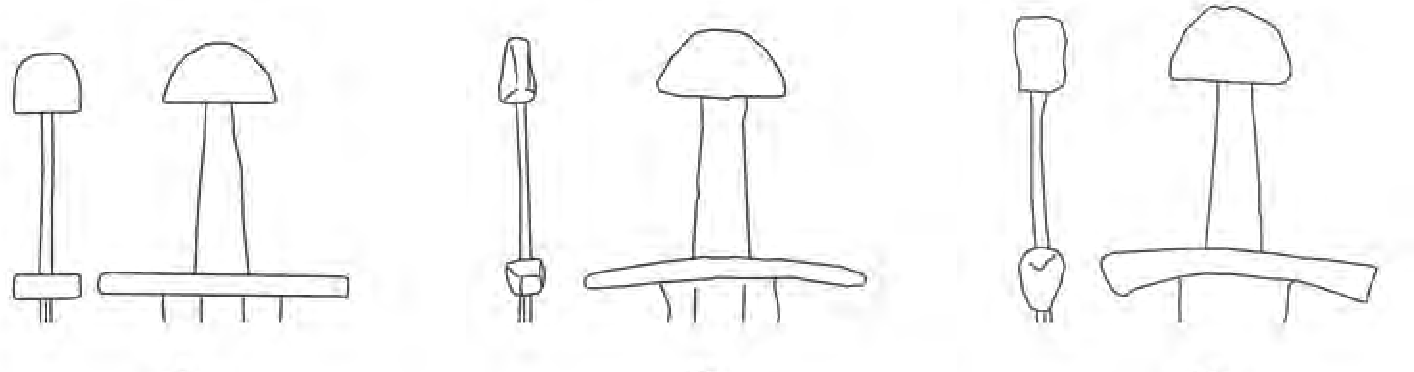


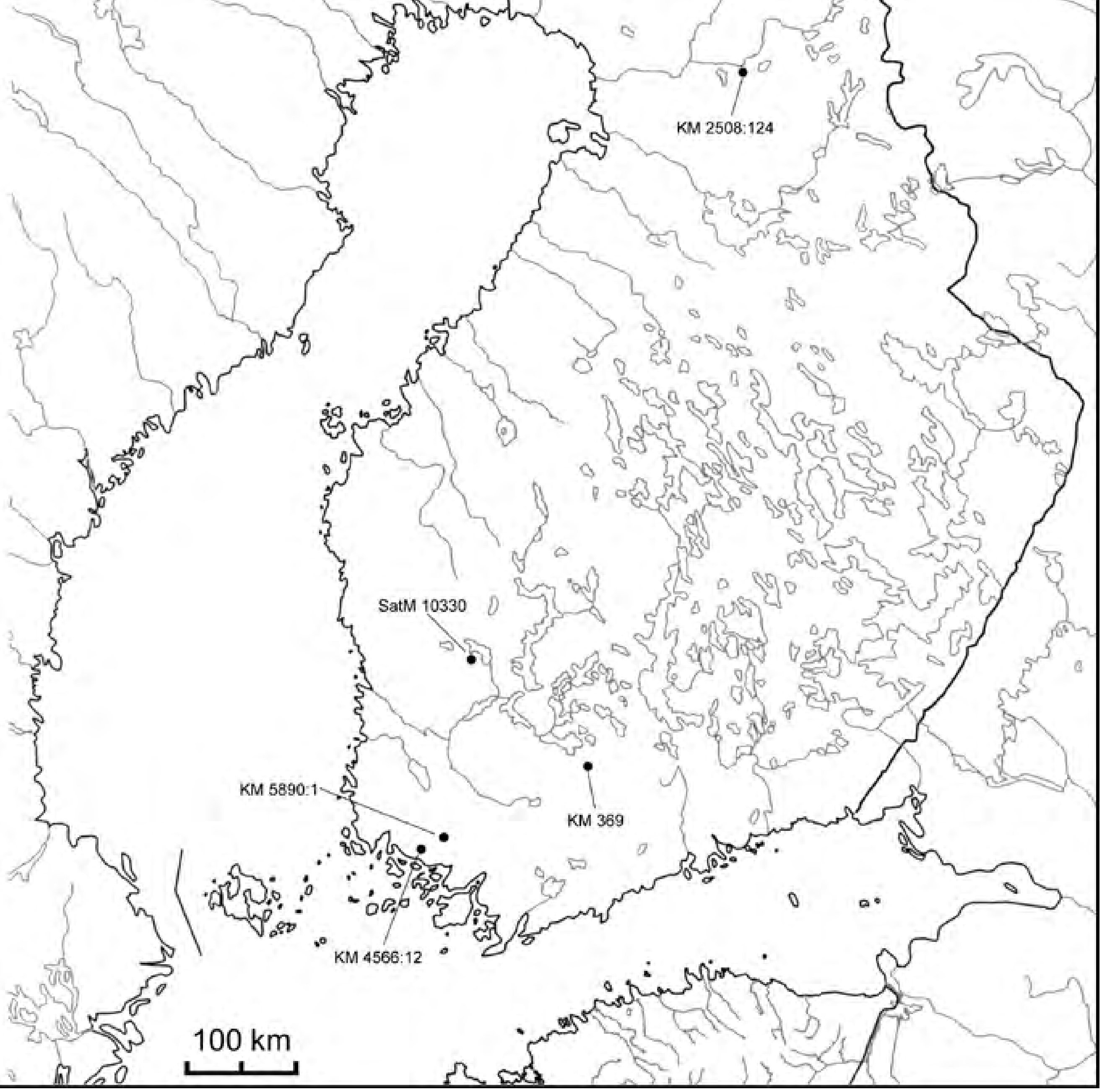
Figure 107. Variants of lower guards observable in Petersen's type X: 1. Straight guard (KM 8120:1), 2. Ends of the guard slightly curved downwards (KM 14196:69), 3. Curved guard with flattened ends (KM 18000:3170).

of the pommel, and the parts of the hilt do not have any non-ferrous decoration. Jouko Räty also distinguishes a third variant (X:3), which has upwardly turned edges of the pommel, thus developing towards a brazil-nut form.[1238]

While Petersen dates the type to between 900 and 1000 AD,[1239] other scholars have placed it chronologically younger, appearing ca. 950 AD and remaining in use until the 11th century.[1240] In Geibig's system, type X swords are placed in the combination types 12.1 and 15.3, dating from 850–1000 AD and 950–1180 AD, correspondingly.[1241] Of these two, type 12.1 is much closer to type X as defined by Petersen. Ada Bruhn Hoffmeyer included the pommel of type X in her group of transitional hilt forms, dating from ca. 1100–1150.[1242] The type has been characterized as Germanic, and is widely known from Central Europe, Scandinavia, the Baltic countries, the British Isles, and even Iceland.[1243] Kazakevičius considers the Baltic examples as possible local manufacture, since the type is very simple in appearance and technology.[1244]

The fluctuation in the dimensions of the pommels is quite small. Only the pommels of the swords from Hattula (KM 8120:1) and Sauvo (KM 9243:2) are clearly thicker than others. The pommel of sword KM 14196:69 from Pöytyä has been classified by Räty in his category X:3.[1245] Instead of pommels, the lower guards display more variation (Fig. 107).[1246] This variation has been previously connected to individual makers or centres of production, as well as chronological matters.[1247] The simplest ones are straight and flat iron bars, appearing in seven swords (KM 3131:6 from Akaa, KM 4923:1 from Urjala, KM 7011 from Kemiönsaari, KM 8120:1 from Hattula, KM 9243:2 from Sauvo, KM 18000:3880 from Eura, and KM 22106:23 from Uusikaupunki). A note must be made of sword KM 3131:6, which is lacking the pommel. The lower guards in swords KM 14196:69 from Pöytyä and KM 20127 from Kokemäki have somewhat downwardly curved ends. In finds KM 9164:2 and KM 18000:3170, both from Eura, the lower guard is also curved, and also flattened at the ends, the latter being more slender in appearance.

1238 *Räty 1983: 76–77.*
1239 *Petersen 1919: 165, 183.*
1240 *Jakobsson 1992: 57; Mandel 1991: 119 and Jones 2002b: 18–19.*
1241 *Geibig 1991: 151.*
1242 *Bruhn Hoffmeyer 1954: 34–36.*
1243 *E.g. Arbman 1937: 227; Bakay 1967: 169; Eldjárn 2000: 329; Geibig 1991: 169; Kazakevičius 1996: 67–68; Mandel 1991: 119; Petersen 1919: 158; Strömberg 1961: 138; Walsh 1998: 232–233.*
1244 *Kazakevičius 1996: 70.*
1245 *Räty 1983: 76–77.*
1246 *This was also observed in connection with X-type swords recovered from the Luistari cemetery in Eura (Lehtosalo-Hilander 1982b: 13.*
1247 *Kivikoski 1938: 210.*



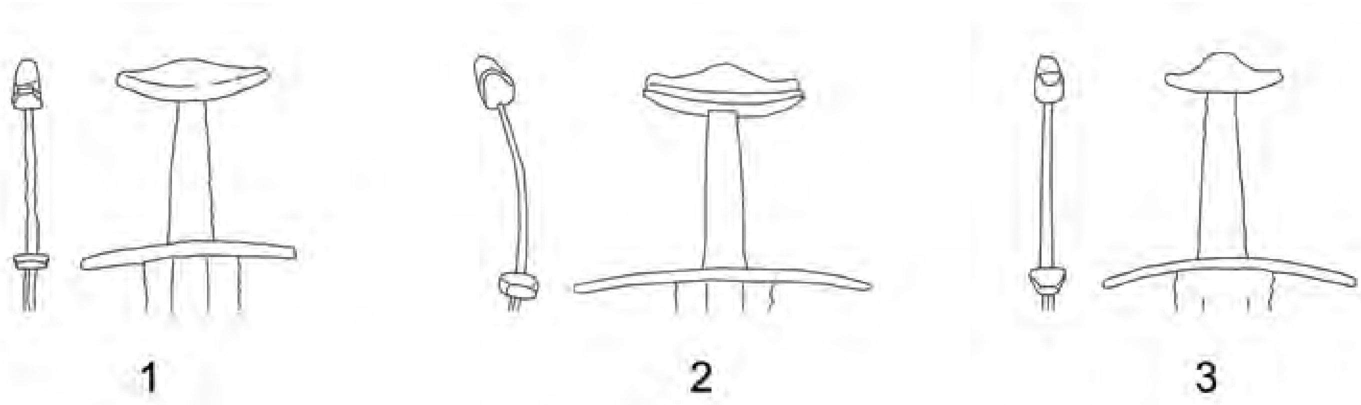
7.2.17. Petersen Y

Figure 108. Hilts of Petersen's type Y.

The studied finds include a total of five hilts of type Y (Fig. 108). This type also lacks the upper guard. The pommel has only a groove to imitate the border between it and the upper guard. The pommel has a bulge in the middle, and the corners of the pommel have curved steeply upwards. In some rare cases though, the pommel may be of two separate parts. Both the pommel and the lower guard are tapering towards their ends when viewed from the top. Normally the lower guard is straight, but it may also be curved downwards or even widened at the ends. The tang was peened straight on the top of the pommel. The parts of the hilt have no kind of non-ferrous decoration. Bernt von zur Mühlen has distinguished a separate, Baltic sub-group of type Y pommels having even faces and no groove.[1248]

Type Y hilts belong to the period between 900 and 1000 AD,[1249] although their time of use may have extended as far as 1100 AD.[1250] Belonging to Geibig's combination type 13.1, the type dates from roughly between 890 and 980 AD.[1251] This type is very common in Viking Age contexts all over Europe, including Scandinavia, Poland, Germany, France, the Baltic countries, Russia and

1248 Von zur Mühlen 1975: 32.
1249 Petersen 1919: 171–173, 183.
1250 Jakobsson 1992: 54; Jones 2002b: 18–19.
1251 Geibig 1991: 151.



Central Europe.[1252] Therefore, the origin has been debated once again, though normally this type has been considered as Scandinavian due to its simplicity.[1253]

Figure 109. Variants of Petersen's type Y: 1. Pommel with rounded ends (KM 369), 2. Pommel with sharper edges combined with a longer and more slender guard (KM 4566:12), 3. Stouter pommel without a decorative groove (SatM 10330).

The five type Y hilts examined here may be divided into three somewhat distinctive variants (Fig. 109). Finds KM 369 from Hämeenlinna and KM 2508:124 from Pudasjärvi have a grooved pommel, perhaps to imitate the border between pommel and upper guard evident in earlier Viking Age hilt types. In addition, the pommels of these two swords are rounded from their ends, and the lower guards are quite wide and flat. In comparison, swords KM 4566:12 from Turku and KM 5890:1 from Lieto have a grooved pommel with sharper raised upper corners, and longer and more slender lower guards.

In only one case (SatM 10330 from Ikaalinen) was the pommel not grooved to resemble a two-part pommel. In this hilt the shape of the pommel is also slightly different and smaller, giving a more robust impression. This last hilt may be an imitation of a grooved type Y hilt, since the parts are quite small and have a negative effect considering the overall balance of the sword in question. The pommel here resembles the Baltic group described by von zur Mühlen.

7.2.18. Petersen Z

Hilts of type Z are also quite common, totalling seven (Fig. 110). The pommel is three- or five-lobed, the middle lobe being higher, wider and thicker than other lobes, as also in the case of type S. In his thesis, Jouko Räty uses the designation Z:1 for the three-lobed pommel, while Z:2 is a five-lobed variant.[1254] The guards are acutely curved away from the grip and taper to the ends when viewed from the top. Both guards may have two decorative grooves near the middle of the guard. The tang was attached to the upper guard, the pommel being attached with rivets. The decoration consists of non-ferrous wires and plates, sometimes attached as an overlay on a hatched surface.

Type Z has been dated to 950–1000 AD by Petersen, i.e. to the end of the Viking Age.[1255] Once again this time span may be a quarter of a century younger at both ends.[1256] For example, the Finnish finds date from between 975 and 1100 AD according to Jouko Räty.[1257] The origin of this type may be in Scandinavia, or it may be Germanic.[1258] Kazakevičius considers some of the

1252 *E.g. Arbman 1937: 227–229; Arbman & Nilsson 1969: 164–165; Bakay 1967: 169; Geibig 1991: 169; Kazakevičius 1996: 71–72; Kirpichnikov 1966: 34; Mandel 1991: 119; von zur Mühlen 1975: 31–32; Nerman 1929: 84–85; Petersen 1919: 169–173.*
1253 *E.g. Gjessing 1931: 255; Nerman 1929: 86.*
1254 *Räty 1983: 82–87.*
1255 *Petersen 1919: 176–177, 183.*
1256 *Jakobsson 1992: 54; Mandel 1991: 119–120 and Jones 2002b: 18–19.*
1257 *Räty 1983: 147.*
1258 *Nerman 1929: 94; Petersen 1919: 176–177.*

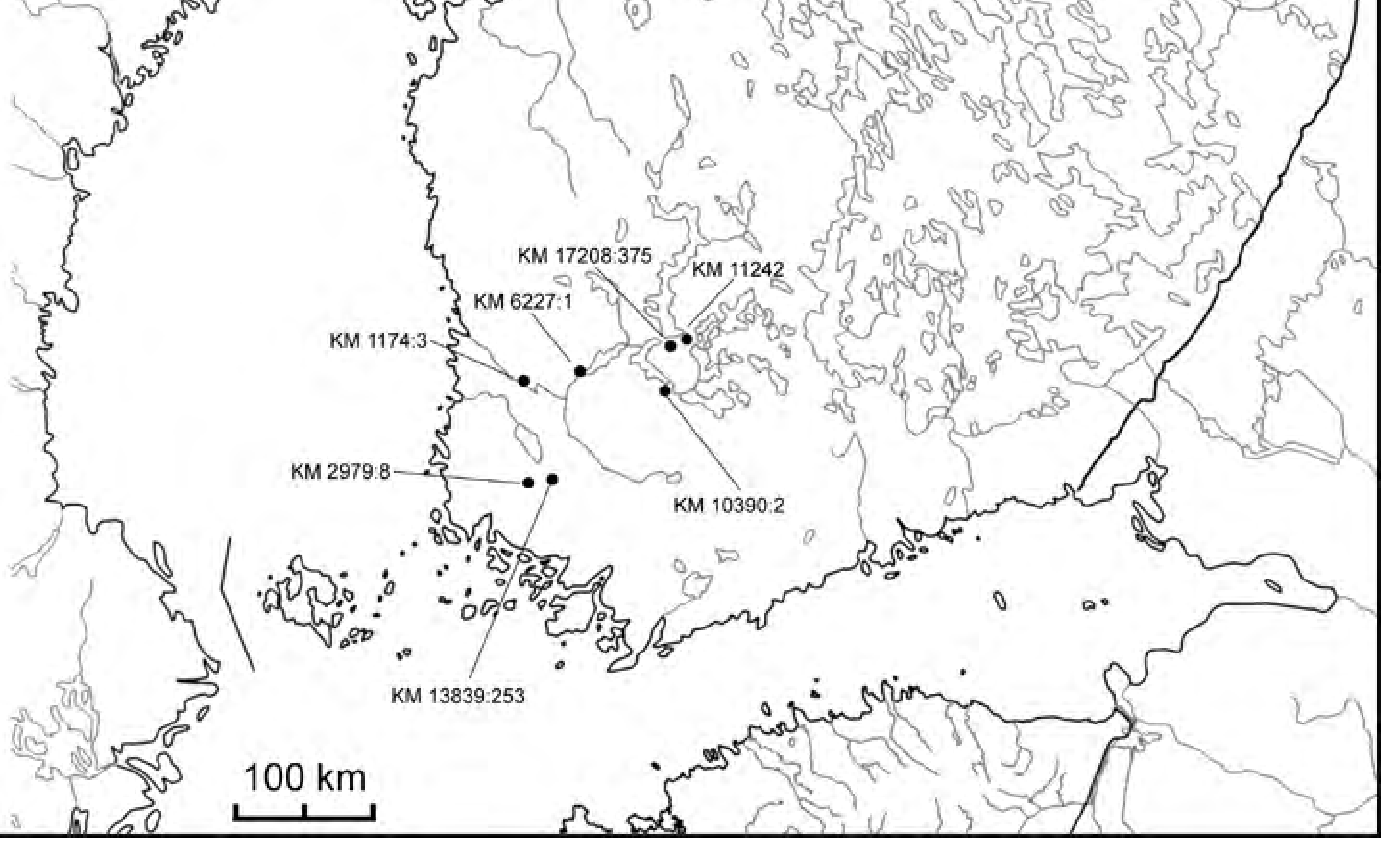


Figure 110. Hilts of Petersen's type Z.

Baltic finds of this type to have been locally made.[1259] The distribution of the type extends to Scandinavia, Russia, the Baltic countries, Poland, and the British Isles.[1260]

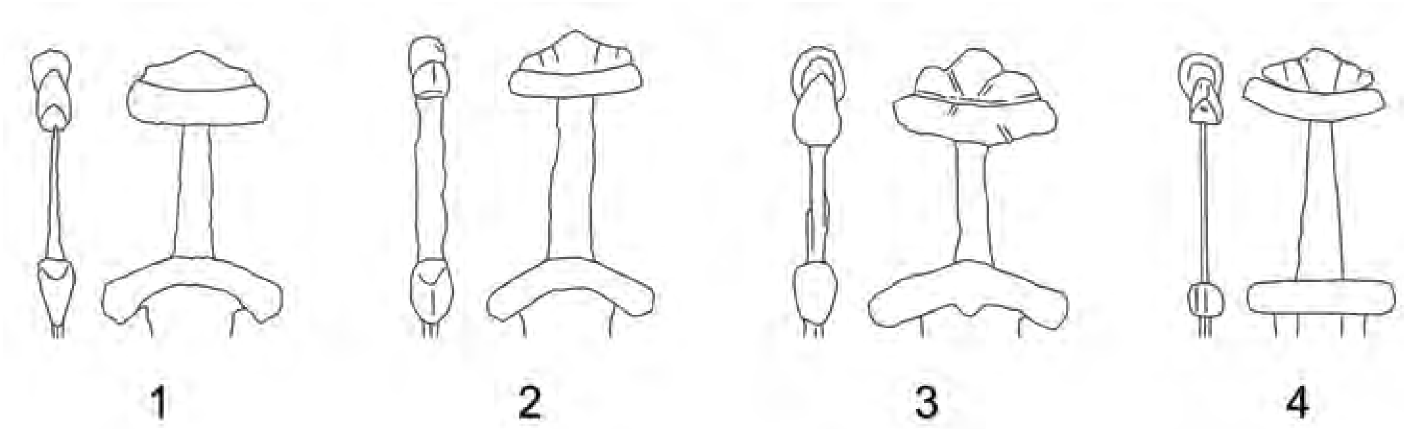
The hilts examined here all have traces of silver-plating, except the swords from Kangasala (KM 11242) and Pöytyä (KM 13839:253), which are badly corroded. Find KM 1174:3 from Kokemäki is interesting in its constructional details, since it has – according to the radiograph – both a curved rivet to attach the pommel to the upper guard, and the tang passing through the pommel and flattened on the top of it. Perhaps this kind of solution was carried out to prevent the pommel and the upper guard from moving in relation to each other. The same kind of construction was made in the case of find KM 2979:8 from Mynämäki, where the pommel and upper guard are both hollow. As an interesting detail, the type Z sword from Sastamala (KM 6227:1) has a hollow iron tube as a grip.

There are numerous variants of type Z according to form (Fig. 111). All the type Z lower guards are curved downwards and somewhat flattened at the ends. An exception is find KM 2979:8 from Mynämäki, but its lower guard appears to have been of some other type. The upper guards on the other hand are not always curved, at least not as much as the lower guards. Sword KM 1174:3 from Kokemäki has an almost straight upper guard, though flattened at the ends, connected to a pommel with three lobes, and without clear borders between the lobes. There is a similar specimen from Kangasala (KM 11242). Sword KM 6227:1 from Sastamala also has a straight upper guard, this time slightly more slender, and connected to a five-lobed pommel with more distinct borders between the lobes. In addition, this sword has an iron tube as a grip; a feature observed only in silver-plated grips (see below).

Sword KM 13839:253 from Pöytyä has a curved upper guard with a three-lobed pommel. The lower guard of this sword has a small sharp tongue extending to the fuller of the blade. In addition, the pommel has small traces of decorative grooves near the midpoint. Together, these features give the object an appearance similar to the well-preserved type Z sword from Vesilahti (KM

1259 Kazakevičius 1996: 78.

1260 E.g. Kazakevičius 1996: 75–76; Kirpichnikov 1966: 34; Mandel 1991: 119–120; Nerman 1929: 27; Petersen 1919: 176; Räty 1983: 86; Selirand 1974: 112; Serning 1966: 36; Tõnisson 1974: 98–99.



2886:11).[1261] The sword from Tampere (KM 17208:375) is very similar to the Vesilahti find having a tongue in the lower guard combined with a five-lobed pommel. A similar kind of curved pommel can be observed in KM 2979:8, with a clear five-lobed pommel. The seventh find of type Z (KM 10390:2 from Vesilahti) has only its lower guard preserved, closely resembling the guard of KM 1174:3 from Kokemäki. All these finds display traces of silver here and there, except KM 13839:253, which is too corroded and has not undergone any conservation. In addition, the hilt of KM 17208:375 also has traces of copper on the hatched surface.

Figure 111. Variants of Petersen's type Z: 1. Three-lobed pommel without clear borders between the lobes, pommel relatively small, upper guard almost straight and high (KM 1174:3), 2. Almost straight upper guard, five-lobed pommel, and an iron grip (KM 6227:1), 3. Curved upper guard and three-lobed pommel, an extension in the lower guard (KM 13839:253), 4. Curved upper guard and five-lobed pommel (KM 2979:8). The straight lower guard of KM 2979:8 is not Petersen's type Z.

In addition to the above, sword KM 15181:2 from Akaa has a lower guard similar to some Petersen's type Z hilts. However, the strongly profiled brazil-nut shaped pommel combined with this kind of hilt bears a resemblance to the bronze-hilted sword from Hattula (KM 17777:1) and is therefore discussed below.

7.2.19. Hilts resembling Petersen's types

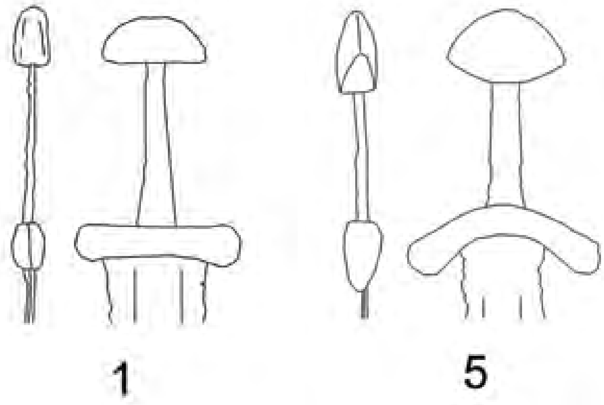
In connection with Petersen's types, some stranger and more unique examples must be mentioned. The first of these is a kind of hybrid with a pommel of Petersen's later type X, and a lower guard of type R or S, more likely R due to its relatively small size (Fig. 112). This find (KM 9164:3 from Eura) is discussed later in connection hilt repairs. According to the parts of the hilt, the dating for this sword is the latter half of the Viking Age or slightly later.

There are also hilts only resembling some of Petersen's types, though not belonging to them in any straightforward manner. One of these is close to Petersen's types L or Z, including features from both types, and being purely none of them (KM 1996:73 from Lempäälä). This hilt has decoration in the form of delicately inlaid wires, approximately 22 per centimetre. The pommel was attached to the upper guard with rivets, and the tang also goes through the pommel. The profile of this hilt resembles Petersen's type L, but the form and especially the cross-section of the pommel are closer to type Z. Type L is characterized as Anglo-Saxon, being found in Scandinavia, France, Iceland and the British Isles, and dating from between 850 and 900 AD according to Petersen,[1262] and 850–980 AD according to Geibig, having included type L into his own type seven.[1263] The hilt may be a kind of imitation of perhaps type Z, since

1261 See e.g. Kivikoski 1951: 15, Tl. 98:781; Kivikoski 1973: 113, Tafel 96:839; Lehtosalo-Hilander 1984: 361; Leppäaho 1964b: 78–79; Moilanen 2010b: 46; Peirce 2002: 127; Räty 1983: 82–87, 155, 277, 347. This hilt was decorated with a St. George's cross, with parallels from Norway and Latvia (see Paulsen 1956: 179; Räty 1983: 85). The blade of KM 2886:11 is undecorated.

1262 Arbman & Nilsson 1969: 175–176; Eldjárn 2000: 329; Petersen 1919: 112–115, 182; Walsh 1998: 233–234.

1263 Geibig 1991: 151.



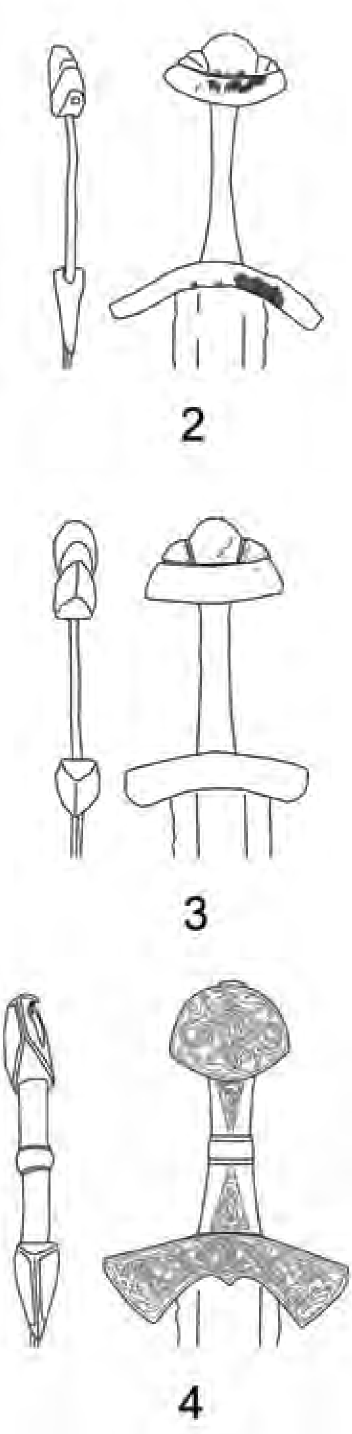


Figure 112.
Hilts mixing and resembling Petersen's types: 1. Sword with pommel of type X (later variant) and lower guard of type R or S (KM 9164:3), 2. Hilt resembling types L or Z (KM 1996:73), 3. Hilt resembling Petersen's type Z or Kirpichnikov's type A local (KM 37257), 4. A unique bronze-cast hilt with lower guard resembling Petersen's type Æ (KM 17777:1), 5. Lower guard of Petersen's type Z and a large brazil-nut shaped pommel (KM 15181:2).

no pure L types are known from the research area. According to type Z, the sword would date roughly from the latter half of the Viking Age.

Sword KM 1996:73 has one almost similar equivalent, found in Wallingford, Great Britain.[1264] The hilt is nearly identical in form, including decoration consisting of vertically inlaid non-ferrous wires. This hilt has been considered as belonging to an intermediate stage in the development of Anglo-Saxon type L towards longer and slender guards evident in the 12th century. In the light of this, sword KM 1996:73 may be of Anglo-Saxon origin.

Yet one more hilt resembles Petersen's type Z having a three-lobed pommel and some features from other three-lobed pommel types (KM 37257 from Pälkäne). The shape of this hilt strongly resembles Kirpichnikov's local type A, but it is silver-decorated iron instead of cast bronze. Kirpichnikov dates the local Russian type A to ca. 975–1100 AD.[1265] The datings of Petersen's type Z correspond to the first half of the period of Kirpichnikov's type A. This sword is perhaps an imitation of a bronze-cast local type A hilt, being also very well executed along with its silver decoration, which is a feature perhaps adopted from type Z. The silver has now melted away almost completely but the hatched surface still remains along with some melted grains of silver. The hatching was done by chiselling small grooves in two opposite directions, ca. 22 grooves per centimetre. Even the attachment of the hilt by peening the tang on the top of the pommel is a feature observed in Kirpichnikov's local type A.

The shape of the guards and especially the net-like silver wire pattern visible on the lower surface of the upper guard links sword KM 37257 with a sword from Köyliö (KM 8602:195). The Köyliö specimen lacks both the pommel and the upper guard, but the net-like decoration and its execution seem strikingly similar.[1266] This lower guard has an almost identical parallel in the hilt of a sword from Lejasdopeles, Lithuania.[1267] The sword has been characterized as Petersen's type Z, although it lacks the pommel, and the guards are not purely of type Z. Also, a sword from Great Britain characterized as a variant of Wheeler's type VII has a hilt almost similar in form, although the decoration is different.[1268]

1264 Thompson 2004: 113.
1265 Kirpichnikov 1966: 42.
1266 See e.g. Tomanterä 1972: 26–27.
1267 Latvijas PSR Arheologija 1974: tab. 64.17; Sėliai – The Selonians 2007: 67–68.
1268 Thompson 2004: 97. The origin of this sword is not stated, and it thus remains a mystery. As a side note, the sword ooks strange, with its cutting edges preserved although the surface is somewhat corroded.

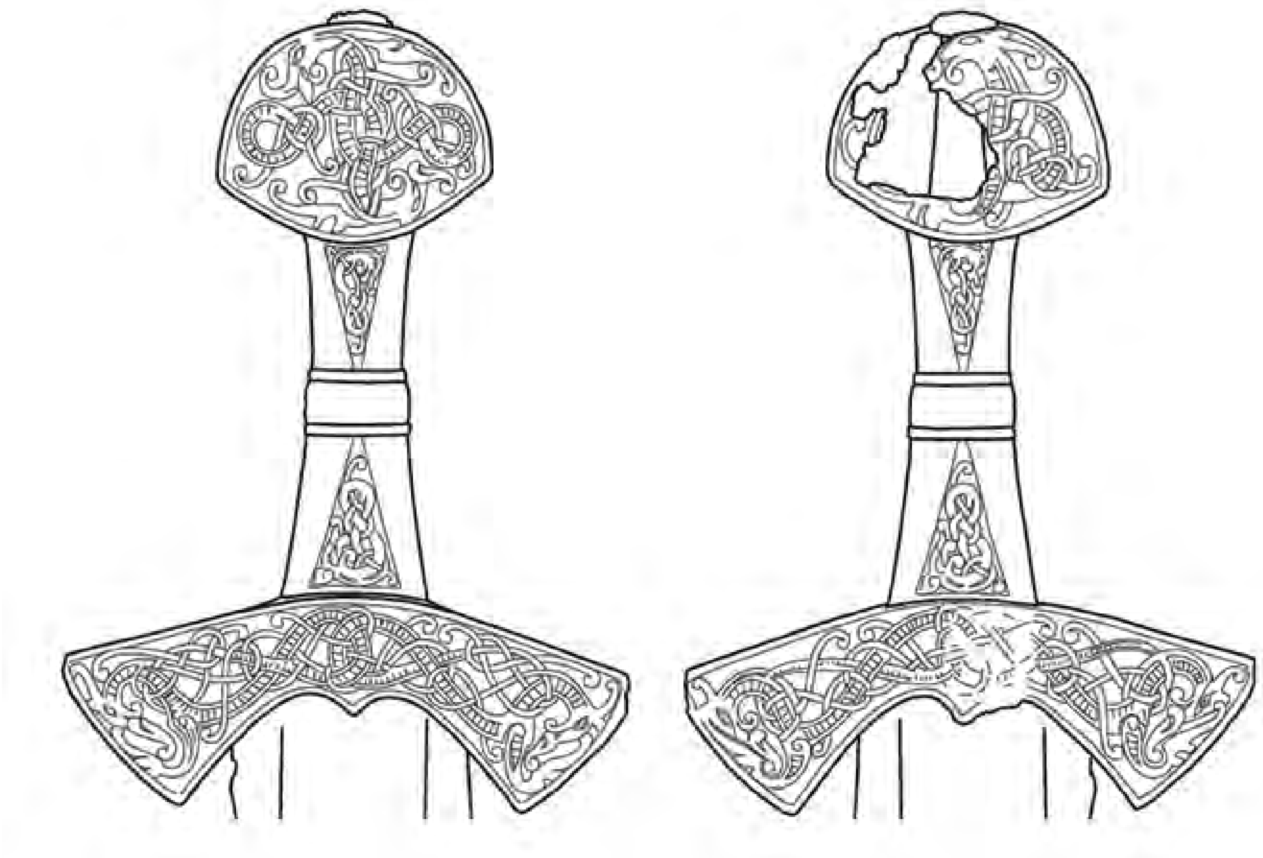


Figure 113. Details of the decorative motifs on the hilt of sword KM 17777:1.

Another sword from Great Britain, the so-called Shifford sword found in the River Thames is of somewhat similar form.[1269] A third case from Britain, from Shifford, has similar kinds of guards with remains of a motif of the same kind, but the pommel is five instead of three-lobed.[1270]

Another unique find is a sword with a hilt cast in hollow bronze (KM 17777:1 from Hattula). The lower guard resembles Petersen's type Æ,[1271] and Jouko Räty calls this type the bronze-hilted and rune-stone –styled type, categorizing it as his own type II.[1272] In the present study, it is called the 'bronze-hilt' type since there are no other bronze-hilted swords among the analysed finds. Type Æ has no proper pommel, but only two guards curving acutely away from the grip, oval when viewed from the top, and widening towards their ends in profile. The lower guard has a small peak on its lower face, pointing towards the blade tip, as in some Petersen's type Z hilts. Petersen's type Æ is dated to between 950 and 1000 AD,[1273] while other scholars place it more likely between 1000 and 1100 AD.[1274] Petersen knew of hilts of this type only from Norway and Sweden, and he thought the type was of Norwegian origin.[1275] According to the possible parallels, the place of origin may also be in the southern parts of Scandinavia.[1276] The sword in question has a different, more like lenticular pommel and also a hollow bronze grip.

The ornaments of the hilt of KM 17777:1 were first carved in the wax models of the hilt's parts and were then made by casting, creating a relief (Fig. 113). All the motifs are composed of one or two symmetrical snake-like beasts, and are very similar on the opposite sides of the hilt. The variations in the dimensions on the opposite sides of the hilt were most likely due to the decorations being carved by hand into the models, each side separately. In addition to the pommel and the lower guard, smaller animal motifs are also to be found on the hollow grip.

1269 *Thompson 2004: 114.*
1270 *Grove 1938: 255–256.*
1271 *See Petersen 1919: 178–180.*
1272 *Räty 1983: 94–102.*
1273 *Petersen 1919: 179–180, 183.*
1274 *Jakobsson 1992: 54; Jones 2002b: 18–19.*
1275 *Petersen 1919: 179–180.*
1276 *Räty 1983: 95.*

The parallels for the ornaments may be found in the snake-like ornaments on Swedish rune-stones in the region of Uppland.[1277] Oiva Keskitalo connected the decoration of the hilt to the rune-stones made by master Asmund Kareson.[1278] According to Keskitalo, the details of the decorative motifs are comparable to the rune-stones made by Asmund, and therefore date from between 1000 and 1050 AD, but not later. On the other hand, Erik Nylén connected the ornamentation of the hilt to Gotlandic artefacts, especially box brooches and animal-head brooches.[1279]

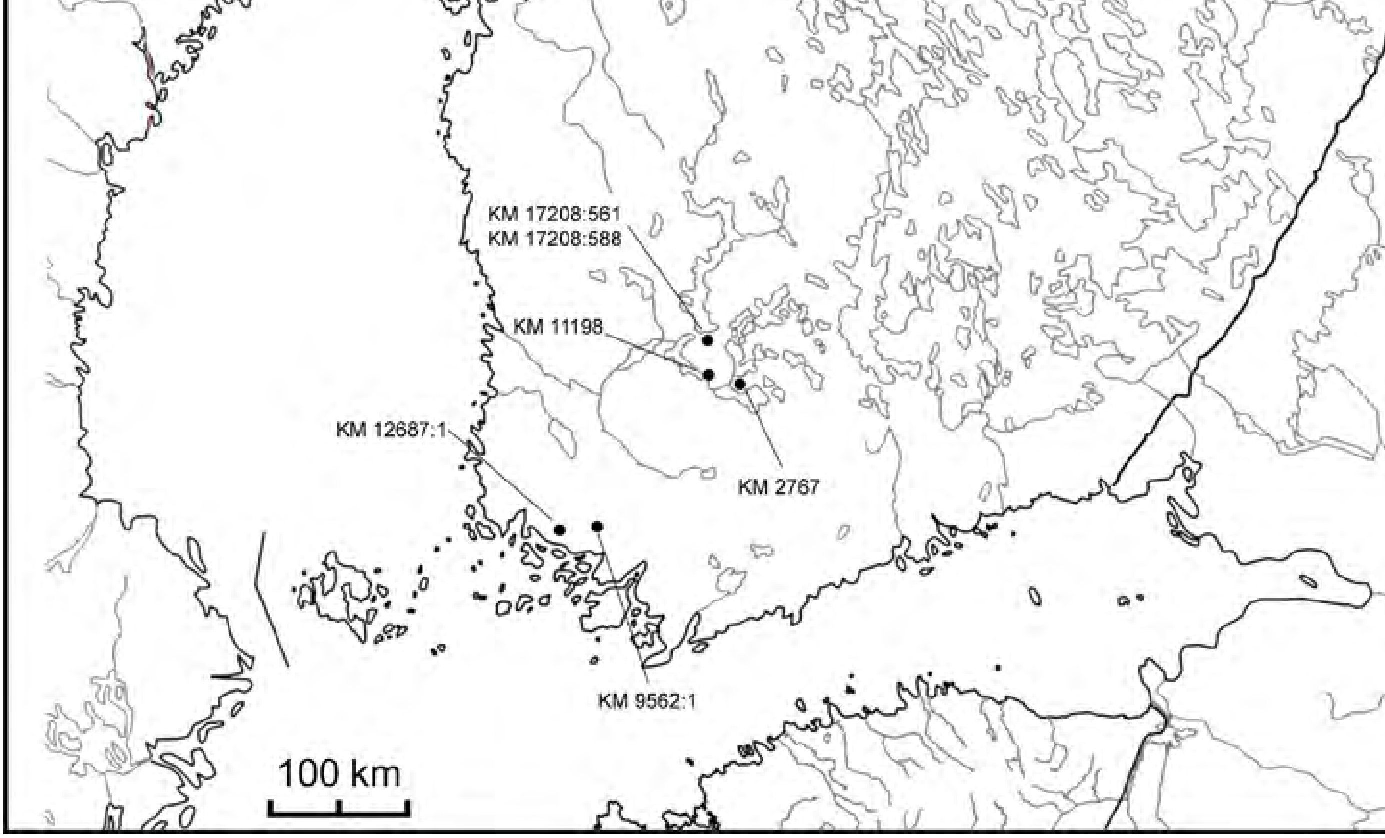
Similarly, the silver-plated sockets of some Petersen type G and M spearheads with carved decoration of rune-stone type date from the first half of the 11th century.[1280] Pirkko-Liisa Lehtosalo-Hilander classified the animal forms into seven different categories according to their details, pointing out that the form in this sword hilt is the most common one (Lehtosalo-Hilander's form number one) in Finland in silver-decorated spearheads, being geographically located mainly in the Upper Satakunta region and the valley of the River Aura.[1281] Stylistically, form number one is close to variant B of the Urnes style.[1282] In addition, the smaller figures in the grip are similar to form number five, evident also in Gotlandic box brooches.[1283]

Jouko Räty has suggested an analogy to picture-stone number III at Ardre in Gotland, Sweden.[1284] The ornaments contain both details from the earlier Jellinge style in the form of line decoration, and animals in the form of the later Urnes style. The picture stone is dated to the beginning of the 11th century.[1285] Räty also suggests that since the palmette-like interlacing, normally found on Gotlandic rune-stones, is missing in the motifs of the hilt, it was possibly made outside Gotland where interlacing of this kind was not of much value and importance as a part of the decorative motif.[1286] Instead, the decorations as well as the hilt may have been manufactured with a strong Gotlandic sense of style in mind.

The hilt itself is unique since no identical parallels are known. Räty mentions a sword from Stevns Å, Denmark, having a hilt almost similar in form but made from iron and decorated with brass wire inlays.[1287] This sword is dated to the second half of the 12th century. Some parallels may be found in the wall paintings of the church of Varde Aal in Denmark, where a similar kind of hilt can be seen along with disc-pommeled swords.[1288] The paintings are dated to the first half of the 13th century. Whereas Räty dated the type to 1000–1100 AD, with sword KM 17777:1 dating from the latter half of the century,[1289] the type may have originally been in use for a longer time. Two hilts of somewhat similar form are also presented in Marian Głosek's study. Especially the lower guards are very similar, although they are of iron with non-ferrous decoration.[1290]

Yet one more hilt not strictly classifiable according to existing typologies is known. Sword KM 15181:2 from Akaa has a lower guard comparable to Petersen's type Z, made of iron but still with no visible decoration visible, at least any more. The hilt does not have any upper guard but only an undecorated iron pommel of very large brazil-nut shape. As a whole, the hilt bears a striking resemblance to the above-mentioned hilt of KM 17777:1 from Hattula, except that the sword from Akaa does not have a metal grip, and the parts of hilt are of iron and remained undecorated.

1277 *See e.g. Brate 1925, Brate & Wessén 1924–36, Holmqvist 1951b and von Friesen 1913.*
1278 *Keskitalo 1969: 95.*
1279 *Nylén 1973: 167.*
1280 *See Lehtosalo-Hilander 1985 for more information and lists of these kinds of spearheads.*
1281 *Lehtosalo-Hilander 1985: 20, 27.*
1282 *Lehtosalo-Hilander 1985: 18; Wilson & Klindt-Jensen 1966: 147.*
1283 *Lehtosalo-Hilander 1983: 294–295; 1985: 23.*
1284 *Räty 1983: 100–101.*
1285 *E.g. Lindqvist 1931: 165; Wilson & Klindt-Jensen 1966: 150–151.*
1286 *Räty 1983: 101–102.*
1287 *Behrend 1970: 94–96; Räty 1983: 94–95.*
1288 *Räty 1983: 95.*
1289 *Räty 1983: 148.*
1290 *Głosek 1984: 169.*



The different features of this hilt must be noted in order to date it. If the guard is of Petersen's type Z – as it may well be, separately from the perhaps later-added pommel – it dates the hilt somewhere between 900 and 1050 AD according to various authors.[1291] Since the overall shape resembles Petersen's type Æ, it may extend the dating of this hilt to 1100 AD. The pommel is quite thin when compared with later, namely 12th and 13th-century brazil-nut pommels, which are also normally associated with long and slender lower guards.[1292]

Figure 114. Hilts of the silver-plated type

Somewhat similar forms may be found in Anatoly Kirpichnikov's typology for Russian finds.[1293] Kirpichnikov's special variation of Petersen's type Z seems to have an oval, non-lobed pommel, but appearing with an upper guard. The so-called "Scandinavian" type is somewhat similar but also an upper guard. Both types have downwardly curved lower guards. Kirpichnikov dates the special Z type to the 10th century, and the Scandinavian type to between 1000 and 1050 AD. It must be noted that Fedir Androshchuk dates this same find to ca. 1050 AD, suggesting that the bronze grip in this particular sword is half a century or even a century later.[1294]

7.2.20. The silver-plated type

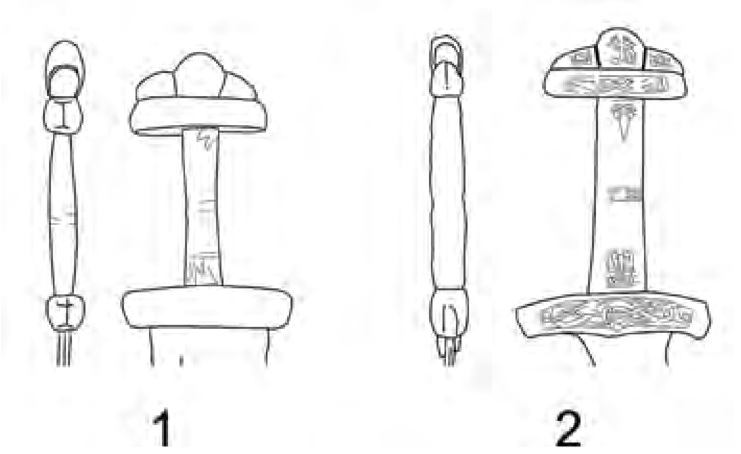
A common type from the transition of the Viking and Crusade Periods is the one with a silver-plated, hollow iron hilt, and also a silver-plated grip made of narrow iron tube. These silver-plated types are to be found six among the studied material (Fig. 114). The pommel is sharply three-lobed, the central lobe being the largest and highest, looking sharper in profile than for example type S. The upper and lower guards are rounded at the sides, somewhat resembling type T, since their ends have curved slightly away from the grip. The grip itself is a hollow iron tube different in diameter in the middle than in the ends. The decoration consists of a silver-plating attached in a hatched iron surface. The silver surface has further been decorated with engraved animal motifs.

1291 ee Chapter 7.2.18 above.

1292 For example, the typologies by Geibig (1991) and Oakeshott (1964) have much thicker pommels dating from the medieval period.

1293 Kirpichnikov 1966.

1294 Androshchuk 2003.



1 2

Figure 115. Variations of the silver-plated type: 1. the common form (KM 17208:588), 2. variant with lower pommel and extension in the lower guard (KM 9562:1).

Sometimes the engraved lines may have been filled with niello. Also the grip was decorated in a similar manner.

This type has been referred to as belonging to Petersen's types S, T or Z because of its three-lobed pommel.[1295] Carl Axel Nordman defined the type as a sub-type of Petersen's T, calling it T:2.[1296] In Anatoly Kirpichnikov's typology of Russian finds, type II resembles this silver-plated hilt, but it is not precisely the same type either.[1297] Jouko Räty classified this hilt as a transitional, post-Viking Age type IIIA.[1298] In the case of Finnish finds, Räty has also observed three variants in regard to pommel form, and two variants of lower guard.[1299] Because of its uniform manner of decoration, form of hilt and especially the existence of iron grips, this hilt is clearly a type of its own.[1300] The method of construction is also different from the above-mentioned Petersen types. In silver-plated hilts the tang is always peened on top of the pommel,[1301] whereas in Petersen's types S, T and Z, pommel is normally attached to upper guard with rivets.[1302] In the present study the type is simply called 'silver-plated'.

This type has been interpreted as of east-Scandinavian origin, the earliest examples dating around 1000 AD.[1303] Silver-plated hilts have been found also in Estonia, dating there between 1050 and 1110 AD.[1304] One example is known from Norway.[1305] Räty has dated the Finnish finds between 1000 and 1100 AD.[1306] Pirkko-Liisa Lehtosalo-Hilander considers them as being the phenomenon of the second half of the 11th century.[1307] Leena Tomanterä extends their period of use, dating the type to between 1000 and 1150 AD.[1308] Jorma Leppäaho, on the other hand, has suggested a dating of 1040–1060 AD according to the animal ornaments.[1309]

Two various forms may be distinguished from the silver-plated swords examined here (Fig. 115). The more common one has five examples: KM 2767 from Valkeakoski, KM 11198 from Lempäälä, KM 12687:1 from Turku, KM 17208:561, and KM 17208:588, the last two being found from the same cemetery in Tampere.[1310] A slightly different variant has been found in Lieto (KM 9562:1). In this hilt, the lower guard has a small extension towards the blade, and the

1295 *According to Birger Nerman, these hilts belong to Petersen's type T (Nerman 1929: 76). Also Mati Mandel includes them under type T, as an animal-decorated variant (Mandel 1991: 117). Helmer Salmo classes them as Petersen's S types (Salmo 1952: 381–382). Ella Kivikoski considers this type as related to Petersen's types S and Z (Kivikoski 1973: 114).*
1296 *Nordman 1943.*
1297 *See Kirpichnikov 1966: 50.*
1298 *Räty 1983: 103.*
1299 *Räty 1983: 106.*
1300 *E.g. Pirkko-Liisa Lehtosalo-Hilander (1985) has defined the type as 'silver-hilted' to distinguish it from Petersen's types.*
1301 *See Tomanterä 1978: 65.*
1302 *Petersen 1919: 142–153, 175–177.*
1303 *Tomanterä 1978: 74.*
1304 *Mandel 1990; Mandel 1991: 118.*
1305 *Kirpichnikov & Stalsberg 1998a: 509–510, Fig. 1.2.*
1306 *Räty 1983: 148.*
1307 *Lehtosalo-Hilander 1985: 8.*
1308 *Tomanterä 1978.*
1309 *Leppäaho 1936.*
1310 *Räty (1983) has classified the lower guards of these swords as his same variant number one. Other silver-plated hilts from Finland very similar in form are finds from Turku, Maaria, Taskula (KM 10833:1, KM 10842:34, and KM 10842:39).*

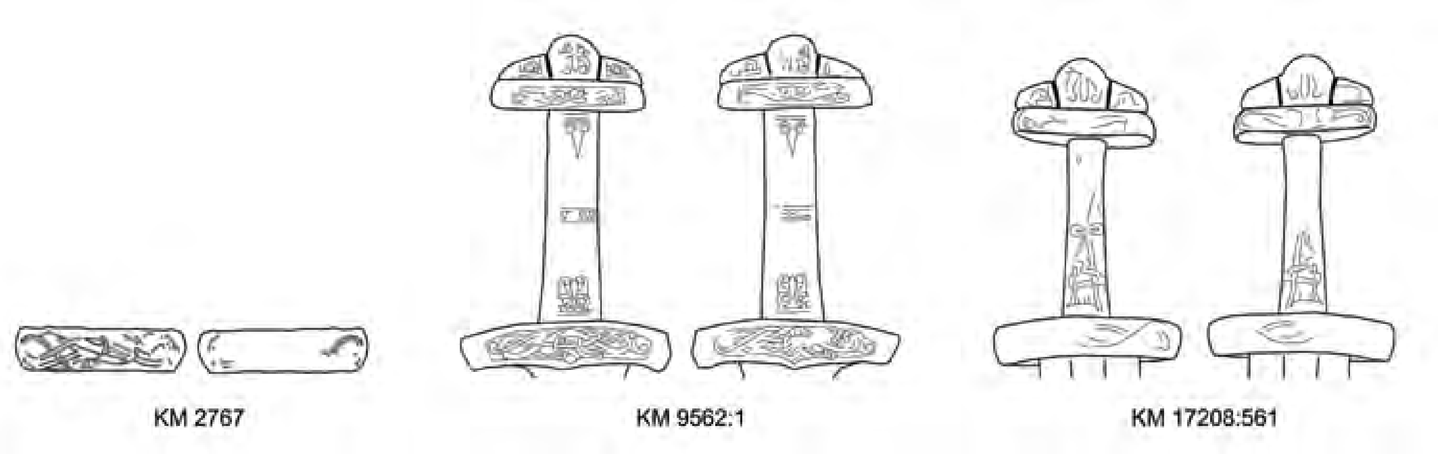


Figure 116. ***Preserved decorative motifs on silver-plated hilts.***

shape of this guard is more angular when compared to other hilts of this type.[1311] Furthermore, the upper guard is lower in height, as is also the pommel, having not such an intrusive elevated central lobe as the other examples presented here. All these hilts have silver-plating decorated with animal-ornament engravings. Possibly the engravings have been filled with niello. The silver was attached in each case to a hatched iron surface, varying from one sword to another. In two cases the hatching was done in only one direction, the other having grooves 28 per centimetre (KM 9562:1), and the other 30 per centimetre (KM 17208:588). In the remaining four hilts, the hatching was executed in two opposite directions. Again, the compactness of the hatched grooves varies: 28/cm in KM 11198, 30/cm in KM 17208:561, and 32/cm in KM 2767 and KM 12687:1.

The decorative motifs have been preserved in three cases (KM 2767, KM 9562:1, and KM 17208:561, see Fig. 116). The motifs on swords KM 12687:1 and KM 17208:588 have been destroyed, with only some fragments preserved. The hilt of KM 11198 consists of only the lower guard, which shows some patches of the hatched iron surface but no silver anymore.

Sword KM 9562:1 from Lieto is ornamented in the rune-stone style, in a similar fashion as sword KM 17777:1 discussed above. Lehtosalo-Hilander connects this hilt – as all other silver-plated hilts – to Gotlandic workshops, and thus dates them to the 11th century.[1312] Furthermore, Lehtosalo-Hilander sees these silver-plated hilts with various animal forms as contemporary with silver-socketed spearheads illustrating Lehtosalo-Hilander's animal forms one and two.[1313] Räty sees all animal patterns evident on silver-plated hilts as a transition phase between the Ringerike and Urnes styles.[1314] The spiralled sections of animal heads represent older Ringerike style, while the animal figures with only one body and forked tails are stylistically closer to Urnes.[1315] Räty has noted the animal composition being similar to a rune-stone in Sjusta, Uppland, Sweden dating from between 1050 and 1100 AD, and also similar to Swedish box brooches.[1316]

The palmettes seem to be inherited from rune-stones, having a characteristic binding, which also resembles fleurs-de-lis of Frankish origin. Räty speculates that the palmettes have been copied into the decoration of sword hilts via the motifs visible on some rune- and picture-stones, where the tails of the serpent-like figures have deformed to resemble palmettes.[1317]

1311 *Also Räty (1983) has noted this variation, the lower guard of this sword being his variant number two.*
1312 *Lehtosalo-Hilander 1983: 293–294.*
1313 *Lehtosalo-Hilander 1985: 29–30.*
1314 *Räty 1983: 105. The transition from the Ringerike to the Urnes style has been dated to ca. 1025–1050 AD (Wilson & Klindt-Jensen 1966: 153–160), or to 1030–1080 AD (Skibsted Klæsøe 1999: 121).*
1315 *Räty 1983: 105; Wilson & Klindt-Jensen 1966: 149. This same phenomenon may also be seen in rune-stones, hence the title "rune-stone style" (e.g. Lindqvist 1931: 163).*
1316 *Jansson 1962: 27–28; Räty 1983: 109. The decoration of the Sjusta stone is quite similar to other rune-stones in Uppland, Gotland and Södermanland.*
1317 *Räty 1983: 104–105.*

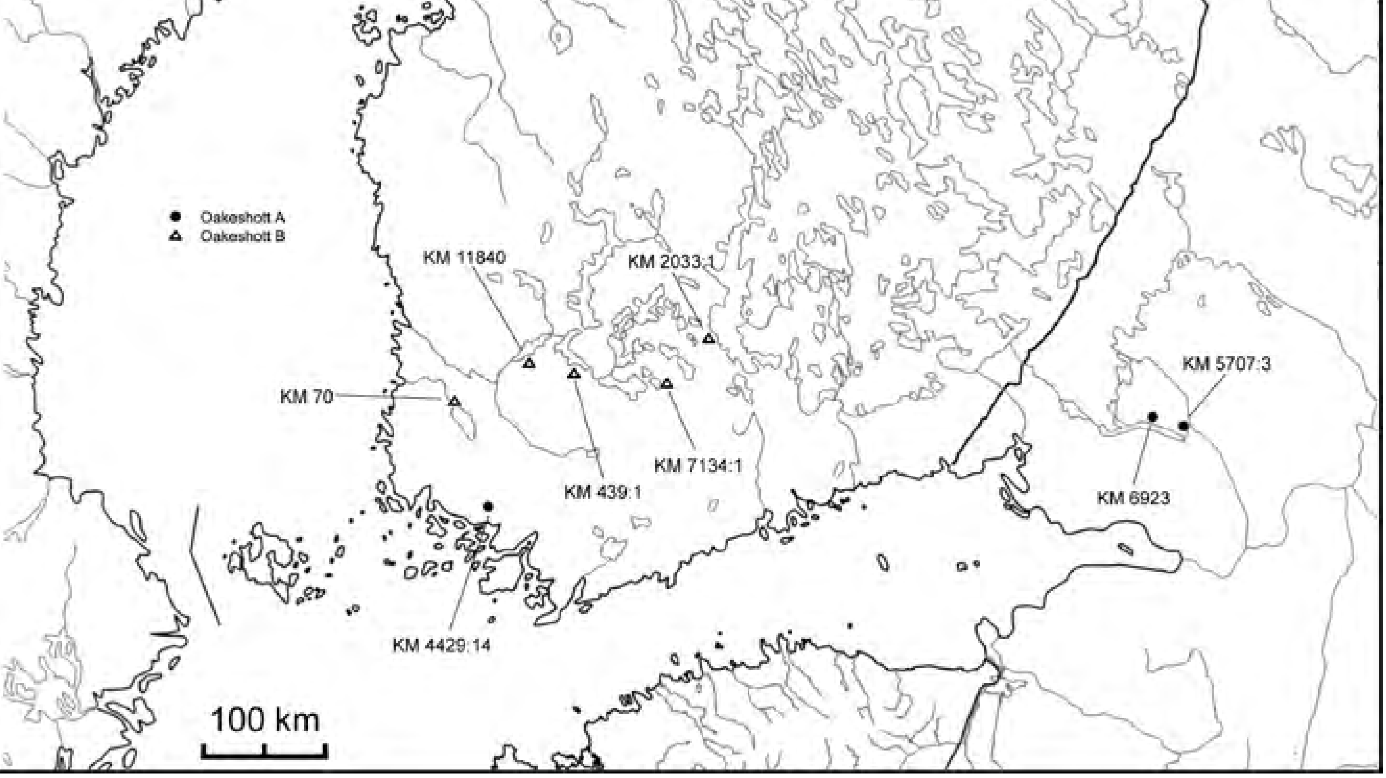


Figure 117. Hilts with brazil-nut shaped pommels.

The ornaments in KM 2767, KM 12687:1 and KM 17208:561 are not preserved in enough detail to be categorized according to Lehtosalo-Hilander's animal forms. It can only be stated that the figures seem slightly different than those in KM 9562:1, though their overall form appear to be quite similar. Räty has interpreted the ornaments in the iron grip of KM 17208:561 as similar to the decoration of a Petersen type G spearhead from Saaremaa, Estonia,[1318] but the interpretation remains highly speculative, because the decoration of the grip is suffered. Also, Räty links the patterns on the grip to the lower guard of a Petersen type K sword from Hedeby.[1319] The fragmentary motifs on the lower guard of KM 2767 look like the rune-stone typed animal figure has become more slender and ribbon-like.[1320]

The origin of this type is unclear. Since this type is widely represented in Finland, Carl Axel Nordman suggested that a blacksmith or a silversmith from the Gotland region made these hilts, or at least their silver decoration and ornaments, in Finnish territory.[1321] On the other hand, the ornamentation points to the direction of Sweden, as discussed above. As Jouko Räty has pointed out, rune-stone number III from Sjonhem, Gotland says that Waldinga-Uddr had made the stone and "valuable weapons".[1322] This has led to speculations that the same person designed or made both the rune-stone and perhaps the decoration evident in silvered sword hilts or sockets of spearheads. Many scholars have believed that these hilts were imported either directly from Gotland or through its regions.[1323]

7.2.21. Types with brazil-nut pommels

Swords bearing brazil-nut or lens-shaped pommels also belong to the transition between Viking and Crusade Periods. There are eight of them among the inlaid swords (Fig. 117). The shapes of these pommels vary slightly. Pommel may be short, resembling a mushroom, or it may be longer, wider and more massive. These two types correspond to Oakeshott's types A and B, the former being longer and the latter shorter and thicker. These types correspond to Jouko Räty's variants

1318 *Anteins 1973: 81; Räty 1983: 111.*
1319 *See Müller-Wille 1969: 106–107.*
1320 *According to Räty (1983: 111–112) this was also the case in the hilt of a sword from Turku (KM 10842:34, 39).*
1321 *Nordman 1931: 198.*
1322 *Lindqvist 1942: 112; Räty 1983: 115.*
1323 *E.g. Kivikoski 1937: 233; Nordman 1942: 272; Räty 1983: 116.*

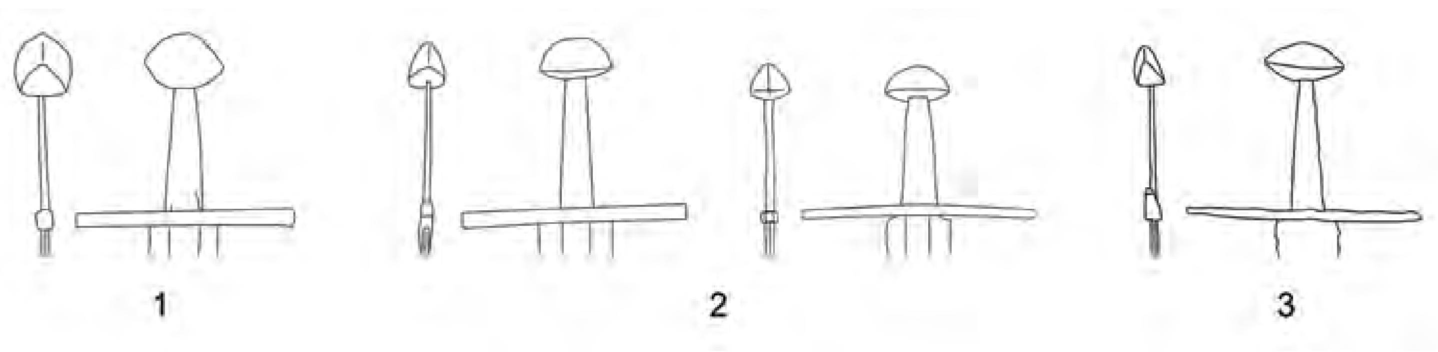


Figure 118. Variations of brazil-nut pommels: 1. Geibig's type 14 (KM 70), 2. Geibig's type 15.5 with straight lower guard (KM 439, on the left) and curved lower guard (KM 2033:1, on the right), 3. Geibig's type 16.1 (KM 5707:3).

two and one of his type number V, correspondingly. Furthermore, Räty identifies four kinds of pommels and two kinds of crossguards among the Finnish finds.[1324] The lower guards are usually long and thin, much like those appearing with disc-pommels. The small versions of brazil-nut pommels may sometimes be confused with Petersen's type X,[1325] but in general the lower face of brazil-nut pommels is curved upwards at its ends, unlike type X. Also, the lower guards associated with brazil-nut pommels are longer than those with Petersen's type X. Here the type is called 'Oakeshott A' or 'Oakeshott B', depending on the proportions.

The brazil-nut forms are very widespread throughout Europe, for example in Central Europe, Scandinavia, Russia and the Baltic countries.[1326] Due to its simplicity, it may have been made in various localities, such as the Baltic countries.[1327] Räty has dated the Finnish examples to 1075–1175 AD.[1328] Altogether, the dating of the brazil-nut type has a long time span. Brazil-nut forms may be included in Wheeler's type VIII, dated to between 950 and 1250 AD.[1329] According to the form of the pommel, Oakeshott dates the more slender type A to 1000–1150 AD, and the bulkier type B to 1050-1150 AD, thus appearing slightly later.[1330] The thicker variant corresponds to Kirpichnikov's type IV, dated to between 1000 and 1300 AD.[1331] Mati Mandel dates this similar form to between 1100 and 1200 AD according to Estonian finds.[1332] Kazakevičius gives a rough dating of 1000–1200 AD for the Baltic finds as a whole.[1333]

Ada Bruhn-Hoffmeyer has dated the brazil-nut pommels between 1100 and 1250 AD.[1334] Bruhn-Hoffmeyer distinguishes between the early, middle and late period pommels. The early period pommels are closest to the characteristic brazil-nut shape, dating from 1100–1175 AD. The middle period pommel dating from ca. 1200 AD has a more curved lower face, developing towards an even upper face. The late pommels resemble Oakeshott's pommel types D and E, dating from 1200–1250 according to Bruhn-Hoffmeyer. In addition to these evolving forms, Bruhn-Hoffmeyer has distinguished a so-called curved quillons type, dating from ca. 1250 AD.[1335]

The brazil-nut pommels can also be found in Geibig's system of classification, under combination types 14, 15, 16, and 18, with added variations. Type 14 is the stoutest version, thick and rounded,

1324 *Räty 1983: 132.*
1325 *See e.g. Peirce 2002: 122–123. Also Ella Kivikoski (1973: 142) identified the brazil-nut pommeled swords Petersen's type X.*
1326 *E.g. Geibig 1991: 173; Kazakevičius 1996: 86–88; Kirpichnikov 1966: 54; von zur Mühlen 1975: T. 52.1 and 52.2; Oakeshott 1960: 137; Tõnisson 1974: 98.*
1327 *Kazakevičius 1996: 88–89.*
1328 *Räty 1983: 148.*
1329 *Wheeler 1927.*
1330 *Oakeshott 1964: 93.*
1331 *Kirpichnikov 1966: 50, 54–55, 59.*
1332 *Mandel 1991: 121.*
1333 *Kazakevičius 1996: 88–89.*
1334 *Bruhn Hoffmeyer 1954: 36–43.*
1335 *Brazil-nut pommels as well as later pommels can be found also on so-called quillon daggers, which resemble miniature swords (e.g. Taavitsainen & Harjula 2004: 138).*

dated to between 1100 and 1200 AD.[1336] Type 15 is a more slender form, having a total of six form variations. The variants are dated differently, in general from 950 to 1230 AD.[1337] Pommels of type 16 are larger and longer than in type 15. Variant one of type 16 is a common brazil-nut form dating from 950–1180 AD, while the pommel of variant two has almost even upper face, dated to between 1180 and 1230 AD.[1338] Also type 18 is of brazil-nut form, somewhat similar to type 14, but not so rounded in cross-section. This type has been dated to between 1100 and 1230 AD by Geibig.[1339] It is noteworthy that the lower guards are highly variable in each type.

Combining Oakeshott's and Geibig's typologies, the studied pommels can be separated into three categories (Fig. 118). The first category resembles Oakeshott's type B and Geibig's combination type 15.5, having three examples among the studied swords (KM 439:1 from Vesilahti, KM 2033:1 from Padasjoki, and KM 11840 from Sastamala). The pommels of these swords are quite bulky and thick, but still somewhat lens-shaped. Lower guards are long and slender, either in the form of a rectangular bar, or then tapering slightly towards the ends. The dating is between 1050 and 1230 AD. Also a fourth one is known, KM 7134:1 from Hämeenlinna, this time with a curved guard, but it is not considered here more closely because it was not measured by me.

The second category of brazil-nut pommels includes those resembling Oakeshott's type A and Geibig's combination type 16.1. There are three of these swords (KM 4429:14 from Turku, KM 5707:3 from Metsäpirtti, ceded Karelia, and KM 6923 from Sakkola, also in ceded Karelia). In these swords the pommel is slightly longer and more slender, and mainly more lenticular in profile. According to the typologies, it dates from somewhere between 950 and 1180 AD.

The third group of brazil-nut pommels consists of pommels of Oakeshott's type B or Geibig's type 14. Of this type there is only one example (KM 70 from Eura). In this case the pommel is clearly lens-shaped, but is of a very round or circular form. The rough dating according to typologies is 1050–1200 AD.

7.2.22. Disc-pommeled swords

The disc-pommeled swords dating from the Crusade Period are categorized according to Leena Tomanterä's classification.[1340] Tomanterä has separated three variants of a disc-shaped pommel. Variant A is the most common one and simplest in form. The pommel is round with a rectangular cross-section and sometimes slightly convex edges.[1341] Variant B has faceted edges and octagonal cross-section.[1342] Variant C does not have round pommel but hexagonal in shape, and it has also faceted edges.[1343] In this work the disc-pommel types are referred to as 'Tomanterä A' or 'Tomanterä B', the type C having only one example in Finnish material, and it does not belong to the material of this work since the blade does not contain ferrous inlays. The forms of the lower guards vary, but they all were long and slender resembling those appearing together with brazil-nut pommels.

Tomanterä dates all the forms of the disc-pommel to roughly 1000 –1200 AD. The Baltic examples have been dated to 1100–1300 AD.[1344] Disc-pommeled swords, both of Tomanterä's types A and

1336 Geibig 1991: 63–65, 151.
1337 Geibig 1991: 65–70, 151.
1338 Geibig 1991: 70–73, 151.
1339 Geibig 1991: 75–77, 151.
1340 Tomanterä 1978.
1341 Tomanterä 1978: 23.
1342 Tomanterä 1978: 23.
1343 Tomanterä 1978: 24.
1344 Kazakevičius 1996: 90–91. Kazakevičius called the pommel spherical.

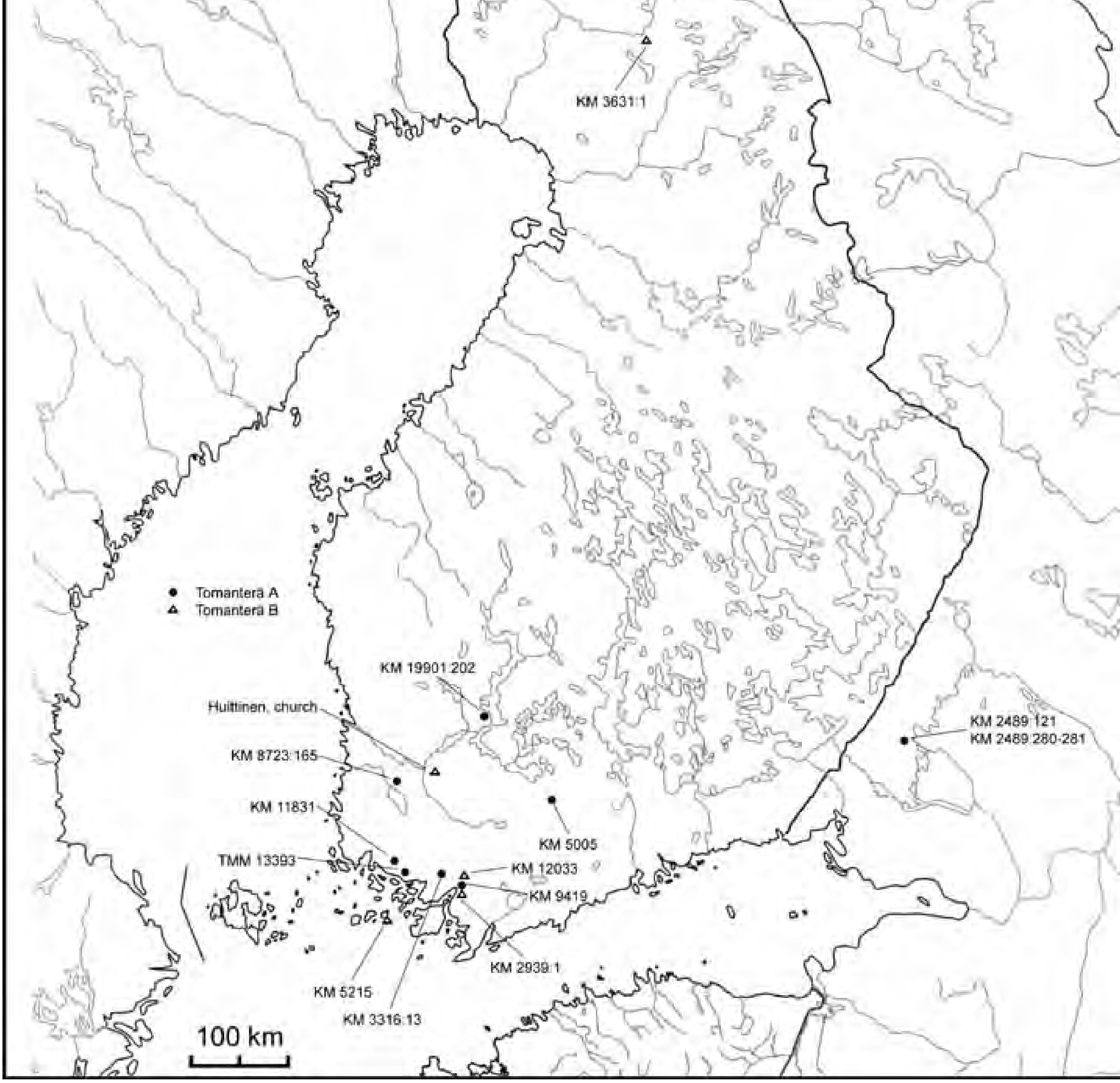


Figure 119. Hilts with disc-shaped pommels.

B have been included in Kirpichnikov's type VI, dated to between 1100 and 1400 AD according to Russian finds.[1345] Mandel dates the Estonian hilts of Kirpichnikov's type VI to 1150–1210 AD.[1346]

The classification of disc-pommels by Oakeshott[1347] is not straightforwardly applicable to studied material, as was also noted by Tomanterä.[1348] Whereas Oakeshott's type G corresponds to type A defined above, the other types do not. In its proportions, the slightly faceted Oakeshott's type H is not the same as those examined here. Oakeshott's type I, on the other hand, would require non-ferrous, decorative discs sunk in the pommel. In any case, Oakeshott's type G dates broadly from 980–1400 AD.[1349] Types H and I are dated similarly.[1350]

1345 Kirpichnikov 1966: 50, 55–56, 59.
1346 Mandel 1991: 122.
1347 Oakeshott 1964: 95–96.
1348 Tomanterä 1978: 24.
1349 Oakeshott 1964: 95.
1350 Oakeshott 1964: 95–96.

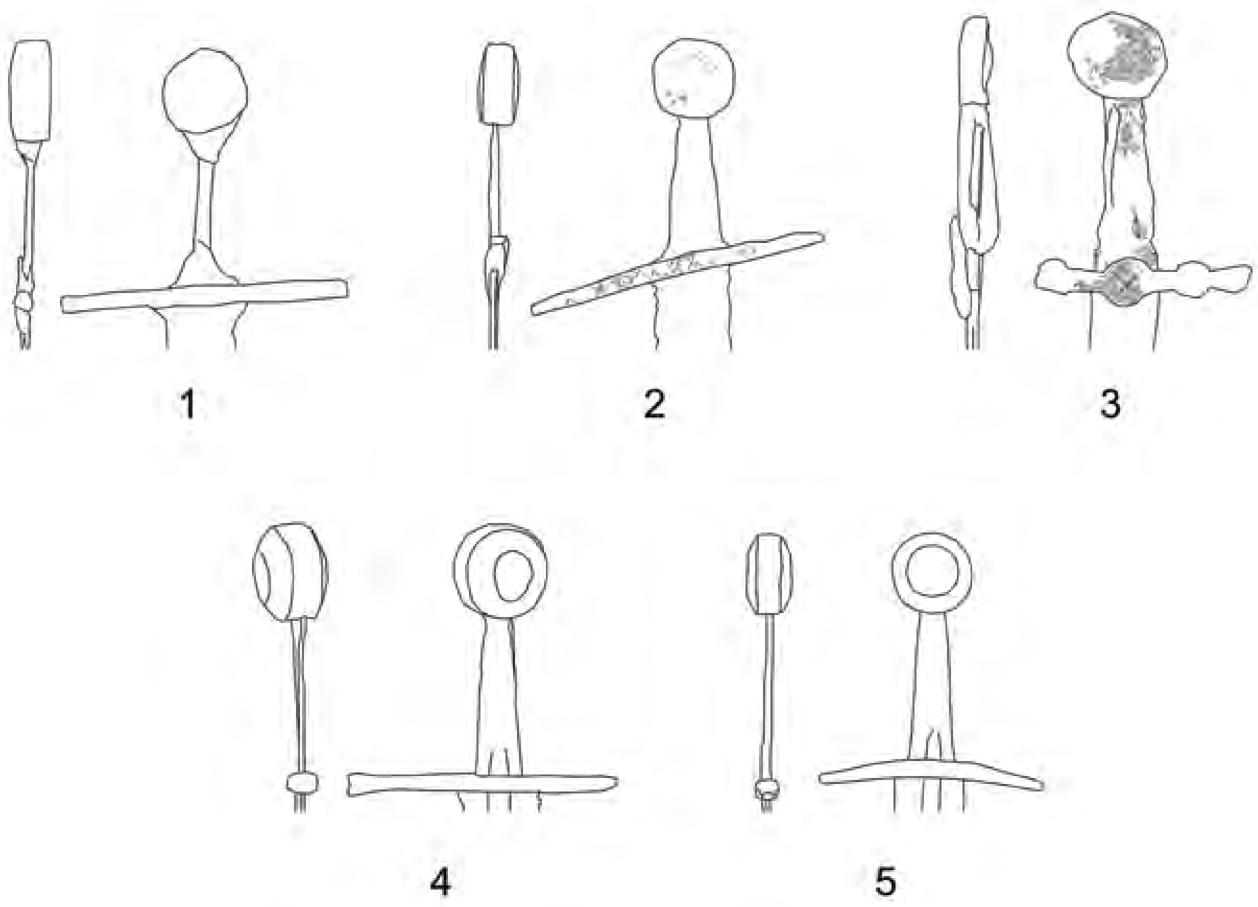


Figure 120. ***Types of disc-pommeled swords: The above row consists of hilts with Tomanterä's type A pommel: 1. Undecorated pommel and straight lower guard (KM 3316:13), 2. Pommel and straight lower guard decorated with silver wires (TMM 13393), 3. Silver-decorated hilt, lower guard has three disc-shaped designs (KM 2489:280–281). The row below presents the variants with Tomanterä's type B pommel with faceted edges: 4. Lower guard with widened ends (Huittinen, church), 5. Curved lower guard and larger central circle in the pommel (KM 3631:1).***

Ada Bruhn Hoffmeyer has her own grouping for the disc-pommeled swords, made before Oakeshott.[1351] Bruhn Hoffmeyer includes all disc-pommeled swords in her group of Romanesque swords proper (group III). Flat disc-shaped pommels of Tomanterä's type A are included in group IIIA, combined with a straight lower guard and dated to between 1100–1300 AD. Group IIIB consists of flat disc-pommels with curved quillons, dating from ca. 1300. Group IIIC includes the variations of the moulded or faceted wheel pommel. Of importance here are phases one and two. In phase one the side panels of the pommel are very large (1150–1250 AD), later in phase two diminishing in diameter, the hilt having a longer grip than in the earlier specimens (1250–1300 AD).

The disc-pommeled sword is universal in Europe, and becomes increasingly common at the eve of the Middle Ages.[1352] Also this type is characteristically simple to make, and accordingly these types of hilts may have been forged all over Europe.[1353]

The disc-pommeled swords are quite numerous in the studied material, a total of fifteen, one of which (KM 8602 A:116 from Köyliö) is uncertain and cannot be defined more accurately since the find is too corroded (Fig. 119). More common ones are those belonging to Tomanterä's type A and resembling Oakeshott's type G, being nine in number (Fig. 120). Six of these hilts (KM 3316:13 from Salo, KM 5005 from Janakkala, KM 8723:165 from Köyliö, KM 9419 from Salo, KM 11831 from Masku, and KM 19901:202 from Ylöjärvi) are plain, undecorated hilts with a long lower guard. One (TMM 13393 from Turku) is otherwise similar, except it has overlaid silver wires on a hatched iron surface, on both the pommel and the lower guard (Fig. 121). The hatching was made in only one direction, with approximately 27 grooves per centimetre.

1351 Bruhn Hoffmeyer 1954: 43–52.
1352 E.g. Kazakevičius 1996: 89–91.
1353 E.g. Kazakevičius (1996: 91) regards the Baltic examples as having been locally made.

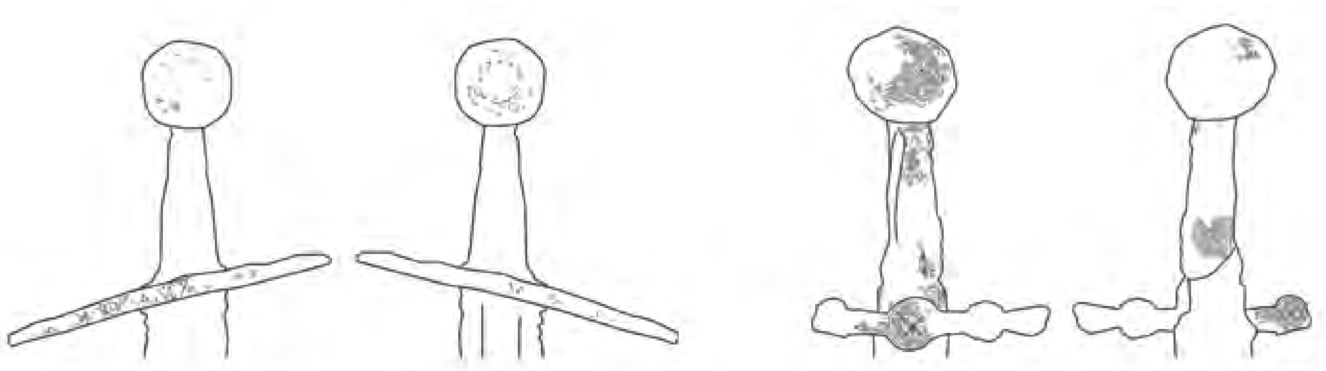


Figure 121. Silver decoration visible on disc-pommeled hilts of Tomanterä's type A.

The two swords from Kaukola, ceded Karelia (KM 2489:121 and KM 2489:280-281) have also a pommel of Tomanterä's type A, but a different kind of lower guard exhibiting flattened ends and three circular designs at even distances from each other. The silver decoration was applied to all metal surfaces of the hilt, including the iron grip. The decoration has been partially preserved on the hilt of KM 2489:280-281, showing a surface hatched in three directions and having 24 grooves per centimetre on average. Since sword KM 2489:121 is of the same form, it most probably had similar decoration on its now badly corroded surface.[1354] A similar, much better preserved example of this kind of hilt can be found in a sword found in Eura (KM 65), although this hilt excludes the decorated iron grip and is slightly different in its details. Also, according to investigations by Leena Tomanterä, the pommel of the Eura sword is solid, while those of the Kaukola swords are hollow and forge-welded from iron sheets and discs.[1355] Outside Finland, only two slender, bar-like lower guards are known from Estonia, having been decorated with similar kinds of spiralled silver wires.[1356] These guards may have originally been from a similar kind of disc-pommeled hilt, although no pommels were recovered. Mati Mandel dates the phenomenon of spiralled silver wire decoration to ca. 1100–1250 AD, and places its production in Finland.[1357]

Stylistically and technologically the hilts from Kaukola can be paralleled with some spearheads and axes of Petersen's type M decorated with similar kinds of spiralled silver wires.[1358] Lehtosalo-Hilander has listed a total of five spearheads with their sockets ornamented in this fashion with acanthus-like spirals.[1359] Silver-wire decorated axes are known three from Finland, two of which – one from Masku, Humikkala, and one from Köyliö, Vanhakartano – are decorated in similar technique and style.[1360] The acanthus-like ornaments are similar to those of Carolingian miniatures, but also in Western Romanesque art and Eastern Byzantine art,[1361] making it hard to trace their origin on the basis of the style. Silver wire ornaments such as these already existed during the Viking Age, and remained in use until the 1300s.[1362]

Five other disc-pommeled hilts belong to Tomanterä's type B, resembling Oakeshott's type H. All these hilts are undecorated, unlike Tomanterä's type A. The faceted pommels of these three swords are of almost same size, only the central circle of the pommel is sometimes larger and sometimes smaller. Sword KM 2939:1 from Salo lacks the lower guard, and the central circle of the pommel is relatively small. A central circle of almost the same diameter can be seen in a sword

1354 *See Tomanterä 1980: 158.*
1355 *Tomanterä 1980: 160.*
1356 *Mandel 1991: 122, T. XI:5, 6.*
1357 *Mandel 1991: 122.*
1358 *Tomanterä 1980: 158–159.*
1359 *Lehtosalo-Hilander 1985: 32. See also Kivikoski 1951: 37, Tl. 144.1110; 1973: 144, Tafel 134, Abb. 1181–1184.*
1360 *Kivikoski 1951: 37, Tl. 145.1115; 1973: 145, Tafel 136, Abb. 1192. See also Tomanterä 1980: 159–160.*
1361 *Tomanterä 1980: 159.*
1362 *Tomanterä 1980: 160.*

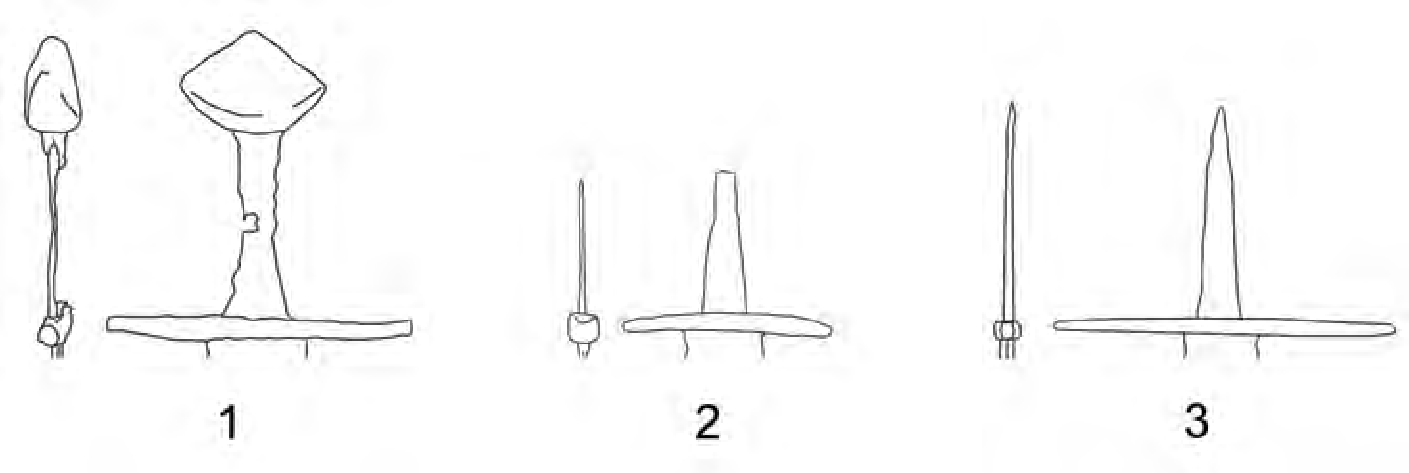


Figure 122. Individual examples of post-Viking Age hilts: 1. Pommel resembling Oakeshott's type E (KM 8656 H23:1), 2. Lower guard resembling Oakeshott's guard type 7 (KM 1822:2), 3. Lower guard resembling Geibig's type 13.2 (KM 12690:299).

found in the Church of Huittinen, displaying also a lower guard with widened ends. A widening lower guard may also be found from the hilt of the sword from Salo (KM 12033), while KM 5215 from Parainen has a straight guard. The sword from Rovaniemi (KM 3631:1) has a larger central circle in the pommel, and again a different kind of lower guard, this time of tapering and downwardly curved type.

7.2.23. Other post-Viking Age hilts

A clearly younger hilt is the one with Oakeshott's type E pommel (KM 8656 H23:1 from Masku, Fig. 122). Also Geibig includes this kind of hilt as his type nineteen. While Oakeshott dates this type of pommel to roughly 1225–1275 AD,[1363] Geibig dates the similar form to between 1100 and 1150 AD.[1364] This type of pommel also corresponds to Bruhn Hoffmeyer's brazil-nut form of the latest type, dated to between 1200 and 1250 AD,[1365] and to Kirpichnikov's type V (ca. 1100–1300 AD).[1366] Kirpichnikov's type V hilts have been dated to ca. 1190–1210 AD in Estonia.[1367] The type clearly evolved from brazil-nut pommels because the shape of the pommel is almost lenticular, but its upper edges have been curved inward. The pommel is connected to a long lower guard of similar fashion as those met in connection with brazil-nut shaped and disc-shaped pommels.

In addition to all above, some hilts had to be categorized by only the lower guard, since the pommel was missing. The lower guard of sword KM 1822:2 from Eura resembles Oakeshott's guard type seven, also observable in Geibig's types 12 and 16.1. The dating is given by Oakeshott to 1100–1400 AD,[1368] while according to Geibig's combination types, similar guards date roughly from between 850 and 1180 AD.[1369] More accurate dating on the basis of this preserved, undecorated lower guard is very difficult.

The lower guards of swords KM 12690:299 from Salo and KM 13399:3 from Masku both resemble Geibig's type 13.2; Geibig dates this type to between 1200 and 1250 AD.[1370] The similar straight, tapering lower guard is categorized by Oakeshott as style one, dating very broadly to 950–1600 AD. Taking the other sword finds from the same cemeteries into consideration, these two swords may originally have had disc-pommeled hilts.

1363 Oakeshott 1964: 94.
1364 Geibig 1991: 77–80, 151.
1365 Bruhn Hoffmeyer 1954: 42–43.
1366 Kirpichnikov 1966: 50, 54–55, 59.
1367 Mandel 1991: 121–122.
1368 Oakeshott 1964: 116.
1369 Geibig 1991: 151.
1370 Geibig 1991: 151.

7.3. On the techniques of decoration

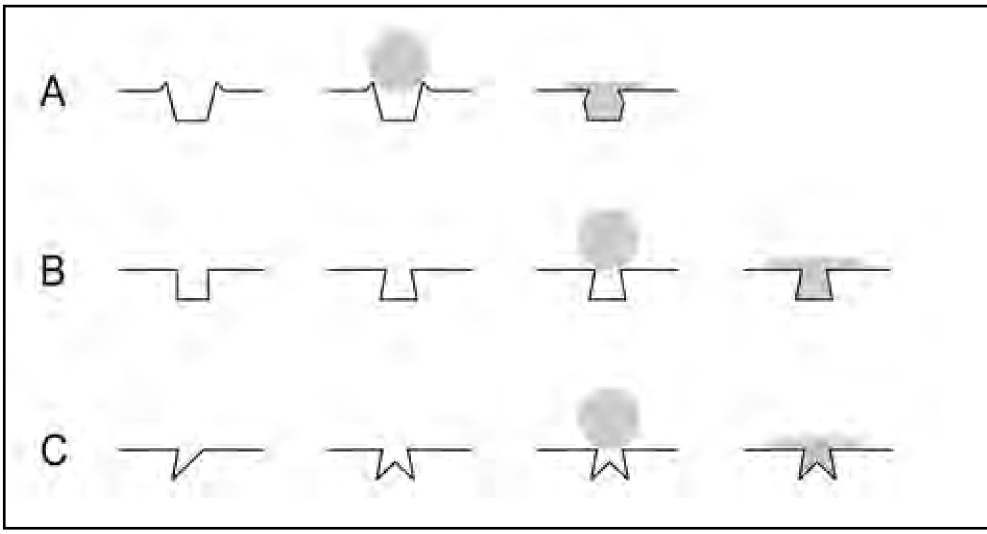


Figure 123. Techniques of inlaying wire: A) Wire inlaid in a struck channel, B) Channel is first struck or carved as rectangular and then undercut with cutting or striking by a chisel, C) W-shaped channel carved with two passes of a chisel.

The actual technique of inlaying non-ferrous wires cannot be examined very successfully, even with the help of a stereo microscope. The wax that was used to create a protective layer on the surface of the sword has accumulated on the bottom of the grooves carved for the inlays. As a result, the small grooves look as if they were all rounded at the bottom. In practice, this was not the case since no wire would stick in such a groove. The groove would have to be wider at the bottom to prevent the inlaid wire from lifting up from the groove. To give a more accurate picture of the decorative techniques, some grinding and re-polishing would need to take place. The cross-sections of the carved or struck grooves would have to be revealed and microscopically examined.

In two finds the grooves were not corroded and not filled completely with wax. The sword of Petersen's special type number one (KM 6746:49 from Turku) showed grooves wider at the bottom. The bottom was even, suggesting two plausible techniques for producing this (Fig. 123). The simplest alternative is to strike a rectangular groove with a non-sharpened or only slightly sharpened blade. Now when a non-ferrous wire wider than the groove is placed on top and hammered, the soft wire will be forged into the groove, and at the same time the edges of the groove bend inwards, locking the wire into its place. Alternatively, the groove may have been carved with a flat chisel and then undercut with another, sharper one. The flat chisel produced a rectangular groove, the bottom corners of which are deepened towards the sides with delicate carving. Instead of carving, the same effect of deepening the corners may also be achieved by driving a chisel into the corner. An alternative to these techniques has been presented by Leena Airola, suggesting that the grooves were punched or chiselled, and their top edges were hammered or punched inwards to create the cavities wider at the bottom.[1371]

Another kind of groove was observed in the H-type hilt from Vehmaa (KM 7472:2). The grooves in this hilt were W-shaped in their cross-section. The grooves had a clear central ridge in the middle. This has been produced by carving each groove twice. The needle-point chisel has first been used to carve one angled groove, after which another groove has been carved on the top of the first one, this time in the opposite angle. The result is an undercut groove holding non-ferrous wires firmly in place.

Since no more detailed analyses were made, insight was sought with the aid of experiments.[1372] Non-ferrous inlays, namely silver and copper, were used in the form of wires to decorate various

1371 *Airola 1998: 13.*

1372 *See Chapter 6.2 on the theory of experimental archaeology. The method has been applied in this work mainly in connection with making ferrous inlays.*

Figure 124. Reconstructions of two sword hilts bearing decoration from inlaid copper and silver wires. The sides of the iron hilts are completely covered with non-ferrous wires, hiding all the iron underneath. The H type hilt on the right also has a copper-plated surface on the upper and lower faces of the lower guard, and on the lower face of the upper guard.

iron hilts of Petersen's types H and K, and a Mannheim type.[1373] It was noticed that the above-described techniques of wire inlays work quite well (Fig. 124). Only the first described technique, that with only a struck rectangular groove, is not the safest one. The wires popped out of their places several time, but the majority of them remained stuck quite well. This technique was refined with an additional phase: after the rectangular grooves were struck, the whole grooves surface of the iron hilt was lightly hammered with a ball-pein hammer to forge the edges of the grooves inwards. This turned out to work very well. However, the safest way is to really undercut the grooves, but the work needs a steady hand, good eyesight, a sharp chisel, and a great deal of patience, all of which would of course have been characteristic of an Iron Age craftsman.
The technique of attaching silver on a hatched or napped surface has been discussed earlier by various authors only in connection with silver-decorated sockets of spearheads, although the techniques seem very similar to those used in hilts of Petersen's types R, S, and Z, as well as the silver-plated type, without forgetting the rare examples of silver-decorated disc-pommeled hilts. In all of them the iron surface is hatched full of small grooves in one, two or even three different directions. The silver wires, and in some cases also copper-alloy wires, were hammered on the hatched surface to stick.

There are various theories about this matter. According to Hjalmar Appelgren-Kivalo, thin silver plates were hammered into a roughed iron surface when red-hot, followed by cycles of heating and hammering, until all the silver was attached to the rough iron surface.[1374] Jorma Leppäaho was also of the opinion that silver plates were used, although he mentions in his work that Harri Moora and Erik Sörling suggested the use of silver wires instead of plate.[1375] Wilhelm Holmqvist stated that both wires and plate had been used as an encrustation.[1376] Andreas Oldeberg suggested mercury silvering, a method in which silver and mercury are melted together and applied hot on the iron surface.[1377] When reheated, the mercury will vaporize and leave a silver surface. Oldeberg also believed there was a possible copper layer between the iron and the silver,[1378] as does Kristina Creutz, who refers to an 'intermediate' layer between the iron and the silver.[1379] In the analyses conducted by Creutz on sockets of spearheads, some mercury was present in this intermediate layer, possibly indicating mercury silvering.

1373 *Making the hilts was an additional project aiming at completing the blades with the non-ferrous inlays presented in Chapter 6. The hilts were actually made only after the blade or blades were completed, but their manufacture is referred to here in connection with hilts. Furthermore, the experimental manufacture of the hilts is not included here, but only briefly the resulting techniques of decoration. The experimental process, as well as more detailed experiments with ferrous inlays, were discussed in Chapter 6.*

1374 *Appelgren-Kivalo 1906–07: 2–3.*

1375 *Leppäaho 1936: 84–85.*

1376 *Holmqvist 1964: 25.*

1377 *Oldeberg 1966: 188.*

1378 *Oldeberg 1966: 197.*

1379 *Creutz 2003: 203–205. See also La Niece 1990.*

Again, analyses were not made on the sword hilts examined here, and as a result some complementary experiments were conducted. Hans-Jürgen Hundt has carried out some experiments in connection with Petersen's type S hilts, concluding that decoration made from silver and copper-alloy plates and wires can be applied directly on the grooved iron surface.[1380] The grooves should preferably be made in two directions to assure the attaching of wires and plates. The latest contribution to this matter has been made by the Latvian archaeologist Dagnija Svarāne in collaboration with the jeweller Jurij Mel'nikov.[1381] In their work, both silver wire and sheet silver were experimentally and successfully applied to iron surfaces covered with small grooves made with a graver. Again, the method of attachment is purely mechanical, and it was found that a surface imitating a silver sheet could have been produced with inlaid wires, as probably is the case with many spearheads. One of their aims was to interpret the description of silvering presented in the work of the Monk Theophilus Presbyter in the 12th century.[1382] According to Theophilus, silver was pressed onto a grooved surface and then evened out and polished with a smooth iron rod. As Theophilus stated, every now and then the silvered object had to be placed on glowing coals, which was interpreted by Svarāne as the annealing or softening of silver.

Figure 125a. Experimental decoration of a Petersen's type S hilt. The grooves have been cut with a chisel in two directions (above left), after which the decorative patterns were carefully hammered on the hatched surface from pieces of copper and silver wire (above right). Figure 125b is a picture of the complete hilt revealing no iron underneath the decorative layer.

I also tried the same technique to reproduce a complete Petersen's type S hilt with decoration of silver wires, copper wires, and both of them twisted together (Fig. 125). The grooves were made with a thin chisel at an angle of approximately 45 degrees. The resulting grooves had their sharp burrs pointing upwards, into which non-ferrous, annealed wires easily got stuck. The wires could have been attached to a surface hatched in only one direction, but two directions give more secure basis, especially when working with very short strips of wires. In the more rounded shapes, such as the lobes of the pommel, hatching in three directions was sometimes needed to secure the wires. In principle, the upward burr will turn again downwards when hammered, locking the soft non-ferrous wire underneath it to some degree. It is essential that the non-ferrous wire is annealed, i.e. softened, to make the technique work. Also, the iron used as the base must be very soft. For this reason, not many smiths master the technique today, since industrial steel is too tough. To make the silver surface even, the parts of the hilt were carefully heated and the silver hammered repeatedly, until finally polished with a smooth iron rod. The resulting silver surface is too thin to be ground in any manner.

The swords from Kaukola (KM 2489:121 and KM 2489:280-281) also have silver wires hammered into a napped surface. Here, though, the iron surface was visible between the spiralled wires. Since the napped, visible parches of iron were probably hammered smooth, Leena Tomanterä has correctly suggested that the iron was blued by heating, creating a sharp contrast between dark blue iron and white silver.[1383]

1380 Hundt 1973.
1381 Svarāne 2007.
1382 Theophilus Presbyter 1979.
1383 Tomanterä 1980: 158.

7.4. Other features

7.4.1. On the fitting of hilts and blades

Figure 125b. Modern-day swordsmiths have a tendency to fit the parts of the hilt exactly into the tang of the blade. This serves two purposes. Firstly, the sword will be better balanced and neater if the parts of the hilt remain exactly on their straight, symmetrical positions. Secondly, the sword would be hard and even unsafe to use if the hilt parts moved and rattled. In the majority of cases, the Late Iron Age smiths sought to do the same. Surprisingly, exceptions are numerous among the studied swords with iron-inlaid blades.

In altogether 38 hilts the fit of the lower guard is improper (see Fig. 87). The slot which through the tang passes is far too large (Fig. 126). This has made the lower guard move from its original position, and in many cases the guard still remains tilted on the tang after being moved when the organic grip has been either destroyed or deteriorated. This phenomenon of an improperly fitting lower guard is most commonly seen in Petersen's type H hilts (eleven cases). Lower guards of this kind are also found in Petersen's types X (five cases), V (four cases), I (three cases), and E (two cases). Also types B, C, N, O, Q, T, Y, and special type 1 all have one find each with a similar kind of feature in the lower guard. Also, the unique hilt resembling Petersen's types L and Z (KM 1996:73) has a lower guard with a hole that is too large. A total of three disc-pommeled swords also have the same feature, as well as one of the two hilts in the study material that could not be classified (KM 3383:2). Of all the above-mentioned hilts with an unfitted lower guard, sixteen have the same phenomenon detectable also on the upper guard. In addition, in four more cases

Figure 126. Examples of poorly fitting parts of hilts. On the left is the lower guard of KM 1996:73 from Lempäälä showing a hole too large for the tang, and a small iron wedge used to tilt the guard in place. On the right is a detail of the pommel of KM 2939:1 from Salo, also with a very large hole compared to the tang.

– in all of which the lower guard is missing – the pommel has a hole too large for the tang. Two of these four are disc-pommeled; one is of Petersen's type X and one of type Z. Jarno-Tapani Pälikkö has suggested that these holes were possibly filled by sliding the end of the grip inside, thus wedging the hilt in position and preventing the organic covering of the grip from breaking too easily.[1384]

In connection with the parts of hilts with slots that are too large, some display an interesting feature. In seven cases the lower guard had been tilted with wedges to be immovable. In six of these hilts (KM 370 from Hämeenlinna, KM 1996:73 from Lempäälä, KM 2345:1 from Loppi, KM 3423 from Vesilahti, KM 8120:1 from Hattula, and KM 31550:1 from Jämsä) the wedge or wedges are small, rectangular pieces of iron, normally inserted from the side of the grip. In the hilt of KM 370 the wedge was driven up the fuller from the lower, blade side of the hilt. Furthermore, sword KM 9243:1 from Sauvo has copper-alloy wedges to fasten both guards from the side of the grip. Another find with the upper guard wedged is KM 30985:1 from Halikko, with a wide iron wedge.

Altogether, four hilts of Petersen's type Y (KM 369 from Hämeenlinna, KM 2508:124 from Pudasjärvi, KM 4566:12 from Turku, and KM 5890:1 from Lieto) seem to share a similar feature: the fit is not exact in the parts of the hilt, but on the other hand, the holes are not exaggeratedly large as in the cases described above. Similar, smaller defects in the fit of the guards and pommels may be seen in Petersen's type E (KM 7752:1 from Salo), the Mannheim-Speyer type (KM 5334:1 from Eura), and one hilt with a brazil-nut shaped pommel (KM 5707:3 from Metsäpirtti, ceded Karelia), all having only one example of this feature.

In the light of the above, the poor fit of the hilt parts is not bound to any definite type or geographical area. The different sizes of the hilts and blades are a strong argument for the various origins of the hilts and the blades. It appears that some of the hilts were made first and then fitted to blades that were perhaps acquired from another locality. Of course, this piece of information does not tell, which were produced locally, the hilts or the blades, or whether they were both acquired from somewhere else. It also seems that the parts of the hilt readily had slots larger than usually needed, clearly to be fitted and wedged by the buyer or another craftsman.

In all above cases the tangs seem original, so they were not re-forged to receive a particular hilt. In a technical sense, this kind of operation has its risks in regard to the blade. To be re-shaped, the tang has to be heated to a forging temperature, which is turn also heats the edged section of the blade, diminishing the functionality of the blade by resetting the crystal structure of the steel and thus softening the blade. Moreover, the surface treatment of the blade will disappear when heated. In simplified terms, the hardening of the blade as well as the etchings, whether connected with ferrous inlays or other pattern-welding, will disappear near the hilt. In this light it would be more favourable to have the hilt preferably too large, than to re-shape the tang.

1384 Pälikkö 2006: 99.

Figure 127. The crudely narrowed tang of sword KM 11198 from Lempäälä.

The re-forging of tangs can, however, be detected in some cases. In a fragmentary sword from Lempäälä (KM 11198), which has a silver-plated lower guard still remaining, although loose, the tang was crudely forged to be narrower (Fig. 127). This had to be done, since the type in question has normally has a hollow iron tube as a grip, a feature requiring a very narrow, rat-tail tang. The same phenomenon can be seen in another silver-plated lower guard, KM 2767 from Valkeakoski. The tang is very narrow, and in addition improperly forged to be lopsided, being clearly off the centreline of the blade. Still, the lower guard assembles as centred, suggesting the conclusion that the tang was re-forged, or perhaps even manufactured along with the blade, to receive its current silver-plated hilt.

In two finds, KM 4254 from Lempäälä and TMM 14105 from Salo, the ferrous inlays on the blade continue under the lower guard. The unlikely alternative is that they were originally attached too close to the hilt, almost on the tang itself. A more likely option is that the tang was re-shaped so that the attachment of the current hilts has become possible.[1385] In some cases it is necessary to forge the tang narrower or thinner, but also to shape the shoulders of the tang to fit the lower guard better. This seems to have been the case with these two swords here. An alternative is that the hilt and the tang were damaged near the upper end, and the remaining tang had to be lengthened so that a hilt – the old or new one – could be properly attached with a grip that was long enough.

7.4.2. Signs of use and repair

Both traces of use and repair are very rare in hilts. These actions may be the reason why a hilt has a pommel of different type than the lower guard. The pommel may have been damaged in battle, or even removed. As a consequence, a new pommel had to be attached, naturally differing from the original as belonging to a completely different 'type'.

In the studied find material, two swords of this kind can be recognized. Sword KM 2979:8 from Mynämäki has a pommel and upper guard of type Z, while the lower guard seems slightly different, close to the silver-plated type. Jouko Räty[1386] has classified this guard as belonging to type T, which is again somewhat different. The hypothesis of the attachment of a new pommel is supported by the fact that the hole for the tang forged in the upper guard of type Z is far too large for the tang, which apparently was not re-forged to receive the new pommel and upper guard.[1387]

1385 Moilanen 2010a: 8–9.
1386 Räty 1983: 61.
1387 Moilanen 2010a: 8.

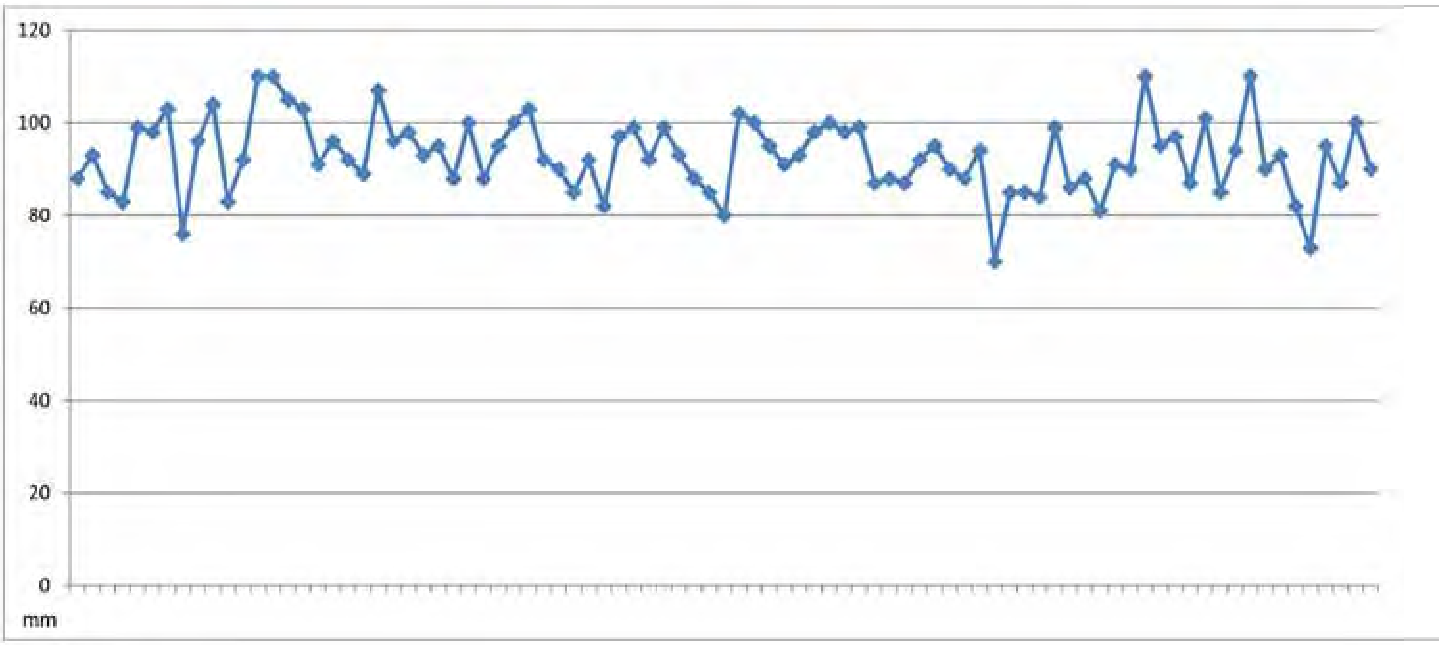


Figure 128. Lengths of grips among the studied finds.

Another similar case is from Eura (KM 9164:3), having a pommel of a later variant of Petersen's type X, while the lower guard is of type R or S.[1388] In this case, the pommel is quite clearly slightly later than the lower guard. Again, the tang was not re-forged, since the hole in the pommel is relatively large and does not fit the tang exactly.[1389]

Similar swords with parts of different type on the same hilt are also known from elsewhere. A good example is a sword from Saaremaa, Estonia, with pommel and upper guard of Petersen's type T2, while the lower guard is silver-plated.[1390] Also a sword from Ylöjärvi, Finland (KM 14553:1) has a lower guard of silver-plated type, and a three-lobed pommel is cast in bronze and represents Kirpichnikov's local type A.[1391]

Clear signs of use, i.e. of battle and handling, are very hard to identify. Actual damage may be observed in only one case, the disc-pommeled sword from the Church of Huittinen. The sword is otherwise in quite good condition and undamaged, indicating that it was originally placed in an inhumation grave from which it was recovered at some point. However, one end of the slender lower guard is broken or even cut, since the place of breakage is quite straight and smooth. This may be interpreted as possible battle damage. For instance, a sword or an axe of the opponent may have hit the lower guard, cutting its end off, since the guard is quite thin.

Silver-plated hilts are interesting with regard to handling. The silver surface overlaying the iron is very thin, certainly less than one tenth of a millimetre. In the silver-plated grips the silver has worn off to reveal iron, or more accurately some of the hatched iron surface. It may be speculated that this wear was caused by repeated handling of the sword.[1392]

7.4.3. Grips

The length of the grip was measured only in those cases where both the lower guard and the upper guard or the pommel, depending on the hilt type of course, were present and in their original places. In some well-preserved cases the original place of the lower guard could be measured, thus making it possible to also measure the grip. Due to their fragmentary nature, not all grips

1388 See also Räty 1983: 54, 76.
1389 Moilanen 2010a: 8.
1390 Mandel 1997.
1391 See Koskimies 1973.
1392 See Moilanen 2010a: 8.

could be measured. In twenty hilts only the lower guard remained, and in three swords only the lower guard was missing. Altogether sixteen blades did not have any hilt, making it impossible to define the length of the grip. Also, in five more finds the parts of the hilt had moved from their original positions and were too corroded for inspection. In one case the tang was broken and missing some of its length.

The measurable grips are presented in Figure 128. This illustration shows that the grips were commonly between 85 and 100 millimetres long. A total of four grips were 11 centimetres long, and in contrast the shortest grip was only 68 millimetres. It seems that the grip length does not clearly correlate with the hilt type or according to chronology. The simplest explanation for the somewhat irrational variation of grip lengths could be the customization of the hilt for the user. Every person has a different hand size, and the assembler of the sword could for example file the tang or the parts of the hilt to be of certain size, perhaps for a certain customer.

Another model of explanation could lie behind the craftsmen forging the tang and assembling the sword. It is hard to believe that even the same craftsman measured every tang he made to be of exactly the same length. It is more plausible that the tangs, as well as other blacksmith's work, were made by pure estimation by eye.

Figure 129. Hilt of sword KM 8602:130 from Köyliö showing a grip layered from wood, textile and leather.

Traces of organic grips have survived in swords deposited in inhumation burials. All the organic parts of finds from cremation cemeteries were burnt away on the pyre. Some wood has survived on the tangs of the following sword finds: KM 3316:13 from Salo, KM 8602 A:116 from Köyliö, KM 8656 H23:1 from Masku, KM 11063:283 from Eura, KM 13839:253 from Pöytyä, KM 19901:202 from Ylöjärvi, KM 23607:490 from Eura, and KM 24740:242 again from Eura. No analyses have been conducted to identify the wood species, since previous research has ignored these traces of organic grips in connection with these particular finds.

The grip of sword KM 8602:130 is exceptional. It has a leather strip ca. seven millimetres wide as the topmost layer, beneath which these seems to be a layer of a woollen textile (Fig. 129). Under these layers was a wooden core against the iron tang.[1393] Similar kinds of layered grips have also been found in swords in Germany, Sweden, the former Yugoslavia and the Czech Republic.[1394]
Some swords have a hollow iron pipe as a grip. This feature appears as a rule in the silver-plated type of hilt discussed above (Chapter 7.2.20). In the examined silver-plated hilts, the grip has been preserved in three swords: KM 9562:1 from Lieto, KM 17208:561 from Tampere, and KM 17208:588, also from Tampere. To create this kind of grip, a sheet of iron must be rolled. Surprisingly, no seams are visible in the studied iron grips, which means that they must have been forge-welded into a tube quite skilfully.

1393 Tomanterä 1972: 24.

1394 E.g. Geibig 1991: 101; Košta & Hošek 2014; Strömberg 1961: 137, T. 40.1; Thålin-Bergman 1986: 14; Vinski 1983b: 498, Abb. 3.1.

As specialities, the disc-pommeled, silver-decorated swords from Kaukola, ceded Karelia (KM 2489:121 and KM 2489:280-281) have an iron grip, also decorated with silver wire overlays on a hatched surface. The third sword of this type of hilt (KM 65 from Eura) does not have an iron grip. Also, the Petersen type Z sword from Sastamala has, quite exceptionally, an iron tube as a grip. In this case the decoration is not visible, most likely because of corrosion. The bronze-hilted sword from Hattula (KM 17777:1) has a hollow grip cast in bronze, in similar fashion as the other parts of this hilt.

Last it should be noted that organic hilt parts, for example pommels made of wood, bone or horn, may have been used, also in connection with guards made of metal.[1395] These have not naturally survived, especially in the case of cremation burials. A good example of an organic hilt is the sword of St. Stephen, preserved in Vienna. The hilt of the sword, excluding the re-wrap of the grip, is dated roughly to the second half of the 10th century according to its decoration.[1396]

7.5. Summary and conclusions regarding hilts

To summarize the above, the hilts attached to the iron-inlaid blades are very variable. The oldest hilts may be dated to the second half of the 8th century, while the youngest may be dated even as late as 1200 AD. Iron-inlaid blades do not seem to concentrate in any specific types of hilts. Firstly, a very wide range of various Petersen's types as well as later ones are exhibited among the studied inlaid swords. Secondly, the percentages of most common hilts attached to these blades closely correspond to the number of all classifiable sword hilts in the Finnish material.[1397] For example, the most common type in Viking Age Finland among all finds is Petersen's type H, which is also the most common hilt type among the iron-inlaid swords too. Common in Finland, both among all sword finds and iron-inlaid ones, are also Petersen's types B, V, X and Z, and also E and Y.

To further complicate the picture, even the same types of hilts have kinds of sub-types, showing not only slightly varying proportions but also different decoration. Besides materials and motifs, the techniques of decoration may also vary within a conventionally defined type. For example, the iron base into which non-ferrous wires were hammered could have been treated slightly differently, while the technique may in principle have been the same. This can best be seen in the frequency and form of chiselled or punched grooves into which the wires were hammered, as well as the thickness of the inlaid wire. Without a doubt, elemental analyses would also give variable results when comparing the chemical composition of the inlaid wires of various hilts, but this could not be done in the present study.

Over half of the studied hilts seem to be made separately, because the slots for the tang of the blade are oversized and thus do not fit the tang as tightly as they should. Moreover, some re-forged tangs also suggest the attachment of a hilt made somewhere else than the blade. It is however impossible to state whether the hilts were made locally or imported from somewhere else. It is only certain that many of them were not made for the particular blades. The technological diversity within conventionally defined types also suggests that same "types" of hilts were produced by different makers or workshops. Perhaps the hilts were even attached locally, with the grip length possibly adjusted to individual users. This activity is evidenced by the repaired hilts having parts from two separate types. All in all, the hilt was more exposed to changes of fashion than the blade.

1395 *E.g. Räty 1983: 134–135.*
1396 *E.g. Fodor 2004; Kalmár 1936: 152–153; László 1977. The blade of the sword bears an ULFBERHT inscription.*
1397 *See e.g. Lehtosalo-Hilander 1985.*

8. THE CHRONOLOGY OF INLAID SWORDS

This chapter concentrates on the chronology of the studied finds. The chronology presented in this chapter is based primarily on typologies of hilts, blades and their decorations as presented in chapters four, five and seven. In addition, earlier chronological presentations of the evolution of inlays are taken in to consideration. Also the dating given by the context of the find (Appendix Three) is used to complement the typological dating.

8.1. Dates for studied finds

The datings for the sword finds studied in this work can be found in Figure 130. The dates are in some cases very broad, since in most cases even the find contexts did not give any grounds for more accurate dating.

To summarize the basis for Figure 130, the starting point is provided by various typologies of the hilt and blade, as well as previous datings for certain inlaid motifs. The typologies of the hilt were discussed in previous chapter, giving grounds for the dating of the hilts. Blade typologies introduced in Chapter 4 were used when permitted by the condition of the find. The type of blade could not be determined in the majority of cases due its heavy corrosion, thus leaving the contours and measurements of the blade being uncertain and impossible to define.

Normally the chronology has been established by leaning only to Scandinavian, i.e. Norwegian, and continental dates, forgetting the work of eastern scholars from e.g. Russia and the Baltic countries. One often neglected group of sources is the early medieval and medieval art, which can offer datings by comparing archaeological specimens to illustrations from certain periods. Find contexts are then used to specify the datings whenever possible. Naturally, swords from closed find combinations such as individual burials are dated more accurately.

One way to date the find is to rely on chronologies established for certain inlaid motifs, inscriptions and materials. These were used also for the dating of the finds in this work, and they are also discussed below in more detail.

The dates given on typological grounds are to the nearest quarter century, as also done in typological attempts by other scholars. More accurate dates for certain finds were achieved with the help of find contexts datable according to coin finds, for example. These are cited in appendix three in accordance with the contexts.

A problem of dating is the separation of the time of manufacture and the time of use. According to Jussi-Pekka Taavitsainen, the time of the use of weapons may have been long due to reuse and possible storage.[1398] Therefore the datings of certain "types" may indicate quite a broad time period.

1398 Taavitsainen 1990: 42–43.

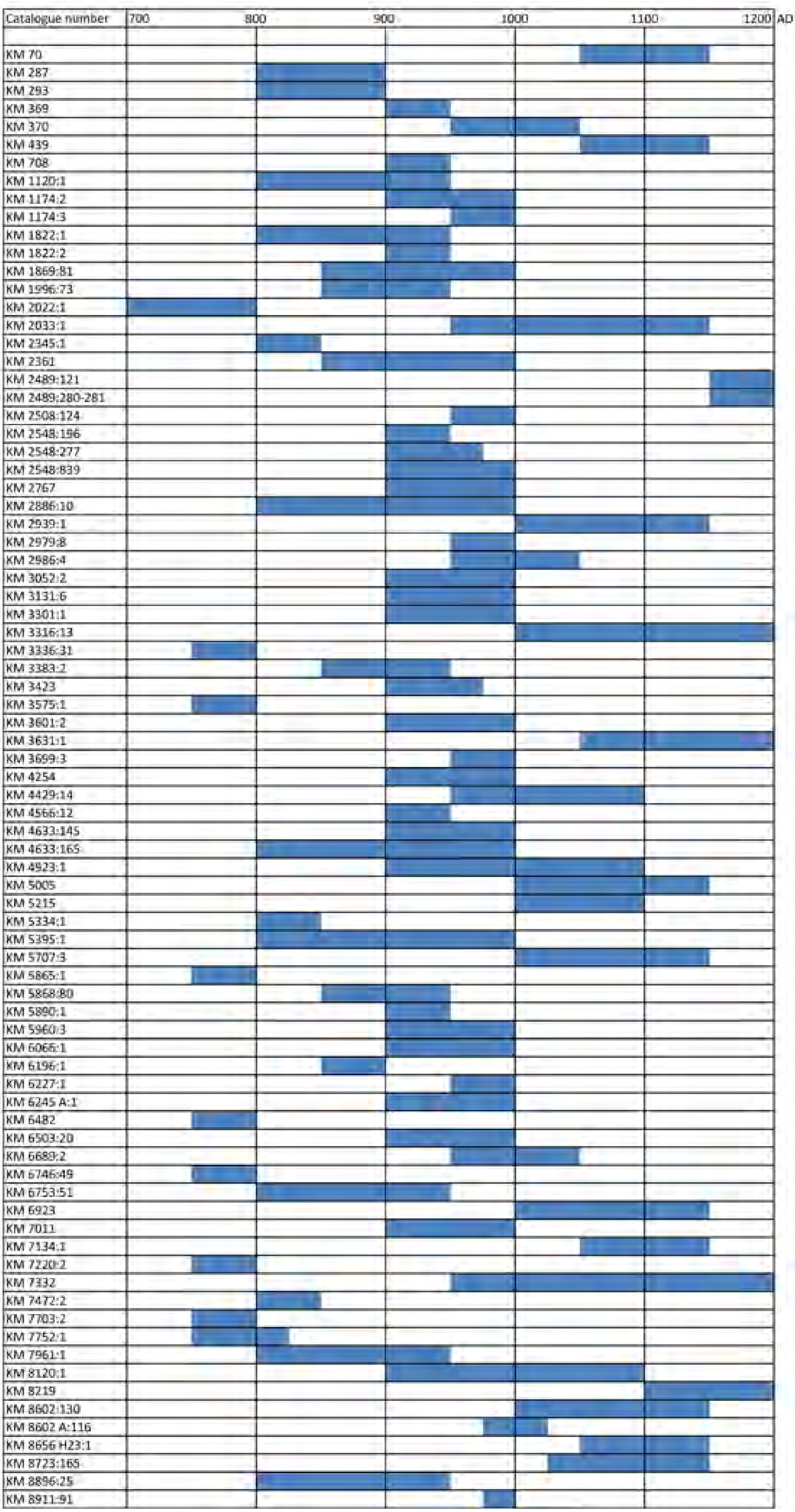
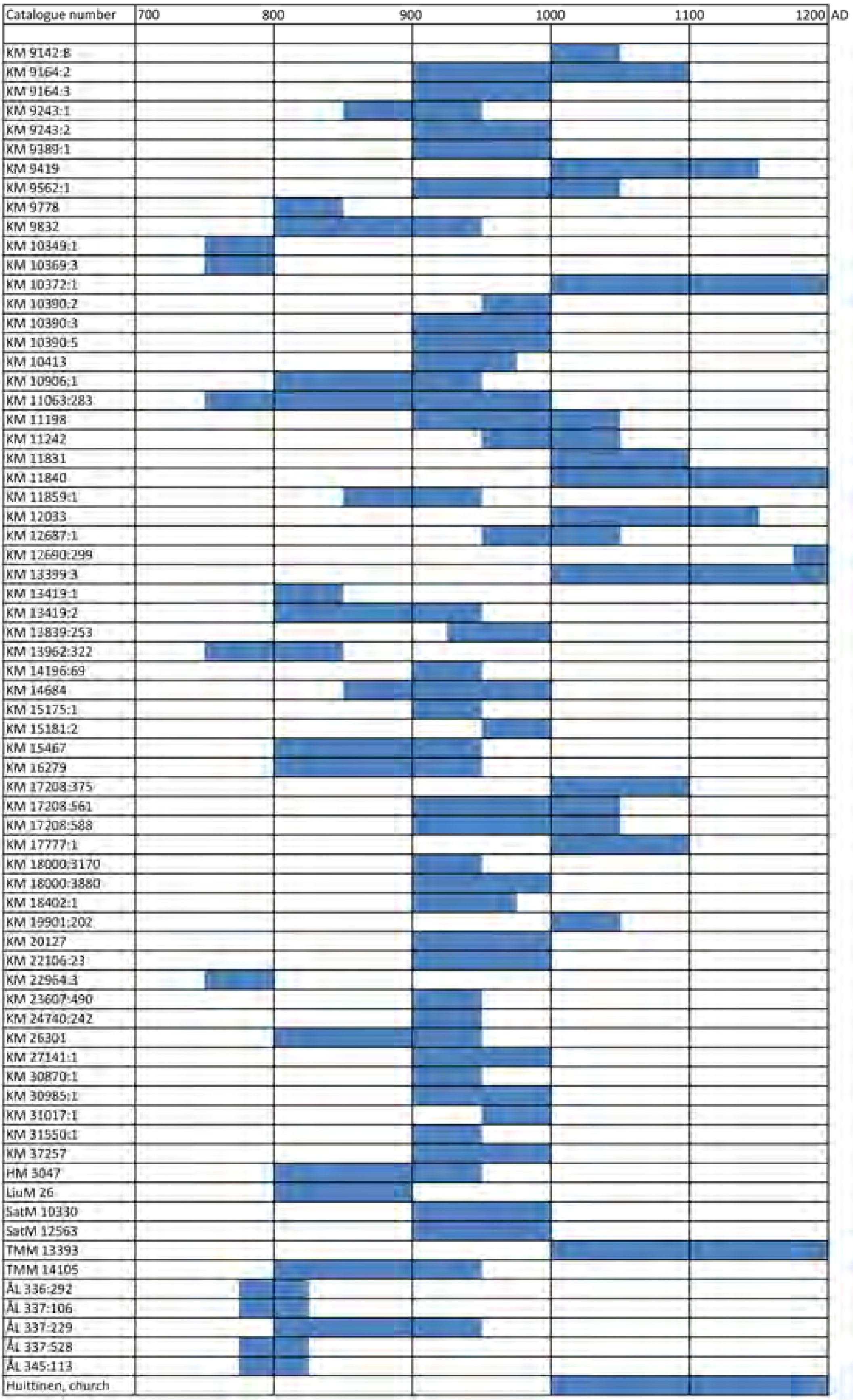


Figure 130. Dates established for the iron inlaid swords studied in this work.


Catalogue number
700
800
900
1000
1100
1200
AD
KM 9142:8
KM 9164:2
KM 9164:3
KM 9243:1
KM 9243:2
KM 9389:1
KM 9419
KM 9562:1
KM 9778
KM 9832
KM 10349:1
KM 10369:3
KM 10372:1
KM 10390:2
KM 10390:3
KM 10390:5
KM 10413
KM 10906:1
KM 11063:283
KM 11198
KM 11242
KM 11831
KM 11840
KM 11859:1
KM 12033
KM 12687:1
KM 12690:299
KM 13399:3
KM 13419:1
KM 13419:2
KM 13839:253
KM 13962:322
KM 14196:69
KM 14684
KM 15175:1
KM 15181:2
KM 15467
KM 16279
KM 17208:375
KM 17208:561
KM 17208:588
KM 17777:1
KM 18000:3170
KM 18000:3880
KM 18402:1
KM 19901:202
KM 20127
KM 22106:23
KM 22964:3
KM 23607:490
KM 24740:242
KM 26301
KM 27141:1
KM 30870:1
KM 30985:1
KM 31017:1
KM 31550:1
KM 37257
HM 3047
LiuM 26
SatM 10330
SatM 12563
TMM 13393
TMM 14105
ÅL 336:292
ÅL 337:106
ÅL 337:229
ÅL 337:528
ÅL 345:113
Huittinen, church

8.2. Chronologies for inlaid motifs

There have been some attempts to establish chronological sequences and evolutional series of various inlaid motifs according to their contents and materials, and they are presented here briefly, because the main focus of this work is on the study of the inlays.

The date of a single blade may be roughly established according to its decoration, i.e. pattern-welding, inlaid motifs, or their combinations. Some authors have made chronological divisions about the blades on these bases. Rudolf Wegeli separated three groups: large pattern-welded inlays, smaller iron inlays, and non-ferrous inlaid marks.[1399] Aleksis Anteins, using broadly the same principles, defined five distinct groups: pattern-welded blades, blades with large pattern-welded inlays, blades with small iron inlays, blades with non-ferrous inlays, and blades with engraved motifs.[1400] The most recent attempt is that of Alfred Geibig, who defined a total of 15 groups, with also more accurate datings for motifs of different content.[1401] These are all cited below, among others.

Pattern-welded blades have been dated to the late 7th century and onwards to ca. 800 AD.[1402] Following the pattern-welded blades are those with geometric iron inlays on a pattern-welded mid-section, dating roughly from 750–800 AD,[1403] maybe even as early as the 7th century.[1404] According to Geibig, they are contemporaneous with large letter sequences in the form of inlays.[1405] After these come geometric inlays in non-patterned blades from 750–950 AD, re-appearing about 1100 AD and disappearing again at the beginning of the 1200s.[1406] Iron spiral designs are said to be a phenomenon of 850–950 AD.[1407]

Names ULFBERHT and INGELRII with their variations are generally considered as belonging to the Viking Age or its latter half, although the period of use may also have been longer.[1408] Small iron characters appear in the 950s, remaining in use until the early 1200s, in the same way as iron cross-potents.[1409] Inlays containing the phrase ME FECIT appear in ca. 950–1030 AD, and 1080–1150 AD.[1410] The later ones are executed in smaller letters than was commonly practised in the Viking Age. Famous GICELIN swords belong to this category, dated to the 11th and 12th centuries.[1411] Small characters begin to predominate in the blades in various forms such as unknown inscriptions (ca. 1050–1170 AD), groups of iron bars (ca. 950–1200 AD, also larger ones exist), religious symbols (ca. 1100-1220 AD), and anagrams in iron (ca. 1050–1150 AD).[1412] The broad parameters of the datings can also be illustrated by the use of non-ferrous cross-potents in ca. 1050–1200 AD.[1413]

1399 Wegeli 1903–05. See also Oakeshott 1964: 140–143.
1400 Anteins 1966.
1401 Geibig 1991.
1402 Geibig 1991: 155.
1403 Geibig 1991: 155.
1404 Jankuhn 1951: 216.
1405 Geibig 1991: 155.
1406 Geibig 1991: 155.
1407 Geibig 1991: 155.
1408 See Chapters 5.3.1. and 5.3.2. for the discussion on the dating of these two names.
1409 Geibig 1991: 155.
1410 Geibig 1991: 155.
1411 See Chapter 5.3.3. for the dating of GICELIN blades, as well as other proper names evident in the studied blades.
1412 Geibig 1991: 155.
1413 Geibig 1991: 155.

In her studies of the Finnish finds Leena Tomanterä, has separated iron inlays from ca. 1000 AD and onwards into six groups.[1414] The first of these includes correctly written GICELIN blades, dating between 1000 and 1150 AD. Se second group consists of similar small ferrous inlays, now in the form of a variation of the sentence IN NOMINE DOMINI, dating from between 1000 and 1200 AD. This second group has four sub-groups: small iron inlays with no clear letters (1200–1300 AD), small pattern-welded inlays and with no actual letters (1100–1200 AD), large pattern-welded inlays (1100–1200 AD), and non-ferrous marks or letters hammered on a hatched surface. Groups from three to six include only non-ferrous motifs, with the same dating as the ferrous ones.

In addition to the above, non-ferrous inlays have been studied, characterized and dated by multiple scholars. Oakeshott divided non-ferrous religious invocations in three groups, and later non-ferrous small figures in altogether six groups.[1415] Tomanterä in Finland included non-ferrous marks in five of her groups.[1416] Marian Głosek attempted to date various motifs and letter combinations, most of which were non-ferrous.[1417] Similarly the motifs discussed by Donat Drboglav were mostly non-ferrous.[1418]

To summarize, it seems that the dating of the blade according to its decoration, especially the inlays, produces a number of alternatives due to the long time spans presented for each type. Of course, the time span may be long, but these datings mostly do not pay attention to the difference between the time of production and the time of use. Moreover, the way these dates are established does not always rely on archaeological finds but instead on histories of art and style. A practical problem is the local nature of the material, especially in Geibig's work, where all the dates are based on an examination of finds from the territory of modern-day Germany.

8.3. Notes on the chronology of inlays in Finnish swords

Among the Finnish finds studied here, the oldest ferrous inlays found on sword blades date from the second half of the 8th century. These are found from blades pattern-welded in their mid-section, some datable even to the first half of the 9th century. The inlaid motifs on these blades vary, but none of them consist of Latin letters yet. Common geometric motifs consist of omega-like designs, circles, spirals, simple lattices, infinity symbols and plain vertical lines. The material of the inlays is also pattern-welded, commonly in similar fashion than the pattern-welded rods used to construct the mid-section of the blade itself. The material of the inlays is twisted, except in omega figures, where the pattern remains straight, perhaps to leave the figure itself clearer to perceive. The same purpose could have been served by leaving the pattern-welding of the blade as straight underneath the inlays in some finds. The inlays were commonly made on one side of the blade, although some swords have inlays on both fullers.

During the second half of the 8th century and first half of the 9th century, letter-like marks start to appear on blades. These are, during their earliest appearance, connected to lattice patterns on the opposite side of the blade. One of these examples has inlays on top of a pattern-welded base of the blade, connected to a hilt of Petersen's type E (KM 7752:1). Other blades in this category no longer have a pattern-welded blade.

1414 *Tomanterä 1978.*
1415 *Oakeshott 1960 and 1964.*
1416 *Tomanterä 1978.*
1417 *Głosek 1984.*
1418 *Drboglav 1984.*

These above-mentioned blades are associated with hilts of Petersen's types B and special types 1 and 2, and also the Mannheim type and Behmer's type VI. In one case (KM 11063:283) the type of the corroded hilt remains unclear, but it somewhat resembles Petersen's types N or X, thus being clearly later than the blade, which, in addition, appears to be shortened from the tip at some stage of its use. Geographically these earliest examples of iron-inlaid blades concentrate in Finland Proper and the Åland islands, two being known also from Ostrobothnia, where settlement prevailed until the end of the Merovingian Period.

The trend of geometric motifs in non-patterned blades continues throughout the 9th century. Omega-like designs, which were found also on pattern-welded blades, are continued to be in use throughout the Viking Age. They are connected to different kinds of lattices in blades datable to 850–1000 AD with hilts of Petersen's types I, S and Y. Omegas may be found with cross crosslets and circles in blades of similar time span and hilt of Petersen's types E, L and Y. Lattices or crosses accompanied by circles or spirals date roughly from 800–1050 AD together with hilts of Petersen's types H, X and Z. Plain spirals in non-patterned blades date from 800–1000 AD, and were found only with type H hilts in the studied material. Mere lattices on one or both sides of the blade are also common, dating widely to 750–1050 AD with hilts of Petersen's types H, T, X and Y, as well as special type 2 and Mannheim-Speyer type. Designs resembling St. John's arms date from between 800 and perhaps as late as 1200 AD, more accurate datings from the material cannot be made.

In addition to geometric motifs, also letter-like marks are common in the 9th century. During this time, these are found in connection with hilts of Petersen's types C, H and I. Geographically the finds datable to the 9th century show a slight expansion also to areas further afield. While the majority of the swords are still found in Finland Proper and Åland islands, some are known from provinces of Satakunta, the Tampere region, Läke Päijänne region of Häme (Tavastia) and Uusimaa.

During the second half of the Viking Age – the 10th century and beginning of the 11th – both geometric and letter-like marks are known, although they are less in number than before but geographically vastly divided. Geometric motifs continue earlier traditions, except that, as a new feature, cross crosslets may be found together with lattices in the first half of the 10th century with Petersen's type X hilts. During this period of time ULFBERHT and INGELRII inlays are common, and also other motifs with clear Latin letters appear.

The majority of examined ULFBERHT blades date from between 900 and 1000 AD, although some may also date from the 9th century. The hilts of these ULFBERHT swords are Petersen's types E, H, N, R, S, V, X and Z, and also silver-plated type. One sword (KM 15181:2) is close to Petersen's types Z and Æ, thus giving a possible date to the 10th century and possibly even after 1000 AD. With regard to variations +VLFBERH+T and +VLFBERHT+, no clear chronological differences exist. It is possible that three out of four variants of the latter date from the second half of the 10th century that is slightly later than the first variant, but this cannot be securely stated. Similarly, no clear chronological differences can be seen in the use of different kinds of lattices and their combinations on the opposite sides of these blades. Even the materials of the inlays do not differ chronologically. All the possible imitations of the ULFBERHT signatures may also be dated to the 10th century. Only one with also text AMEN and Petersen's type V hilt (KM 370) may be dated slightly later, between 950 and 1050 AD.

INGELRII blades all date from between 950 and 1050 AD, one perhaps from the 10th century, with accompanying hilts of Petersen's type O, V and Y. All in all it seems that these may be slightly later than the ULFBERHTs, as also indicated by earlier research.

Blades with other combinations of Latin letters apart from ULFBERHT and INGELRII contain some other maker's names also datable to the end of the Viking Age. Inscription INNOMEFECIT accompanied with an Oakeshott type A pommel (KM 4429:14) dates from between 950 and 1100 AD. Also other swords with brazil-nut shaped pommels may appear before the midpoint of the 11th century. The sword with inscription BENOMEFECIT and a silver-plated hilt (KM 17208:588) can be dated to 900–1050 AD, having also larger inlays than other three swords mentioned above.

Other combinations of Latin letters fall into both larger, pattern-welded inlays, and also smaller non-patterned ones, dating also very broadly from about 900 AD to perhaps 1200 AD. Sentence IN NOMINE DOMINI is quite common among the studied finds, especially in abbreviated and varied forms, dating also from between 900 and 1200 AD. In many cases these varied versions of IN NOMINE DOMINI sentence are met in connection with some other Latin name or combination of letters observable on the opposite side of the sword blade. Also other letter combinations have a similar dating and possibly refer to words or sentences derived from Christianity.

Geographically inlaid swords become more widespread during the 10th century. More swords are known from the Tampere region than from Finland Proper, whereas finds from Satakunta and Tavastia proper are also numerous. Some finds are known even from Central Finland and Lake Päijänne region of Häme (Tavastia), not to mention one anomaly from Northern Ostrobothnia.

In the 11th and 12th centuries swords have generally disc-shaped (Tomanterä's types A and B) or brazil-nut shaped (Oakeshott's types A and B) pommels accompanied by slender crossguards. Also other types exist as single examples, such as Oakeshott's type E, and a cast bronze-hilt resembling Petersen's type Æ. Motifs with Latin letters and words are most common including maker's names such as GICELIN. The imitation of these words and sentences led to a great number of letter-like marks during this period, while geometric motifs clearly began to disappear. In regional terms, Finland Proper has provided more finds than other provinces. The only swords with ferrous inlays recovered from the territory of ceded Karelia date from this period of time.

As a short excursion into the inlaid materials, it can be stated that pattern-welded inlays were utilized first, when the whole phenomenon of inlaying iron into sword blades seems to have been born. According to the swords examined in this work, large pattern-welded inlays were in use from ca. 750 AD all the way perhaps to 1200 AD. This later date derives from the fact that some swords datable here to this young a time period have found to have these kinds of inlays, mainly in the form of Christian phrases or combinations of Latin letters. Moreover, letter-like inlays were also constructed of large pattern-welded rods throughout their time of appearance.

Contrary to common beliefs, also smaller inlays, traditionally regarded as appearing during the Crusade Period, were in some cases made of twisted pattern-welded rods. According to the finds, smaller inlays, about half the size as those used in ULFBERHT blades, may have appeared already in the middle of the 10th century, their use being most common from 1000 AD onwards. No chronological divisions can be made on when small pattern-welded inlays were replaced by ones made from plain iron and steel. It seems that both were in use at the same time. Furthermore, according to the finds, no border can be drawn between the time of use of larger and smaller inlays, but they were used side by side in the late Viking Age and the whole Crusade Period. This also leads to observe that the narrower blade form, which also had a narrower fuller, was taken in use perhaps during the very late Viking Age, and that the wider, older-style blades were not abandoned at this time.

An interesting phenomenon is the existence of some “middle-sized” inlays. In the swords examined here, these date roughly from between 900 and 1200 AD, most likely from the 10th and 11th centuries. Again, some of these are pattern-welded and some are not. Since the inlays cannot be strictly categorized as “large” or “small”, the blades, too, are “middle-sized”.

It should also be noted that not all inlays were pattern-welded before the appearance of smaller inlays. Large, plain iron and steel inlays are observable from the beginning of the 9th century onwards, the earliest examples being attached in pattern-welded blades. Among the studied finds, the most common motifs such as ULFBERHT and INGELRII were found in some cases to have been made of non-patterned material.

Lastly with reference to chronology, it must be taken into consideration that the phenomenon of ferrous inlays as well as its trends and changes cannot be strictly related to certain archaeological periods. Thus it has been more natural to express the dating as certain centuries than to refer to parts of particular periods. It must also be remembered that although fashions changed during the centuries, older, “outmoded” weapons were still deadly and functional, and for this reason older swords may have been used much later than they were produced, creating a long time span in the archaeological record.

9. IRON-INLAID SWORDS IN FINLAND AND EUROPE

This chapter returns to the questions presented in the introduction. How many iron inlaid swords have been found in Finland? What are the reasons behind the great diversity of inlaid motifs and inscriptions and the technological variation of inlays and blades carrying them? What was the status of inlaid swords in Late Iron Age Finland? What was the situation in Europe as a whole?

The presentation of the observations made in previous chapters begins with a discussion of the meaning and purpose of the motifs. The technological aspects emphasized in this work are presented as connected to the origin and manufacture of both the blades and their inlays. The topics covered include the origin and refinement of raw materials, the manufacturing in practice, and discussion on the trade of weapons as well as possibilities of local manufacture. Also the use and discard of these weapons are considered.

9.1. On the number of inlaid swords in Finland and Europe

The basic question asked in the introduction was, how many iron inlaid swords have been recovered from Finland. In mainland Finland, the Åland islands and the territory of ceded Karelia the number is 151 as indicated by this study, perhaps even more if time and resources had permitted the complete examination of all finds from the above-mentioned areas. This number is roughly equivalent to slightly less than one third of all swords from the time period from which blades with ferrous inlays are known.[1419] During the Viking Age, ferrous inlays were found at least in approximately 40 per cent of the swords.

When taking a look at the European situation, the numbers are slightly different (Fig. 131). For example in Sweden, over four hundred swords have been studied, dating from the Merovingian Period and the Viking Ages showing that 68 of these had ferrous inlays, i.e. less than one fifth of the examined swords.[1420] In Norway, it has been estimated that about 3,000 swords have been recovered from the Viking Age alone.[1421] It is clear that this vast a number of swords is well-nigh impossible to study in detail. However, a sample of 111 blades examined by the Russian-Norwegian sword project showed that even 94 of them had ferrous inlays.[1422] In Russia a total of 40 blades were found to be equipped with ferrous inlays, while the total number of these Viking Age swords was 87.[1423] From Denmark, only about 160 swords from the Viking Age are known,

1419 his time span covers swords from ca. 600 AD all the way to 1200 AD, i.e. from the Merovingian Period to the Crusade Period.
1420 Thålin-Bergman & Arrhenius 2005.
1421 Martens 2004.
1422 E.g. Stalsberg 2008.
1423 E.g. Kirpichnikov 1970b.

only thirteen having iron inlays.[1424] From the Baltic territories over 460 swords are known from the 9th to 13th centuries, at least 51 (about eleven per cent) having a ferrous inlaid motif or inscription.[1425] In Estonia, at least 73 swords from the 8th to 13th centuries were known in 1991,[1426] and the number has most likely grown today. Of all these, 19 have been found to be ferrous inlays (ca. one fourth).[1427] Nine out of 142 (ca. seven per cent) radiographed swords in the collections of the British Museum, dating from Anglo-Saxon period and the Viking Age, were decorated with ferrous inlays.[1428] From the continent, 347 finds have been catalogued from German collections dating from 700 to 1200 AD, 54 of these having an iron inlaid blade (roughly 16 per cent).[1429]

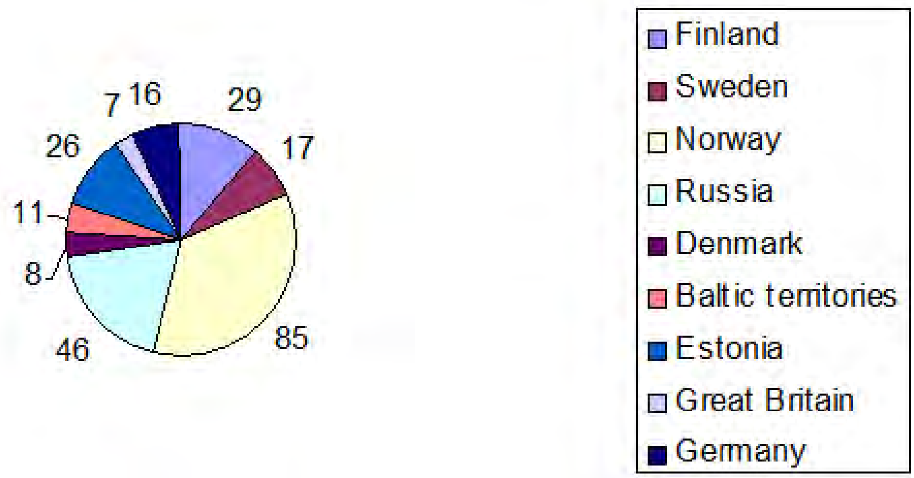


Figure 131. Percentages of iron inlaid swords among domestic and foreign finds as studied so far. The numbers for Norway and Great Britain were calculated from samples, not all sword finds from countries in question.

It is hard to make any comparisons about the frequencies of iron-inlaid swords between various territories and countries of Europe, because the research has not been systematic to reveal all inlaid blades, and furthermore, previous publications rarely even mention the total number of swords recovered from a given area and from a specific period of time. Of course, there may be one or multiple reasons behind the spatial variation of the number of inlaid swords, being based on trade networks, local production, demand of specific types of swords or blades, the meaning and significance of inlaid motifs etc., but the preliminary reason seems to lie in the manner of research.

However, the percentage of iron inlaid swords in Finland seems to be almost the same as in Russia during the Viking Age. Russian swords have been well studied by Anatoly Kirpichnikov, and the figure is thus quite reliable. Considering that also German finds and some of the British ones were also systematically studied, the Finnish number is comparatively high. In contrast, Norwegian swords seem to have even more ferrous inlays if the studied sample is to be believed. Interestingly, the German iron inlaid swords are fewer than in Scandinavia. Although the figures are not exact, it seems that inlaid swords are greater in number in Scandinavia than elsewhere in Europe, indicating active trade, local manufacture, or even both. These points of view are discussed below in more detail.

One reason for the common occurrence of swords at least in Norway may be explained through written sources. A medieval law is known from Norway according to which all free adult men should own a compilation of weapons including an axe or a sword together with a spear and a shield.[1430] Since Finland lacks any written sources from this period, it is impossible to state if these kinds of codes of law had been in common use. In contrast, the number of swords in

1424 Pedersen 2010.
1425 Kazakevičius 1996. This figure consists of finds from Latvia, Lithuania, Belarus, the Kaliningrad Oblast, and the northwestern area of Poland.
1426 Mandel 1991.
1427 Mandel 1991 and Prank 2011.
1428 Lang & Ager 1989.
1429 Geibig 1991.
1430 Solberg 1985: 68.

general may be considerably lower in the Frankish areas due to burial customs, which were Christian in the Frankish realm.

In any above case, the number of swords is vast. In the case of Finland, the whole number of recovered swords and blade fragments is 677 as stated in Chapter 1. These are only the recovered ones, leading us to assume that many remain still unfound. In addition to all these, not all swords were deposited in the ground, but they were probably recycled or otherwise ended elsewhere. It is impossible to even estimate the original number of swords that existed here during the Late Iron Age, but it must have been larger than the number of those recovered. The large numbers of swords then give grounds to surmise that the number of swordsmiths was correspondingly high.

9.2. The meaning and purpose of inlaid motifs

9.2.1. Questions of language and religion

The examination of how inlays were understood in Europe, especially in Scandinavia and Finland first requires a brief excursion into the language that was used during the Late Iron Age. In the Frankish areas in Continental Europe Latin had been the common written language even before the Carolingian era, and literacy and writing were promoted during the Carolingian renaissance in the 8th and 9th centuries, during the reign of Charlemagne. The picture, however, is mixed, because a vast number of dialects, both Germanic and Romance-based, were spoken in the Frankish territories in this period.[1431] It has been suggested that the skills of reading and writing were limited to certain classes of society such as administrative organs, but this matter is under debate.

In the case of Scandinavia, a generally accepted term is *common Scandinavian*, a quite uniform mixture of dialects spoken in Scandinavia from the Late Merovingian Period to the end of the Viking Age.[1432] The language was divided between East and West Scandinavian, the former consisting of Old Swedish and Old Danish, and the latter, also known as Old Norse, comprising old versions of Norwegian, Icelandic and Faroese.[1433] It is still uncertain where Finland stands in this setting. It is commonly claimed that some kind of proto-Finnish language belonging to the Finno-Ugric group of languages was spoken in Finland already during the Early Iron Age, but it seems likely that, due to trade contacts, at least East Scandinavian was familiar to these contemporary residents.[1434]

Writing itself was scarce. In Sweden, numerous rune-stones stand as witnesses of the runic alphabet, which prevailed from the Early Iron Age onwards.[1435] Some Finnish finds also show names and marks executed with runes. During the Viking Age Latin alphabet was not yet familiar in Scandinavia. Writings on birch bark strips dating from 11th century onwards have been found in considerable numbers from Novgorod in Russia, showing an early form of Cyrillic alphabet as well as ancient Russian language and some Baltic Finn language.[1436] It is necessary to mention here

1431 E.g. McKitterick 1989: 7. Romance languages include all languages that were evolved and based on Latin.
1432 E.g. Wolf 2004: 41.
1433 Wolf 2004: 41–42.
1434 E.g. Barnes 2008: 280.
1435 E.g. Stenberger 1964: 810–811. Williams, H. 2008; Wolf 2004: 45–46.
1436 E.g. Uino 2003b.

a sword found from modern-day Ukraine with pattern-welded inscriptions of Cyrillic appearance transliterated as "KOVAL" and "LJUDOTA", meaning a blacksmith named Ljudota.[1437] This particular sword has been dated to the 11th century,[1438] contemporaneous with the oldest birch-bark texts.

It is obvious that in the light of the above, the majority, if not all, inhabitants of the present area of Finland, were unable to read Latin letters, since they were not yet known in Scandinavia during the Viking Age. Of course the possibility of immigrants of higher social status from Continental Europe cannot be excluded. Either the language was a form of Old Scandinavian or something else, but Latin texts were most likely incomprehensible. Thus, ferrous inlays in swords were regarded as perhaps magical symbols[1439] or then as mere evidence of good quality (see below).

It may have been so that in the first stages when ferrous inlays were a fresh phenomenon in swords, they were acquired as status artefacts of a kind to reflect societal position or wealth, for example. The situation may have changed due to Christian missionaries, but still the large number of misspelt inscriptions as well as imitative series of Latin letters suggests that in many cases the texts remained still not understood. Their meaning, however, may have been associated with the Christian faith.

Also the imagery, especially Christian, would have meant something else here. Of course artefacts with Christian forms of symbolism and decoration were imported here perhaps as early as the Migration Period.[1440] These, however, possibly appear as random, and their imagery was regarded as something else than purely Christian. The actual process of Christianization as indicated by inhumation burials was begun already at the end of the Viking Age in Finland,[1441] while elsewhere in Scandinavia, namely in Denmark and Sweden, the process had begun perhaps already in the 9th century.[1442]

Christianity came to the area of modern-day Finland from both the west and east, from the directions of Sweden and Novgorod,[1443] not forgetting the possible role of Denmark.[1444] Lately, the Finnish scholar Unto Salo has claimed that Christianity was rooted in Finland already around 800 AD, and that this Christianity was of eastern origin and was overridden by Roman Catholicism from the 11th century onwards.[1445] This claim has been criticized, since it is based on Christian imagery evident in archaeological artefact finds as well as linguistics, whereas literary sources indicate that the earliest possible congregations date from the second half of the 12th century.[1446]

Along the Christianization religious symbols became more common and more importantly, understood as Christian. How far and how fast this became established is not known. Thus, it remains speculative if the Christian abbreviations, words and sentences kept their original meaning in Finland or even in Scandinavia towards the end of the Viking Age or even in the Crusade Period. Markus Hiekkanen has noted that even the first literary mentions of the first Crusade to Finland are conspicuous and considerably later than the claimed event itself.[1447] Moreover,

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1437 *Anteins 1973: 48; Kirpichnikov 1966: 41; Stalsberg 1989: 19–20; Stalsberg 2008: 21.*
1438 *E.g. Stalsberg 1989: 19–20.*
1439 *E.g. Kivikoski 1961: 245.*
1440 *E.g. Hiekkanen 2005: 13; Purhonen 1998: 45; Salo 2005b.*
1441 *E.g. Hiekkanen 2005: 13; Hiekkanen 2007: 13–14; Purhonen 1998: 147–149; Valk 1994 and cited references.*
1442 *E.g. Brink 2008; Sawyer & Sawyer 1993: 100–104; Steinsland 2007: 468–475.*
1443 *E.g. Purhonen 1998: 178; Steinsland 2007: 475; Taavitsainen 1989.*
1444 *Lind 2007.*
1445 *Salo 2005a: 319–320.*
1446 *E.g. Drake 2006 and references cited.*
1447 *Heikkilä 2005; Hiekkanen 2005: 14.*

the appearance of Christian symbols and artefacts does not necessarily mean that the owner had actually adopted the Christian faith.

The pre-Christian religion of Scandinavia has been discussed a lot.[1448] To generalize, this religion seems to have been a largely unorganized folk religion consisting of a mythology with Germanic elements as well as beliefs and rites observable in everyday life.[1449] Besides artefacts and place names, literary sources as well as later folk beliefs have been used to interpret the features of these pagan religions, and a note has to be made on the written sources, since they are of later date than the Viking Age itself.[1450] In any case, inlays on sword blades studied here cannot be connected to the features of these pagan beliefs, but they all reflect Christianity.

9.2.2. The various meanings of inlaid motifs

As stated at the very beginning of the introductory chapter, a sword in general could have multiple meanings, symbolizing, for example, status, wealth, religious ideas and beliefs, not to mention the function of the sword as a pure weapon. While swords were common weapons throughout the Iron Ages, it is significant for this work to inspect the phenomenon of ferrous inlays. Why were they utilized in the first place and why they were first made in such a complicated manner as fine pattern-welding? What meanings and messages did the ferrous inlays express?

The purposes and meanings of various inlaid motifs and inscriptions are discussed in Chapter 5, presenting motifs found on Finnish swords. Undoubtedly, all the figures and motifs had some meaning during the Iron Age, but this meaning, or a multiplicity of them, is no longer known.[1451] It is certain that they did not have any significance considering the sword as a practical weapon, indicating the purely decorative use of pattern-welding and inlaying.[1452] The contents of motifs and marks themselves are then somewhat harder to approach. Of course the maker had some function in mind when executing the inlays, but what about the user of the sword, or a blacksmith forging his own version, a pirated copy, or his customers?

The meaning of the inlays is not unambiguous, for it was not the same everywhere in Europe but bound to religion and beliefs of various localities and communities (see above) and also to secular matters such as the cost and quality of the weapon. It has been suggested that whatever the function of these motifs, they were not understood abroad, where the blades were imported from the Frankish areas.[1453] Thus, illiterate people could not understand texts and names written in the Latin alphabet, and considered the marks as symbolizing something else. The same may be said about the symbolic figures on sword blades. As Ian Hodder has put it, the basis for any decorative elements lies in societies' beliefs and cultural symbols, whereas the practical execution is affected by the personal attributes and artistic traditions of the maker.[1454]

Considering the whole sword instead of mere inlays, the shape and style of the sword was gradually changing when the inlays came into use. Iron hilts classified by Petersen and later by others were coming into use at the same time as the first inlaid marks on pattern-welded blades appeared. Also the overall shape of the blade changed (see Chapter 1), creating a new fashion to seek after.

1448 See e.g. Andrén 2014 and Steinsland 2007 for further references and most recent views.
1449 See e.g. Hultgård 2008.
1450 E.g. Steinsland 2007: 36–37.
1451 E.g. Oakeshott 2002: 9.
1452 E.g. Lang & Ager 1989: 89. It must be pointed out that poor welding seams of inlaid marks could actually weaken the blade, causing it to bend and fracture more easily in these places.
1453 Kirpichnikov & Stalsberg 1993a: 37.
1454 Hodder 1982: 183. The personal attributes are discussed below in connection with the phase of manufacture.

The inlaid marks were however distinct, because not all blades were decorated with them. Still, taking into consideration the vast number of inlaid blades and their imitations, there was a serious demand for them. Perhaps for functionality in battle, perhaps because the markings were wanted for some other reason, one cannot know for certain any more. In any case the imitations were made to exploit this demand. Perhaps imported blades were so rare that more blades needed to be forged locally, or maybe random blacksmiths conducted business with their own blades after they saw how eagerly these blades were desired.

In general, blacksmiths' names could have been understood as signs of high quality.[1455] It is noteworthy that the names of swordsmiths also occur considerably earlier, during the Celtic La Tène period and also in Roman times. In the Roman period sword names such as Ricus, Riccim, Ranvici, Cocillus and Tasvit can be found.[1456] Also symbols inlaid in copper alloys, gold and orichalcum are sometimes found.[1457] These names and marks were not always found in the sharpened section of the blade, but were hidden in the tang under the hilt. The actual names were not inlaid but punched with specific stamp tools most likely intended to mark a large number of blades. This kind of hidden signature was not evidently meant to be displayed, unlike Late Iron Age motifs. These marked Roman blades were normally pattern-welded and exhibited high quality work of their time.[1458]

Religious words and phrases appearing from the Late Viking Age onwards may also be understood quite straightforwardly to represent the spread of Christianity and to amass this religious power to the sword and its bearer. Perhaps the best examples are swords signed by Gicelin, all having also the inscription "in nomine domini", "in the name of the Lord".[1459] This same phrase has many variations and possible abbreviations, some of which are likely to be imitations in order to falsify the origin of the sword and/or to gain some element of religious power.

Geometric motifs are harder to interpret. One theory is that especially geometric motifs such as lattices were also marks of the manufacturer and are thus a way to control manufacture and trade.[1460] For example, two Late Merovingian swords from Germany, one with letter S and one with a spiral, were interpreted as marked by the maker.[1461] The complex lattice inlays may have acted as signs of skills of the blacksmith as well as a sign of the quality of the work.[1462] Furthermore, these somewhat complex motifs are considered as referring to Carolingian smithies, as opposed to simpler vertical lines and letter-like marks, which could be produced outside Frankish areas.[1463] Still, in my opinion, all these marks could have been easily imitated, not just the simplest ones.

Geometric motifs may also be interpreted as symbols with some magical meaning.[1464] Maybe inlays were seen as having a kind of protective function providing invulnerability and perhaps superiority in war and battle.[1465] Pattern-welded inlays may have symbolized fire and the sun, and perhaps they were believed to be strong enough to ward off evil spirits.[1466] Also cabbalistic meanings have

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1455 E.g. Stalsberg 1989: 22.

1456 Ellis Davidson 1962: 42–43; Engelhardt 1867: 241; Oakeshott 1960: 99. Especially swords from Danish bogs such as Nydam and Vimose included these kinds of markings.

1457 Rosenqvist 1970; Stephenson 1999: 61. Orichalcum is an alloy of zinc and copper, i.e. an alloy known as brass.

1458 Pleiner 2006: 215–216.

1459 E.g. Oakeshott 2002: 9.

1460 Kirpichnikov & Stalsberg 1993a: 37; Lorange 1889: 12–14.

1461 Böhne & Dannheimer 1961: 111.

1462 Kirpichnikov & Stalsberg 1998a: 507–508.

1463 Kirpichnikov 1970a: 175.

1464 Kirpichnikov & Stalsberg 1993a: 37; Lorange 1889: 12–14; Oakeshott 1960: 144.

1465 Kirpichnikov & Stalsberg 1998a: 507.

1466 Kirpichnikov 1970b: 61.

been suggested.[1467] At its simplest, the inlaying of geometric motifs may have served the function of plain decoration, since at all times people have had the need to mark all kinds of artefacts with some means.[1468] Whatever the original meaning of the geometric motifs, they lost it when imported far away from their place of manufacture.[1469] It must be noted that geometric motifs, especially different kinds of lattices are essential also to ULFBERHT and INGELRII –blades. This has led to speculation that the same kind of name and lattice pattern could indicate a certain bladesmith or family.[1470]

In addition to clearly Christian words and sentences in Latin letters, some symbols may also be interpreted as Christian. The Christian meaning of these symbols is other than actually pictured, making the symbols and their meanings generally accepted among Christian art and decoration.[1471] Since the symbols have been interpreted as Christian, it has been natural to assume that the blades in question were manufactured in Continental Europe, where Christianity prevailed at the time.[1472] Especially circles, crosses, omegas and spirals indicate Carolingian smithies, while simpler ones such as mere lines could have been made also elsewhere,[1473] although it must be kept in mind that symbols, especially those with some geometric patterning, are relatively easy to memorize and imitate when compared, for instance, with Latin letters.

The most interesting inlays, and unfortunately the least noticed among scholars, are those with letter-like marks and sometimes also geometric figures. These have been recognized to imitate some Latin letter combinations, perhaps a name like Ulfberht or Ingelrii, the maker being some illiterate blacksmith selling the swords for illiterate people.[1474] Judging from the number of these kinds of motifs, these false, misspelt names were actually acquired by customers. In this case, the wrongly spelled names did not have any effect on buyers, since other values dictated the meaning of the inlays.

According to Anatoly Kirpichnikov and Anne Stalsberg, the production of these imitative, though quite qualified blades in some cases took place somewhere in Northern Europe, since they have found twelve from Norway, nine from Sweden, two from Finland, one from Estonia, and three or four from Russia.[1475] The number of Finnish examples in this category is far larger as indicated by the present study (a total of 33 examples), and thus supports the hypothesis of Scandinavian origin of these blades. Taking into account this Finnish situation, systematic research may reveal more marks and motifs of these kinds elsewhere in Scandinavia.

It is interesting to note that no runes were ever welded on sword blades, which may be due to the fact that runes were no longer used in Continental Europe at the time.[1476] In some cases, though, runes are also suggested, for example in the case of a sword from Sæbø, Norway, having a complex lattice pattern on one flat and fragmentary inscription on the other, interpreted as runes dedicated to Thor.[1477] More likely, this blade should be included in the category of letter-like marks, having been forged by an illiterate blacksmith. The lack of runes on sword blades reflects

1467 *Räty 1978: 18.*
1468 *Kirpichnikov & Stalsberg 1998a: 512.*
1469 *Kirpichnikov & Stalsberg 1993a: 37.*
1470 *Räty 1983: 171.*
1471 *See Salo 2005b: 43.*
1472 *E.g. Unto Salo (2005b: 128) suggests that the very well-preserved Ulfberht blade fragment from Valkeakoski, Finland (KM 2767) was forged in a Continental European smithy since its geometric motifs are all "Christian" i.e. three vertical lines, an omega, a cross crosslet, an omega, and another three vertical lines.*
1473 *Kirpichnikov 1970a: 175.*
1474 *E.g. Cowen 1934: 181; Jankuhn 1951: 216; Kirpichnikov & Stalsberg 1998a: 509. See also Chapter 5.3.4.*
1475 *Kirpichnikov & Stalsberg 1998a: 512.*
1476 *E.g. Ellis Davidson 1962: 43.*
1477 *Lorange 1889: Tab IV.1; Petersen 1916: 121; Petersen 1919: 69. See also Chapter 5.3.4.1. for further details.*

the fact that people were seeking blades with patterns, symbols or Latin letters – everything that looked Frankish – and runes would have told that the blade was of local manufacture and thus perhaps not as good as the Continental ones. This leads one to assume that local manufacture for instance in Scandinavia was perhaps kept secret, and the products were claimed to originate from Continental Europe. On the other hand, runes may have not been considered as 'powerful' or 'meaningful' as symbolic motifs and Latin letters, which were then attempted to be replicated in local products.

In Finland, it is very likely that Latin texts in blades were incomprehensible, even during the Crusade Period, when there was still a large number of vague combinations of Latin letters in the swords. From a down-to-earth perspective, the inlays – whether inscriptions or other motifs – were regarded as marks of quality, allowing the smith to ask for a higher price for the sword. Other, symbolic meanings can also be surmised.

9.2.3. Information from artworks and written sources

The importance of inlaid motifs becomes evident when looking at pictorial sources emerging as late as the medieval period, though elsewhere than in Finland. Although the motifs are plain and pictured as mere figurative lines instead of actual pattern-welding, they must have had some importance, since they were added to the picture.[1478] Alternatively, inlays may have been so common that it was only natural to depict swords with marks on their blades. The majority of these depictions date from the 11th century and later, when blade inlays had been in use for couple of centuries, causing them to be widely known and distributed. The relatively late date of these depictions of inlays may connect them to non-ferrous figures appearing in the last stages of ferrous inlays and later, although the similarities between these artworks and inlays in actual finds are scarce even in this case.

Descriptions of inlaid marks can also be found in written sources, especially those recorded by Arab travellers and historians.[1479] Al-Kindi, a 9th century philosopher of Baghdad stated that the majority of Frankish sword blades have crosses, circles and half-moons as decorative elements.[1480] To be precise, the description says that these decorations are made of bronze or gold.[1481] Moreover, swords are said to consist of both soft iron and hard steel.[1482] Frankish swords are also said to be of whitish colour with a red background.[1483]

According to the translation of the writings of Al-Nadim, Frankish swords had often Latin inscriptions.[1484] Al-Biruni has added that marks raised the price and value of the sword,[1485] although the reason for this, whether practical or connected to beliefs, is not stated. Al-Kindi also related that unlike the Frankish swords, "slimanish" swords had no decoration in the form of crosses, but they were still of the same good quality.[1486] Both were made or soft iron and hard steel forged together to create patterns.[1487]

1478 *See Chapter 6.1.5. for examples of pictorial presentations of sword blade inlays in period and medieval art.*
1479 *Anatoly Kirpichnikov has gathered a great deal of information from these written sources and published it already in 1970.*
1480 *Kirpichnikov 1970a: 172.*
1481 *Zeki Validi 1936: 25.*
1482 *Zeki Validi 1936: 21.*
1483 *Zeki Validi 1936: 25.*
1484 *Zeki Validi 1936: 26.*
1485 *Kirpichnikov 1970a: 172.*
1486 *Zeki Validi 1936: 25.*
1487 *Zeki Validi 1936: 20–21.*

One blade from Norway had an iron inlaid human head figure, which has given reason to posit analogies with the Far East and assume the wide distribution of certain motifs.[1488] Al-Biruni stated in the 10th century that if the sword presents a picture of a man, the value of the sword will be even higher.[1489] When imported to Scandinavia, a human figure on a sword blade may have represented various things, for example Odin, the maker of the sword blade, or even the enemy.[1490] This is mentioned here as a curiosity, since such figures are not known from Finnish finds. Another thing is that the drawing of this human figure in the publication from 1998 appears to be very delicate, while it may be wondered if such a figure may have been executed with large, forge-welded inlays. After all, the publication does not mention how the figure was revealed from the corroded blade.

To move slightly closer, some accounts can also be found in the Anglo-Saxon epic Beowulf, dating from somewhere between the 7th and 11th centuries.[1491] According to Hilda Ellis Davidson, it includes many compounds with the word *mæl*, i.e. a mark or a sign, in connection with swords. In some cases swords are depicted as coloured with marks of fire, which could be interpreted as pattern-welded inlays on the blade.[1492] Of course the term can be interpreted in various ways, and it can also mean plain pattern-welding. This is hard to determine partly because the dating of the work in question divides opinions.

Other Arab writers have incorporated information of swords in general, as well as peoples producing them.[1493] These accounts do not mention inlays, but in some cases descriptions interpreted as referring to pattern-welding of blades. What is evident from these sources is that they claim swords being made by various peoples and in various places in Europe.[1494] For example, Arab writers could have used the term *Rus* to describe Scandinavian people in general producing swords like Franks did.[1495] These interpretations would support the theory of Scandinavian manufacture of swords in general. It must also be noted that while several accounts mention swords with different terms, these are hard to connect to any particular types of swords or decorations.[1496]

9.2.4. The significance of pattern-welding

In a technical sense, inlays, especially pattern-welded ones may have been seen as trademarks, signs of blacksmith's skills and the high quality of the blade in question. The technical complexity of the inlays may have been a way to prevent their copying,[1497] although as the experiments discussed in Chapter 6 showed, it is relatively simple to inlay a sword blade with pattern-welded rods, and with various other techniques.

Ferrous inlays continued the tradition of pattern-welding on a smaller scale than before, thus connecting pattern-welding to a costly, high-quality sword blade and possibly also to the upper

1488 he inlays of this sword were documented and published by Anatoly Kirpichnikov and Anne Stalsberg (1998a).
1489 Al'-Biruni 1963: 63.
1490 Kirpichnikov & Stalsberg 1998a: 512.
1491 E.g. Howe 1997.
1492 Ellis Davidson 1962: 121–122.
1493 See Zeki Validi 1936.
1494 E.g. Zeki Validi 1936: 22–29.
1495 Zeki Validi 1936: 22. The term Rus has been investigated more closely, especially in connection with Ibn Fadlan's texts, and it was found to have multiple interpretations (Montgomery 2000: 23).
1496 See Szymczak 2010 for a case study concerning early medieval and medieval Polish literature.
1497 E.g. Räty 1983: 181.

classes of society.[1498] Since pattern-welding was practised earlier and used to compose the mid-sections of sword blades, the tradition of patterning was regarded as important enough to be continued. Perhaps pattern-welding was also of some social importance to sword-bearers, having the need to carry a sword of attractive appearance.[1499] After all, the way the inlaid pattern-welded rods were made is purely the repetition of an earlier innovation and technical tradition.[1500] It has often been claimed that pattern-welding was mastered in only a few Frankish smithies, but this was hardly the case, since the technique had been practised for centuries before the introduction of ferrous inlays. The continuity of pattern-welding can clearly be seen also in those blades of pattern-welded mid-section with inlays on top.

After pattern-welding slowly ceased, the tradition of ferrous inlays remained, perhaps still to indicate good quality. This correlation between high quality and the existence of inlays must have existed in the first stages of the utilization of ferrous inlays, but I believe that since inlays became more and more common over time, their significance as indicators of quality must have decreased. Of course the methods of steel production were developed, and thus possibly also fewer low-quality swords were on the market.

Towards the Crusade Period, the Finnish finds display a clear decrease in pattern-welded inlays while plain iron and steel inlays start to predominate. This may, on the one hand, be a consequence of the diminishing of the meaning of pattern-welding. On the other hand, younger, smaller inlays were harder to construct from pattern-welded rods, the patterns being also harder to discern due to the small size of the inlays. Small pattern-welded inlays do exist, however, at least in the Finnish material of the present study. Some larger inlays, even imitative inscriptions, may thus be considerably later than their models.[1501]

One viewpoint is that pattern-welding became "secularized", making its conceptions of quality and cost disappear. According to Radomir Pleiner, this phenomenon can be seen in the spread of the pattern-welding technique into varied cutleries such as knives in the Slavic territories already during the 10th century.[1502] These kinds of knives still existed in the 14th century.[1503]

9.3. Views on the origin and manufacture of inlaid blades

9.3.1. Sources of raw materials

To summarize the results of the preceding chapters, the analyses discussed in Chapters 4 and 5 shed light on the composition, or rather a wide range of chemical compositions, observed in both the blades and the ferrous inlays. To be brief, it was no surprise that the compositions varied from blade to blade. The pattern-welded inlays seemed to have carbon steel and phosphorus-rich iron to create a proper contrast between the layers of the welded and twisted packs, a phenomenon similar to the majority of pattern-welded artefacts of the whole Iron Age.

1498 *E.g. Chropovsky 1983: 137–138.*
1499 *Thompson 2004: 118.*
1500 *E.g. Kirpichnikov 1970a: 172; Lang & Ager 1989: 101; Menghin 1983: 17–18.*
1501 *For example, ULFBERHT-swords with inlays from non-patterned iron or steel.*
1502 *Pleiner 2006: 220.*
1503 *Pleiner 2006: 222.*

The geological provenance of the used iron ores was also discussed, although the matter can be debated.[1504] In the case of blades, the Finnish finds were surprisingly neutral, only two had higher manganese contents typical of Norwegian and Central European ores, and in some cases the presence of aluminium could hint towards Scandinavian ores.[1505] In the studies of Alan Williams, highly elevated carbon contents were taken as indicators of crucible steel produced east of Europe.[1506] Williams also published analyses of other Finnish swords as well as foreign finds, most of them being high in manganese, though not all. In general, the carbon contents varied from one part of the blade to another, indicating the use of different kinds of iron and steel even within the same blade. The inlaid materials had only distinctive amounts of phosphorus, normally in the brighter element of pattern-welding.

The analyses clearly show a variety of compositions, some of which are undoubtedly from Continental Europe and some originated from elsewhere. Of course the provenance of the materials is not necessarily the same as the locality where the swords were manufactured, but it seems likely that they were made in various parts of Europe. For example two Danish swords from the 2nd century AD were found to be forged from local phosphorus-rich iron extracted from bog ore.[1507] There is no completely reasonable explanation why these swords would have been made elsewhere, taking into consideration the poor quality of the material. The same line of thought can be applied to inlaid swords as well.

In similar fashion to the above, some analysed Finnish inlaid blades exhibiting Scandinavian-like, relatively poor materials were most likely locally made. What is interesting is the fact that not only blades with imitative inscriptions were improper for battle usage, but also some blades with correctly spelled inscriptions. The correctly written ones are commonly somewhat atypical, for example ULFBERHT sword KM 1174:2 has non-patterned inlays, and KM 2767 does not have contrasting materials in its pattern-welded inlays.

As noted in Chapters 3 and 4, the quality of the ore greatly affects the quality and properties of the produced iron, and not all iron is suitable for a proper sword. It is clear that a good swordsmith – as well as any smith producing edged tools or weapons – needs good-quality steel to make a tough and sharp blade. According to the analysed carbon contents, this was the intention as far as such material was available and the smith knew how to work it into a proper blade. In contrast, there are blades with poorer materials. It is unlikely that a skilful swordsmith would make a sword from unsuitable materials when lacking better steel. Instead, these poor-quality blades were made by inexperienced smiths, who in the worst cases did not want to focus on the quality of their work.

The precise determination of the quality of steel was harder back then than it is at present. The use of certain kinds of ores as well as currency bars made the task easier (see below). In practice, a blacksmith was forced to quench-harden a small trial piece to define the properties of the steel. An experienced smith could deduce the properties of the steel to some degree simply by the feel of it during forging. Carbon steels are stiffer and harder to forge than softer iron, which is not good enough to produce any kind of cutting edge.

To speculate on the origin of the raw materials, some detailed information was presented in Chapter 3.5 clarifying that various European localities had better ores than others. Thus good-

1504 *It must be remembered here that the composition of the bloom itself remains somewhat heterogeneous after the smelting and even after refining by forging and welding, leading the amounts of trace elements to vary slightly from place to place (Buchwald 2005: 163–164).*

1505 *Swedish ores in particular are rich in aluminium (Buchwald 2005: 147).*

1506 *See Chapter 4.5.1. for details and references.*

1507 *Buchwald 2005: 206.*

quality steels were valued trade goods, refined from suitable, selected ores. Smelters were able to collect certain types of ores according to their appearance and colour, for example phosphorus-rich ores are mixed with green and yellow, whereas manganese-rich ores are black.[1508] Varying regional qualities of different ores were probably very well known, not only to the ironmakers, but also to the blacksmiths and consumers.[1509]

When determining the provenance of iron ores it must be kept in mind that the provenance of the ore is not necessarily that same as the locality where the blacksmith's products were manufactured. Iron and steel were traded and transported as currency bars of various size and shape. Currency bars are known from all over Europe throughout the Iron Age and especially from the Migration Period onwards.[1510]

Currency bars come in too many shapes, sizes and compositions to be discussed here in detail. To mention only a few examples, in Southwest England sword-shaped currency bars are found already in Pre-Roman contexts.[1511] Slightly similar, sword-shaped, long, and flat bars dating from the Late Iron Age and early medieval period have been found in Gotland, Haithabu and Winchester, for example, being, on average, low-carbon bloomery iron.[1512] Ring-shaped bars from Gotland in Sweden and Northwest Russia have been found to have considerably high carbon content, ca. 0.6–0.8 %.[1513] Kristina Creutz has suggested that these semi-finished bars could have been used for the cutting edges of weapons as well as pattern-welding.[1514] Tongue-shaped iron lumps from Sweden containing up to 0.8 % phosphorus would have been more suitable for pattern-welding, if they did not happen to be dated as late as the 12th century.[1515] These are mentioned here as an examples of how the composition of the bars has varied, and that certain shapes were known to be made of certain kind of iron or steel, which in turn was known to be suitable for certain purposes or artefacts.[1516] Certain types of steel bars were traded as hardened, so that the blacksmith could tell the quality of the steel for example by filing.[1517]

In some rare cases the carefully analysed material used in the sword was connected with a certain type of currency bar. A 7th–8th century sword from Småland, Sweden (catalogue number SHM 5889) was analysed from its hilt parts, revealing a characteristic nickel/cobalt pattern comparable to many spade-shaped currency bars.[1518] From Germany, Belgium and Switzerland are known sword-shaped bars (*saumon d'épée*), which are flat bars with a handle-shaped form at one end. These are presumed to be either half-fabricated swords or just plain currency.[1519] In either case, the material is, according to experiments conducted by Radomir Pleiner, suitable e.g. for swords used by the Celtic tribes.[1520] Analogies concerning Late Iron Age currency bars and swords have not yet been made.

1508 Buchwald 2005: 146–147.
1509 Thålin-Bergman & Arrhenius 2005: 26.
1510 Tylecote 1987: 249.
1511 Allen 1968: 308; Brown 1971: 226; Tylecote 1987: 254.
1512 Pleiner 2006: 32–37; Tylecote 1987: 255.
1513 Hjärthner-Holdar 1993.
1514 Creutz 2003: 119.
1515 Buchwald 2005: 173. Phosphorus-rich iron could also have been used in difficult welds to ease the welding, since this kind of iron is easier to hammer-weld (Buchwald 2005: 329).
1516 See Buchwald 2005: 103–105 for properties of various kinds of Iron Age currency bars.
1517 Buchwald 2005: 104. Blacksmiths have traditionally used a file test to determine the hardness of heat-treated steel. It is easy to file soft iron but hardened high-carbon steel cannot even be scratched.
1518 Thålin-Bergman & Arrhenius 2005: 67.
1519 Allen 1968: 316–317.
1520 Pleiner 1993: 74.

Crucible steel is a completely separate subject (see Chapter 4.5.1.2). Alan Williams has claimed that some ULFBERHT swords were made of this high-carbon steel of eastern origin, being imported to Europe as smelted cakes. He recognizes that one problem of this theory is that no written sources contain any mention of this activity.[1521] Williams however considers that the steel import took place via the Volga trade route, which was in its most active use during the Viking Age, and that the manufacture of ULFBERHTs ceased as the trade route was no longer used, thus eliminating the import of crucible steel.[1522] It should be mentioned that high-carbon (ca. 0.8–1.5 % carbon) steel lumps were also recovered from Southampton, England, dating to the 9th century.[1523] Furthermore, similar cast steel was also produced in Russia, where it was known as *bulat*, "watered steel", but the earliest documented cases are from the 15th century.[1524] Williams's theories are discussed in more detail in Chapter 4.

Raw materials, either imported or made on site, sometimes had to be further processed to make them suitable for sword blades and inlays. With regard to the blades, carbon is the crucial element, which should be included at least in the material of the cutting edges to make them harder. Listed in Chapter 3.1 were the main methods to incorporate carbon into iron and thus turn it into steel. Carbon-rich iron could be obtained already during smelting, or then by processing raw iron by rapid cooling in snow or by cementing. There is some evidence from Viking Age Helgö, Sweden that different kinds of ores were utilized by using a similar smelting process, resulting in different kinds of steel.[1525] In accordance with the carbon contents, it must be mentioned that the smelted blooms could contain very high-carbon areas, especially near the tuyere, where the temperature is at its highest.[1526] Hypereutectoid steel (see Chapter 3.1.1) could then be obtained from blooms and not only from cast steel.

From the viewpoint of practicality, it would be easier and faster to obtain ready carbon steel for blades, instead of diffusing carbon into iron by some method. This is because the diffusion of carbon into hot iron is very slow, even when the temperature is kept relatively high, and the whole process is hard to control to get carbon evenly diffused.[1527] It has been estimated that it will take about five hours to make carbon diffuse at a depth of two millimetres, with carbon content of no more than 0.5 per cent.[1528] Of course, this is a matter of resources. If a blacksmith wanted to make a good blade, he was forced to make his own steel if it was not readily available. In addition, carbonization may have been a very specialized procedure, which was not mastered by all smiths.[1529]

The making of the pattern-welding for inlays normally required irons of two different types. Pattern-welded materials could have been made by the blacksmith or smithy, which also manufactured the blades, or then pattern-welded rods could have been made elsewhere and traded as raw material. A smith might have had pattern-welded ribbons in stock, for example, to produce an order much faster.[1530] As became evident in the experiments (Chapter 6), it is likely that inscriptions for multiple swords could have been made from the same, layered pack.

1521 *Williams 2007: 234.*
1522 *Williams 2007: 239.*
1523 *Mack et al. 2000.*
1524 *E.g. Panseri 1965: 17.*
1525 *Thålin-Bergman & Arrhenius 2005: 65.*
1526 *E.g. Buchwald 2003: 171–173.*
1527 *E.g. Pelsmaeker 2010: 12.*
1528 *Tylecote & Gilmour 1986: 15.*
1529 *Lyngstrøm 2003: 24.*
1530 *Maryon 1960a: 31.*

In all likelihood many blacksmiths used irons and steels from different sources to compose a single artefact, and the reuse of iron from old artefacts cannot be excluded.[1531] This further complicates efforts to establish the provenance of all iron artefacts and especially complex ones such as swords and spearheads. For example, a spearhead from Broa, Sweden, was found, according to trace element analyses, to have materials from two localities: edges from one place and pattern-welding and the iron core from another.[1532]

In the case of pattern-welding, even the different layers of a single pack may originate from various sources. If we assume that, as the analyses show, phosphorus-rich iron was used to create contrast, it could have been imported to the Frankish areas from Scandinavia. On the other hand, some phosphorus-rich ores are also to be found in Continental Europe.[1533] Furthermore, this kind of iron was readily available in Scandinavia for pattern-welding purposes. One theory is that pattern-welded ribbons themselves served as currency, and they were traded to swordsmiths, who used them to compose sword blades and later on the inlays.[1534] This is only one explanation for the similarity of the majority of pattern-welded rods during the Late Iron Age.

The actual organization of the trade in raw materials – if such existed – is hard to trace, since written sources do not shed any light on the matter. It may be deduced that the blacksmith was normally a completely different person than the one making the iron – the ironmaster.[1535] This can be seen for instance in artefacts where local and distant materials were combined.[1536] Of course in smaller localities, the blacksmith could have made his own iron and steel all the way from the collecting of the ore. This was however very time-consuming, and the actual production of artefacts was left to a minimum when compared with the time and effort spent on making and refining the material.

9.3.2. Manufacture: tools, environment and expertise

Following the acquisition and/or refinement of the raw material, the manufacture of the actual blade took place. The technical process was clarified in Chapter 6 through analyses, theories and experimental archaeology. This covered not only the process of pattern-welding and inlaying, but also the steps of the production of a complete sword blade. The tools that were used and their simplicity were also discussed. It was noted that inlays – as well as complete blades – could have been forged and polished with very simple tools. Also the order in which the blade was forged into shape could be altered to meet the skills and conventions of the blacksmith. Similarly, inlays could be produced in variable ways – some faster and easier and some slower and more difficult – again in accordance with the personal habits and ingenuity of the maker.

What must be noted is the size and shape of the forge in which the blade was heated. The heating of one part of the blade to forging temperature required a forge open to at least two sides, enabling the blacksmith to stab the sword through the forge and thus enabling him to heat a short portion anywhere on the blade. Another thing is the heat-treating forge, which should be as long as the blade itself to heat it evenly on its full length. The constructions may vary from ground-level to raised. As the analyses in Chapter 4 showed, not all blades were heat-treated, and thus the smithy perhaps did not contain a large or long forge at all. Otherwise the environment did not require any

1531 *E.g. Ypey 1980: 203.*
1532 *Thålin-Bergman & Arrhenius 2005: 68.*
1533 *Buchwald 2005: 177–178.*
1534 *E.g. Creutz 2003: 138, 277; Thålin 1967: 238.*
1535 *E.g. Buchwald 2005: 102.*
1536 *Lyngstrøm 2003: 24.*

special solutions apart from the water tank used for heat treatments and to cool the tools;[1537] the smithy could have been located outside or inside. In practice, this means that inlaid swords may have been produced even in the simplest smithies.

As stated before, the scale of the smithy remains varies greatly from simple furnaces to actual buildings. Radomir Pleiner has stated that smithies were present in every Late Iron Age pre-urban centre such as Hedeby.[1538] In many cases, as in Moravia, these smithies were actual buildings with indoor forges large enough also for making sword blades,[1539] although nothing tells of what types of artefacts were produced in these smithies.

The question of expertise calls for further discussion. According to the author's experiments, the forging of a double-edged sword blade requires some skill not to forge it too much on one bevel. Also the distal tapering towards the point, both in width and thickness, requires some skill to achieve. Clearly a blacksmith cannot forge a sword blade just like that; he or she needs some practice and, according to my personal experience, will ruin few blades before the forging of that particular shape becomes familiar.

As noted above, iron was plentiful in both Continental Europe and Scandinavia, providing blacksmiths with material with which to practise. Pattern-welding is also relatively easy since it is only an application of forge-welding, which was already required to complete almost any iron object during the Iron Age and the whole preindustrial era. In similar fashion, inlaying iron was also a mere application of basic blacksmithing techniques regardless of which method of inlaying was utilized (see Chapter 6).

The expertise comes into question when taking a look at the methods with which the blades were constructed (see Chapter 4.4). As became clear in the discussion of Chapter 4, inlaid blades were constructed in various ways, some very simple and some more complicated. The question of who had enough skills and resources to forge inlaid sword blades is hard to answer. Of course specialized blacksmiths, potentially even weapon-smiths, already existed during the Roman Iron Ages.[1540] Some blacksmiths most likely executed even the non-ferrous decoration on their ironwork. For example, a blacksmith's grave in Bygland, Norway included three Petersen type K spearheads decorated with silver and copper-alloy wires.[1541] Also the selection of tools indicated both ironwork and non-ferrous metalworking. We must also note the four Petersen type Q swords from the same grave, the corroded blades of which are unfortunately still unstudied, thus not showing any traces of patterning or inlays on their suffered surfaces.[1542]

Smiths with less skills certainly existed. A good example of this is given in the doctoral thesis of Jüri Peets, who found that in some studied Estonian knife blades soft and hard materials were mixed, thus resulting in a poor blade.[1543] Similarly some analysed inlaid sword blades proved to be of unsuitable materials and therefore of bad quality considering the effectiveness and usefulness in combat.[1544] This phenomenon may also be connected to reducing material costs,[1545] which could also have happened at the cost of the buyer.

1537 E.g. Pleiner 2006: 133–134.
1538 Pleiner 2006: 160–162.
1539 Pleiner 2006: 162–163.
1540 Oldeberg 1942: 190–191.
1541 Blindheim 1963: 31. See also Chapter 7.3.
1542 Blindheim 1963: 31, 63–64.
1543 Peets 2003: 269.
1544 See Chapter 4.4. for details.
1545 Chris Caple (2006: 104–105) states that material costs in artefact production may be reduced by diminishing the volume of the object by e.g. hollowing, using materials of lower quality, and making imitations of expensive objects from poorer materials.

At this point it becomes necessary to concentrate for a while on pattern-welding, namely its spread in Late Iron Age Europe. This discussion is needed, if the origin of pattern-welded inlays is to be addressed. Instead of inlays, previous research has concentrated on the origin of pattern-welded swords and spearheads, which in any case may be used to hypothesize where pattern-welding was practised. Other sources are smithing evidence that can be associated with pattern-welding.

According to studied artefacts and the diversity of pattern-welding (see Chapter 5.2.2.1), the technique was widely known in Europe, not only in some smithies in the Frankish areas, as has been traditionally assumed.[1546] Pattern-welding has even been considered as a secret and mythologized art, known only by few.[1547] In experiments organized by Kristina Creutz for her doctoral thesis, pattern-welded rods were found to be relatively easy to make.[1548] The experiments conducted for the present study also verify this.

Concrete evidence of localities of pattern-welding is scarce from Iron Age Europe. While pattern-welded artefacts are too numerous to be even counted, no smithies with clear indications of this activity have been discovered. However, some uncertain finds are known. Two possible pieces of a welded pack are known from Finland, from the multi-period site of Varikkoniemi in the City of Hämeenlinna. These are short, cut ends of welded bars, consisting of six or seven layers displaying structures of ferrite and martensite, i.e. iron and carbon steel respectively.[1549] Varikkoniemi is problematic because of its multi-period nature with Viking Age finds but also many later contexts all mixed by extensive land-use, and the material has been at least partly misinterpreted.[1550] In view of this, the two packs may also be from historical times, resulting from, for example, making of pattern-welded barrels for firearms during the 18th and 19th centuries.

In the foreign material, the find of smithy tools from Mästermyr, Sweden contained also a seven-layered pack with all its layers of iron.[1551] This is reminiscent of sword KM 2767 from Valkeakoski, with its pattern-welded letters and marks made from completely similar iron. Another site in Sweden, namely Helgö, revealed some pieces of iron with layered constructions, also hypothesized to be connected to pattern-welding activities.[1552] Furthermore, finds from the hillforts of Soontagana and Naanu in Estonia include two welded and cut fragments of layered and rolled iron bars, which may imply pattern-welding.[1553] All the above-described finds are hard to connect definitely to the phenomenon of pattern-welding. For example, the finds from Varikkoniemi and Mästermyr may alternatively be interpreted as pieces welded from scrap iron for the purpose of producing a larger lump of iron.[1554]

Some Scandinavian researchers have suggested that pattern-welding was practised in Scandinavia at least during the Late Iron Age.[1555] To mention some pattern-welded artefacts typical of Scandinavia, at least ten patterned one-edged Viking Age swords are known from Norway,[1556] and an axe from Hedeby, Denmark has been stated to have patterned structures.[1557] Taking into consideration the

1546 *E.g. Thålin-Bergman 1983c: 157 maintains that pattern-welding was practised in older Roman weapon-making centres, although it is very hard to prove if the technique was known elsewhere.*
1547 *E.g. Cramp 1957: 65.*
1548 *Creutz 2003: 277.*
1549 *These objects (KM 26058:1652 and KM 26058:1175) were analysed by Jüri Peets for his doctoral thesis (Peets 2003: 265–266). See also Schulz 1994: 135.*
1550 *Taavitsainen 2006: 53.*
1551 *Arwidsson & Berg 1983: 19, Pl. 30.*
1552 *Thålin-Bergman & Arrhenius 2005: 16.*
1553 *Peets 2003: 265–266.*
1554 *Peets 2003: 265–266.*
1555 *E.g. Liestøl 1951: 95.*
1556 *Stalsberg 1989: 14; Stalsberg 1994: 187.*
1557 *E.g. Stalsberg 1989: 17; Thomsen 1978: 78–86.*

widespread ores in Scandinavia and Russia, Anne Stalsberg has noted that the large amounts of iron in these areas enabled the blacksmiths to practise and develop their skills,[1558] to learn pattern-welding by trial and error without wasting valuable resources too much.[1559]

Norwegian pattern-welding has also been regarded as plausible by other scholars on the same grounds.[1560] Nonetheless, pattern-welding has been regarded as limited to spearheads, and not applied to swords, and that only a few larger smithies practised it, possibly those belonging to chieftains' farms.[1561] Pattern-welding as a phenomenon has been regarded as a Continental European innovation, Scandinavian blacksmiths having learned it from Continental smiths.[1562] Another theory is that pattern-welded blanks or mere layered rods were imported to Scandinavia, where they were used to shape swords and spearheads.[1563] Pattern-welded spearheads have also been regarded as Swedish manufacture according to local concentrations of certain types of these weapons.[1564] England is also one likely place where pattern-welding was practised.[1565]

To conclude regarding pattern-welding, there is no evidence against the theory that pattern-welded artefacts were forged in Scandinavia and perhaps also in present-day Finnish territory during the Late Iron Age. Pattern-welded artefacts were familiar form the Middle Iron Age onwards, and the technique was relatively simple. Furthermore, Finnish smiths may have readily acquired pattern-welded rods, and shaped them to fit spearheads and swords. Thin ribbons for inlays may be obtained by simply flattening an untwisted, layered pack. These in turn may have been inserted into a sword blade with various methods, as suggested by the experiments.

9.3.3. The weapons trade

It was presumed in early research that swords were spread to Scandinavia – as well as to other areas outside the Frankish realm – through peaceful trade, and that many swords were then locally hilted.[1566] A good example of this is from Russia, where Anatoly Kirpichnikov has noted that Russian weapons have features from north, west and east in both construction and decoration.[1567] Kirpichnikov has surmised that Scandinavians and Slavs traded Frankish sword blades into Russian territories, since the hilts and their ornaments display Scandinavian influence.[1568] In similar fashion, complete swords may have been traded to the north from the Frankish areas. Traditionally, this trade has been considered as having followed the routes established along seas and rivers. According to the latest research, local trade was established through a number of central places for certain areas, from which the trade goods were then transported to certain sites where long-distance trade operated, the whole functioning as a network.[1569]

The latest research suggests that this network developed in phases.[1570] During the 8th century only undefended coastal sites such as Dorestad and Birka acted as trading posts. At the end of that century new sites emerged, such as Staraya Ladoga in Russia to mark the eastern trade route. At the beginning of the Viking Age, Hedeby (Haithabu) was founded as a port on the Baltic, in

1558 *Stalsberg 1989: 22–23.*
1559 *It should be noted here that I also learned pattern-welding myself by trial and error after first observing completed artefacts.*
1560 *E.g. Blindheim & Heyerdahl-Larsen 1999: 87; Martens 2004: 126.*
1561 *E.g. Martens 2004: 131.*
1562 *Martens 2004: 136.*
1563 *Martens 2004: 135.*
1564 *Thålin-Bergman 1983b: 273.*
1565 *Ellis Davidson 1962: 34.*
1566 *E.g. Jankuhn 1951: 228.*
1567 *Kirpichnikov 1970a: 167.*
1568 *Kirpichnikov 1970a: 172–174.*
1569 *E.g. Sindbæk 2008 and references cited.*
1570 *See Sindbæk 2008: 150–153.*

similar fashion as Kaupang in Norway. During the middle Viking Age these larger sites still existed, although the network was largely demolished by Viking raids, at the same time emphasizing eastern trade. Swords and other weapons are known to have been sacrificed as possible ritual offerings in wetland areas in particular.[1571] Large numbers of Viking Age weapons, including swords, have been found deposited in the River Dnepr along the eastern trade route. One theory is that this was practised by Gotlandic travellers, since similar kinds of offerings are known from Gotland.[1572] At the end of the Viking Age, fortified, urban centres became common and at completely new geographical locations in comparison with earlier ones.

The situation in Finland may be traced by the spread of settlement. Settlement concentrated in the southwestern parts of the country, namely the provinces of Finland Proper and Satakunta, but also in Häme (Tavastia) proper and the Tampere region, from where the settlement spread even to central Finland and the eastern parts of Finland as well as northern Karelia.[1573] One suggestion is that the coastal regions of southern Finland were considered dangerous to live in since one of the major trade routes passed by it.[1574] The evidence of a Viking Age trading centre in the archipelago in Kyrksundet in Kemiönsaari, formerly known as Hiittinen, also gives reason to assume otherwise. The Ostrobothnian settlements were no longer in use, and the region was situated far from any trade routes. The Åland Islands, although strongly influenced by Scandinavians due to migration from Sweden from the Middle Iron Age onwards, also have finds of some Finnish artefact types as evidence of contacts.

The question if people from Finland have participated the Viking voyages is under debate. At least artefacts of presumably Scandinavian origin have been discovered, along with Scandinavian-type burials, along the eastern trade routes as far as the Black Sea, and eastern coins found in large quantities in the Åland Islands imply trade contacts.[1575] Finnish coin finds are not necessarily brought here by indigenous people but merchants and travellers. Against this background, it would seem plausible that inlaid swords as well as other types of swords, among other things, could have ended up on the Finnish mainland along the trade routes, although the major areas of settlement were some distance from the conventionally recognized routes.

European written sources of the period contain numerous mentions of weapon trade. Anne Stalsberg has listed the mentions concerning the trade of weapons occurring in the Carolingian capitularies from 8th and 9th centuries.[1576] Many of them strictly prohibit the sales of arms and swords outside the kingdom, and even merchants were forbidden to take arms with them to sell abroad.[1577] Interestingly, Stalsberg has noted that these capitularies do not forbid weapon trade as organized and executed by the king, but the prohibition is only against smuggling of weapons by independent merchants.[1578] As Stalsberg has pointed out, literary sources do not imply that any large-scale export of weapons to Scandinavia did not take place, rather it was attempted to prevent "Vikings" from acquiring any weapons from the Franks.[1579] Some sources even specify who were not to ultimately have the weapons, for example Scandinavians, Slavs or Saxons.[1580]

1571 E.g. Lund 2004.

1572 Androshchuk 2002.

1573 See e.g. Vilkuna 2007 for the situation in Häme (Tavastia). It must be noted that these inland centres may also have been important trade centres like the coastal sites.

1574 E.g. Edgren 2008: 471.

1575 Edgren 2008: 478.

1576 Stalsberg 2008: 21–22. Capitularies are collections of legislative acts, which were spread throughout the kingdom by the church and its legislative organs. The name comes from their chapters called capitula in Latin.

1577 To mention a few, these kinds of restrictions appear in the Capitulare Mantuatum from 781 AD, the Capitulare Missorum from 803 AD, the Capitulare of Thionville from AD 805, the Capitulare of Boulogne from 811 AD and the Edictum Pistence from 864 AD (Stalsberg 2008: 21–22). See also Arbman 1937: 231 and Stalsberg 1989: 13.

1578 Stalsberg 2008: 22.

1579 Stalsberg 2008: 21–22.

1580 Airola 1987: 20; Maryon 1960a: 25; Stalsberg 2008: 21–22.

Logically, restrictions in trade made it harder for traders to obtain swords or blades for sale, and therefore the stock could have been collected from many smiths instead of a single maker.[1581] Stalsberg lists also other methods of how weapons were acquired from the Franks.[1582] According to her, the prohibition on Frankish merchants to sell weapons outside the kingdom refers to smuggling. Another way was to claim weapons and swords as ransom, for leaving the kingdom for instance. The third method was plunder, which was, according to Stalsberg, also practised around the Mediterranean for the same purpose. According to Philip Grierson, circulation of artefacts may occur also, in addition to the above, through political payments and gift exchange,[1583] the latter being mentioned in Norse sagas.[1584]

Following Stalsberg's views, the large-scale trade of weapons between Scandinavia and the Frankish kingdom seems to be out of the question. Moreover, the vast number of recovered swords from the Viking Age alone requires some other explanation. Could this number of swords have been smuggled, for instance? Or could they have been imported by some other means mentioned above? Or is the most likely explanation local manufacture, as has been suggested? At least smuggling is not the most plausible alternative considering the vast number of swords.

In connection with trade, the value and cost of swords is central. Some information has been compiled from Anglo-Saxon laws and Frankish sources concerning the Viking Age.[1585] These point to swords of various price classes. A sword from Western Europe was worth 126 grams of silver, while another sword from Britain was worth of 1,860 grams of silver; modern prices in pounds in sterling being interpreted as 1625 and 24 000 respectively. A sword and scabbard from Central Europe was worth 478 grams of silver, i.e. about 6,170 GBP sterling in modern currency. Already from these numbers it becomes clear that different kinds of swords had various prices. The cheapest sword here was of approximately the same value as an ox, while the most expensive one was worth six male slaves.[1586] In the Laxdæla Saga, a sword was interpreted to be worth sixteen milk cows.[1587] Unfortunately no source indicates what type of sword is in question, nor it is possible to relate a certain value to for example an inlaid sword. The cheapest ones, however, could have been those without any decoration.

What then could have been used in Late Iron Age Finland to pay for imported swords? The most traditional view is that various types of furs were used in trade activities.[1588] One possibility is that falcons were traded; one falcon was considered as valuable as a sword.[1589] Jaakko Masonen has also presented the possibility that beaver castoreum was imported to be used as a medicine.[1590] Slaves are most likely out of question at least in large numbers, since the population of Late Iron Age Finland was quite small. Although estimates are difficult, it has been suggested that at the end of the Iron Age the population of the settled areas of Finland was at least around 50,000.[1591] From the Viking Age onwards coin finds increase dramatically, but according to the find contexts as well as finds of scales, silver was used by its weight.

1581 Thålin-Bergman & Arrhenius 2005: 9.
1582 Stalsberg 2008: 22.
1583 Grierson 1959: 124–138.
1584 See e.g. Creutz 2003: 244 for references for spears and swords as gifts.
1585 See Siddorn 2000: 97–102.
1586 Siddorn 2000: 100–101.
1587 E.g. Magnusson & Palsson 1975; Short 2009: 105.
1588 E.g. Lehtosalo-Hilander (1992: 63) lists animals such as European elk, squirrel, marten, fox and sable, which were hunted for furs.
1589 Bertrand 1966: 282.
1590 E.g. Masonen 1989.
1591 E.g. Lehtosalo-Hilander 1984: 274–275.

9.3.4. Discussion on production and imitation outside the Frankish realm

Some studies in the field of weapons and swords have suggested that swords in general were manufactured in various geographical localities in Late Iron Age Europe. Namely the Scandinavian production of weapons has been repeatedly suggested, not always in the case of swords, though, but of smaller ones such as spearheads and war-knives. Even in Finland, some forms of Merovingian and Viking Age spearheads and shield-bosses are considered as local work,[1592] as well as some forms of scramasaxes of the Merovingian period.[1593] The reason why double-edged swords are often considered to be of Continental European origin may lie in old, widely accepted archaeological conventions.[1594] Other weapons seem to be easier to categorize by form, the grounds upon which local models are often recognized, but the shape of a fullered, double-edged sword is much more standard. It also remains obscure, on what basis an object such as a sword has been regarded as so hard or even impossible to make.

Let us first take a brief glance at various written sources mentioning the production of swords in general at the European level. According to various Arabian authors, there were two people producing swords during the Late Iron Age: Franks (*farang*) and East-Scandinavians (*rus*).[1595] Lena Thålin-Bergman notes that while the majority of eastern sources mention Frankish swords, the matter is not straightforward since even Scandinavia might have been considered as a province of the Frankish realm.[1596] Good examples of this are the writings of Ibn Fadlan.[1597] The assumption that all weapons, especially swords, were made in Frankish smithies along the River Rhine is much older, dating back to the end of the 19th century.[1598] Even today, many scholars are of this opinion on the grounds of the long-lasting weapon-making tradition for instance in that particular area.[1599]

Some sources even mention something about the actual construction of the sword blades. For example an Arabian writer called Ibn Hudhayl wrote in the 14th century that Frankish swords had steel edges and iron body, whereas Indian swords were made in a different manner.[1600] In this instance, the term Frankish may be used to refer to all European swords. Although considerably earlier, from the 5th century, the letters of King Theoderic's secretary, Cassiodorus, reveal some interesting points. Cassiodorus compares the centre parts of Teutonic swords to snakes, praising also their ability to polish the blades.[1601] Hilda Ellis Davidson notes that, at least according to some translations, the letter mentions a kind of shiny dust used to polish the sword blades, and this has been connected to areas near the River Elbe, where *Kieselguhr*, i.e. silica-rich diatomaceous earth used in abrasives is very common.[1602]

The Frankish areas of Continental Europe have been significant in producing weapons from very early on. Already in the 4th century AD, the area near modern Mainz in Germany was famous for

1592 E.g. Creutz 2003; Pihlman 1990: 260. Since Late Iron Age weapons seems to be most common in Eura in the Finnish context, it has been suggested that weapon production took place there during that period of time (Lehtosalo-Hilander 2000b: 209).

1593 E.g. Lenkkeri 2007: 94–95; Salmo 1938: 140–142.

1594 See Chapter 2 for a history of sword studies.

1595 Liestøl 1951: 93–94.

1596 Thålin-Bergman 1983b: 278.

1597 Zeki Validi 1936.

1598 E.g. Jankuhn 1951: 220.

1599 E.g. Thompson 2004: 117.

1600 Dinnetz 2001.

1601 Cassiodorus 2006: 209. See also Smith 1957: 199–200.

1602 Ellis Davidson 1962: 105–109 and references cited.

its edged weapons.[1603] Especially the localities by the Rhine and at Noricum were in the centre of the Merovingian and Carolingian empires, and thus also presumed to be the central area in which pattern-welded weapons were manufactured.[1604]

As noted by Kristina Creutz, the Frankish kingdom was in a central position in weapon production at the European level, while in the Baltic Sea region the centre was Gotland in Sweden.[1605] Thålin-Bergman is also of the opinion that while objects of eastern origin have been found in Gotland, some weapons may have been traded from Gotland to the east.[1606] However, Thålin-Bergman notes that no evidence supports Gotlandic weapon-smithing.[1607] Furthermore, half-fabricated swords may have been imported to Gotland, because the ores were not so widespread, and the burning of charcoal for iron production and iron-working would be clearly seen in vegetation and pollen diagrams of the area.[1608] But what if the steel and the charcoal were imported from elsewhere? This activity is not so easily detected. One suggested place of sword production may be Anglo-Saxon England, where – it has been surmised – some chieftains may have brought foreign swordsmiths.[1609]

Considering iron inlaid swords, it is possible to make inlays also on half-fabricated blades with certain techniques, as demonstrated in Chapter 6, although this is not as easy as making both at once. In this connection the famous Hulterstad cache of sword blades with unfinished tangs must not be forgotten.[1610] Of these five swords, two were differently spelled ULFBERHTs and three were found to have plain symbols. Thålin-Bergman and Arrhenius have assumed that they may have been imported as half-fabricated pieces from the Franks, and they were gathered from various sites of production.[1611]

At the heart of this study is the discussion of the manufacture of the ferrous inlays. Presented above are theories and views for both Frankish and non-Frankish manufacture of swords in general during the Late Iron Age, while inlays or inlaid swords are another matter. Many scholars and researchers maintain that at least some of the inlaid swords are copies of originals, most often stated as Frankish models.[1612] Considering the geographical distribution of the finds, it is notable that only a small part of all European Late Iron Age sword finds, especially from the Viking Age, come from the Frankish areas, where the manufacture has commonly been claimed to be taken place, and where the northern expeditions did not extend.[1613] This, however, may be connected to burial customs, since the Frankish areas were already Christianized and pagan burial habits were no longer followed.

The Norwegian researcher Anders Lorange suggested already at the end of the 19th century that some types of inscriptions and inlaid motifs may be of Norwegian origin, although he stressed the continental manufacture.[1614] In the studies of the last two decades, other Norwegian scholars, for example Anne Stalsberg has claimed that Norwegian blacksmiths had both the tools and

1603 *E.g. Schubert 1957: 66.*
1604 *E.g. Ellis Davidson 1962: 34; Hodges 1982: 118–119; Tylecote 1987: 273.*
1605 *Creutz 2003: 117.*
1606 *Thålin-Bergman 1983b: 278.*
1607 *Thålin-Bergman 1983b: 278–279.*
1608 *Thålin-Bergman 1983b: 279–280.*
1609 *Thompson 2004: 108.*
1610 *E.g. Arbman 1937: 232; Thålin-Bergman & Arrhenius 2005: 51. Hulterstad is on the island of Öland off the coast of Sweden.*
1611 *Stalsberg 2008: 10; Thålin-Bergman & Arrhenius 2005: 9.*
1612 *E.g. Geibig 1989: 242; Kirpichnikov & Stalsberg 1993a: 37; Stalsberg 2007b: 14.*
1613 *E.g. Geibig 1991: 179.*
1614 *Lorange 1889: 29.*

the knowledge to produce inlaid swords.[1615] Anatoly Kirpichnikov regards also Russian and Swedish manufacture as plausible, the technique itself being of Carolingian origin.[1616] Also the Baltic production of sword inlays has been suggested on the basis of large number of inscriptions accompanied by Petersen's type T hilts of possibly local manufacture.[1617] However, it must be kept in mind that the hilts most likely originated from a different smithy than the blades. All in all, geometric marks are considered as local substitutes for Latin inscriptions, produced in a number of localities in addition to the Frankish realm.[1618]

The experimental evidence tells that only simple tools and settings were needed to produce even an inlaid sword blade. These observations support manufacture in various places, since no special equipment was needed. Simple forges and blacksmith's tools found in Scandinavian contexts are appropriate for the work. Even the rare Finnish finds of Late Iron Age smithing tools and forges, namely from Räisälä and Kurkijoki in ceded Karelia, Virala in Janakkala, Varikkoniemi in Hämeenlinna, and Finström in the Åland islands, were all possible sites for making inlaid swords.[1619]

Considering the imitations, what alternatives then are there to be able to make ferrous inlays on sword blades, or on a larger scale, to make complete blades? Michael Schiffer and James Skibo have presented a few options.[1620] Regarding imitations, the first thing that comes to mind is of course self-teaching attained solely by trial and error, as was the case, for example, in the experiments conducted in this work. Alternatively, the techniques and methods could have been learned from some other source, in this case from another swordsmith. This in turn may have taken place by mere verbal instruction or then through demonstration.

In regard to actual inscriptions, copies are suggested to be distinguished by their different kinds of letters and spellings.[1621] Imitations are regarded as cruder and less detailed as the originals, although a certain general picture was attested.[1622] Some Finnish finds presented in Chapter 5 clearly imply this kind of copying, such as finds KM 370, KM 10390:5 and KM 13839:253, all being possible imitations of the ULFBERHT motif. In these cases some letters were rendered correctly or nearly correctly, while many only resemble Latin letters. It would seem that local craftsmen had seen a correctly spelled inscription and were trying to copy it to their own products.

Although it has been commonly claimed that inlays were copied in poorer blades to falsify their quality,[1623] it must not be taken for granted that all copies of inlaid swords were of poorer quality than the originals. The imitations might as well be of high standard, and the inlays were made to get an even higher price. A temporally distant analogy for this phenomenon is found from the shipwreck of the St. Mikael, a Russian merchant galliot sunk in 1747 in the Archipelago Sea off Southwestern Finland. Of interest here are some of the pocket watches recovered from the wreck, which counterfeit signatures to raise the price, while the watches were nonetheless of high standard.[1624]

1615 E.g. Stalsberg 2007b: 17.
1616 Kirpichnikov 1970a: 175–177.
1617 Kazakevičius 2007: 351.
1618 E.g. Stalsberg 2008: 2.
1619 See Moilanen 2011 for further details and references.
1620 Schiffer & Skibo 1987: 597.
1621 E.g. Jones 1997.
1622 E.g. Kirpichnikov & Stalsberg 1998a: 509; Thålin-Bergman & Arrhenius 2005: 19.
1623 E.g. Geibig 1991: 118.
1624 Fagerström 2005: 198; Väärennös 2007: 5.

It must also be noted that the seller or the producer of a falsified brand may not necessarily claim that his product is genuine, but only a fake.[1625] In the case of inlaid swords this is hard to testify. The situation was more likely the opposite, because no runes were inlaid on sword blades but only figures and letters resembling continental ones. An exception is the Ukrainian sword with possibly Cyrillic inscriptions KOVAL and LJUDOTA. Was the purchaser literate or not? If so, he or she would have known that the product is of local origin.

An interesting question is the recognition of a certain "handwriting" of a blacksmith. This definition of a handwriting is based on the fact that every individual performs tasks in their own personal way due to individual motorics.[1626] Kristina Creutz managed to attribute Petersen type M spearheads to various blacksmiths around the Baltic Sea region,[1627] although her results may be criticized since the construction of the spearheads could have been studied in more detail. Her classification relied only on the shape of the artefacts. Moreover, interesting results were obtained in an early American study, where five blacksmiths were commissioned to forge thirty nails each, after which all 150 nails were categorized according to their shape.[1628] As a result, only twelve nails were left unclassified; all the other nails could be successfully classified according to their "handwriting". As Creutz stated, each blacksmith executes a given artefact according to a certain idea or model, but this is done in personal ways.[1629]

Initially, one task for the study of the inlaid motifs in this work was to connect similarly made motifs and inscriptions to certain blacksmiths, thus trying to solve, how many makers can be distinguished from the studied material. This proved to be close to impossible due to the diversity of the swords and their inlays. One reason behind the varied inlaid motifs may lie in the technology, namely in the technique with which the inlays were sunk and attached to the blades. With the most likely techniques to have been used (see Chapter 6.7.2 for a summary) it is impossible to make inlays identical in their measurements and appearance. This was noticed also in the experiments: no two identical inlays were produced. To complicate the picture even more, the dimensions of the studied blades also varied, which may also be a consequence of variable raw materials from which the blade blanks were assembled and welded.

Finally with regard to inlaying, it has been suggested that the decorative pattern-welding on Late Viking Age and Crusade Period spearheads was executed as narrow inlays.[1630] These spearheads would however require at least detailed radiographic studies and also preferably cross-sectional analyses to verify that the pattern-welded ribbons are surface inlays and not structural parts of the spearhead. Technically, this kind of inlay is still possible. More detailed studies would be needed to solve the matter and further to speculate on the origin of these spearheads and their connection with the manufacture of inlaid sword blades in connection with this technological analogy.

Connected with manufacturing and its localities, the position of the swordsmith in Late Iron Age society is of crucial importance. With regard to the specialized production of weapons, Kristina Creutz has discussed the attributes of a weapon-smith.[1631] According to her, a weapon-smith was 1) a respected and even feared person due to his skills and abilities. A weapon-smith was in the prehistoric period 2) superstitious, and probably regarded himself as 3) possessing both practical and magical knowledge. Owing to this supernatural element, the smith was regarded 4) both as a human and a supernatural being. These kinds of smiths were 5) permanently settled and of course

1625 Sarsila 1988: 147.
1626 E.g. Hill 1978: 245.
1627 Creutz 2003.
1628 Carlisle & Gunn 1977.
1629 Creutz 2003: 29.
1630 Thålin-Bergman & Arrhenius 2005: 33.
1631 Creutz 2003: 163–164.

6) specialized to certain artefact form. Specialized weapon-smiths may have been 7) free men with 8) a considerably high status in society. The weapon-smith was not an isolated person but 9) integrated into society around him. Indeed the weapon-smith has been related to 10) masculine work, although women, too, may have practised the working of iron.

While some of these above-mentioned points would need further inspection, especially the superstition attached to the blacksmith, these are outside the scope of this research. For example, was above-described kind of supernatural element present in the work of smaller-scale smiths, manufacturing for example mere nails or household utensils, or was it connected only to weapon-smiths or even swordsmiths only?

Janet Lang has discussed the blacksmith as appearing in myths, suggesting that at all times during the prehistoric and medieval eras blacksmiths were associated with mystical and secret powers.[1632] For example, blacksmiths were considered as supernatural in Germanic mythology.[1633] This in turn has caused the smiths to be kept in high value. On the other hand Anne Stalsberg has noted that Frankish sources do not contain mentions of blacksmiths having some special status in society.[1634] Could it be that the position of Frankish smiths was different from those in Scandinavia? Were the crafts of the blacksmith and in particular the weapon-smith seen differently in Scandinavia, perhaps in a more supernatural manner relating to local religion, beliefs and myths? It must be stressed that mythology and tales depict a world of their own, and a blacksmith could have been just an easy target to be at all related with supernatural powers, since he transforms his raw material to completely another form and composition.

The high status of blacksmiths in society has also been promoted by the theories of Terje Østigård, who has suggested that blacksmiths acted also as cremators of the deceased, since they had the necessary skills and tools to raise the temperature high enough.[1635] Another claim is that blacksmith's role as cremator and a kind of ritual specialist was strengthened by the possible use of human bones in the production of steel.[1636] One way to make steel is to let it absorb carbon at a high temperature, and thus the source of carbon may have been animal and human bones.[1637]Accordingly, it has been claimed that since swords had human-like features according to some sources, the blacksmiths tried to incorporate human elements into swords in this manner.[1638] Thus, the deliberate destruction of the sword during burial in the Viking Age can be seen as dehumanization.[1639]

As a weaponsmith described by Creutz, a swordsmith, too, most likely settled in one place because the whole array of tools and forges is laborious to make. Still, the relatively simple setting for the work could be arranged by an itinerant smith. One thing to remember is the time consumed in making a sword blade. It is unlikely that an itinerant smith would undertake such a feat, depending of course on the phases of manufacture he would perform. The forging itself can be completed in a few days, depending, of course, on the complexity of the blade and its decorations, but the grinding and polishing is a completely another matter. As Creutz has observed, a permanent smithy also enabled the smith to use apprentices or assistants, most likely needed to complete a sword faster.[1640]

1632 Lang 2007: 15–18.
1633 E.g. Brady 1979.
1634 Stalsberg 2008: 21.
1635 Østigård 2006: 440.
1636 Gansum 2004; Østigård 2006: 442.
1637 Østigård 2006: 440.
1638 Gansum 2004; Gansum & Hansen 2004; Østigård 2006: 440.
1639 Østigård 2006: 445. This act does not necessarily require the presence of a blacksmith.
1640 Creutz 2003: 150–151.

Like Creutz, Eldrid Straume also discussed the status and mobility of blacksmiths. According to Straume, smiths could be divided into farm-smiths and professional smiths, of which the latter worked on commission for the higher ranks of society and was also permanently settled.[1641] Furthermore, Straume sees that the specialized blacksmiths worked at a marketplace, at an administrative centre or a farm, mostly by a request.[1642] The two-fold division into so-called village smiths and mastersmiths had also been suggested by Terje Østigård.[1643]

John Ljungkvist has noted that the archaeological traces of specialized handicraft concentrate in larger trading centres or places where high-status persons of society, such as Viking chieftains, were resided.[1644] According to Ljungkvist, the specialized items were produced either for the chieftain and his folk or for trading purposes. This leads to the question of whether the craftsman was free or obliged to follow his lord.[1645] Creutz sees the weapon-smith more as a free agent, since he was respected due to his human and divine skills.[1646] Again, the matter is very problematic.

Taking into account the smithies from historical times, it must be stressed that blacksmiths rarely worked alone. Apprentices and helpers were most likely common even during the Iron Age, because, for example, larger artefacts were difficult to hold while hammering them. Similarly, the work may have been divided among blacksmiths or apprentices in larger and specialized smithies. Lena Thålin has suggested that during the Viking Age the blacksmith was the one who forged and heat-treated the sword blade, while another worker (*svärdfejaren*) carried out the polishing, sharpening, as well as the attachment of the hilts and scabbards.[1647] It has even been speculated if the *svärdfejare* also made the inlays,[1648] but at least in the case of ferrous inlays, their manufacture belonged clearly to the blacksmith. According to Thålin, the term *svärdfejaren* is known from early medieval sources in Scandinavia, indicating that blades were imported rather than forged locally. Anatoly Kirpichnikov and Anne Stalsberg have noted that a Central Asian text from the 9th century claims that several craftsmen are involved in the making of a sword blade.[1649]

Also the subject of slaves and blacksmith's helpers has been discussed. According to Stalsberg, it is very unlikely that a literate man practised blacksmithing, or even specialized in it, and that slaves carried out the hard work in Frankish smithies.[1650] These slaves came from numerous localities, for example from the Slavic countries, and they were sold in turn to the Middle East and Spain.[1651] Especially in the case of ULFBERHT swords, Stalsberg has suggested that the actual Ulfberht was merely a supervisor in a monastic hierarchy, and that the slaves forged the blades and signatures, the whole weapon production being supervised by bishops and abbots.[1652] This took place either on the estates of the churchmen, or as literary sources state, in a number of Carolingian monasteries situated in modern-day Switzerland, Germany, France and Italy,[1653] although the types of weapons produced were not stated. It has even been claimed that the names appearing with the phrase "me fecit" would imply that the smith in question had the blade made

1641 *Straume 1986: 53, 56.*
1642 *Straume 1986: 52.*
1643 *Østigård 2006: 440.*
1644 *Ljungkvist 2008: 190–191.*
1645 *Ljungkvist 2008: 191.*
1646 *Creutz 2003: 156–157.*
1647 *Thålin 1972: 539–540.*
1648 *Thålin 1972: 540.*
1649 *Kirpichnikov & Stalsberg 1998a: 508 and references cited.*
1650 *Stalsberg 2007b: 12; Stalsberg 2008: 20. Furthermore, Stalsberg (2008: 20) notes that literate slaves were most likely used elsewhere than in smithies.*
1651 *Stalsberg 2008: 20 and references cited.*
1652 *Stalsberg 2007b: 13; Stalsberg 2008: 19. See also Chapters 5.3.1.3. and 5.3.1.4. on ULFBERHTs.*
1653 *Stalsberg 2007b: 13; Stalsberg 2008: 19 and references cited.*

by slaves instead of carrying out the work himself.[1654] Stalsberg also noted that according to literary sources, land-owning blacksmiths could pay the rent for the land by producing weapons for the church or the king.[1655]

In the case of swords, manufacturing costs can be reduced, for example, by specialization to one maker, letting less skilled blacksmiths execute simpler phases of manufacture, grouping the industry, and using repetitive methods.[1656] Instead of one blacksmith doing all the phases of the sword, the work could be divided into different, consecutive phases. For instance, a smith or smiths could carry out the forge-welding of the blade blank from different kinds of iron and steel. In the second phase the inlays are sunk and welded, perhaps from rods made by another smith. Then, another smith shapes the blade, while heat treatments could require their own specialization. Finally, grinding and polishing may be done even by craftsmen with no experience in blacksmithing itself.

In the grouping of industry, all these above-described phases and craftsmen would work in a single smithy or very close to each other, enabling the completed products to be gathered together for market or the commissioning party. To further centralize production, even the ironmakers could be included in this picture. This kind of focusing of resources is comparable to industry aimed at producing a very large number of certain products. Kristina Creutz uses the term *smith zone* to describe the areas where manufacture, supply and demand all took place.[1657] These areas may be certain administrative or geographical areas, for example territories of tribes or villages, or even centres of production.

Blacksmith's graves as well as separate finds of tools may be used to reflect the number of smiths in Late Iron Age societies.[1658] However, the definition of a blacksmith's grave has been debated.[1659] Referring to earlier attempts to categorize and calculate the number of smith's graves or merely graves with smithing tools, it can be stated that on the European scale these graves occur most commonly in Scandinavia and especially in Norway.[1660] In Finland the number of smith's tools in graves can be limited into one example only, which is close to the frequencies in other Baltic countries and also in Russia.[1661] One theory is that, for one reason or another, the Slavs as well as contemporary Finnish people did not have the need to put smith's tools into graves.[1662]

In Finland the structure of society is not definitely known. It has been presumed that perhaps leaders and chiefs were the authorities of families, giving rise to a kinship-based societal organization.[1663] The graves and cemetery types do not show any chieftain-graves or the like, which, according to Edgren, does not mean that richer folk did not exist in society.[1664] It has normally been assumed that society was egalitarian. If a swordsmith or several of them dwelled in Late Iron Age Finland, were they bound to serve, for example, a family or village authority, or were they so-called independent entrepreneurs? Did their skills come from trial-and-error self-teaching or had somebody taught them how to make blades and their inlays? These questions are valid throughout Scandinavia and not only in a single locality.

1654 Stalsberg 2007b: 14; Stalsberg 2008: 21.
1655 Stalsberg 2007b: 13.
1656 Caple 2006: 105, 107. In addition, Caple maintains that these costs can be reduced by using templates and machinery, neither of which apply to sword forging or inlaying during the Iron Age.
1657 Creutz 2003: 193.
1658 See Chapter 6.3. for most important tool finds in Scandinavia.
1659 E.g. Wallander 1989.
1660 See Creutz 2003: 157–159; Grieg 1922; Müller-Wille 1983; Petersen 1951; Sjøvold 1974; Wallander 1989.
1661 Creutz 2003: 158–159.
1662 Edgren 1993: 236.
1663 E.g. Edgren 2008: 481.
1664 Edgren 2008: 481.

All in all, in the light of the above it is highly problematic to trace who made inlaid swords and where this was done. Was the status of the sword maker different in Central Europe than in Scandinavia or even in the Baltic countries and Finland? Are these geographical differences between the ways in how the swordsmith have been seen by others? A contradiction can mainly be seen between the mythical role of a swordsmith and the more practical role of a craftsman and labourer. Secondly, the large number of smith's graves in Scandinavia strongly suggests the existence of blacksmiths with variable skill levels, which is of course supported by the varying levels of quality in the examined swords, not to mention the vast number of swords from Scandinavia and Europe in general. The small number of finds of smithing tools elsewhere does not necessarily suggest that such smiths did not exist.

9.3.5. On the origin of the hilts

As stated above, the focus of this study is on the blades and their inlays, while hilts receive less attention because their origin is in most cases different from the blades. It was observed in Chapter 7 that while some hilts are well fitted to the blade and its tang, some are very loose and attached crudely with wedges. The same observation was made by Alfred Geibig when examining the German material.[1665] Properly and carefully attached hilts may in some cases have been manufactured by the same person as the blade,[1666] but more likely the work was divided into phases and among different craftsmen. This can be clearly be seen in Petersen type K hilts with maker's names such as HILTIPREHT, HARTOLFR and HLITER, the two first from Ireland and the last one from Norway.[1667]

With regard to hilts, Fedir Androshchuk has claimed – on the basis of the statistical variation in Scandinavian finds – that every sword during the Viking Age was made to fit the needs and properties of the buyer.[1668] Kirpichnikov and Stalsberg mostly concur regarding this, stating that swords were custom-ordered, thus limiting the possibility of local hilts being attached to imported blades.[1669]

A great deal has been written on the decorative motifs on some types of Viking Age hilts. It has been suggested that already some early Merovingian period inlay decorations are of Nordic origin.[1670] However, the style does not straightforwardly dictate the origin. For example, the Scandinavian-style Viking Age swords from Russia may also be of local origin, if immigration of a blacksmith or plain influences come into question.[1671] Lately it has been attested that at least Petersen's types O, R, T, V and Z were manufactured in several places in Nordic countries and perhaps around the whole Baltic Sea area.[1672] Also simpler, undecorated types were most likely produced locally, for example Petersen's types M and Q, where the places of welding seams vary, possibly indicating different makers.[1673] This phenomenon was also observed in the Finnish finds in addition to varying types of decoration within same typological entity, also suggesting multiple manufacturers.

1665 Geibig 1991: 95.
1666 E.g. Oakeshott 1960: 139.
1667 E.g. Oakeshott 1960: 141; Edge & Williams 2003: 193.
1668 Androshchuk 2003: 42.
1669 Kirpichnikov & Stalsberg 1998a: 509, 513.
1670 E.g. Holmqvist 1951a.
1671 E.g. Stalsberg 1989: 23.
1672 E.g. Martens 2004: 135.
1673 Martens 1994: 181.

Also other scholars have recognized Scandinavian, namely Gotlandic, features in many Viking Age hilts.[1674] In Finland, Birka has been considered as a midpoint between the Franks and Finland, since many Finnish sword hilts have decoration in Scandinavian styles.[1675] By the same token, Hedeby (Haithabu) has been considered as an important market place for weapons during the Viking Age. Pieces of hilts have been regarded as evidence for hilt production and the repair of swords.[1676]

The presence of parts of different types within the same hilt is a phenomenon connected to repairs and replacements (see Chapter 7.4). A similar phenomenon is also known from the Estonian material.[1677] It is doubtful if a swordsmith or the one producing and attaching the hilt would compose a hilt from two different kinds of units. The question then rises, from where the newly attached part, normally the pommel and/or upper guard, was acquired. Was it from the stock of a local manufacturer, or did it belong to imported, loose hilt parts? Was it collected from a cemetery perhaps? These questions cannot be definitely answered here.

Taking into consideration this discussion on hilts and the observations made in Chapter 7, it seems that a large number of swords were at least assembled in Scandinavia using locally forged or at least locally decorated hilts.[1678] The origin of the blades has traditionally been located in the Frankish territories. On the other hand, nothing contradicts the idea that both blades and hilts were of Scandinavian manufacture, only from different workshops and craftsmen. In this case, also smaller-scale local trade networks should be considered, and not only long-distance trade, although at least some of the sword blades and hilts ended up here through these routes.

9.4. Inlaid sword in use

9.4.1. Practical use and its evidence

Here, the term 'practical use' means swords being used in combat and battle situations, for the purpose for which this weapon was originally developed. Concrete evidence of this is summarized in Chapter 4.8, where nicks and burrs on the cutting edges of blades as well as bent tips and various acts of repair are documented. Curiously, the majority of these damages and repairs were observed in swords found from Häme (Tavastia) proper and nearby areas. This observation is disturbed by the poor condition of the majority of the examined finds, and it is thus not statistically valid. There is no definite reason to believe that in these places violence was in some way more common, although it must be noted that especially this part of Finland was a target of plunder during the Crusade Period, at least according to the Chronicle of Novgorod.[1679] The people of Häme (Tavastia) also made counterattacks to the east during the 12th century.[1680] An alternative explanation may lie in the customs of breaking swords for burial. This type of deliberate breakage is discussed in Chapter 4, and it was found more plausible to interpret these above-mentioned marks as battle damage rather than the intentional destruction of the blade.

1674 *E.g. Lehtosalo-Hilander 1983: 290.*
1675 *Kivikoski 1971: 88–89.*
1676 *Geibig 1989: 251.*
1677 *Mandel 1997.*
1678 *See also Lehtosalo-Hilander 2000b: 210.*
1679 *E.g. Lind 1977.*
1680 *E.g. Ailio 1915: 338–339.*

Since the sword was created to harm other men, its presence in a society implies the existence of violence in practice or at least in ideology.[1681] According to Sami Raninen, Iron Age societies were familiar with actual violence, since weapons were also used in ritual activities (i.e. burial).[1682] Gareth Williams has noted that warfare was not limited only to raiding Vikings, but it was common in Northern Europe as a whole.[1683] In the case of Finland, violence in Iron Age societies has been discussed to some degree, but the matter has remained purely conjectural. Raninen has stated that there is no plausible way by which we could estimate the extent of violence present in Finnish Iron Age societies.[1684] Nor can the existence of weapon finds be strictly used to reflect the degree of violence.[1685] Even the signs of use are not statistically valid, since so few swords are in sufficient condition to permit their determination.

No written evidence from the Viking Age can be found to tell about the situation of war and peace in the present-day area of Finland. Only two Swedish rune-stones evidence warlike activities, one erected to the memory of the son of one Björn, who – as has been interpreted – died in Finland, and the other in memory of Egil, who died in Häme (Tavastia).[1686] Also Norse sagas have been interpreted to contain depictions of plundering expeditions in Finland,[1687] but the dating of the sagas is questionable.

From the Crusade Period onwards, however, some written sources contain mentions of military and warlike activities in Finnish areas, with outside threats from the territories of Estonia, Sweden, Denmark and eastern trade routes.[1688] It must be noted that Crusade Period traces of use could be detected in some iron inlaid swords, although the majority of them are in Viking Age blades. Furthermore, Crusade Period and early medieval hillforts have been taken as evidence of collective violence, although these hills may have also served functions connected to socio-economic matters within societies.[1689] Especially the hillforts in Läke Päijänne region of Häme (Tavastia) may have been connected to internal conflicts rather than against any outside threat, whereas in Häme proper the threat may have come from the direction of Novgorod.[1690]

According to the evidence on Finnish sword finds, they cannot be considered as mere status or display artefacts, but they were fought with, strongly implying the presence of violence and armed conflicts, although the nature of these confrontations cannot be deduced. This concerns all kinds of Late Iron Age swords, since the battle damage and repairs evident in inlaid blades were also found in other kinds of blades. Inlaid blades did not seem to have any special status among other types of swords. In the case of Finland, the poor degree of preservation of skeletal material prohibits the inspection of possible battle damage. Healed and unhealed wounds were quite common, for example, in Anglo-Saxon burials.[1691]

A source that is often neglected in this matter is the pictorial evidence. Nearly all period or early medieval depictions of inlaid swords present the sword in a battle situation, in the hand of a

1681 E.g. Lang 2007: 20-21 and references cited; Raninen 2006: 8.
1682 Raninen 2006: 8–9.
1683 Williams 2008: 199.
1684 Raninen 2006: 5.
1685 E.g. Raninen 2006: 8.
1686 E.g. Huurre 1979: 221; Montelius 1914: 93.
1687 E.g. Huurre 1979: 220–221.
1688 See Gallén 1984; Taavitsainen 1990: 145–146 and references cited. These sources include Swedish annals and rune-stones (earliest 1150 AD), Norse and Icelandic sagas, Danish chronicles (10th and 11th centuries), and the Chronicle of Novgorod (1042 AD onwards).
1689 Luoto 1984; Taavitsainen 1990: 142–146.
1690 Taavitsainen 1990: 146.
1691 See. e.g. Lang 2007: 36–39 and Wenham 1989.

warrior or a soldier.[1692] Also this serves as evidence for the use of inlaid swords in battle. If these swords were display weapons of the elite, for instance, why would they have been depicted in combat scenes?

The usability of the sword has sometimes been discussed. This discussion namely centres on two terms: the so-called swords of common men, intended for use in combat, and so-called luxury swords.[1693] Luxury swords are characterized as having a strongly profiled hilt decorated with non-ferrous metals.[1694] Swords of common men are characterized as heavy weapons.[1695] This kind of twofold, artificial division calls for further criticism. First of all, the categorization does not consider blades at all but only hilts. Secondly, the aspects of weight and usability in battle need more inspection. The overall weight of the sword is higher in the case of decorated hilts, i.e. in these "luxury" swords. If heaviness is used to mean the balance point and thus the ease of handling the sword, the undecorated hilts seem to have the balance point somewhat nearer the tip of the blade, making them harder to use in combat. Then again, the overall weight of these swords with undecorated hilts is smaller than the decorated ones, making the slightly forward balance point meaningless considering the handling properties of the sword.

All in all, balance points could be measured in 28 of the studied inlaid swords (see Appendix Two). To present some statistics, swords with undecorated hilts included Petersen's types Y and X as well as brazil-nut pommeled and disc-pommeled hilts belonging to Oakeshott's types A and B and Tomanterä's types A and B. Hilts decorated with non-ferrous metals included Petersen's types H, I, E, R, V and special type 2, and also silver-plated and bronze hilts. Among these decorated hilts, the balance points were between 70 and 200 mm, while in undecorated hilts the balance points fell between 115 and 215 mm. Despite the combinations of types of hilts and blades, the swords were designed and balanced for practical use. One surviving exception, however, is KM 24740:242 from the Luistari cemetery in Eura, weighing over 2.3 kilograms.

A distinct question is the real usability of swords as combat weapons when taking the terrain into consideration. Of course a sword is a natural choice in melee situations in open terrain, but what about the forested terrain prevailing in most places in Finland? Swords are of no use in terrain full of obstacles, while long spears and especially bows and arrows are more practical. Bows and arrows are also much more useful in siege situations at hillforts. Perhaps swords were not primary weapons to be used in large conflicts, but in smaller ones such as duels. Of course other values may have dictated the urge to own and carry a sword.

The earliest finds of horse-gear in Finland date from the Migration period in the Middle Iron Age,[1696] while the latest research has revealed that horses were known here already during the Bronze Age.[1697] General expert opinion across Western Europe and Scandinavia has been that during the Merovingian Period and the Viking Age swords were used as infantry weapons. This seems plausible since the weight and the shape of these swords were better suited to this kind of combat, as for example depicted in the sagas. The importance of armed cavalry increased from the 10th century onwards, but it is under debate if the early mounted warriors formed actual cavalry or were only mounted infantrymen.[1698] The shift in battle tactics may be connected to the change in the proportions of the sword in the 11th century. In any case, the usability of mounted warriors

1692 See Chapter 6.1.5. for examples.
1693 E.g. Lehtosalo-Hilander 1982c: 49; Lehtosalo-Hilander 1985: 9; Nordman 1943: 53.
1694 Lehtosalo-Hilander 1985: 9; Lehtosalo-Hilander 2000b: 188.
1695 Lehtosalo-Hilander 1985: 11; Lehtosalo-Hilander 2000b: 188.
1696 See Taavitsainen 1976.
1697 Bläuer & Kantanen 2013.
1698 E.g. Nicolle 1995: 76–77.

in the forested terrain of Finland is highly questionable, even though horses and their use were familiar.

According to Hjalmar Falk, some written sources indicate that old swords were re-forged into other artefacts, or a spearhead could have been made from an old sword blade.[1699] This is known as an act of recycling, whereas in reuse the sword was repaired or in some way improved. Systematic radiography could reveal structures from, for example, pattern-welded artefacts integrated as part of some other, later smith's product. So far, artefacts of this kind have not been identified.

9.4.2. An artefact of status and power?

The sword has been considered as a status symbol, especially during the Late Viking Age in Finland, when hilts were decorated with silver, and in contrast, swords from the same period in Sweden and Norway have been regarded as heavy and practical.[1700] This observation returns to the above-criticized idea of practical swords versus luxury swords.

Of course – as also in the case of modern objects – the more the sword was decorated, the more expensive it was and therefore probably expressed more symbolic notions. This decoration included not only the hilt but also the blade. This is perhaps one reason why inlaid blades were desirable: they were more expensive than undecorated ones and they reflected newer fashion and technology than the older pattern-welded blades. This demand was then answered, due to scarce trade of weapons, by local manufacture taking place in Scandinavia, perhaps in Russia and also in Finland. The marks were not understood in their original sense. Instead, the appearance of the blade was enough. In a similar way, decorated hilts were purchased by those who could afford them.

The meaning of a sword in Late Iron Age, more precisely Viking Age, society, has been discussed on numerous occasions. In several cases, Scandinavian sagas are referenced to link swords with mystical properties, or at least to theorize that contemporary people regarded them in this manner. They were sometimes given supernatural properties, and also names, which tells that swords were – at least in tales such as sagas – personified to some degree.[1701] It is natural to assume that swords recovered in cemeteries actually belonged to the deceased, who carried them and used them in battle,[1702] although contrasting opinions have been presented.[1703]

Could the burial customs give any clues as to the bearers and users of these swords? Unfortunately, in many Finnish Late Iron Age burials the individual is hard to distinguish due to the burial custom, i.e. cremation in extensive cemeteries (see Appendix Three). In the rare cases when an individual burial could be distinguished – normally an inhumation – the other grave goods did not give any special indications of the status of the deceased when compared with burials with other types of swords. The only noteworthy burial is from Mikkola in Ylöjärvi, which contained sword KM 19901:202. In this burial the deceased was determined as male, and he was buried with the tip of the sword pointing towards his head, a knife on his throat, and in a coffin nailed shut with spearheads.[1704] In this case, however, the exceptional burial was connected to the properties of the deceased, most likely having no connection with the sword type.

1699 Falk 1914.
1700 Lehtosalo-Hilander 1985: 11.
1701 See e.g. Ellis Davidson 1962: 158–188; Oakeshott 1960: 150–152.
1702 E.g. Purhonen 1998: 40. Swords have been considered as very personal weapons.
1703 E.g. Sami Raninen (2005: 50–51 and references cited) has presented several factors affecting a weapon burial, including views that the sword may have been buried only to promote certain attributes of the deceased, or then the deposited sword wanted to be buried to get rid of it.
1704 See Sarkki-Isomaa 1986.

Pirkko-Liisa Lehtosalo-Hilander, who has studied the Viking and Crusade Period inhumation cemeteries in Finland, Luistari in Eura in particular, has claimed that according to the analysis of grave goods, a sword (in general) does not necessarily imply that the deceased was a chieftain or a particularly rich person.[1705] According to the large number of inlaid and other types of swords of the Viking Age and the Crusade Period in Finland, it was not a weapon belonging to only chieftains and the like, as I would also suggest. Swords were obtained by people who could afford them. It may hold true that they were also acquired as status artefacts of a kind and indicators of wealth and possibly also power. This function, however, did not predominate, for it seems that the bearers of swords were ready to use them also in combat when necessary (see Chapter 9.4.1. above).

Sami Raninen has suggested that, at least during the Early and Middle Iron Ages, the burial with weapons was connected with men who had some special status in their community, perhaps both during their lifetime and after death.[1706] This hypothesis is based on earlier finds than those dealt with here, and thus much smaller in number. This theory may be plausible in connection with Early Iron Age burials, but it is difficult to apply to Late Iron Age burials, where weapons are much more plenty. Raninen has also theorized that swords, among other weapons, may have belonged to some kind of warrior ideology, meaning that certain people would have wanted to enhance their warrior identity, though not necessarily having belonged to a class or group of actual warriors.[1707] The determination of the deceased is complicated by the very poor degree of preservation of skeletal material, even in inhumation burials.

In comparison, Anglo-Saxon weapon burials have been well studied. Interestingly, in some cases the deceased was only a child or an elder and had clearly been unable to wield a sword, making some swords not actually owned by the person with whom it was buried.[1708] Similarly, 5th and 6th-century sword graves from the same localities indicated taller and more muscular people than later sword graves.[1709] In light of these observations, it seems that some swords clearly belonged to people who actually used them in combat, while in some cases the sword was included in the burial for some other, symbolic, purpose.

In all cases in the Finnish material when an individual burial could be distinguished, inlaid swords have been interpreted as belonging to male graves, at least according to the artefact assemblage placed with the deceased. On only one occasion – KM 17777:1 from Hattula – the sword was found in the close vicinity of a female grave. While this particular sword may not necessarily belong to the female grave, it contained whatsoever another sword with non-ferrous inlays.[1710]

The actual burial customs, discussed in more detail in Appendix Three, display no differences between various types of swords, whether decorated or not. In cremations, all kinds of swords were similarly ruined by bending and fire.[1711] Sword blades with ferrous inlays did not receive any special treatment when compared to other kinds of swords. This in turn promotes the hypothesis that iron-inlaid blades were of no special status, merely being objects of fashion and possibly also function. Other contexts, such as possible hoards and sacrificial deposits, do not represent inlaid swords in any special manner but similarly to accompanying sword finds.

1705 *Lehtosalo-Hilander 1982c: 49.*
1706 *Raninen 2005: 51.*
1707 *Raninen 2006: 4.*
1708 *Härke 1990; Lang 2007: 22–23.*
1709 *Härke 1990; Lang 2007: 22–23.*
1710 *See also Appendix three and Taavitsainen 1990: 91 for interpretations.*
1711 *In the treatment of weapons, regional differences may occur in different cremation cemeteries (Karvonen 1998: 8–10).*

9.5. Conclusions

To return to the questions presented in the introduction, the conclusions may be summarized as follows. The first purpose of this work was to establish the number of iron inlaid swords in Finland, since no systematic studies have been conducted previously. The overall number of Late Iron Age swords in Finland is relatively high in comparison with neighbouring areas and with regard to the assumption that the areas of settlement in Late Iron Age Finland were not a major part of the trade networks but lay instead outside the main trading routes. In addition, the number of decorated blades is similarly high, although comparisons are difficult due to the lack of systematic studies elsewhere. Blades with ferrous inlays were not rarities in Late Iron Age Finland but quite common, contrary to traditional beliefs.

The diversity of inlaid motifs and materials and their dating were also in focus. Although similar texts and marks existed, nearly all the examined inscriptions and motifs were unique in appearance, arrangements, and in many cases even in materials. It is clear that at least some of the studied swords originated from the Frankish realm, perhaps the correctly spelled ones at least. Possibly local or Scandinavian products are the blades with letter-like marks as well as those with obscure letter sequences and failed attempts to spell actual inscriptions.

The study of the technology of the blades and their inlays showed similar technical and material diversity. Good-quality blades existed side by side with poorer blades, the quality of the blade not being dependent on the inlaid motifs in all cases. This is to say that in some cases the correctly spelled inscription was not accompanied by a blade of decent properties.

On the grounds of the varying levels of technology, studies of the provenance of the materials, as well as the wide range of motifs, these blades with ferrous inlays were also manufactured outside the Frankish areas, most likely in Scandinavia from locally produced iron and steel. This hypothesis is supported by experimental evidence showing that inlaid sword blades could be made with various techniques – depending on the smith's skills – and with simple tools evident in archaeological find material throughout Europe. The quality of the swordsmiths' work varied considerably, and – according to obscure motifs sometimes found also on battleworthy blades – the level of blacksmithing was high even in some smithies in Scandinavia.

Traditionally, Finnish research has considered iron-inlaid blades, as well as other decorated sword blades, as expensive imports and thus objects reflecting high societal status and wealth. In the light of this work, iron inlaid swords were very common during the Late Iron Age in Finland, having been acquired by those who could afford them. As objects of fashion during the Viking Age, their demand was a probable reason for local manufacture at least on the Scandinavian scale, at least when, according to written sources, the trade of weapons from Continental Europe was restricted. According to the traces of use, at least some of these swords witnessed actual combat, and were not mere display items.

In this work it became very evident that a Late Iron Age sword has two distinct parts – the blade and the hilt – both of which originated from different workshops and thus from various geographical localities. While the decorative motifs are of Scandinavian, namely Gotlandic, character in many cases, their imitation elsewhere in Scandinavia is also a possibility. It is then very likely that undecorated hilts were also made in the present area of Finland, and attached to blades made in another locality closer or farther away, as indicated by the poor fit of hilts and blades.

Naturally this study leads to new questions regarding Late Iron Age sword finds. The technical properties of the sword blades should be analysed more in order to connect specific solutions to specific types of inscriptions. In addition, the materials of the inlays should be more carefully examined, namely for their trace elements to observe any possible differences and to determine the origin of the pattern-welded materials to some degree. The hilts, too, should be studied through various analyses to determine their structure and materials more reliably. It is, however, possible that this will complicate the picture even further.

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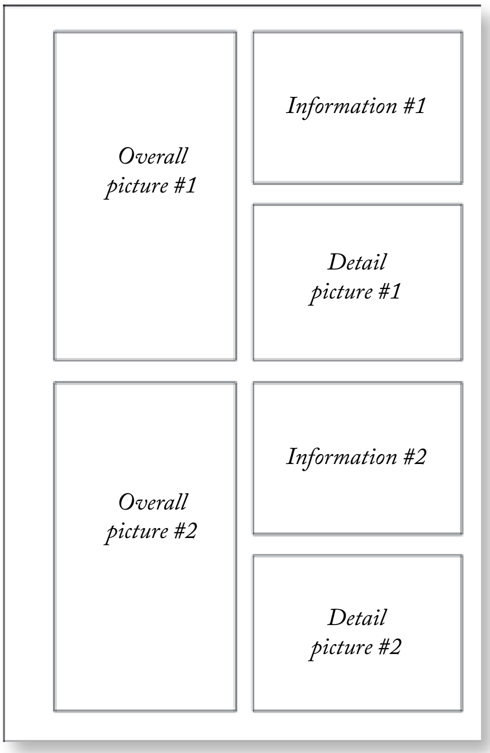
APPENDIX 1

MEASUREMENTS OF THE STUDIED SWORDS

The table below lists the measurements of all the studied swords. The numbers in the top row refer to Figure 6 in the main text. Measures marked with a single asterisk (*) refer to grips with bronze or iron tube, from which the measures were taken. A double asterisk (**) in connection with a collection number indicates a find that was not personally studied and its measurements are thus from earlier publications. All measurements are in millimetres.

Catalogue number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
KM 70	979	840	139	50	28	20	13	95	3–4	27	16	88	4–4,5	160	10	13				57	41	39
KM 287	567	448	119	54	47	20			4,5	24	13	98	5–6	98	21	27						
KM 293	938	795	143	51	32	20	10	40	4–5,5	30	18	93	4,5–6	98	12	20	73	10	19	69	28	17
KM 369	870	750	120	57	34	20	11	17	4,5	28	16	65	4–5	126	8	22				91	27	15
KM 370	702	557	145	57	42	27	18	8	3,5–5	24	15	83	5–5,5	99	14	23	78	16	24	72	32	24
KM 439:1	962	823	139	55	28	19	11	130	3–5	25	14	99	4–5	163	11	11				53	29	26
KM 708	653	498	155	54	38	24	16	10	3–4	30	15	103	3–5				71	14	21	67	38	21
KM 1120:1	812	674	138	54	36				3,5–7	30	19	98	3–5	99	21	30	87	19	35			
KM 1174:2	239	116	123	51	44	20	20		4	24	16	103	4	113	20–31	25						
KM 1174:3	545	411	134	49	40				4–4,5	22	14	76	3–6	101	18–24	18	80	18–22	18	64	22	22
KM 1822:1	755	624	131	52	34	19			5	26	15	104	5,5	97	13	24	80	14	21			
KM 1822:2	613	513	100	51	39	20			3,5–4,5	29	14	88	3–5	140	12	21						
KM 1869:81	545	440		45	33	18			1,5–3	28	8	105	2–3,5									
KM 1996:73	384	251	133	51	44	24	21		4	21	14	83	4–4,5	117	13	16	66	14	15	54	23	15
KM 2022:1	876	766	110	45	32	21	13	25	3–4	21	7	110	2–5									
KM 2033:1	908	782	126	49	26	18	11	90	3–4,5	31	18	92	4–4,5	186	8	14				50	26	29
KM 2345:1	732	641	91	43	28	13	8		2–3,5	17	10	68	2,5–4	85	22	24						
KM 2361	675	510	165	54	43	21	16		4	27	15	110	3,5–5	116	12	20	72	10	19	72	33	18
KM 2489:121	1031	824	207	59	40				4–6	43	27	110	21–22	186	15–31	21				69	66	23
KM 2489:280–281	904	714	190	45	34				3–4	29	24	105	3–5	131	12–29	19				61	56	19
KM 2508:124	890	755	135	47	27	20	10	75	4	26	16	103	4–5	137	8	22				85	10–25	20
KM 2548:196	319	194	125	51	43		19		4	23	16	91	4–6	129	14–15	22				77	18	20
KM 2548:277	315	154	161	57	52	22	21		4–5	32	21	96	4–5	103	16–18	27	83	16	37	75	33	33
KM 2548:839	739	739		50	29	25	12	30	2,5–3,5													
KM 2767	220	215	5	50	45	23	21		4,5	19	19	5	4,5	81	20	22						
KM 2886:10**	430			47		20																
KM 2939:1	731	579	152	48	36	10			3,5–5,5	28	11	95	2,5–5							55	57	36
KM 2979:6	516	366	150	50	38	23	22		2–3	26	12	92	3	82	19	19	80	14	17	64	25	26
KM 2986:4	365	265	100	46	41	20	18		4	23	10	100	3–5									
KM 3052:2	315	193	122	55	49	21	20		3,5–4,5	21	15	89	4,5–5	97	12–18	19	68	11–17	17			
KM 3131:6	504	398	106	64	47	28	24		3–5	33	16	95	4–5	120	11	22						
KM 3301:1	766	626	140	52	37				3–4,5	24	17	107	4–5	99	18	24	78	15	22			
KM 3316:13	778	613	165	46	34	20	15		2–3	15	9	96	4–4,5	182	14	17				54	55	30
KM 3336:31	715	660	55	45	39	16	16		3,5–4	18	10	39	5	77	16	20						
KM 3383:2	248	145	103	47	44				3–4	28	12	91	3	92	12	18						
KM 3423	452	341	111	59	46	24	22		3–4	25	17	94	4–5	98	17	27						
KM 3575:1	971	811	160	51	31		12	80	5	22	16	98	4	74	20	25				62	42	20
KM 3601:2	665	550	115	53	40	24	20		3–4,5	27	15	115	3,5–5									
KM 3631:1	973	815	158	44	26	10	8	5	3–5	33	15	93	3–5	141	12	16				53	53	32
KM 3699:3	419	252	167	50	43	22			3–3,5	22	15	95	3–4	97	17	22	74	21	25	66	34	25
KM 4254	784	737	47	56	36	23	15	50	3–4	24	20	29	3–4	107	18–29	21						
KM 4429:14	576	438	138	45	37	12	9		4	28	13	100	3–4							78	38	34
KM 4566:12	802	678	124	61	46	21	18		3,5–4,5	27	16	88	3,5–4	179	9	24				87	14–27	17
KM 4633:145	892	721	171	60	33				3–6	30	22	90	5,5–7,5	98	24	36	90	22	38	80	35	29
KM 4633:165	775	613	162	62	40				3–5,5	28	21	100	4–4,5	107	19	28	82	15	36	75	28	33
KM 4923:1	574	440	134	56	50	24	22		4	26	17	88	4,5–5	113	12	24				62	34	25
KM 5005	427	267	160	44	36	13			3–4	27	19	95	4,5–5	108	10	18				55	55	29
KM 5215**		533		46		17								195	10	10				58	58	
KM 5334:1	718	557	161	55	44	22			5,5–6,5	24	18	137	5,5–7	77	21	32	67	20	32	55	24	26
KM 5395:1	793	623	170	57	39				4–4,5	28	18	100	6	100	20	29	86	20	37	82	30	34
KM 5707:3	707	571	136	46	33	12	10		3–4,5	26	10	103	3–4	172	7	5–12				80	26	21
KM 5865:1	728	579	149	49	35	15	12		4–6	22	13	92	5–7	80	20	18	68	19	17	60	18	16
KM 5868:60**			158	54	47	24				31	18			96	13	23	78	12	22	72	30	21
KM 5890:1	914	784	130	57	29	20	12	70	3–7,5	28	18	90	4–5,5	166	9–10	23				79	18–30	18
KM 5960:3	509	509		43	34	19	11		4–5													
KM 6066:1	915	815	100	59	34	29	15	42	3,5–5	33	21	100	4–6									
KM 6196:1	757	673	84	60	45	23			3–4	37	31	57	6	101	27	32						
KM 6227:1	556	412	144	51	38				5,5–7	25*	21*	92	13–17*	95	15–19	25	77	15	19	64	22	24
KM 6245 A:1	844	720	124	57	39	28	18		5	26	23	82	5	99	18	24	83	17	27			

Catalogue number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
KM 6482	394	289	105	53	43	20	16		4–5	25	12	83	3–3,5	70	22	19						
KM 6503:20	563	480	103	49	44	24	22		4	28	18	103	3–5									
KM 6689:2	907	772	135	51	27	23	11	40	3,5–4	22	8	135	3–5									
KM 6746:49	992	832	160	54	34	20	12	70	4–6	27	17	97	4,5–6	91	17	25	79	17	23	73	29	17
KM 6753:51	984	832	152	59	39	26	13	75	5–6	29	17	99	4,5–6	86	15	28	75	15	31	68	23	26
KM 6923	940	813	127	52	32	23	13	80	3–4,5	31	17	83	4,5–5,5	162	11	10–14				67	31	25
KM 7011	911	777	134	55	28	22	14	50	2–4	24	13	93	4,5–6	124	10	24				57	31	24
KM 7134:1**	426	288	138	50		12				28	15			213	16	14				57	36	29
KM 7220:2	229	82	147	55	50				4	25	15	92	2–5	72	18	18	59	15	15	52	19	13
KM 7332	862	733		51	31	23	15	65	4–4,5	27	4	129	5									
KM 7472:2	938	779	159	51	28	18			3,5–5	34	22	99	5	95	18	27	79	14	31	74	28	28
KM 7703:2	833	704	129	52	44				3–4	51*	48*	89	16–22*	93	15	23	83	15	20			
KM 7752:1	964	813	151	60	34	25	18	80	4–4,5	30	17	93	4–4,5	93	16	31	71	17	29	65	25	25
KM 7961:1	403	255	148	51	41	25			3,5–4,5	27	12	131	2–5	93	17	23						
KM 8120:1	395	262	133	60	49	21	19		4,5–5,5	27	14	88	5–5,5	127	13	30				57	32	33
KM 8219	559	457	102	55	45	23	18		4–5	33	16	102	4–4,5									
KM 8602:130	783	623	160	51	37	19	14		4,5–5	29	22	85	21–22	107	22	27	87	19	28	78	34	26
KM 8602 A:116	694	563	131	56	40	18			9	30	26	60	13	86	15	25				43	36	22
KM 8656 H23:1	1174	1008	166	53	33	12			4–7	36	24	102	4	159	11	15				76	53	30
KM 8723:165	1069	920	149	49	30	13			3–4,5	33	16	100	3–5	191	12	15				51	48	22
KM 8896:25	925	796	129	57	32	22	15		4–5	26	18	95	4	97	18	28	83	16	34			
KM 8911:91	555	462	93	55	44	21	18		4,6	25	16	93	5									
KM 9142:8	241	187	54	50	45	11	11		4–5	31	22	54	5									
KM 9164:2	626	489	137	50	37	17	12		3–5	17	12	91	4	122	17–22	23				59	29	23
KM 9164:3	901	764	137	54	28	23	14		4–5,5	24	11	93	3–5,5	89	16–23	18				58	28	20
KM 9243:1	960	801	159	52	32	22	14	60	3,5–5	28	14	98	2–5	99	16	28	81	12	25	74	33	25
KM 9243:2	984	847	137	58	35	21	13	110	4–6	29	14	100	3,5–5	132	8–11	26				60	29	29
KM 9369:1	323	293	30	52	44	20	17		4,5–5	25			5									
KM 9419	1070	929	141	43	22	11			2,5–4	26	16	90	4–5	162	11	12–16				52	51	20
KM 9562:1	570	414	156	49	40	20			2–3,5	24*	29*	98	16*	99	18–24	18	72	13	16	70	14–23	17
KM 9778	945	769	176	59	48	24	19		4,5–5,5	26	12	99	3,5–5	88	24	17–25				78	53	16–21
KM 9832	202	47	155	61					5	24	17	87	4–6	107	19	31	87	17	37	81	32	35
KM 10349:1	780	627	153	52	41	21	16		5	25	14	88	3–5	75	23	21	65	19	19	56	23	17
KM 10369:3	805	762	43	52	33	20			3,5–4,5	30		23	7	84	20	18						
KM 10372:1	943	816		58	27	31	14	65	2,5–3,5	31	1	127	2–4									
KM 10390:2	235	207	28	43	34	19	18		2,5–3	18	18	7	5	109	21	17						
KM 10390:3	453	312	141	50	39				3–4,5	24	17	87	4–5	95	14	24	73	11	23	68	29	23
KM 10390:5	454	358	96	52	46	26	21		3,5	24	15	80	4–6	90	16	22						
KM 10413	553	443	110	55	42	26			3–4	30	14		4,5	93	17	24	68	17	26			
KM 10906:1	984	822	162	55	33	22	13	45	4–6	27	16	94	3–5	99	20	32	85	16	35	82	32	33
KM 11063:283	773	652	121	58	36				10	28	22	92	11–14	122	12	24	67	17	25			
KM 11198	552	407	145	59	43	25	20		4	12	4	126	4–5	86	19	23						
KM 11242	627	475	152	51	35				3–5	24	8	79	4,5–6	105	21	27	87	19	24	65	18–33	31
KM 11831	849	692	157	44	30				2,5–3,5	28	14	91	3–4	180	12	14				53	54	22
KM 11840	986	851	135	47	22	14	9	135	3–6	27	14	95	4,5–6	138	12–14	14				48	26	35
KM 11859:1	659	541	118	50	41	20	15		5	28	14	90	6	100	13	23	77	14	23			
KM 12033	614	462	152	44	37				2–3,5	29	20	88	4	175	11	10–18				65	53	30
KM 12687:1	1119	967	152	47	25	20			4–5	24*	20*	90	13–15*	99	21	24	68	16	18	65	25	21
KM 12690:299	1002	843	159	49	26				3,5–6	30	4	147	3–6,5	230	6–12	7–15						
KM 13399:3	937	819	118	49	27				7–11	31	8	109	3,6–10	209	6–9	16						
KM 13419:1	923	765	158	46	30	12	10	170	4–5	17	15	88	4,5	106	24	36	82	26	33	77	38	29
KM 13419:2	957	788	169	60	38	22	14		3,5–5	31	21	94	6,5–10	106	22	28	87	19	37	80	34	35
KM 13839:253	495	342	153	53	45				7–9	22	17	70	10	110	29–22	24	92	21	27	69	15–33	30
KM 13962:322	882	730	152	56	33				5–8	25	14	85	7–8	85	22	37	70	21	35	61	24	27
KM 14196:69	967	835	132	60	30	20	12		5–7	29	20	85	4–6	143	10	20				66	37	22
KM 14684	358	281	77	56	44	22	19		4–4,5	25	17	58	4–5	117	13–19	26						
KM 15175:1	854	734	120	53	33	22	14	40	3–4	24	16	84	4,5–5	93	19	23	70	17	25			
KM 15181:2	441	312	129	43	34	18			3	22	16	68	6	105	18–22	21				66	43	22
KM 15467	289	120	169	57	51	23	23		3–5	26	18	99	4–5	102	22	33	85	20	34	76	28	30
KM 16279	470	348	122	54	40				3–5	28	12		4,5–6,5	89	17	28						
KM 17208:375	945	793	152	52	30				4–5	29	25	65	8	115	22–26	28	88	20	25	73	25	30
KM 17208:561	944	796	148	47	24	15	12	125	2,5–3,5	24*	24*	86	16*	89	19	20	69	16	17	64	27	22
KM 17208:588	904	752	152	57	35	29	16	30	3–3,5	20*	18*	88	10–16*	86	22	22	71	17	20	62	25	19
KM 17777:1	921	761	160	58	38	33	19		3–3,5	33*	25*	81	13–16*	129	22–42	24				63	52	25
KM 18000:3170	975	835	140	56	34	20			5–7	28	17	91	6–7	140	12–22	24				62	37	23
KM 18000:3880**	990			65										148						62	41	33
KM 18402:1	920	764	156	62	35	28	21	45	3–5	24	19	90	4–5	105	19	31	86	19	32	79	28	29
KM 19901:202	1133	950	183	54	30				3–7	34	25	110	13–14	189	13	26				53	60	34
KM 20127	890	766	124	62	31	24			3–5	26	18	84	3–4	108	8	18				61	32	15
KM 22106:23	822	680	142	58	32					38	27	95		142	10	19				55	37	21
KM 22964:3	1017	866	151	55	30	23	15	80	5	23	12	99	5	78	15	32	66	15	27	60	20	20
KM 23607:490	937	767	170	57	37	24	18	65	5–6,5	33	20	97	8	94	20	32	85	18	34	81	35	32
KM 24740:242	954	775	179	59	43	23			10–14	35	27	87	9–10	122	27	41	102	25	42	91	40	39
KM 26301	956	789	167	62	38				4	22	21	101	4,5	103	20	28	89	17	33	81	29	31
KM 27141:1	807	666	141	52	28	16	10	42	4–5	20	15	85	7	98	15–19	22	72	15–18	22	60	26	23
KM 30670:1	857	717	140	55	29	20–25	12–14	60–70	2,5–3	30	14	94	3–4	92	15	20	73	17	22	64	26	22
KM 30985:1	1002	812	190	63	42	27	19	120	5–7	30	20	110	5–6	95	22	32	89	21	38	84	37	34
KM 31017:1	576	410	166	55	45				9	25	13	90	10	101	20	22	85	20	30	75	36	29
KM 31550:1	855	732	123	55	34	24	14	30–50	2–4	25	20	93	3–5	99	16	19	70	14	24			
KM 37257	425	274	151	51	46	25	22		4–4,5	21	17	62	4–4,5	98	19–21	22	74	20–21	22	58	30	23
LiuM 26**	513			50		18																
HM 3047	809	681	128	50	35	21	16		3,5–5	29	17	73	3–5	97	15	25	79	13	28	76	27	27
SatM 10330	887	758	129	58	31	25	16	70	2,5–5	30	18	95	3–5	151	8	24				71	26	16
SatM 12563	536	501	35	55	42	30	23		2,5–3,5	22	15	20	3–4	96	15	18						
TMM 13393	976	825	151	46	27	19			4–4,5	35	18	87	2–6	190	8–13	13				54	51	25
TMM 14105	865	703	162	59	35				3–4	28	16	100	2,5	100	16	29	79	15	31	74	30	30
ÅL 336:292**				52										81			71					
ÅL 337:106**	910													76			62					
ÅL 337:229**	945			61													93					
ÅL 337:528**	855			49													78					
ÅL 345:113**				57																		
Huittinen, church	996	842	154	52	27	11			2,5–4,5	27	17	90	4–6	168	9–14	19				55	55	38



APPENDIX 2

CATALOGUE

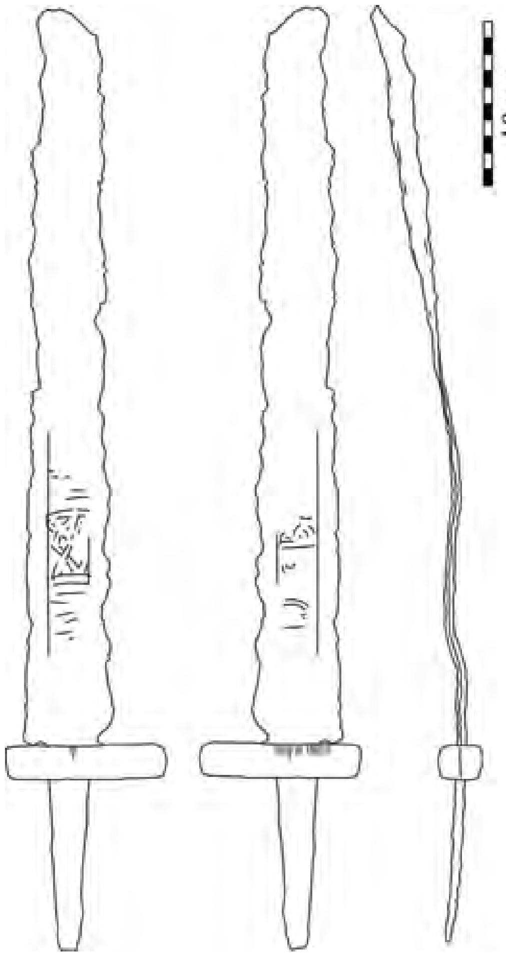
This appendix is the catalogue part of this thesis including all documented and known iron inlaid swords from Finland. The finds are presented according to their catalogue numbers. Finds under catalogue numbers of the National Museum of Finland (KM) are presented first due to their overwhelmingly large number as compared with the collections of smaller local museums. Other catalogue numbers are from the collections of the Häme museum (HM), the former Liuksiala museum (LiuM), the Satakunta museum in the municipality of Pori (SatM), the museum centre of Turku (TMM), and the Åland museum (ÅL). One sword is kept in the church of Huittinen without any specific collection number.

The condition of the find is stated briefly as poor, fair or good, the last-mentioned displaying only small corrosion pits and with the cutting edges preserved. A find in poor condition is no longer properly measurable due to extreme corrosion. A find in fair condition falls between these two extremes. While the measurements are found in Appendix 1, the weight of the sword is listed here in grams (g). The weight is the total weight of the sword or its parts altogether. In some cases heavily corroded swords could not be weighed. Also the balance point is given as millimetres (mm) indicating the distance of the balance point from the lower face of the lower guard or from the shoulders of the tang in specimens where the lower guard is missing. Balance points were measured from complete and straight swords only, and if the condition of the find allowed.

In the text section concerning of each sword the contents of their inlaid motifs and inscriptions are mentioned briefly, as also their materials. Also the manner in which the inlays were revealed or studied is stated as surface examination or by radiography. Other radiographs, if reported, do not necessarily show only the blade but also the hilt. The hilt is referred to as in Appendix 2 – according to existing typologies. Also the materials and decoration of the hilt are noted, while more detailed information is presented in Appendix 2. The find context and time of discovery are briefly stated. More accurate descriptions of find contexts are given in Appendix 4. Finally, a list of literature with mentions of the sword in question is presented.

The pictorial presentation of the finds includes two pictures of each sword. In some cases the find was not personally documented, and thus the picture has been made according to previously published pictures and presentations. The first drawing is the overall picture of the find from both flats as well as from the side of the edge. In the edge view, the lower picture of the flat (referred to as side one in the text of this work) faces downwards. The scale is given under the drawing. If the find was markedly bent, both flats of the sword were drawn as straight to give a clearer picture of the inlays and the shape of the find. The degree of the bending can be seen in the edge picture.

While the overall pictures present only the outlines of the inlays, the second drawing shows the details, i.e. the patterns evident in the inlays. Black colour represents "steel" while white areas are "iron", in practice meaning the differences in carbon or phosphorus content. It must be noted that all inlays have been drawn as they were seen with the unaided eye or by means of radiography. No interpretative marks or lines have been drawn.



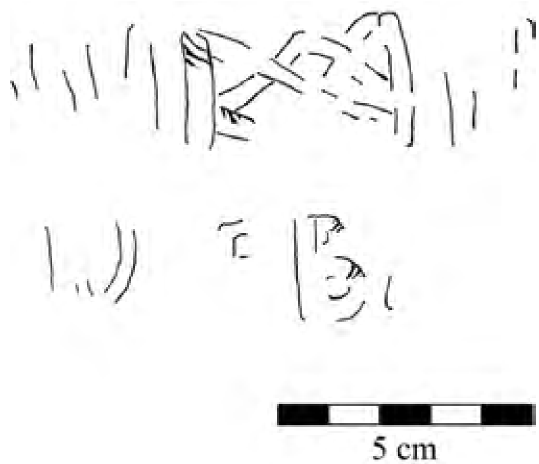
KM 70 Eura, Kauttua

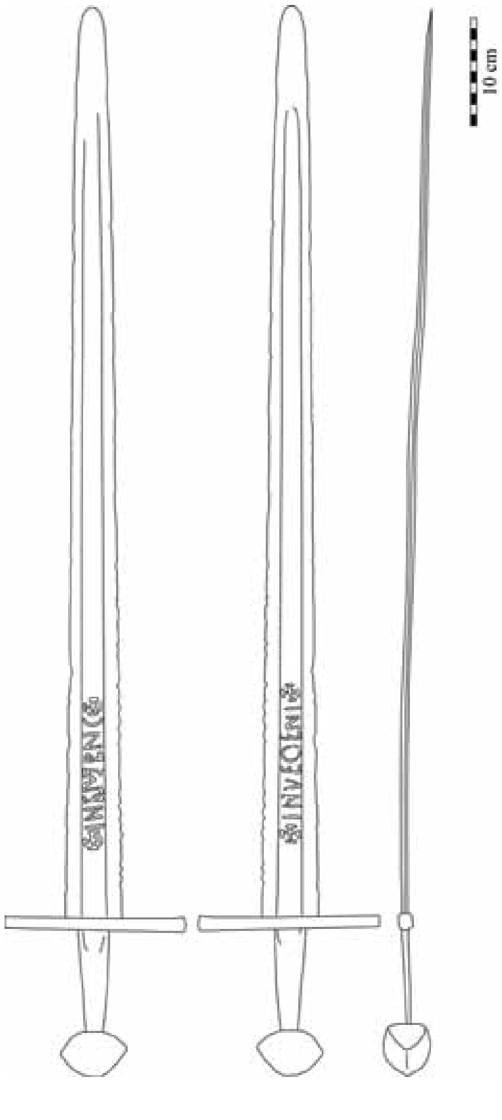
A complete sword in good condition. Weight: 1,123 g. Balance point: 180 mm. On one side the fuller contains the inscription +INVEOENI+, and the reverse side bears the inscription +INbMPNC+. The material of the inlays could be pattern-welded rod, but the patterns are unclear. Some inlays have corroded away, so their material must have contained a great deal of carbon, and according to their colour, much the same amount as the blade. The inlays were defined by surface examination. Radiographs: no. 3326.

The hilt belongs to Oakeshott's type B, and more accurately Geibig's type 14. The parts of the hilt are of undecorated iron.

The sword is a stray find from near a factory from 1849.

Literature: Anteins 1973: 51, 62; Kivikoski 1951: 36; Leppäaho 1964b: 20–21; Räty 1983: 131–133, 154, 175–178 , 293; Räty 1998: 45; Salmo 1952: 383, 492; Salo 2005: 124.





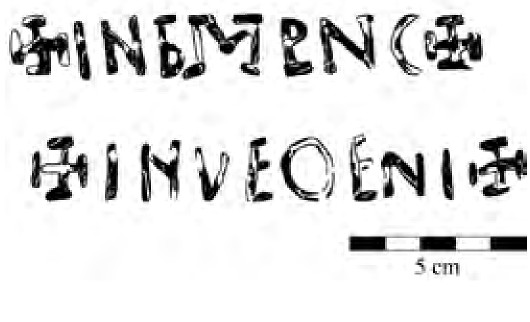
KM 287 Åland, Saltvik, Kvarnbo

A fragmentary sword in poor condition. The pommel, the lower guard, and the lower half of the blade are missing. Weight: 646 g. On one side, the fuller contains the fragmentary inscription V FB, which could indicate an ULFBERHT inscription. The reverse side contains the remains of a woven lattice and vertical lines. The material of the inlays could be twisted pattern-welded rod, which does not show any colour differences. The inlays were defined by surface examination and radiograph no. 2982.

The hilt belongs to Petersen's type H. The lower guard is of iron and decorated with inlays from silver wire (16 wires/cm).

The sword is a burial find from a mound, which contained a cremation. The mound was excavated by K. A. Bomansson in 1857.

Literature: Mikkola 1999: 48; Räty 1983: 38–39 , 152, 162–163, 221; Räty 1998: 39–40, 49.



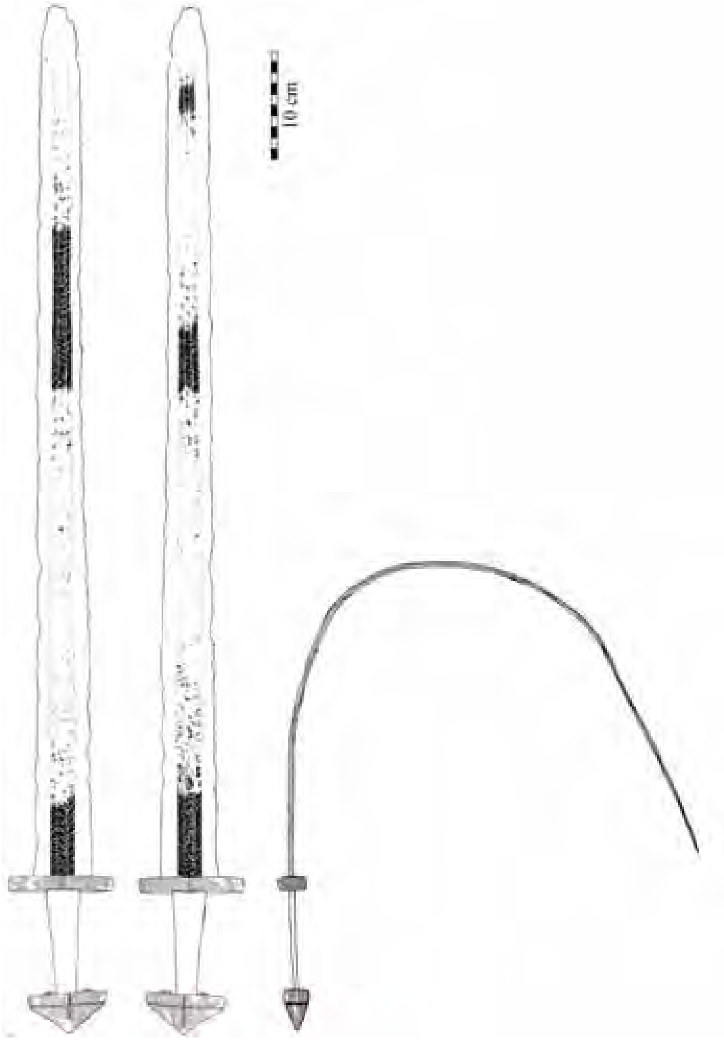
KM 293 Åland, Saltvik, Bertby

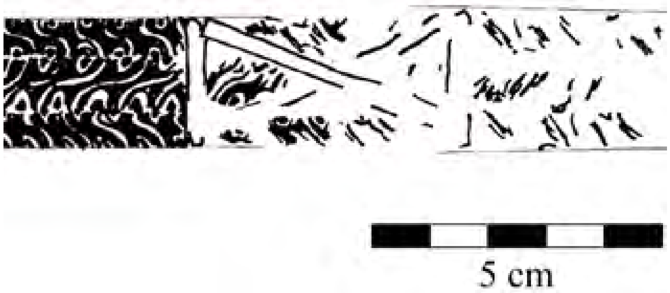
A complete sword in good condition. Weight: 1,110 g. The blade is strongly bent to resemble the letter U. The fuller consists of three or most likely six twisted, pattern-welded bars. Each bar contains seven layers (four of steel and three of iron). On one side the fuller contains a lattice symbol. The material of this inlay seems to be iron, because the blade has corroded more than the inlay. The inlays and pattern-welding were defined by surface examination.

The hilt belongs to Petersen's type I. The parts of the hilt are of iron and decorated with silver wire inlays.

The sword is a grave find from a mound, which contained a cremation burial (KM 291–293). The mound was excavated by K. A. Bomansson in 1857.

Literature: Aspelin 1880: fig. 1685; Kivikoski 1963: 13; Mikkola 1999: 48; Räty 1983: 43–44, 152, 159, 162–163, 219.





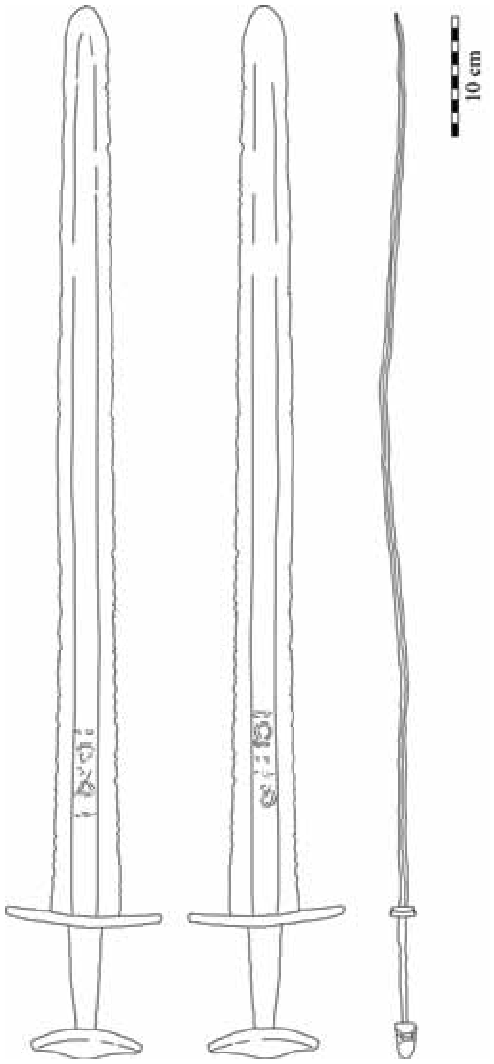
KM 369 Hämeenlinna, Vanaja, Katinen

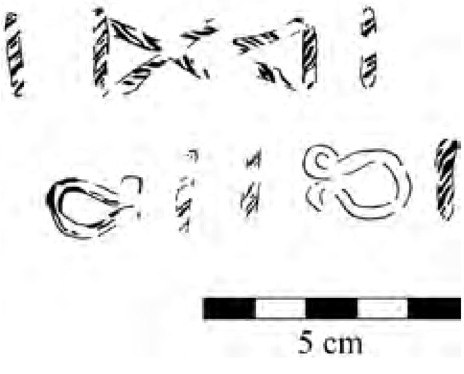
A complete sword in good condition. Weight: 828 g. Balance point: 175 mm. On one side the fuller contains two volutes and vertical lines, and the reverse side contains simple woven lattice and vertical lines. The material of the inlays seems to be both straight and twisted pattern-welded rod, which probably contains 3–5 layers. The inlays were defined by surface examination and radiographs nos. 3032 and 3035.

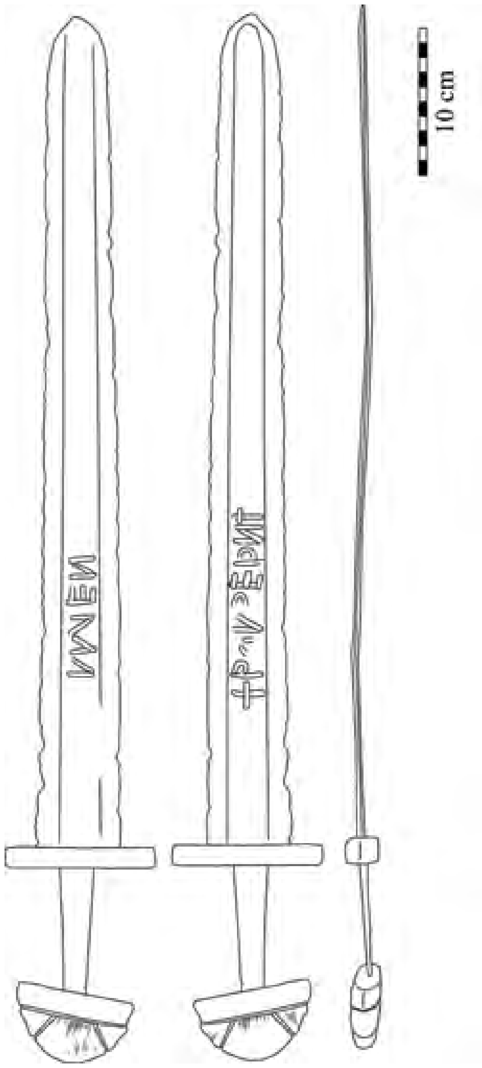
The hilt belongs to Petersen's type Y. The parts of the hilt are of undecorated iron. The tang is riveted on top of the pommel, which has a groove to make it look like it was assembled from two pieces.

The sword belongs to a group of finds (KM 368–403) recovered while making Helsinki-Hämeenlinna railroad in 1859 and is possibly from a level-ground cremation cemetery.

Literature: Anteins 1973: 61; Aspelin 1875: 348; Aspelin 1880: kuva 1572; Heikel 1878: 77–78 ; Hirviluoto 1992: 44; Kivikoski 1939: 212; Kivikoski 1951: 15; Leppäaho 1964b: 40–41; Moilanen 2010b: 44–45; Müller-Wille 1970: 79, 87; Räty 1983: 79–81, 156, 162, 165, 272; Räty 1998: 39–40, 49.







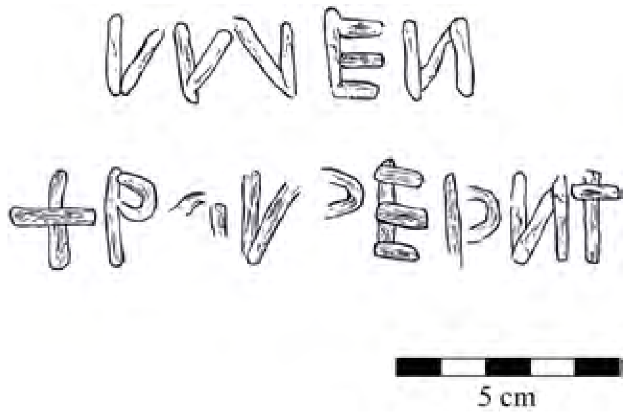
KM 370 Hämeenlinna, Vanaja, Katinen

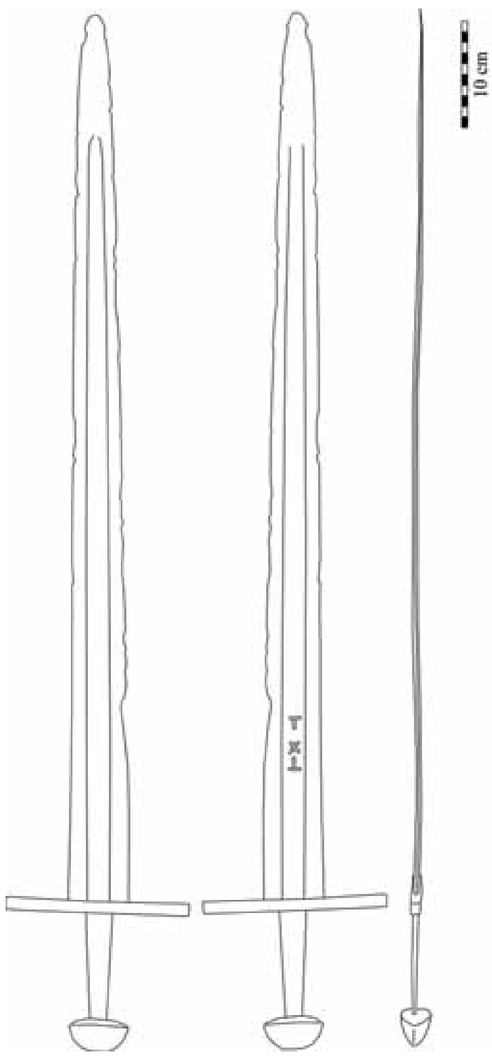
A complete sword in good condition. Weight: 1,054 g. Balance point: 100 mm. On one side the fuller contains letter-like marks resembling an ULFBERHT inscription, and the reverse side is marked with the word AMEN in reversed letters. The material of the inlays seems to be steel rod, which shows longitudinal slag inclusions, and which has corroded away in most parts. The inlays were defined by surface examination and radiographs nos. 547 and 3618.

The hilt belongs to Petersen's type V. The parts of the hilt are decorated with vertical wire inlays.

The sword belongs to a group of finds (KM 368–403) recovered during the construction of the Helsinki-Hämeenlinna railway in 1859 and is possibly from a level-ground cremation cemetery.

Literature: Aspelin 1875: 348; Heikel 1878: 77–78; Hirviluoto 1992: 45; Kivikoski 1951: 14, Tl. 97:777; Kivikoski 1973: 113, Tafel 95:836; Moilanen 2010a: 8–9; Räty 1983: 64–66, 156, 162, 165, 177–178, 255, 346; Räty 1998: 39–40, 49; Tallgren 1931a: 187.





KM 439:1 Vesilahti, Laukko, Pajalahdenranta/Riihimäki

A complete sword in good condition. Weight: 1,018 g. Balance point: 215 mm. On one side the fuller contains two rotated T-figures and the mark X. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination. Radiographs: no. 3604.

The hilt belongs to Oakeshott's type B, more accurately to Geibig's combination type 15.5. The parts of the hilt are of undecorated iron.

The sword is probably a grave find from 1860 from a cairn (KM 439:1–23).

Literature: Aspelin 1880: kuva 1542; Hakanpää 2000: 132–133; Heikel 1882: 31–32, kuva 48; Honka-Hallila 1984: 61; Kivikoski 1939: 211; Kivikoski 1951: 36; Moilanen 2010a: 4; Räty 1983: 131–133, 154, 159, 293; Salmo 1952: 112, 492.

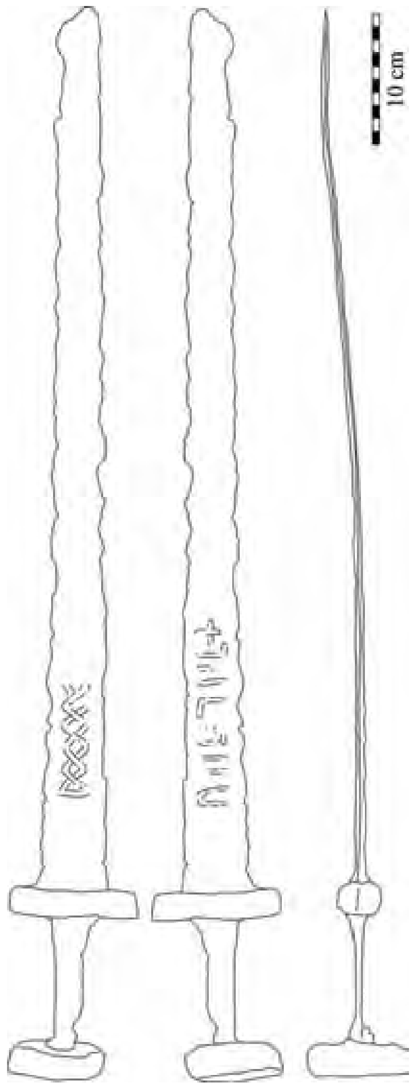
KM 708 Hämeenlinna, Tuulos, Juttila, Haaksivalkama

A fragmentary sword in good condition and lacking the lower guard. Weight: 664 g. On one side the fuller is marked with the fragmentary inscription +VLFI RI I+⅃, and the reverse side contains some vertical lines and a woven lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination. Radiographs: no. 3563.

The hilt belongs to Petersen's type V. The parts of the hilt are iron, and no decoration is visible any more.

The sword is a stray find from the shore of Lake Pyhäjärvi from 1868, most likely originating from a level-ground cremation cemetery.

Literature: Aspelin 1880: kuva 1604; Heikel 1878: 70–71; Kivikoski 1951: 14; Moilanen 2010a: 8; Räty 1983: 64–66, 156, 162, 254.



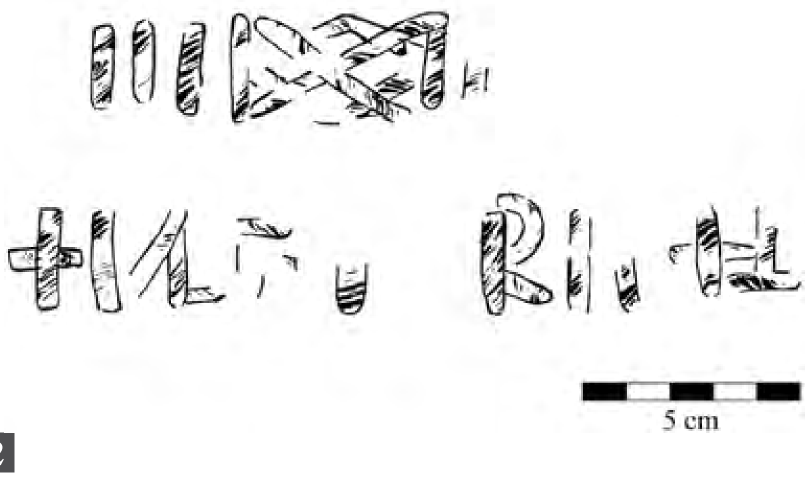
KM 1120:1 Eura, Pappilanmäki

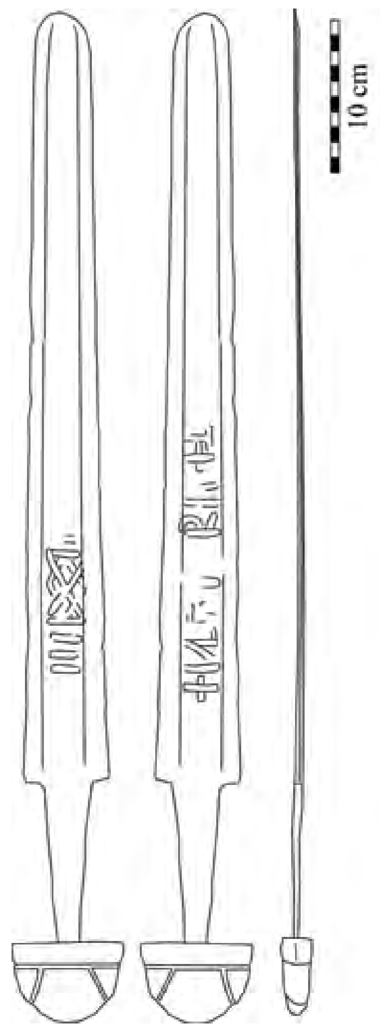
A fragmentary sword in poor condition and lacking the pommel. Weight: 937 g. On one side the fuller contains letter-like marks, and the reverse side contains a lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3312. Other radiographs: no. 651.

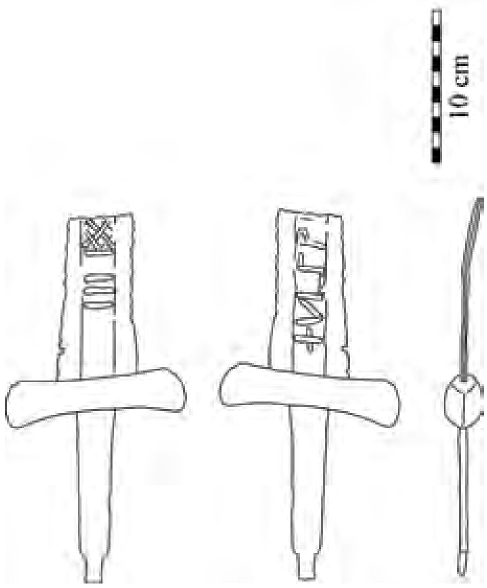
The hilt belongs to Petersen's type H. The parts of the hilt are iron, and no decoration is visible any more.

The sword is a grave find from an inhumation cemetery, grave no. 1 (KM 1120:1–5) and was excavated by K. E. F. Ignatius in 1870 (KM 1120:1–5).

Literature: Räty 1983: 38–39, 233–234; Salmo 1952: 45, 378, 492.







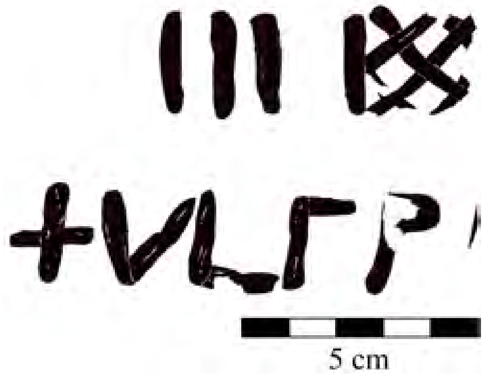
KM 1174:2 Kokemäki, Äimälä, Leikkimäki

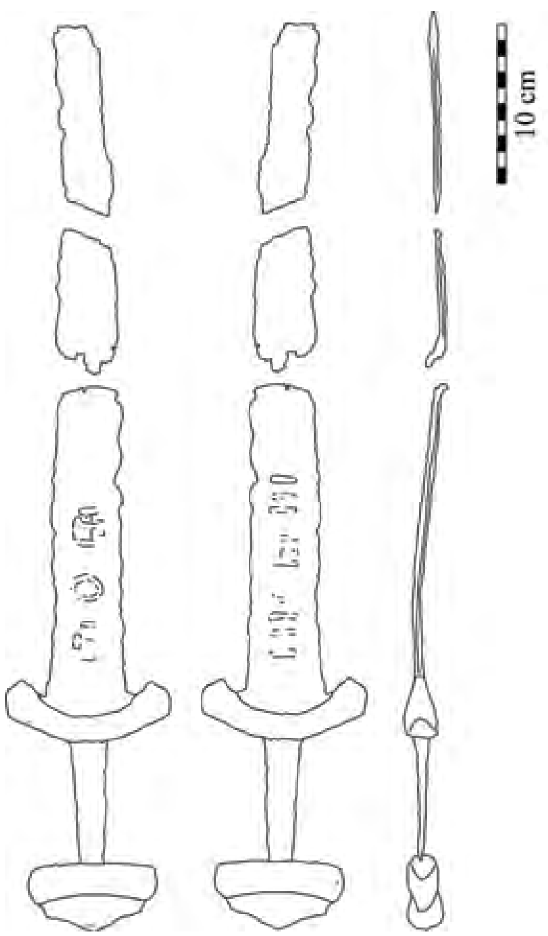
A fragmentary sword in fair condition and without its pommel and the lower half of the blade. Weight: 920 g. On one side the fuller bears the fragmentary inscription +VLFP, and the reverse side contains a fragmentary motif consisting of a woven lattice and three vertical lines. The material of the inlays appears to be steel, displaying possibly longitudinal slag inclusions or a corroded structure. The inlays were defined by surface examination.

The hilt belongs to Petersen's type S. The lower guard is iron and is decorated with silver-plating on a hatched surface (26 grooves/cm in two directions).

The sword is a cemetery find from a level-ground cremation cemetery and made in 1870 while ploughing a field (KM 1174:1–35).

Literature: Anteins 1973: 61; Aspelin 1875: 340; Aspelin 1880: kuva 1457; Kivikoski 1951: 14; Leppäaho 1964b: 42–43; Müller-Wille 1970: 79, 87; Räty 1983: 54–55, 155, 162, 164, 248, 351; Räty 1998: 39–40, 48; Salmo 1952: 60, 382, 492.





KM 1174:3 Kokemäki, Äimälä, Leikkimäki

A fragmentary sword in poor condition. Weight: 596 g. The lower half of the blade is broken into two pieces, which both can be found under catalogue number KM 1174:34, which also contains a piece of bronze spiral and a corroded iron ball. On one side the fuller contains vertical lines and fragmentary letters. The reverse side contains two cross potents and a circle. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiographs nos. 3032 and 3034.

The hilt belongs to Petersen's type Z. The parts of the hilt are of iron and show traces of silver-plating.

All parts of the sword are cemetery finds from a level-ground cremation cemetery and made in 1870 while ploughing a field (KM 1174:1–35).

Literature: Aspelin 1875: 340; Aspelin 1880: fig. 1454; Kivikoski 1951: 15; Räty 1983: 82–87, 275; Salmo 1952: 60, 492.

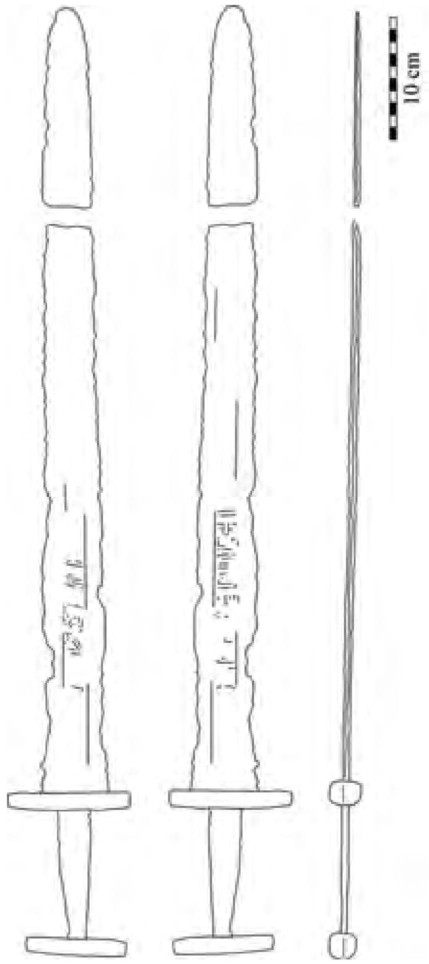
KM 1822:1 Eura, Pappilanmäki

A fragmentary sword in poor condition and without its pommel. The blade is broken in the middle. Weight: 812 g. On one side the fuller contains unidentified marks and a cross, and the reverse side contains remains of perhaps a woven lattice and some vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiographs nos. 561 and 3162.

The hilt belongs to Petersen's type I. The lower guard is iron, and no decoration can be detected due to corrosion.

The sword is a stray find from an inhumation cemetery in 1876 (KM 1822:1–6).

Literature: Mikkola 1999: 48; Räty 1983: 43–44, 155, 162, 168, 234; Räty 1998: 39, 41, 47; Salmo 1952: 45, 378, 492.



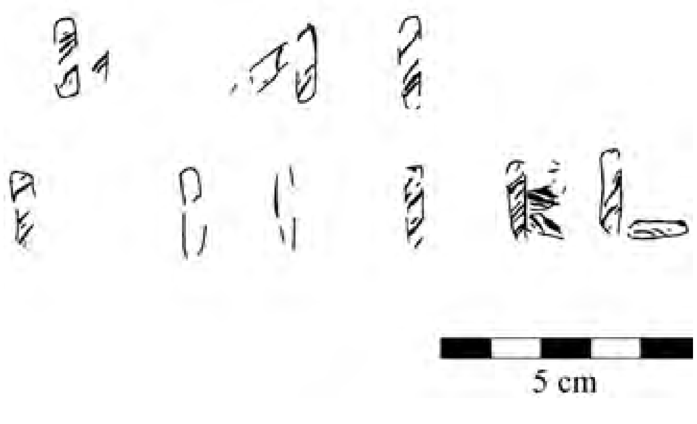
KM 1822:2 Eura, Pappilanmäki

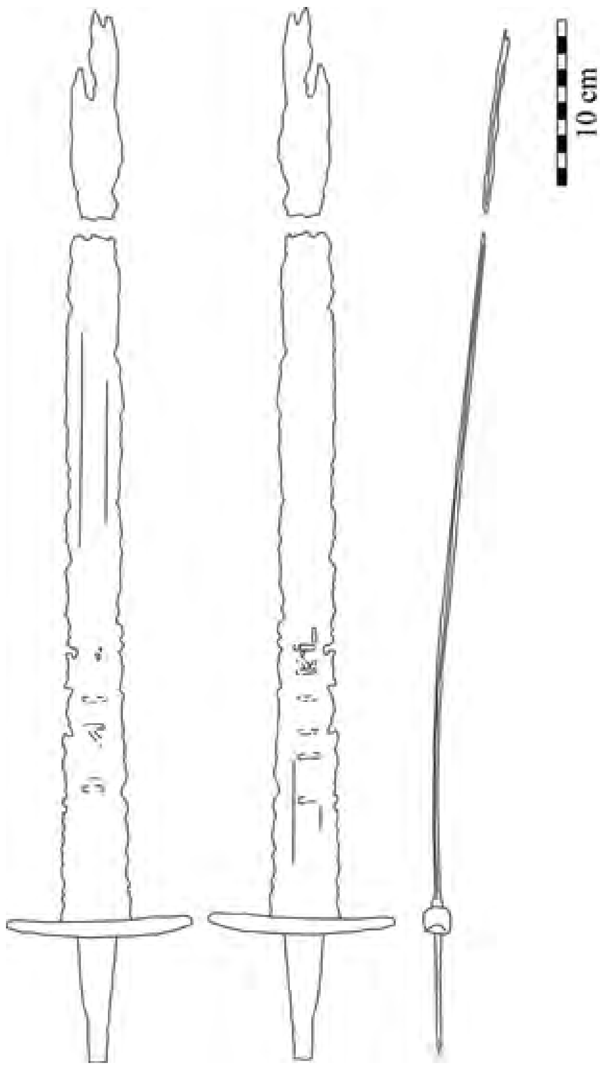
A fragmentary sword in poor condition and lacking its pommel. The blade is broken into two parts near the tip. Weight: 526 g. On both sides the fuller contains fragmentary letter-like marks. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3311.

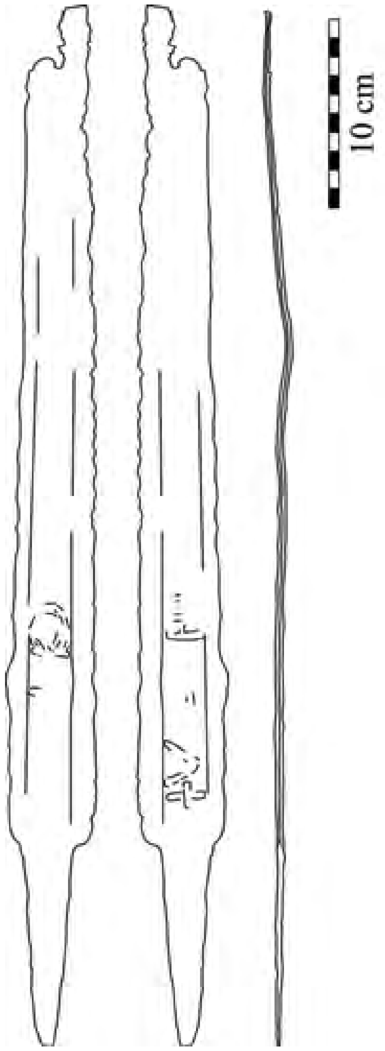
The lower guard is undecorated iron and resembles Oakeshott's type 7 and Geibig's types 12 or 16.1.

The sword is a stray find from an inhumation cemetery in 1876 (KM 1822:1–6).

Literature: Kivikoski 1951: 15; Räty 1983: 76–78, 261; Salmo 1952: 45, 492.





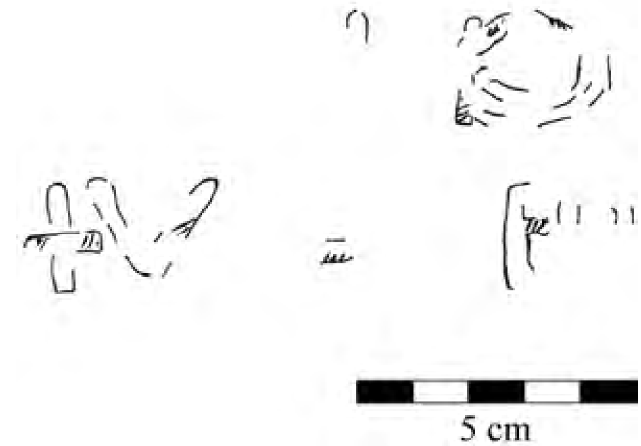


KM 1869:81 Hämeenlinna, Tuulos, Juttila

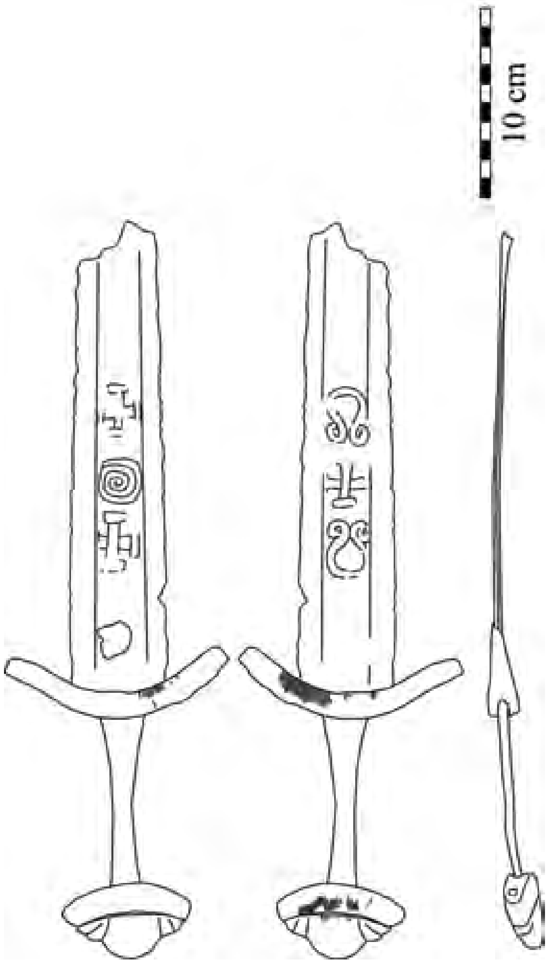
A fragmentary sword in poor condition, without the lower half of the blade and the parts of the hilt. Weight: 240 g. On one side the fuller contains letters +V and perhaps E, which could indicate an ULFBERHT inscription. The reverse side contains the remains of a woven lattice. The material of the inlays could be twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 2989.

The sword is possibly a cemetery find from a level-ground cremation cemetery in 1877. The sword belongs to artefacts collected from Hauho parish and brought to the museum by A. O. Heikel in 1877 (KM 1869:1–84).

Literature: Aspelin 1880: 300; Heikel 1878: 70–71; Mikkola 1999: 48; Räty 1983: 43–44, 156, 162–163, 239; Räty 1998: 39–40, 49.



KM 1996:73 Lempäälä, Haurala, Henneri



A fragmentary sword in good condition and without the lower half of the blade. Weight: 438 g. On one side of the blade there is a molten lump of bronze in the middle of the fuller. On one side the fuller contains two volutes and a cross crosslet, and the reverse side contains two cross crosslets and a spiral. The material of the inlays is both twisted and straight pattern-welded rod, which contains nine layers. The inlays were defined by surface examination. Radiographs: no. 3526.

The hilt resembles Petersen's types L and Z. The parts of the hilt are decorated with silver wire inlays (22 wires/cm).

The sword is a stray find from a sand pit on Henneri Ridge, possibly from a cremation cemetery. The sword belongs to a group of finds collected by A. O. Heikel in 1879 (KM 1996:1–120).

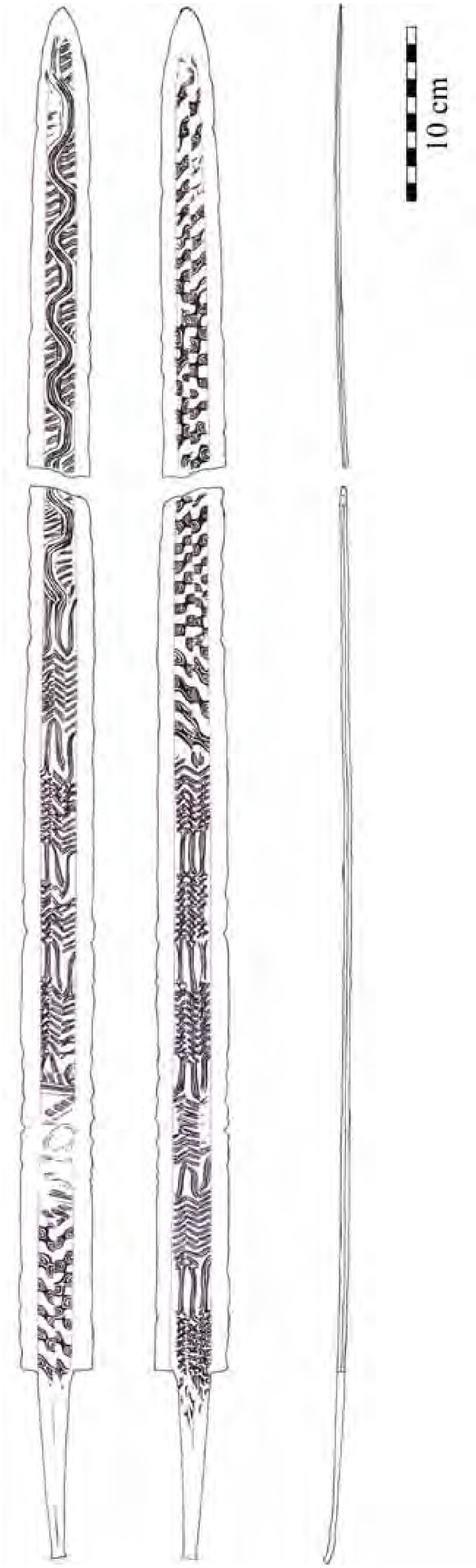
Literature: Anteins 1973: 56, 63; Aspelin 1880: kuva 1555; Heikel 1882: 12, kuva 11; Honka-Hallila 1984: 43; Kivikoski 1951: 14, Tl. 96:771; Kivikoski 1973: 113, Tafel 96:842; Lang & Ager 1989: 103; Leppäaho 1964b: 24–25; Räty 1983: 82–87, 155, 182, 276, 347, 350–351; Salmo 1952: 125, 377, 380, 492.

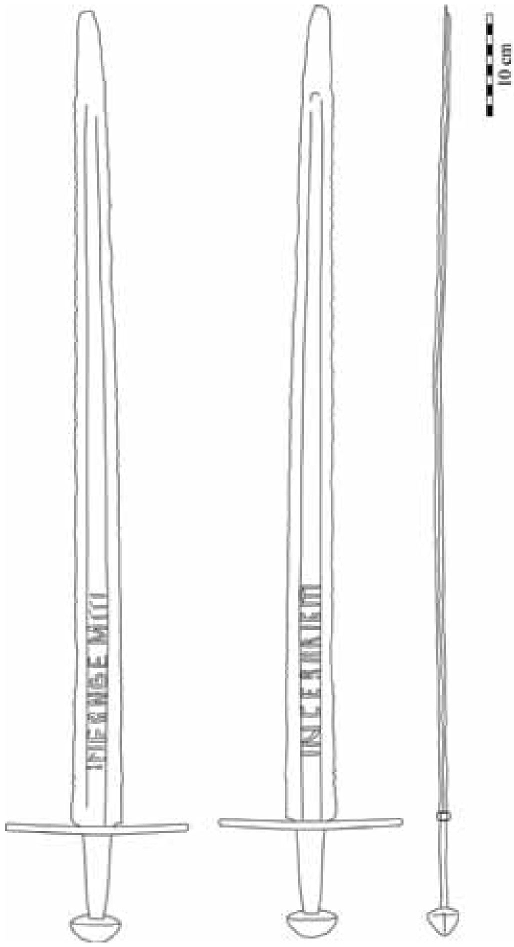
KM 2022:1 Vehmaa, Lahdinko, Huolila

A sword blade in good condition and broken into two pieces. Weight: 711 g. The fuller consists of several, differently manipulated pattern-welded bars. Each basic bar contains seven layers (four of iron and three of steel). On one side the fuller contains unspecified inlays. The material of the inlays is the same pattern-welded bar as also in the blade. On the same side of the blade, near the tip, there is a serpent-like pattern made in the same way as separate inlays. The inlays were defined by surface examination.

The blade is possibly a grave find from a cairn (KM 2022:1–13). The artefacts were sent to the predecessor of the National Museum in 1880.

Literature: Anteins 1973: 34–35, 60; Jones 2002a: 148–149; Leppäaho 1964a: 14; Leppäaho 1964b: 66–69; Moilanen 2010b: 40–41; Pellinen 2005: 181–182; Tomanterä 1984a: 341.





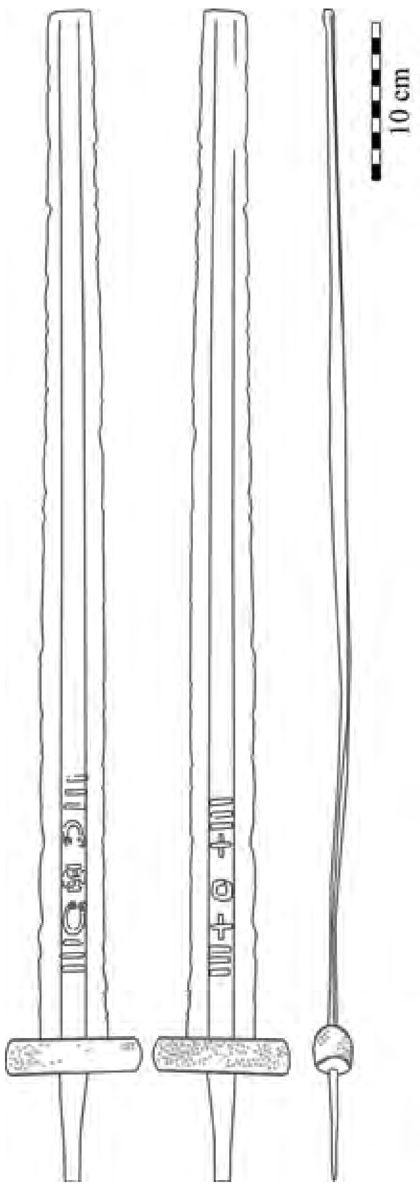
KM 2033:1 Padasjoki, Osoila, Kapakka

A complete sword in good condition. Weight: 792 g. Balance point: 190 mm. On one side the fuller is inscribed INEERIIRIEITI, and the reverse side contains the inscription INERNGEMITI. The material of the inlays contains a great deal carbon compared with the blade, since inscription INERNGEMITI has corroded away almost completely. The inlays show slight differences of colour, which could indicate some kind of pattern-welded material. The inlays were defined by surface examination and radiograph no. 3164.

The hilt belongs to Oakeshott's type B and more accurately Geibig's combination type 15.5. The parts of the hilt are of undecorated iron.

The sword belongs to a group of finds discovered on the lands of Kapakka farm in 1878 (KM 2033:1–2). The sword was given to the museum in 1880.

Literature: Kivikoski 1951: 36, Tl. 139:1086; Leppäaho 1964b: 14–15; Nordman 1924: 139; Oakeshott 1991: 54; Peirce 2002: 122–123; Päijät-Hämeen kiinteät muinaisjäännökset 2008: 261; Räty 1983: 131–133, 156, 172–173, 294, 348; Räty 1998: 43.



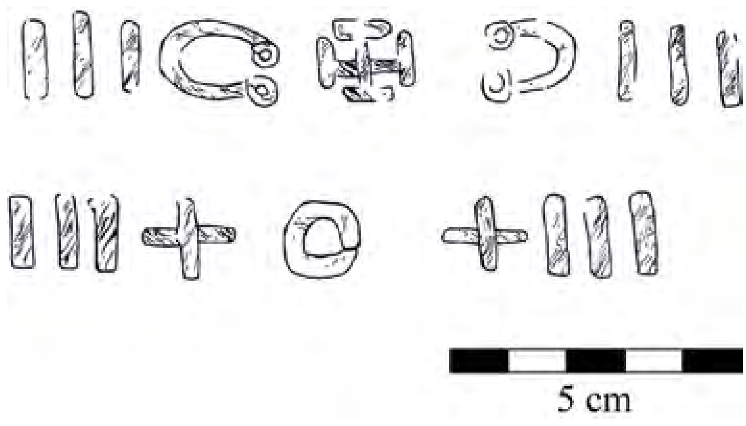
KM 2345:1 Loppi, Launoinen, Ilomäki

A fragmentary sword in fair condition and lacking its pommel, upper guard and the tip of the blade. Weight: 526 g. On one side the fuller contains a circle lined with two crosses and six vertical lines. The reverse side contains a cross potent lined with two omega-like figures and six vertical lines. The material of the inlays seems to be twisted pattern-welded rod with layers of almost similar kind of iron. The inlays were defined by surface examination and radiographs nos. 554 and 3620.

The hilt belongs to Petersen's type E. The parts of the hilt are of iron and decorated with round stamps (2–3 mm in diameter), and possibly also non-ferrous wire inlays which have subsequently been lost.

The sword belongs to a group of finds found while digging a potato field in 1884 (KM 2345:1–5), and it is possibly from a level-ground cremation cemetery. The sword was sent to the museum in 1885.

Literature: Anteins 1973: 56, 63; Kivikoski 1939: 203; Kivikoski 1951: 14, Tl. 97:776; Lang & Ager 1989: 104; Leppäaho 1964b: 24–25; Räty 1983: 56–62, 156, 252, 346.



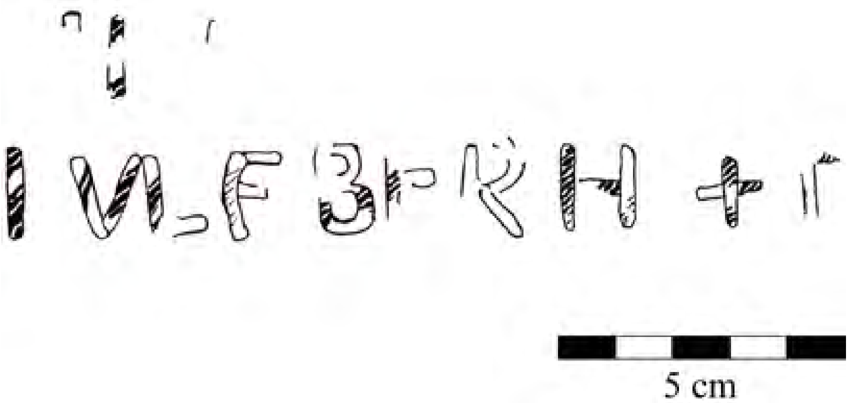
KM 2361 Eura, Vähä-Vahe

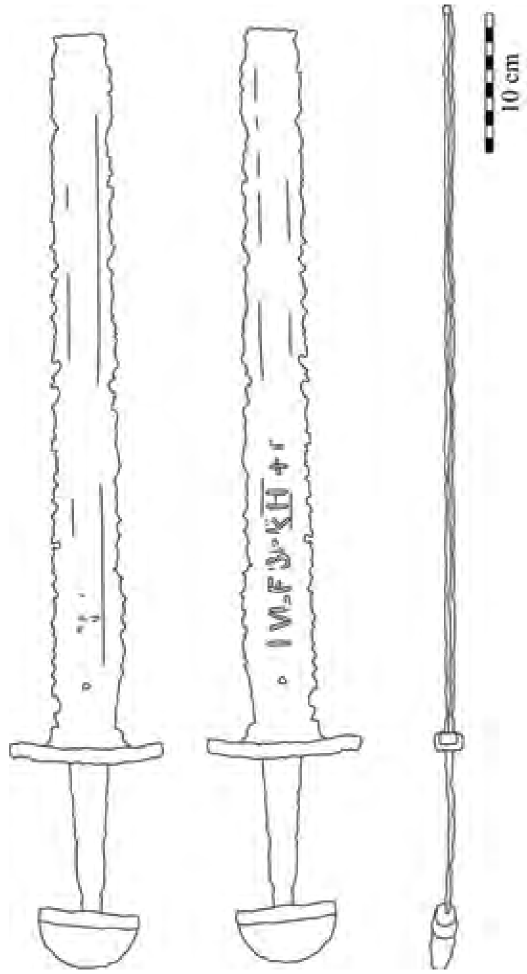
A fragmentary sword in poor condition and lacking the tip of the blade. Weight: 600 g. On one side the fuller contains the inscription I VLFBERH+T, and the reverse side has the remains of possible vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 653 and 3163.

The hilt belongs to Petersen's type N. The parts of the hilt are of undecorated iron.

The sword is a stray find discovered in 1857 beside the road from the Eura Church to the village of Kauttua.

Literature: Anteins 1973: 61; Lehtosalo-Hilander 2000b: 190; Leppäaho 1964b: 44–45; Müller-Wille 1970: 79, 87; Räty 1983: 73–74, 155, 162, 165, 262; Räty 1998: 39–40, 48; Salmo 1952: 492.





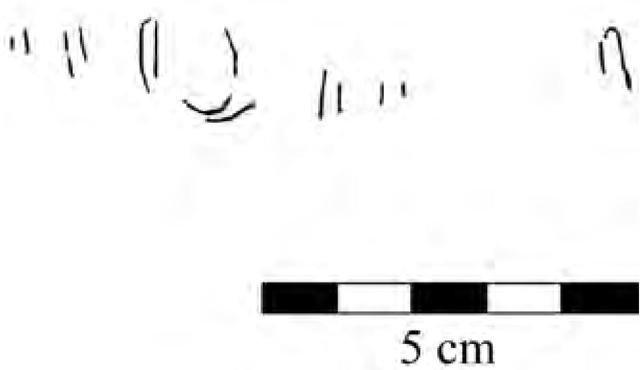
KM 2489:121 Kaukola, Koverila, Kekomäki

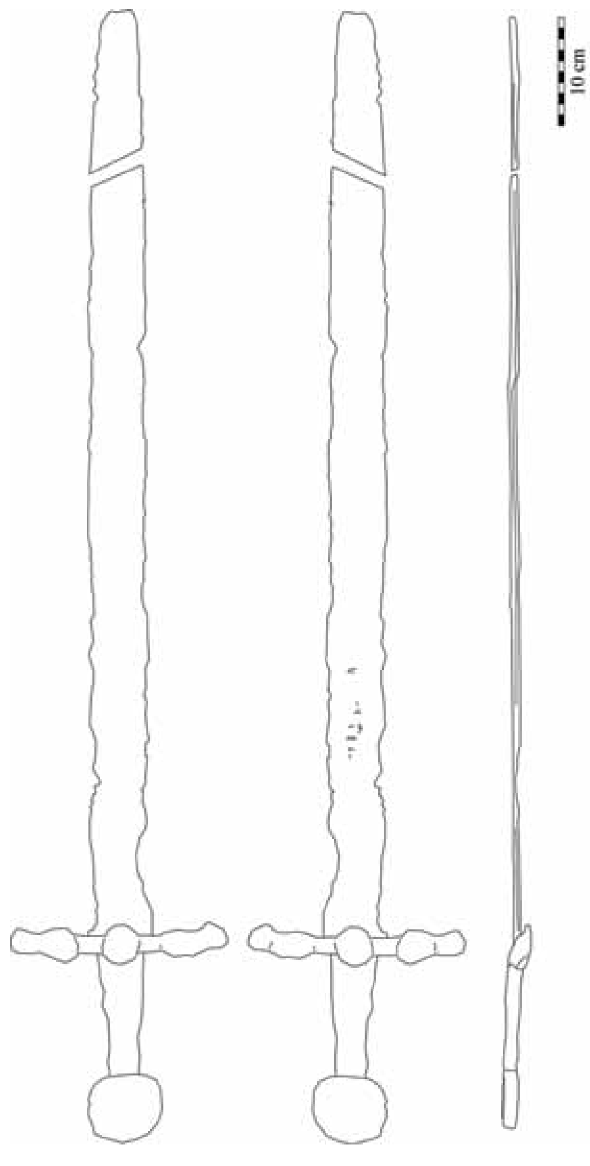
A complete sword in poor condition and broken into two pieces near the blade tip. Weight: 966 g. On one side the fuller contains possible letter-like marks. The material of the inlays is steel rod, which is mostly corroded away. The inlays were defined by surface examination and radiograph no. 3517. Other radiographs: nos. 16., 23., 24., 35. and 2911.

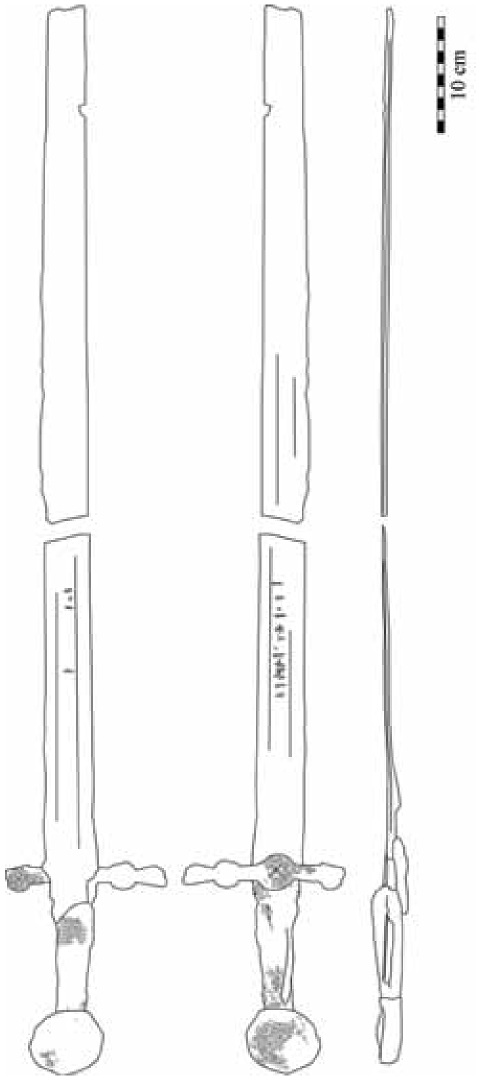
The hilt belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of iron and possibly decorated with silver wire inlays, although they are no longer visible because of corrosion.

The sword is a grave find from a cemetery, containing the inhumations of four bodies (KM 2489:1–239). The grave (no. 1) was excavated by T. Schwindt in 1886 (KM 2489:1–381).

Literature: Kirpichnikov et al. 2006: 46, 51–52, 63; Kivikoski 1951: 36; Saksa et al. 2003: 397–398; Tomanterä 1978: 26, 37–38, 58, 61, 130; Tomanterä 1980.







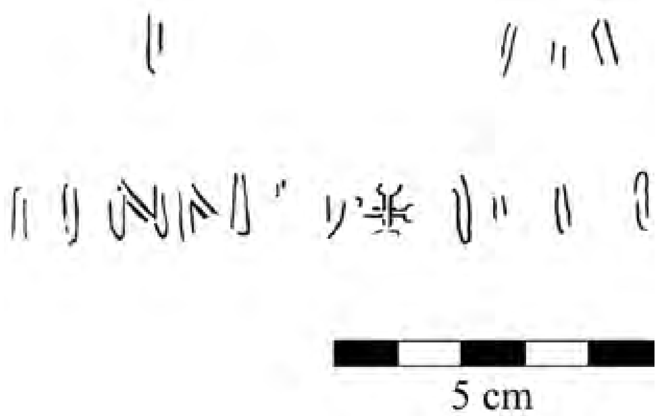
KM 2489:280–281 Kaukola, Koverila, Kekomäki

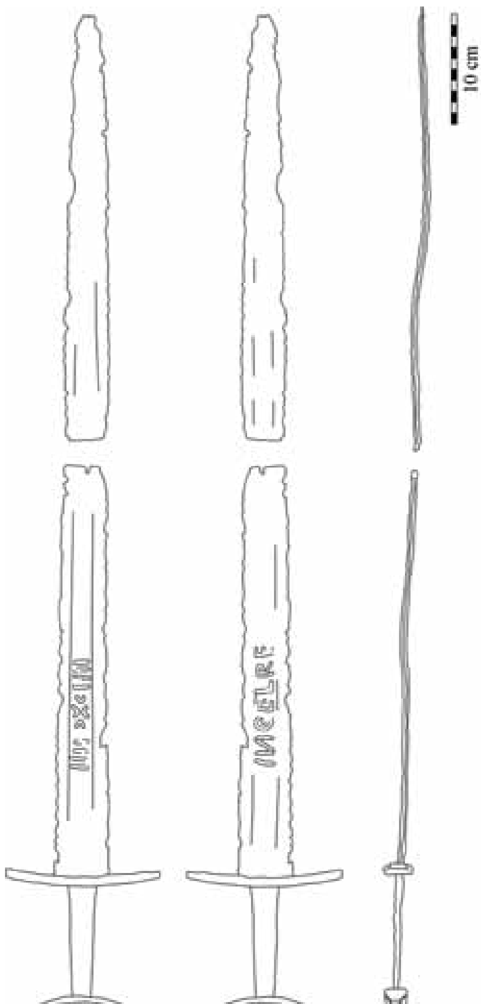
A complete sword in poor condition. Weight: 686 g. On one side the fuller contains letter-like marks and a cross crosslet. The other side is marked with fragmentary vertical lines. The material of the inlays is steel rod, because the inlays have mostly been lost through corrosion. The inlays were defined with the aid of radiographs nos. 2915 and 3524.

The hilt belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of iron and are decorated with silver wire inlays beaten onto a hatched surface (24 grooves/cm in three directions).

The sword is a grave find from an inhumation cemetery, grave no. 3 (KM 2489:277–377), containing two deceased. The grave was excavated by T. Schwindt in 1886 (KM 2489:1–381).

Literature: Kirpichnikov et al. 2006: 46, 52–53, 64; Kivikoski 1951: 36; Leppäaho 1964b: 90–91; Tomanterä 1978: 26, 38, 58, 61, 130; Tomanterä 1980.





KM 2508:124 Pudasjärvi, Kurjenkoski

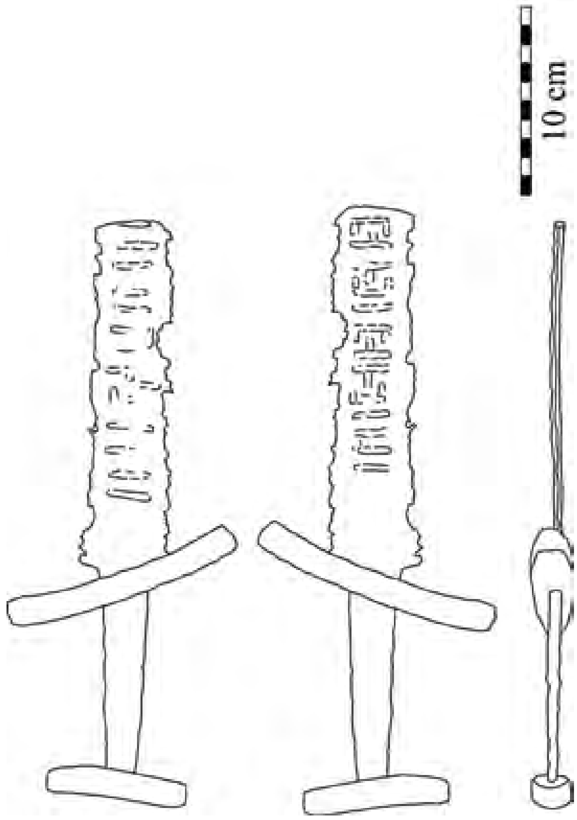
A complete sword in fair condition. Weight: 728 g. The blade is broken in the middle. On one side the fuller contains the inscription I┴GELRE, and the reverse side has a motif consisting of four arrow-like inlays and eight vertical lines. The material of the inlays seems to be iron, which shows possibly longitudinal slag inclusions or a corroded structure. In addition, the material of the inlays seems to have lower carbon content than the blade, because the blade has corroded more. The inlays were defined by surface examination. Other radiographs: no. 566.

The hilt belongs to Petersen's type Y. The parts of the hilt are of undecorated iron. The pommel has a groove to make it look like it has two parts.

The sword is a stray find and belongs to artefacts collected from Oulu parish by A. H. Snellman (KM 2508:1–131).

Literature: Huurre 1983: 365; Kivikoski 1939: 212; Kivikoski 1951: 15; Moilanen 2010a: 4; Räty 1983: 79–81, 157, 172–173, 272; Räty 1998: 42–43; Snellman 1887: 42, kuva 78.

KM 2548:196 Laitila, Rukoushuone-Kansakoulunmäki

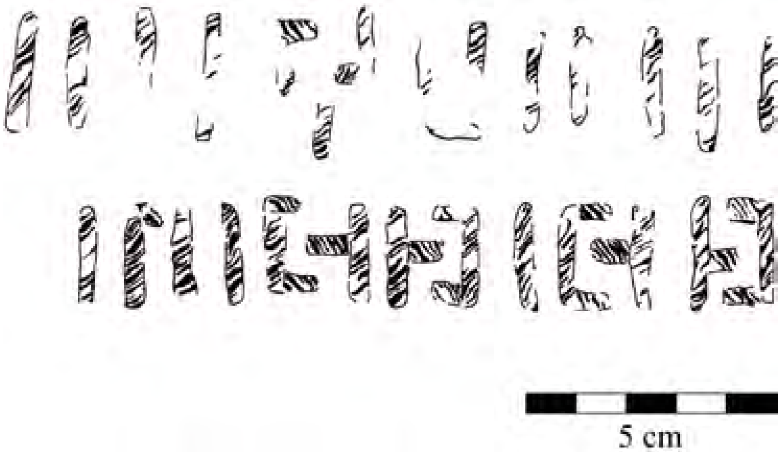


A fragmentary sword in poor condition, without the lower half of the blade. Weight: 540 g. On both sides the fuller is marked with letter-like symbols and vertical lines. The material of the inlays is twisted pattern-welded rod, which contains seven layers (four of iron and three of steel). The inlays were defined by surface examination and radiographs nos. 570 and 3168.

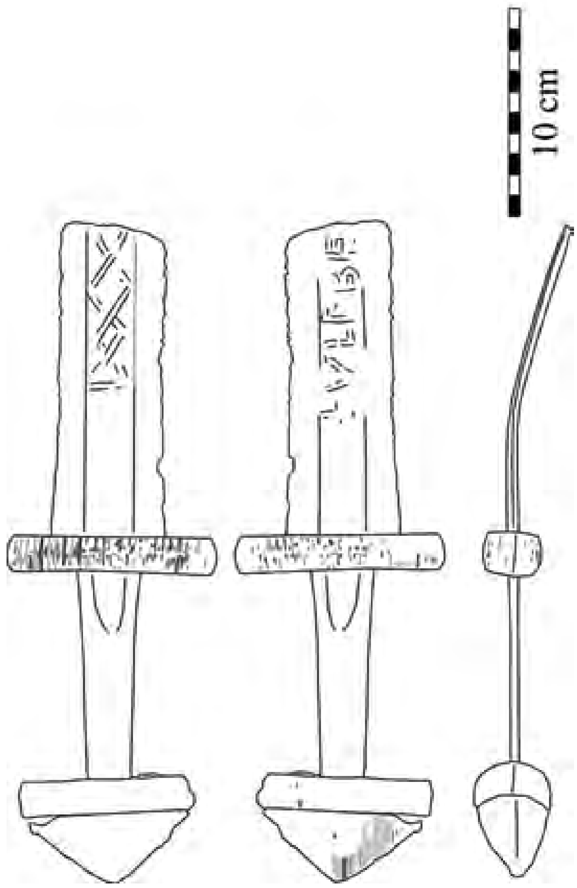
The hilt belongs to Petersen's type Q. The parts of the hilt are of undecorated iron.

The sword is a cemetery find from a level-ground cremation cemetery and excavated by T. Schwindt in 1887 (KM 2548:1–863).

Literature: Kivikoski 1951: 14, Tl. 97:774; Kivikoski 1973: 113, Tafel 95:834; Räty 1983: 50–51, 152, 162, 164, 244, 345; Räty 1998: 39–40, 48.



KM 2548:277 Laitila, Rukoushuone-Kansakoulunmäki

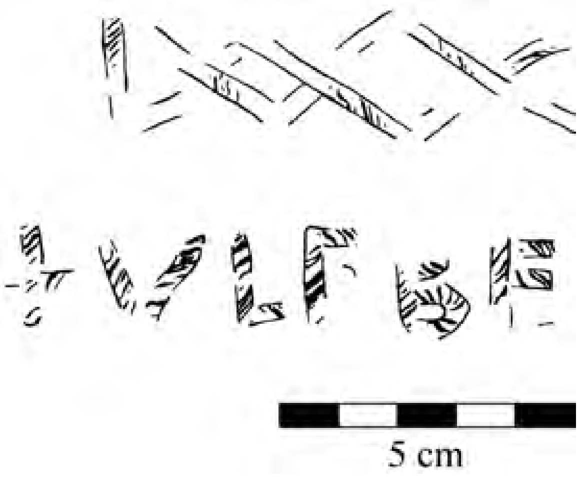


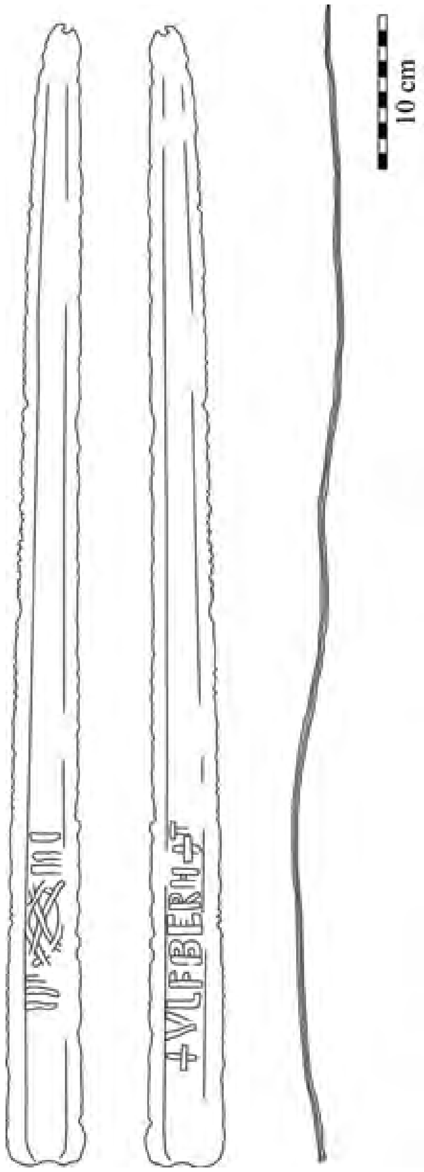
A fragmentary sword in good condition, without the lower half of the blade. Weight: 792 g. On one side the fuller contains the inscription +VLFBE, and the reverse side contains a simple lattice pattern. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3383.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with inlays of silver and bronze wires (23 wires/cm). The wires are arranged to form vertical stripes of silver (four wires) and bronze (five wires).

The sword is a cemetery find from a level-ground cremation cemetery and excavated by T. Schwindt in 1887 (KM 2548:1–863).

Literature: Räty 1983: 38–39, 152, 223.



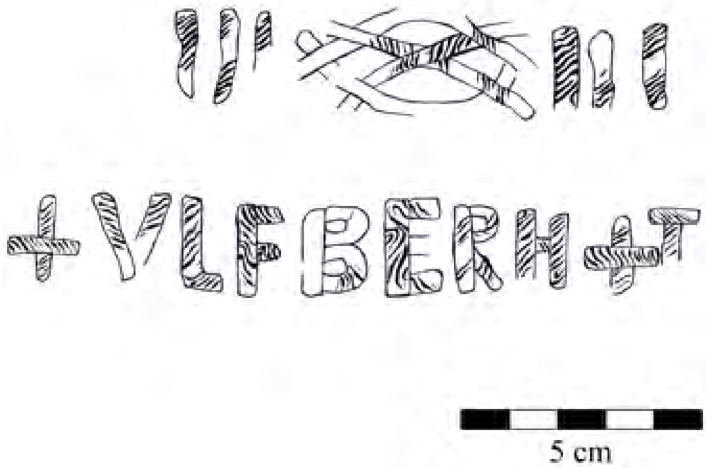


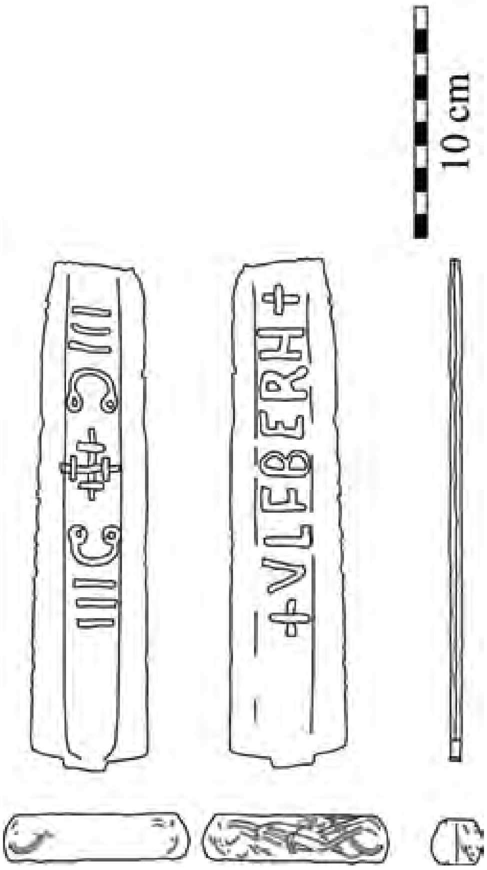
KM 2548:839 Laitila, Rukoushuone-Kansakoulunmäki

A fragmentary sword blade in fair condition and lacking the tang and the parts of the hilt. Weight: 351 g. On one side the fuller is marked with the fragmentary inscription +VLFBERH+T, and the reverse side contains woven lattice and six vertical lines. The material of the inlays is twisted pattern-welded rod, the steel layers being mostly corroded away. The inlays were defined by surface examination.

The sword is a cemetery find from a level-ground cremation cemetery. The sword was possibly found with finds KM 2548:840-843. The cemetery was excavated by T. Schwindt in 1887 (KM 2548:1–863).

Literature: Anteins 1973: 61; Leppäaho 1964b: 46–47; Moilanen 2010a: 7; Müller-Wille 1970: 79, 87; Räty 1998: 39, 41, 48; Williams 2009: 128, 153.





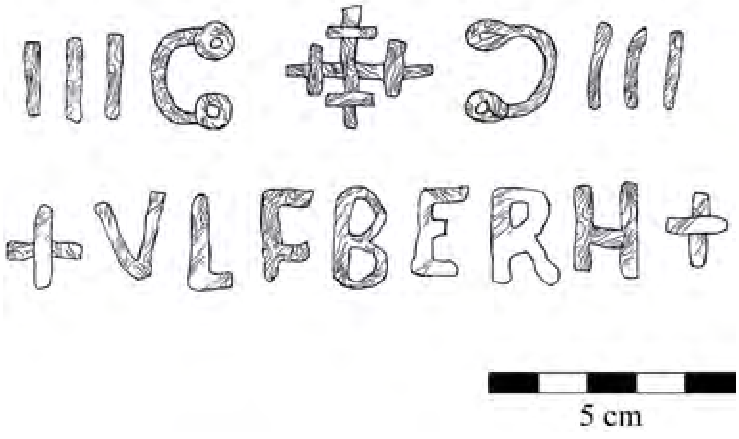
KM 2767 Valkeakoski, (formerly Sääksmäki), Rapola

A fragmentary sword in good condition. Weight: 360 g. Most of the blade is missing, as also the tang, the pommel and the upper guard. On one side the fuller bears the inscription +VLFBERH+, and the reverse side contains a cross crosslet, two volutes, and six vertical lines. The material of the inlays is twisted pattern-welded rod, which most likely contains 7–9 layers, all of which seem to be of iron. The inlays were defined by surface examination.

The lower guard belongs to the silver-plated type. The guard is made of iron, which has silver-plating decorated with engravings. Silver has been attached to a hatched surface (32 grooves/cm in two directions).

The sword is a stray find from a cattle road near Rapola Ridge in 1891.

Literature: Anteins 1973: 61; Hirviluoto 1987: 25; Hirviluoto 1992: 44; Jaakkola 1935: 200–201; Kivikoski 1939: 207; Kivikoski 1951: 15, Tl. 99:785; Kivikoski 1973: 114, Tafel 97:844; Lang & Ager 1989: 103; Lehtosalo-Hilander 1984: 361; Leppäaho 1964b: 36–37; Moilanen 2010b: 46–47; Müller-Wille 1970: 79, 81, 87; Oakeshott 2002: 8; Räty 1983: 106, 112, 156, 162, 166, 287; Räty 1998: 39, 41, 49; Salo 2005: 78; Tomanterä 1978: 66–67, 136; Tomanterä 1984a: 341; Williams 2009: 137, 175.

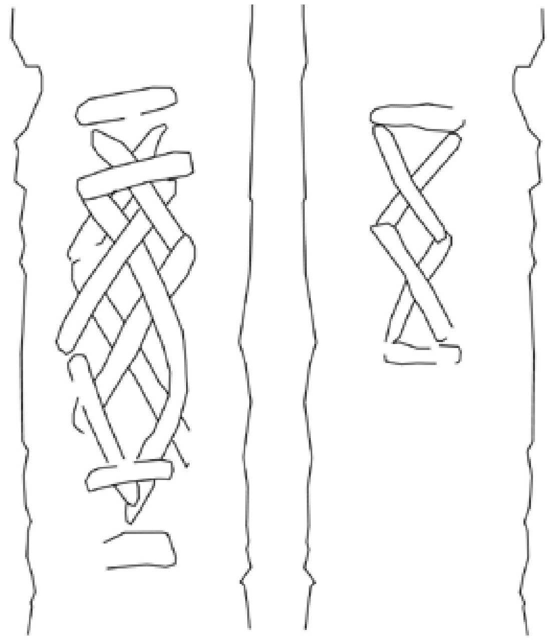


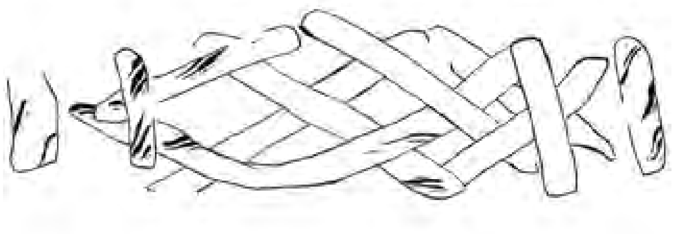
KM 2886:10 Valkeakoski (formerly Sääksmäki), Solberg

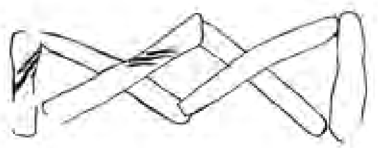
A fragmentary sword blade in poor condition. On one side the fuller contains a simple lattice, while the other side contains a woven lattice. The material of the inlays may be twisted pattern-welded rod. This sword was not documented for this work, and the drawings are based on previous publications.

The sword is a stray find from a hill known as Solberg in 1892. The sword belongs to artefacts sent to the museum by S. Wilskman in 1893 (KM 2886:1–20).

Literature: Anteins 1973: 57, 63; Leppäaho 1964: 12–13.







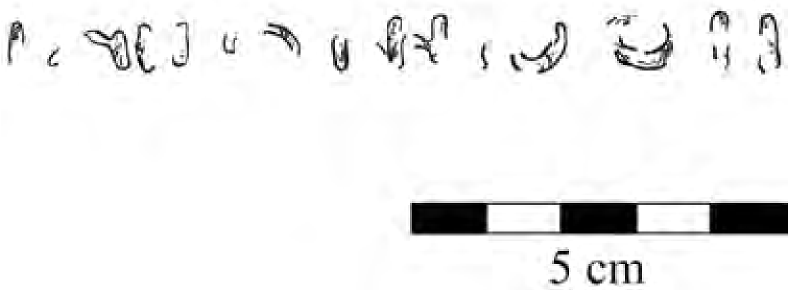
KM 2939:1 Salo, Perniö, Yliskylä

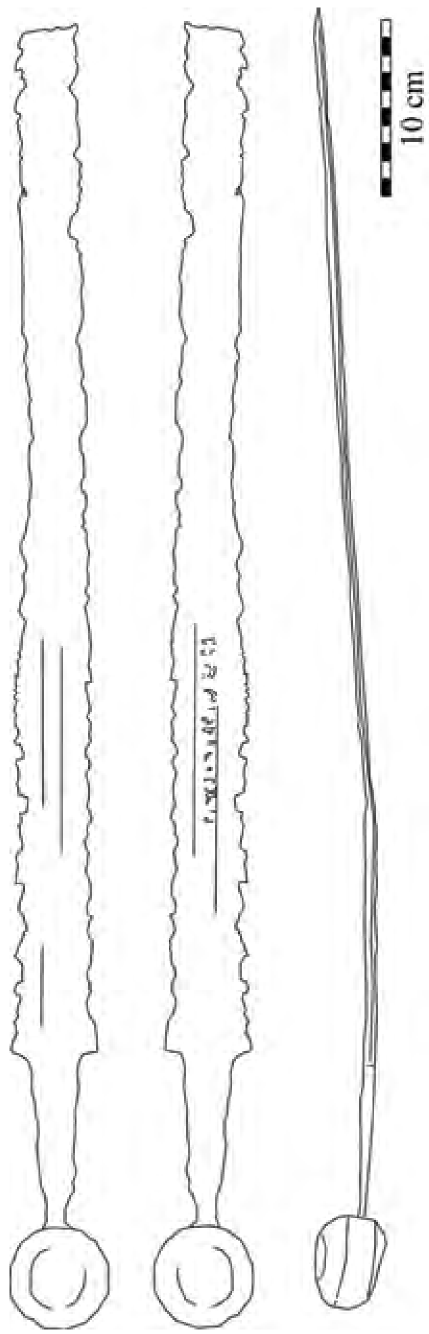
A fragmentary sword in poor condition and without the tip of the blade and the lower guard. Weight: 784 g. On one side the fuller bears fragmentary letter-like marks. The reverse side has a twisted pattern-welded rod welded lengthwise in the fuller. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3520. Other radiographs: no. L43.

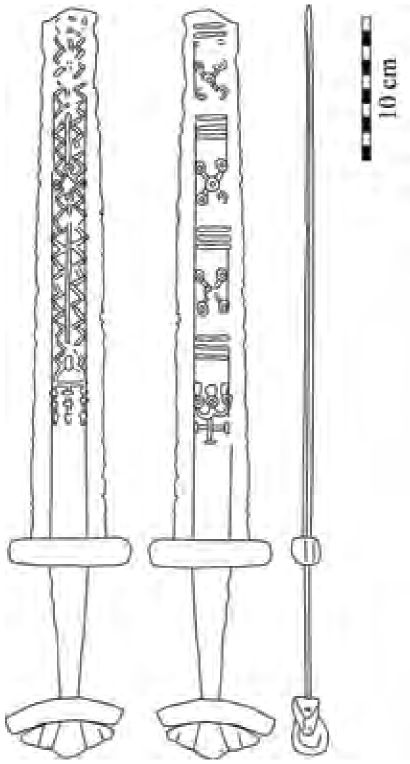
The pommel belongs to Tomanterä's type B, close to Oakeshott's type H. The pommel is of undecorated iron.

The sword is a grave find from an inhumation cemetery situated in the churchyard of the chapel of Yliskylä in 1891 (KM 2939:1–3).

Literature: Kivikoski 1951: 36; Leppäaho 1964b: 28–29; Tomanterä 1978: 36, 58, 61, 133.







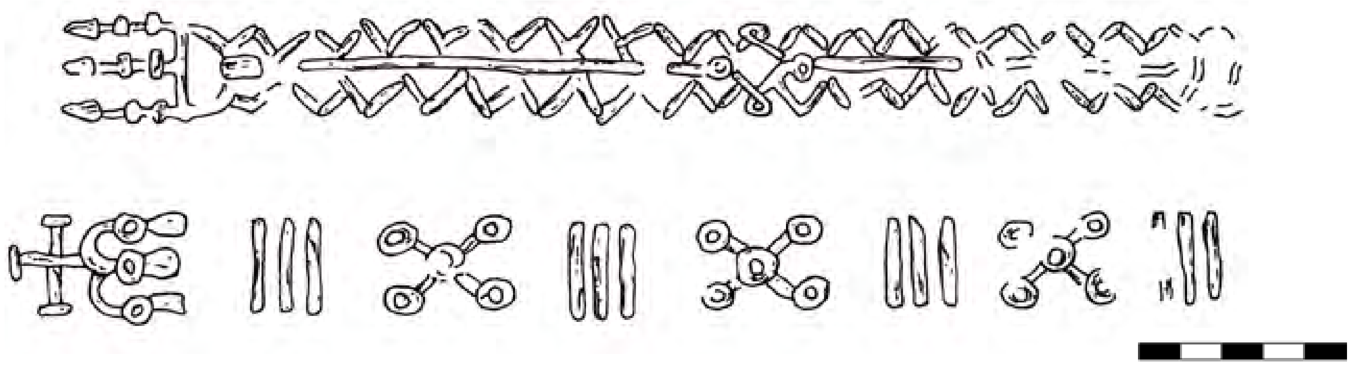
KM 2979:8 Mynämäki, Tarvainen, Junnila

A fragmentary sword fair condition. Weight: 538 g. The lower half of the blade is missing. On one side the fuller contains vertical lines and patterns resembling St. John's Arms, and the reverse side contains a lattice pattern. The inlays of both sides seem to have been continued also to the broken portion of the blade. The material of the inlays appears to be plain iron, which has corroded less than the blade. The inlays were defined by surface examination. Other radiographs: no. 560.

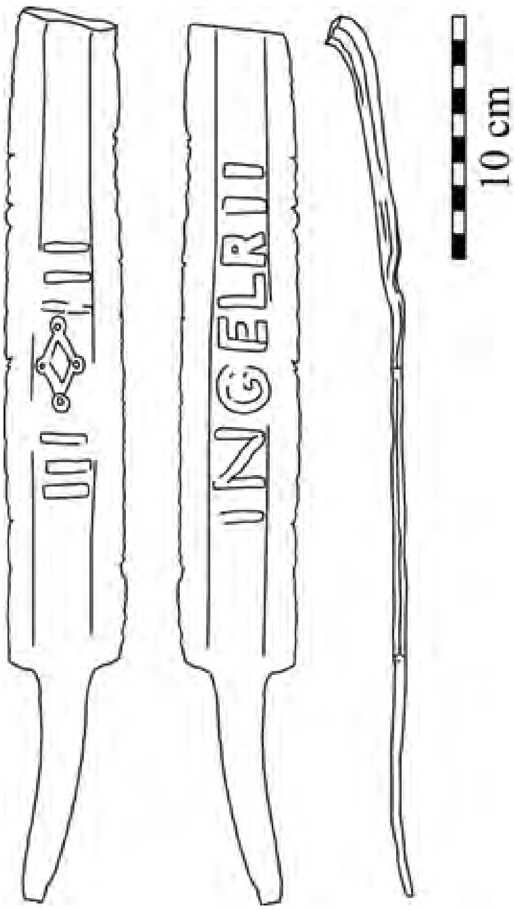
The pommel and the upper guard belong to Petersen's type Z while the lower guard is close to the silver-plated type. The parts of the hilt are iron, and the pommel and the upper guard bear traces of silver-plating.

The sword is a stray find from a hillside on the lands of Junnila farm. It belongs to a group of artefacts collected in 1894 by K. A. Bomansson (KM 2979:1–27).

Literature: Kivikoski 1951: 15, Tl. 99:782; Leppäaho 1964b: 26–27; Moilanen 2010a: 8; Räty 1983: 56–62, 82–87, 152, 177–178, 249, 273; Tomanterä 1978: 53–54.



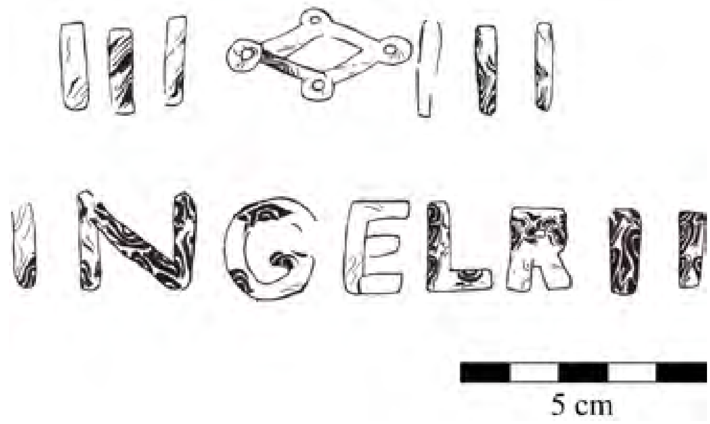
KM 2986:4 Tampere, Messukylä, Takahurri, Kä



A fragmentary sword in fair condition, lacking the lower half of the blade and the parts of the hilt. Weight: 333 g. The blade is laminated from seven layers of alternating iron and steel so that the surface of the blade is steel. On one side the fuller bears the inscription INGELRII, and the reverse side contains six vertical lines and a pattern resembling St. John's Arms. The material of the inlays appears to be twisted pattern-welded rod, which contains 9–11 layers. The number of steel layers seems to be greater, because most of the inlays have corroded away. The inlays were defined by surface examination.

The sword is a stray find from the yard of Kässä farm and belongs to artefacts collected from Tampere by S. Wilskman in 1894 (KM 2986:1–6).

Literature: Anteins 1973: 46, 62; Hirviluoto 1992: 45; Leppäaho 1964b: 34–35; Moilanen 2010a: 4, 6–7; Räty 1978; Räty 1983: 172–173; Räty 1998: 43; Salmo 1952: 104, 493.



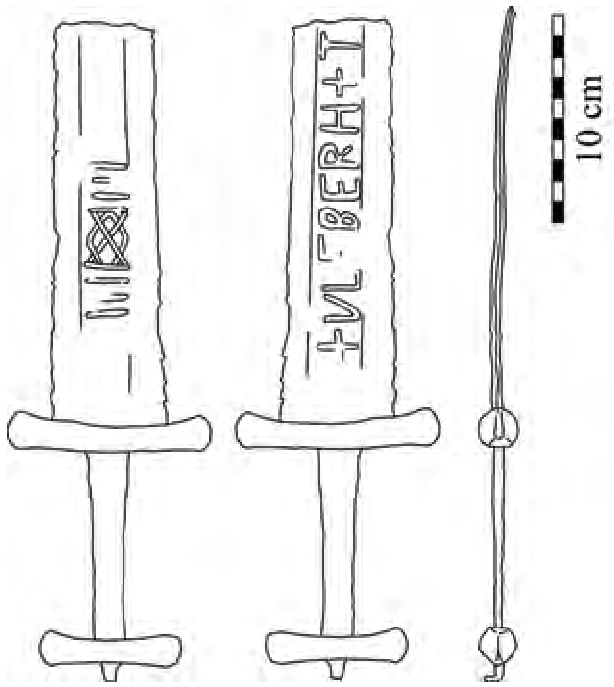
KM 3052:2 Mynämäki, Raimela, Savu

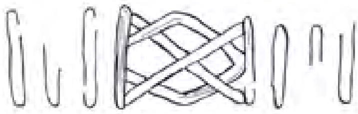
A fragmentary sword in poor condition, without the lower half of the blade and the pommel. Weight: 420 g. On one side the fuller bears the inscription +VLFBERH+T, and the reverse side contains six vertical lines and a woven lattice. The material of the inlays seems to be non-twisted pattern-welded rod, which contains 3–5 layers. The carbon content of these layers cannot be defined, but layers seem to have less carbon than the blade. The inlays were defined by surface examination and radiograph no. 569.

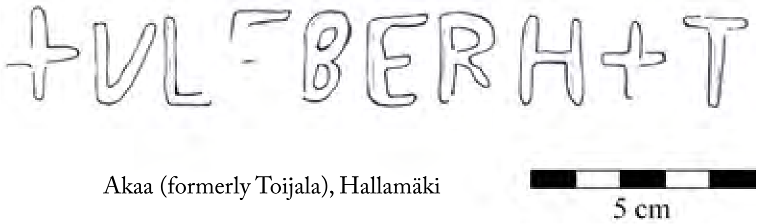
The hilt belongs to Petersen's type R. The parts of the hilt are of iron and bear traces of silver-plating on a hatched surface (28 grooves/cm in one direction).

The sword is a stray find from the lands of Savu farm. The sword was sent to the museum some 30 years after it was found, and belongs to a shipment of artefacts received in 1895 (KM 3052:1–11).

Literature: Anteins 1973: 61; Leppäaho 1964b: 40–41; Müller-Wille 1970: 79, 87; Räty 1983: 54–55, 152, 162, 164, 245–246; Räty 1998: 39–40, 49.







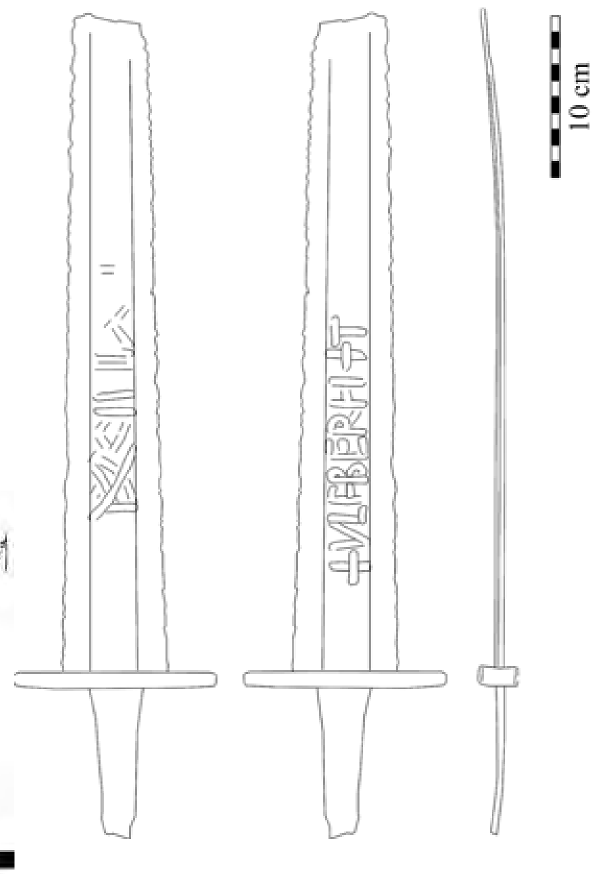
KM 3131:6 Akaa (formerly Toijala), Hallamäki

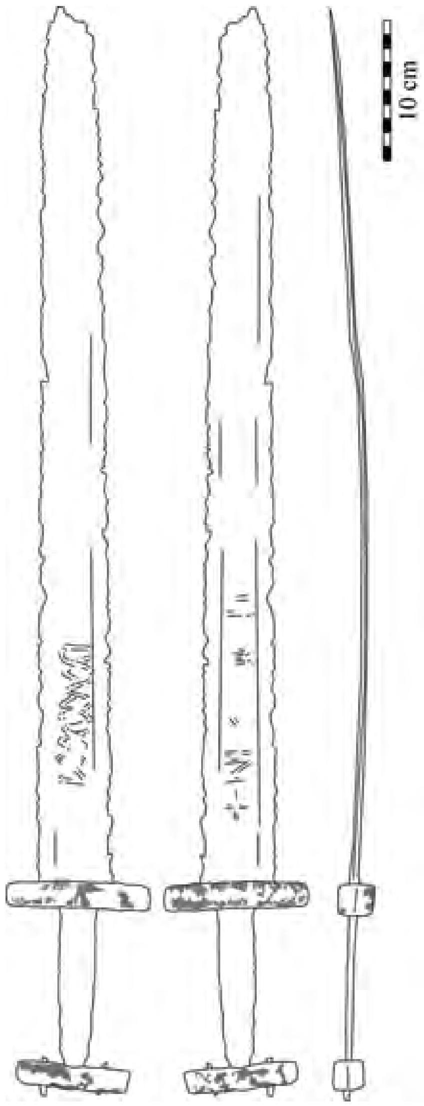
A fragmentary sword in fair condition and without the pommel and the lower half of the blade. Weight: 720 g. On one side the fuller is marked with the inscription +VLFBERH+T, and the reverse side contains remains of two woven lattices with two vertical lines between them. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3852.

The lower guard possibly belongs to Petersen's type X and Geibig's combination types number 8 or 12.1. The lower guard is undecorated iron.

The sword belongs to finds made in 1896 during construction work (KM 3131:1–6).

Literature: Räty 1983: 75–76, 156, 158, 266.





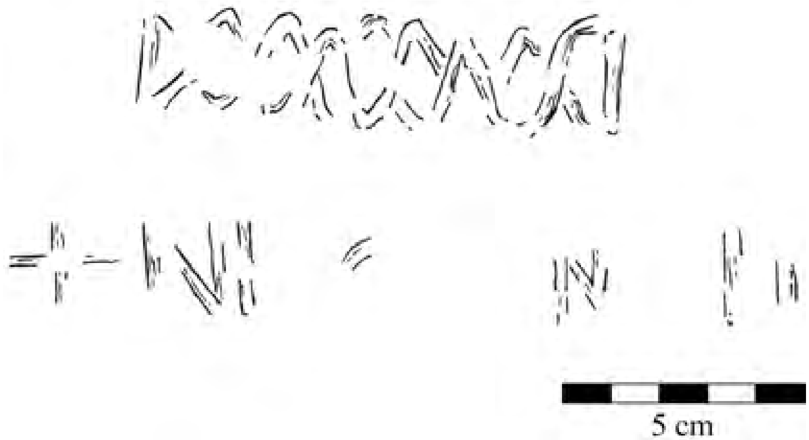
KM 3301:1 Valkeakoski, Sääksmäki, Rupakallio

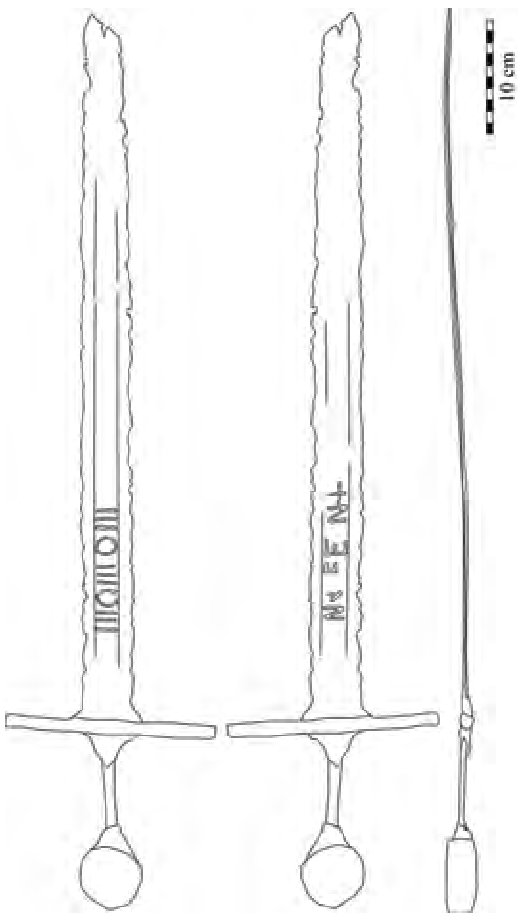
A fragmentary sword in good condition with the tip of the blade and the pommel missing. Weight: 822 g. On one side the fuller contains a cross and fragmentary letter-like marks. The reverse side contains a lattice weave. The material of the inlays is iron rod, which has corroded less than the material of the blade. The inlays were defined by surface examination and radiograph no. 3619. Other radiographs: no. 675 and 1267.

The hilt belongs to Petersen's type V. Both guards are of iron and decorated with inlays from silver and bronze wires (22 wires/cm).

The sword is a stray find from the field of Rupakallio farm, possibly from a level-ground cremation cemetery. The sword belongs to artefacts collected and sent to the museum by K. A. Pettersson in 1896 (KM 3301:1–3).

Literature: Hirviluoto 1992: 45; Räty 1983: 43–44, 156, 177–178, 239.





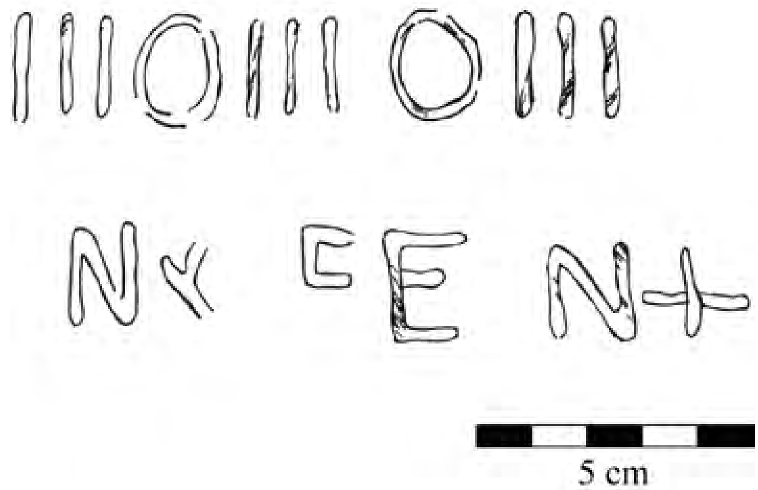
KM 3316:13 Salo, Halikko, Lampola

A fragmentary sword in fair condition and lacking the tip of the blade. Weight: 950 g. On one side the fuller contains the fragmentary inscription NX FE N+, and the reverse side contains nine vertical lines and two circles. The material of the inlays seems to be twisted pattern-welded rod, which has corroded away in most parts. The inlays were defined by surface examination and radiograph no. 3525. Other radiographs: no. K8.

The sword belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of undecorated iron.

The sword is possibly a grave find from a mound in 1896 together with a bronze finger-ring (KM 3316:13–14). The sword belongs to a group of artefacts (KM 3316:1–17), from which finds 13-15 and 17 are found from Halikko.

Literature: Anteins 1973: 59, 62; Kivikoski 1951: 36; Leppäaho 1964b: 28–29; Mikkola 1999: 43; Tomanterä 1978: 39, 61, 129.



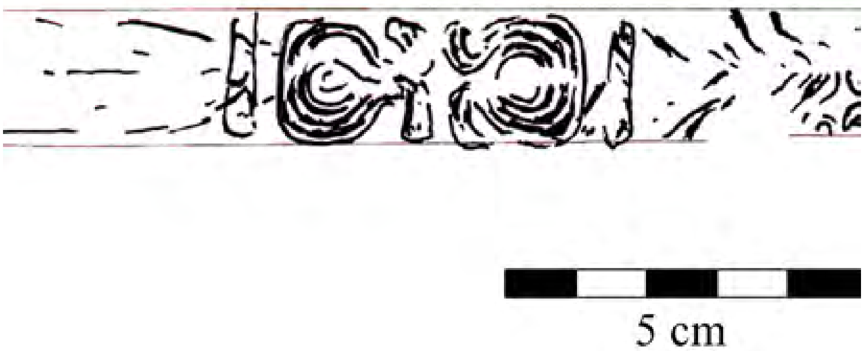
KM 3336:31 Uusikaupunki, Kalanti, Hallu, Pietilä

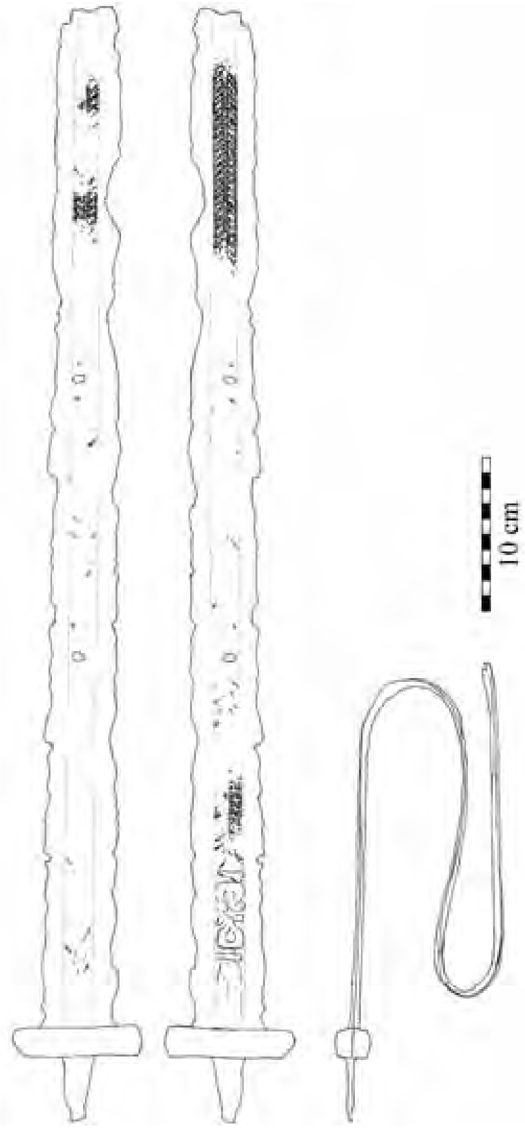
A fragmentary sword in poor condition, without the lower half of the blade, the upper guard and the pommel. Weight: 474 g. The blade is strongly bent to resemble letter S. The fuller consists of two or most likely four twisted, pattern-welded bars. Each bar contains seven layers (four of iron and three of steel). On one side the fuller contains two volutes and two vertical lines. The material of the inlays is non-twisted pattern-welded rod, which most likely contains seven layers (four of iron and three of steel) like the ones also used in the blade. The inlays were defined by surface examination and radiograph no. 607.

The lower guard is in very poor condition but it possibly belongs to Petersen's type B. The guard is iron and does not show any signs of decoration.

The sword is a cemetery find from a level-ground cremation cemetery on the lands of Pietilä farm, which was excavated by T. Schvindt in 1896 (KM 3336:1–210).

Literature: Räty 1983: 18–19, 152, 159, 182, 198.





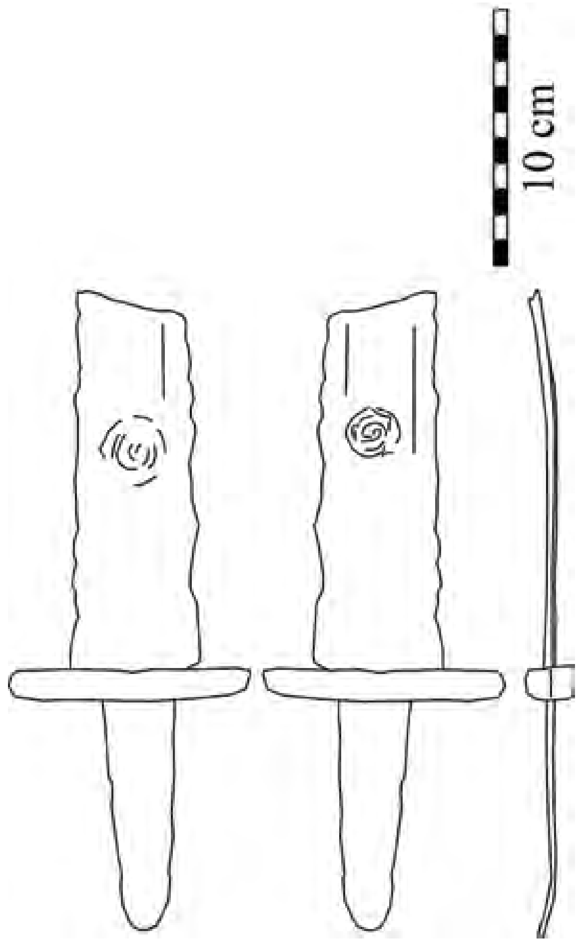
KM 3383:2 Padasjoki, Nyystölä, Tylppölä

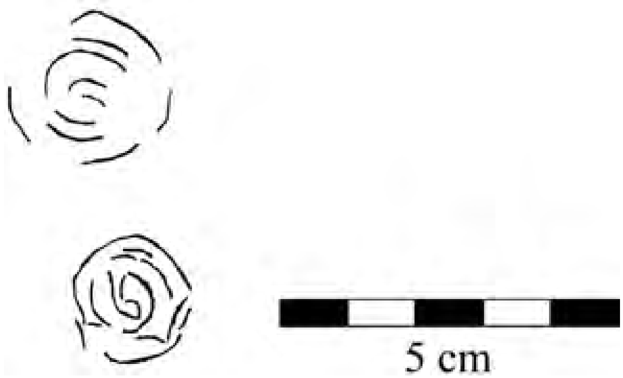
A fragmentary sword in poor condition lacking the pommel and the lower half of the blade. Weight: 226 g. On both sides the fuller contains spiral-like figures. The material of the inlays has higher carbon content than the surface of the blade, because the inlays have corroded away. The inlays were defined by surface examination. Radiographs: no. 662 and 3529.

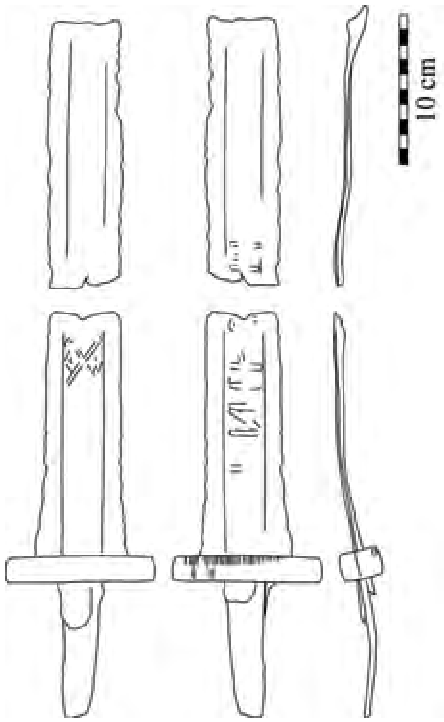
The type of the hilt cannot be defined. The lower guard is undecorated iron.

The sword is a stray find from the floor of a cowshed in 1895, and was sent to the museum in 1897 together with finds KM 3383:1–6.

Literature: Leppäaho 1964b: 22–23; Räty 1983: 43–44, 156, 182, 239.







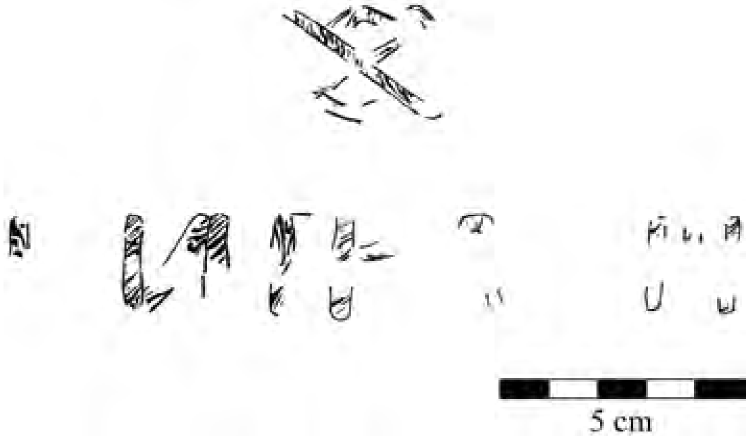
KM 3423 Vesilahti, Kirmukarmu

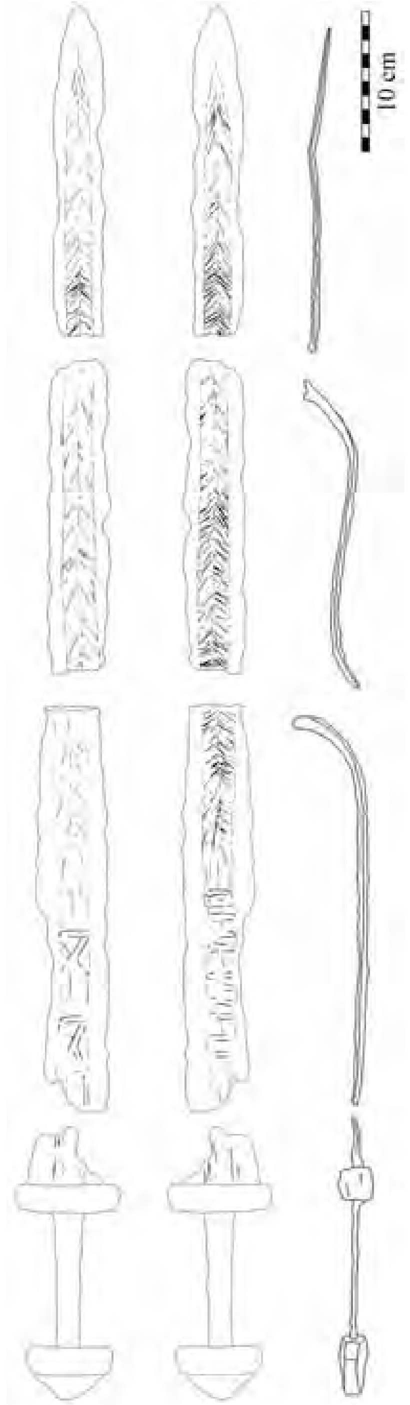
A fragmentary sword in poor condition and broken into two pieces. The lower half of the blade and the pommel and the upper guard are missing. The fragment of the lower half of the blade pictured below is find KM 3451:4. Weight: 492 g. On one side the fuller is marked with the fragmentary inscription I VI FP R III, and the reverse side contains fragments of a woven lattice. The material of the inlays is twisted pattern-welded rod, which contains seven layers (four of steel and three of iron). The inlays were defined by surface examination and radiograph no. 3522. Other radiographs: no. 571 and 1033.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical wire inlays (22 wires/cm).

The sword is a stray find from a level-ground cremation cemetery. The sword was sent to the museum in 1897. The lower half of the blade (KM 3451:4) belongs to a group of finds (KM 3451:1–7), which was brought to the predecessor of the National Museum by A. O. Heikel and H. J. Heikel in 1897 along with other finds from Vesilahti (KM 3451:1–22).

Literature: Honka-Hallila 1984: 57; Räty 1983: 43–44, 155, 179, 237; Salmo 1938: 68, 339–340; Salmo 1952: 113, 474–475.





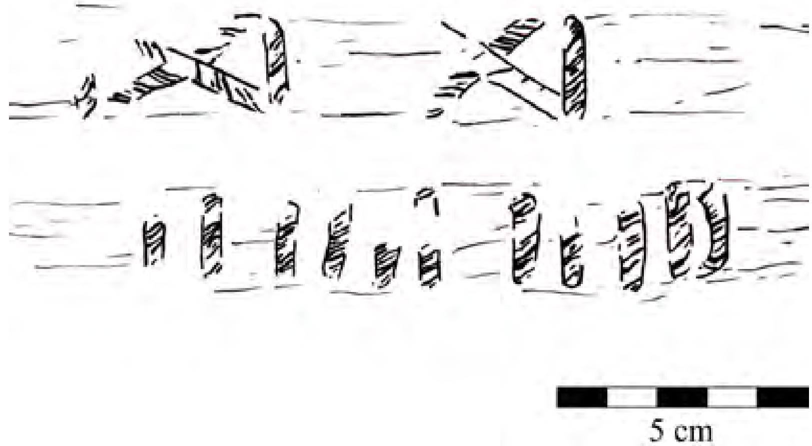
KM 3575:1 Laitila, Kodjala, Raulo, Ristenkömppä

A complete sword in poor condition, broken into four pieces. Weight: 1,040 g. The fuller consists of two or four twisted, pattern-welded bars, which are twisted in same directions on the opposite sides of the blade. The pattern remains untwisted under the inlays. On one side the fuller contains vertical lines and letter-like marks. The reverse side contains two fragmentary lattices. The material of the inlays is twisted pattern-welded rod. The inlays and the pattern-welding of the blade were defined with the aid of radiographs nos. 2987 and 3384.

The hilt belongs to Petersen's type B. The parts of the hilt are of undecorated iron.

The sword belongs to a group of finds from the lands of Raulo farm, Ristenkömppä hill (KM 3575:1–3), probably from a burial cairn. This group of finds was sent to the museum in 1898.

Literature: Räty 1983: 18–19, 152, 158–159, 199; Salmo 1938: 10, 246, 340, Tafel XIII:2.

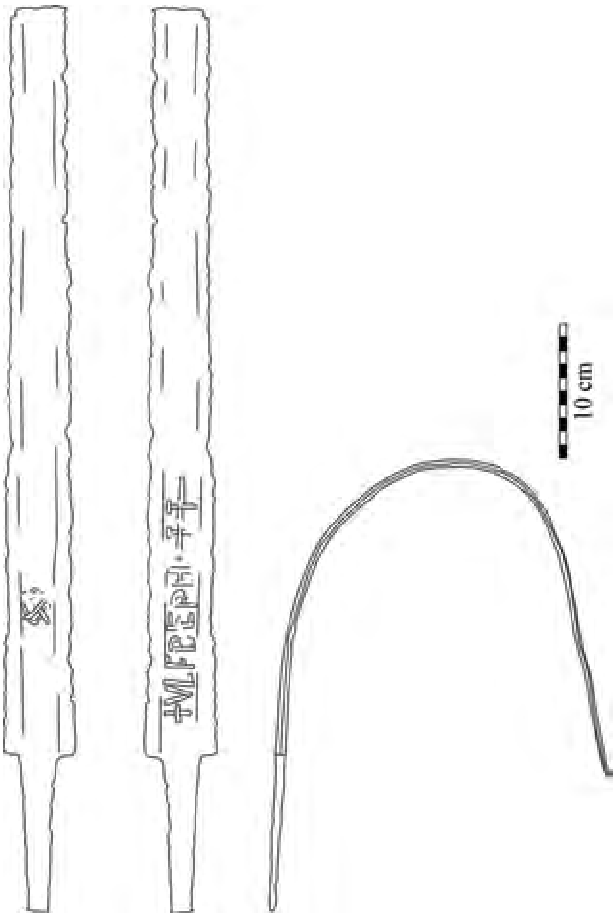


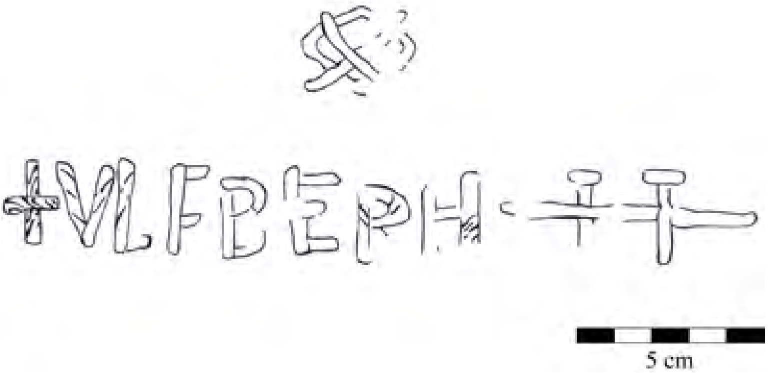
KM 3601:2 Hollola, Nokkola, Taka-Tommola

A fragmentary sword in poor condition, lacking the tip of the blade and the parts of the hilt. Weight: 523 g. The blade is strongly bent to resemble letter U. On one side the fuller contains the inscription +VLFBERH++, and the reverse side contains a woven lattice. The material of the inlays seems to be twisted pattern-welded rod. The inlays have been corroded away in most parts, and accordingly they must contain a greater amount of steel compared with the blade. The inlays were defined by surface examination.

The sword is a stray find along with another sword from 1898 from the field of Taka-Tommola farm (KM 3601:1–2), possibly from a level-ground cremation cemetery.

Literature: Anteins 1973: 61; Lahelma 2002: 25; Leppäaho 1964b: 46–47; Müller-Wille 1970: 79, 87; Päijät-Hämeen kiinteät muinaisjäännökset 2008: 140; Räty 1983: 162; Räty 1998: 39, 41, 48; Williams 2009: 135, 171.





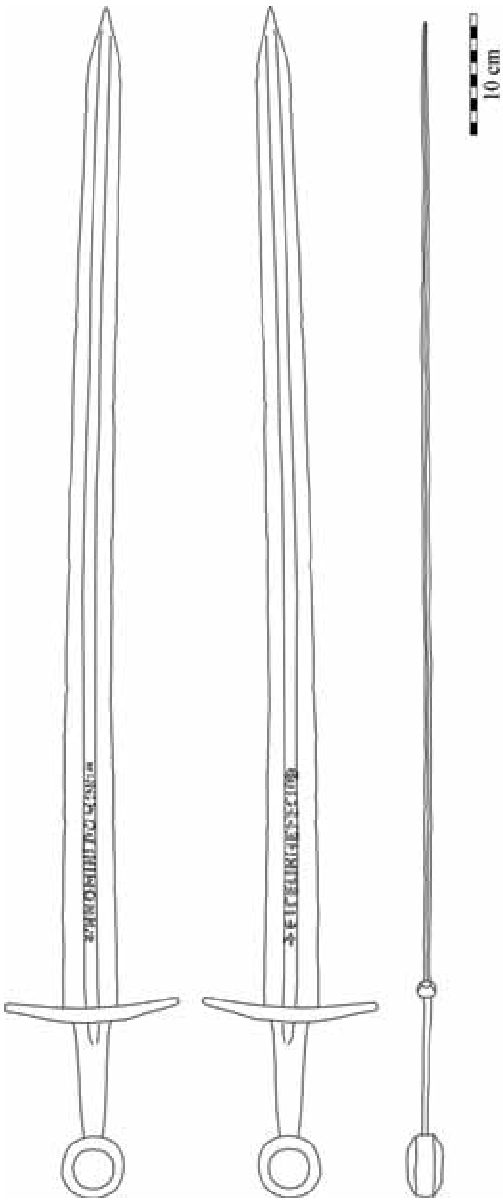
KM 3631:1 Rovaniemi, Marikkovaara

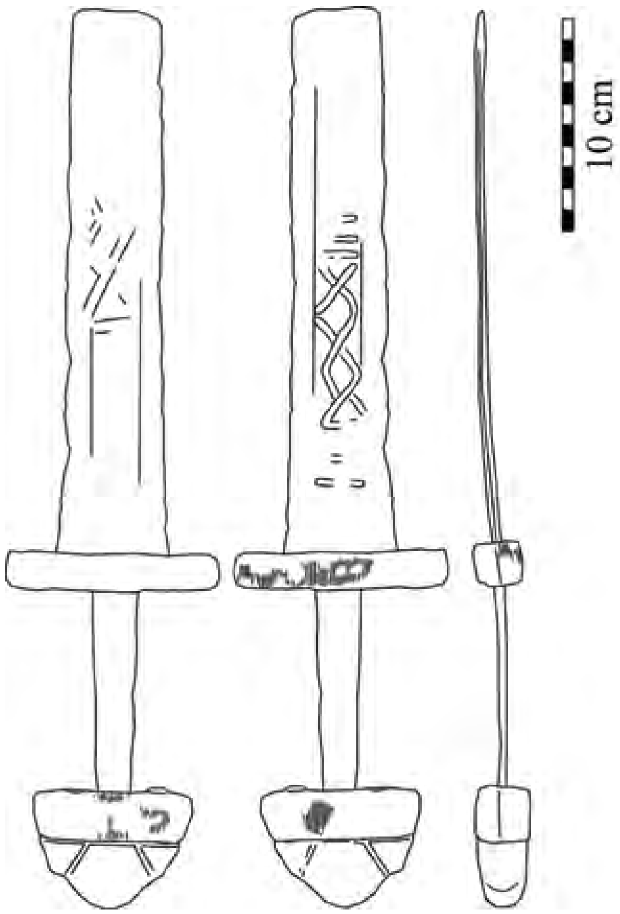
A complete sword in good condition. Weight: 1,123 g. Balance point: 115 mm. On one side the fuller contains the inscription +INNOMINEDOMINI+, and the reverse side contains the inscription +GICELINMEFECIT+. The material of the inlays seems to be steel rod, which has corroded away in most parts. The inlays were defined by surface examination.

The pommel belongs to Tomanterä's type B, close to Oakeshott's type H. The parts of the hilt are of undecorated iron.

The sword belongs to a group of artefacts recovered under small rocks almost on the surface of the earth (KM 3631:1–4). The sword was sent to the museum in 1898.

Literature: Huurre 1983: 365–366; Kivikoski 1951: 36, Tl. 139:1089; Kivikoski 1973: 143, Tafel 131:1167; Leppäaho 1964b: 58–59; Moilanen 2010a: 8–9; Moilanen 2010b: 52–53, 57; Oakeshott 1991: 57–58; Peirce 2002: 134–135; Pälikkö 2006; Sarvas 1973; Tomanterä 1978: 26–27, 31, 58, 61, 133; Tomanterä 1984a: 340.





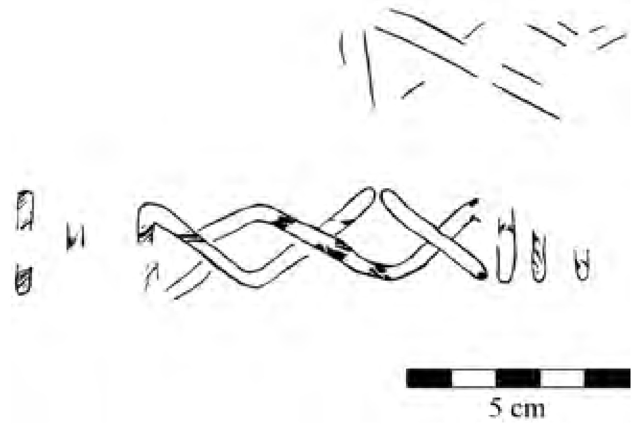
KM 3699:3 Nousiainen, Kärmälä, Mikkola

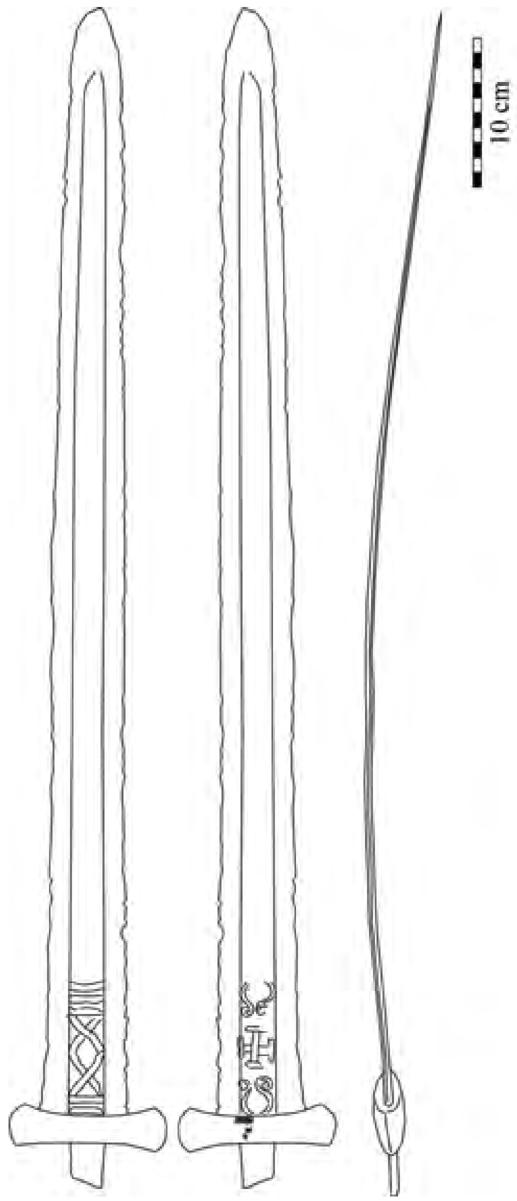
A fragmentary sword in good condition and without the lower half of the blade. Weight: 636 g. On both sides the fuller contains lattice patterns. The material of the inlays seems to be twisted pattern-welded rod, of which layers contain more carbon than the surface of the blade. The inlays were defined by surface examination. Radiographs: no. 3527.

The hilt belongs to Petersen's type T2. The parts of the hilt are decorated with silver and brass wires (29 wires/cm).

The sword is a stray find among charcoal in the north side of Mikkola main building (KM 3699:1–9), possibly from a level-ground cremation cemetery. The sword was sold to the museum in 1899.

Literature: Kivikoski 1951: 14; Leppäaho 1964b: 44–45; Räty 1983: 64–66, 152, 253.





KM 4254 Lempäälä, Haurala, Henneri

A fragmentary sword in good condition and without its pommel and upper guard. Weight: 918 g. On one side the fuller contains two volutes and a cross crosslet, and the reverse side contains a simple woven lattice and vertical lines. The material of the inlays is both twisted and straight pattern-welded rod, which contains possibly 3–5 layers. The inlays were defined by surface examination. Radiographs: no. 3534.

The lower guard belongs to Petersen's type S. The guard is iron and bears traces of a hatched surface (25 grooves/cm in three directions).

The sword is a stray find from the yard of Henneri farm, possibly from a burial cairn. The sword was sent to the museum in 1903.

Literature: Anteins 1973: 56, 62; Honka-Hallila 1984: 43; Kivikoski 1951: 14; Leppäaho 1964b: 22–23; Moilanen 2010a: 8–9; Räty 1983: 54–55, 155, 248; Salmo 1952: 125, 492.

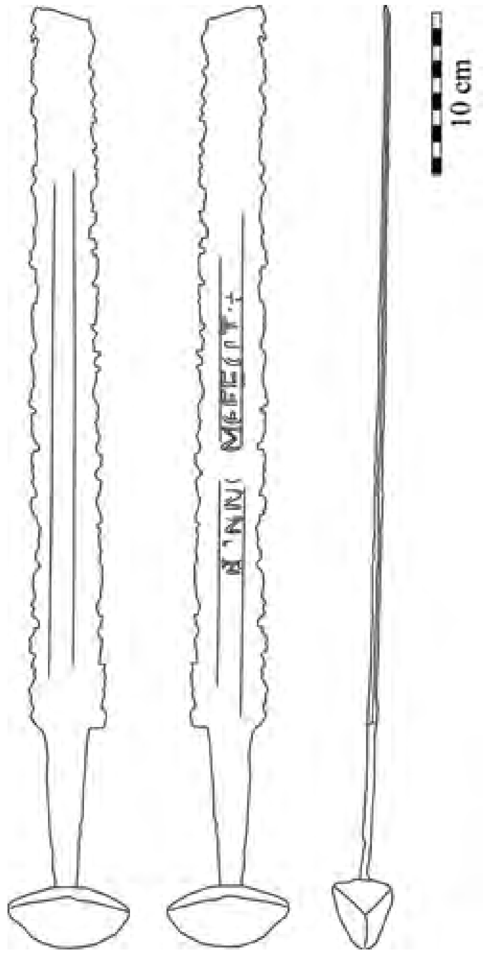
KM 4429:14 Turku, Maaria, Saramäki, Marttila

A fragmentary sword in poor condition and without the lower half of the blade and the lower guard. Weight: 550 g. On one side the fuller is marked with the fragmentary inscription +INNOMEFECIT. The material of the inlays seems to be steel. The inlays were defined by surface examination. Radiographs: no. 2988.

The pommel belongs to Oakeshott's type A, and more accurately to Geibig's type 16.1. The brazil-nut shaped pommel is undecorated iron.

The sword is a cemetery find from a combined level-ground cremation cemetery and inhumation cemetery on the lands of Marttila farm, more likely originating from an inhumation grave. Sword belongs to artefacts collected by J. Rinne in 1908 (KM 4429:1–19).

Literature: Anteins 1973: 49, 62; Kivikoski 1939: 17, 210, Tl. 37:4; Kivikoski 1951: 36; Leppäaho 1964b: 16–17; Moilanen 2010b: 57; Räty 1983: 131–133, 153, 176, 291, 349; Räty 1998: 44–45.



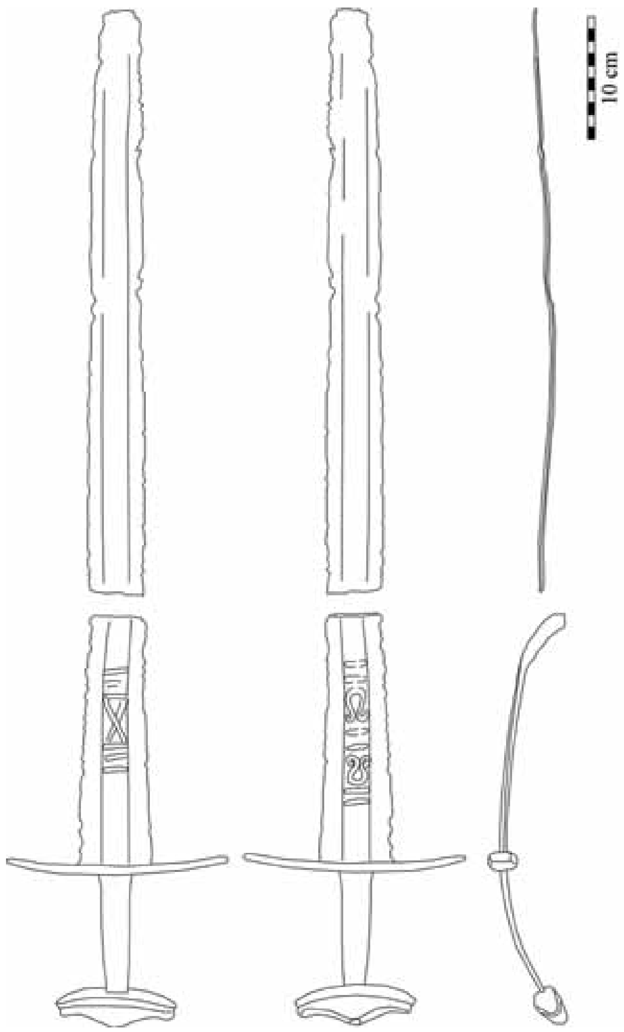
KM 4566:12 Turku, Maaria, Saramäki, Marttila

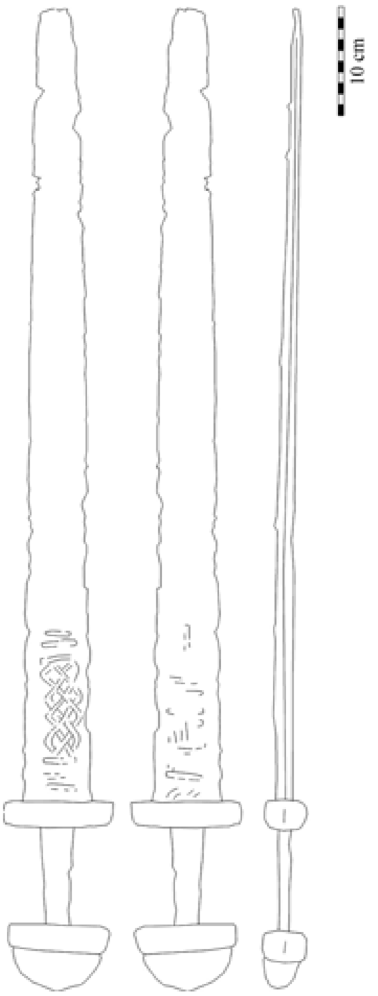
A fragmentary sword in good condition. The lower half of the blade is broken into a separate piece (KM 7275:1). Weight: 844 g. On one side the fuller contains two volutes and vertical lines, and the reverse side contains a lattice and vertical lines. The material of the inlays seems to be both non-twisted and twisted pattern-welded rod, which contains three layers (one of iron and two of steel). The inlays were defined by surface examination. Radiographs: no. 573.

The hilt belongs to Petersen's type Y. The parts of the hilt are of undecorated iron. The pommel has a groove to make it look like it has two parts.

The sword is a cemetery find from a level-ground cremation cemetery excavated by J. Rinne in 1905 (KM 4566:1–126). The lower half of the blade (KM 7275:1) was discovered in A. M. Tallgren's excavation at the site in 1917 (KM 7275:1–287).

Literature: Kivikoski 1939: 17, 211; Kivikoski 1951: 15; Räty 1983: 79–81, 153, 182, 268.





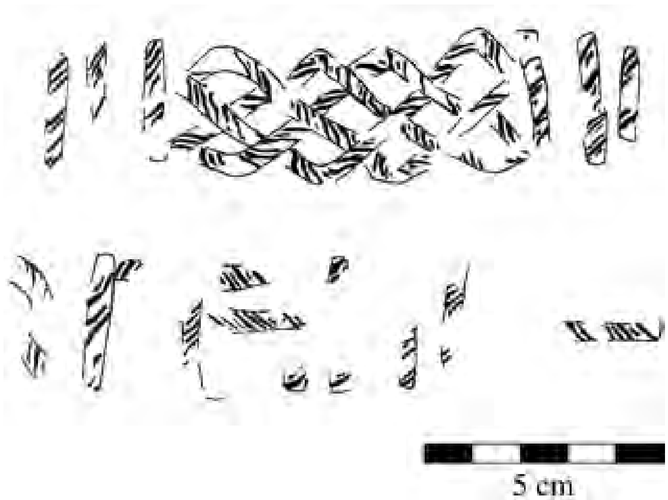
KM 4633:145 Eura, Osmanmäki

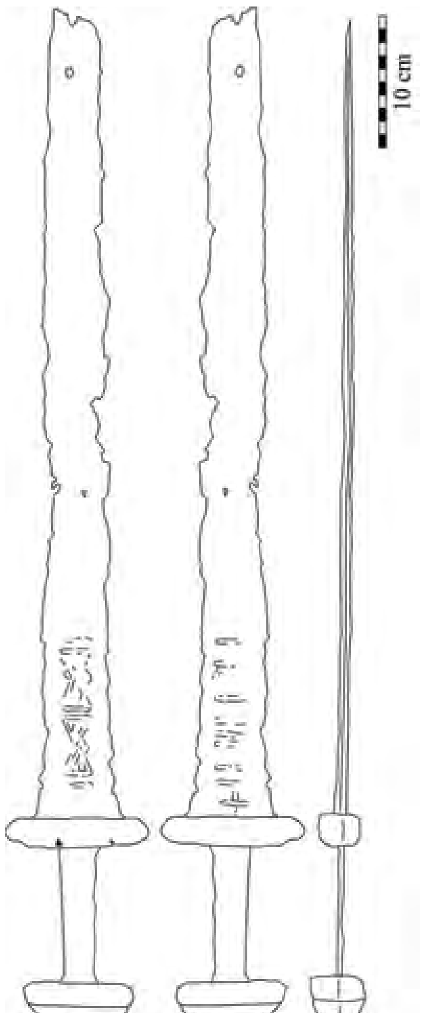
A complete sword in poor condition and lacking the tip of the blade. Weight: 1,516 g. On one side the fuller has a lattice weave flanked by two vertical lines. The other side of the fuller contains some fragmentary unidentified marks. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 593. It must be noted that it was not possible to take stereo images, so the inlays are drawn from a single radiograph making the interpretation difficult.

The hilt may belong to Petersen's type V, although the shape is highly corroded. The parts of the hilt are of iron and do not show any traces of decoration anymore.

The sword is a grave find from find location no. 20 in the excavation report i.e. an inhumation grave (KM 4633:140–158). The grave was excavated by H. Appelgren in 1905 (KM 4633:1–183).

Literature: Kivikoski 1939: 203; Mikkola 1999: 48; Räty 1983: 38–39, 155, 162, 167, 232–233; Räty 1998: 39, 41, 47; Salmo 1952: 30, 32–33, 376, 491.





KM 4633:165 Eura, Osmanmäki

A complete sword in poor condition and without the tip of the blade. Weight: 1,093 g. On one side the fuller bears two woven lattices and vertical lines. On the other side the fuller is marked with a cross and some fragmentary unidentified marks. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 1870, 1872 and 2605. Other radiographs: 2599 and 2605.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical wire inlays (16 wires/cm).

The sword is a stray find from a pit, probably from an inhumation cemetery (KM 4633:165–183). The sword belongs to artefacts recovered before excavations carried out by H. Appelgren in 1905 (KM 4633:1–164).

Literature: Salmo 1952: 30.

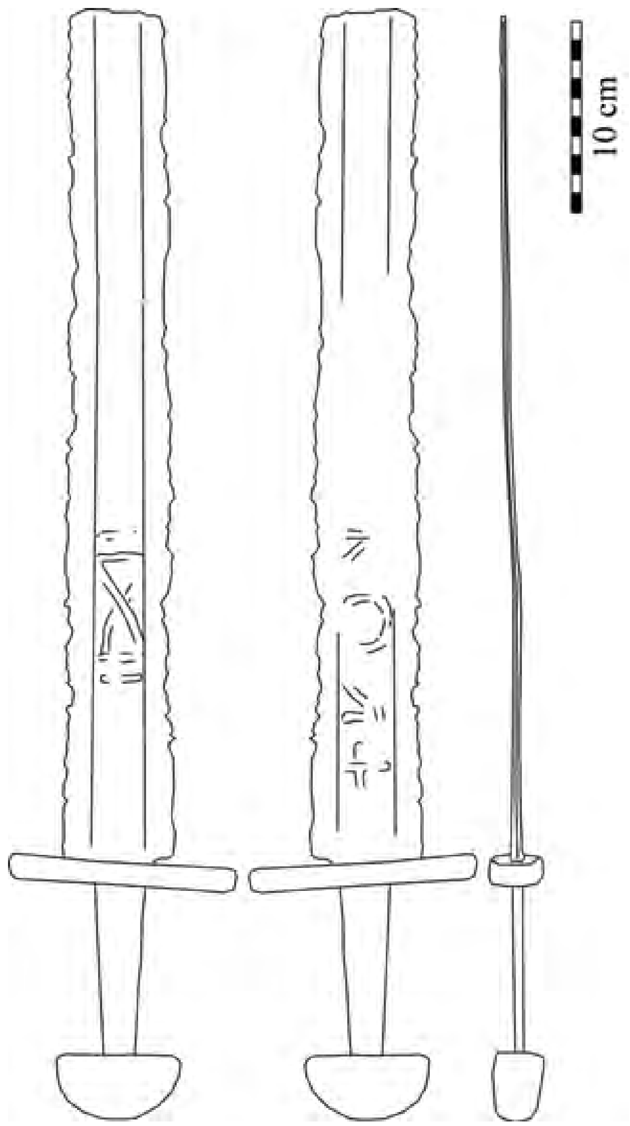
KM 4923:1 Urjala, Salmi, Härmä

A fragmentary sword in good condition, lacking the lower half of the blade. Weight: 690 g. On one side the fuller bears a cross, a circle and two V-shaped figures. The reverse side contains a lattice lined by two vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3659. Other radiographs: no. 548 and 666.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword belongs to a group of finds from the yard of Härmä farm (KM 4923:1–12, not all of which are from the same exact place), possibly from a burial cairn or several cairns. The sword was claimed for the National Museum in 1907.

Literature: Kivikoski 1951: 15; Räty 1983: 75–76, 267.



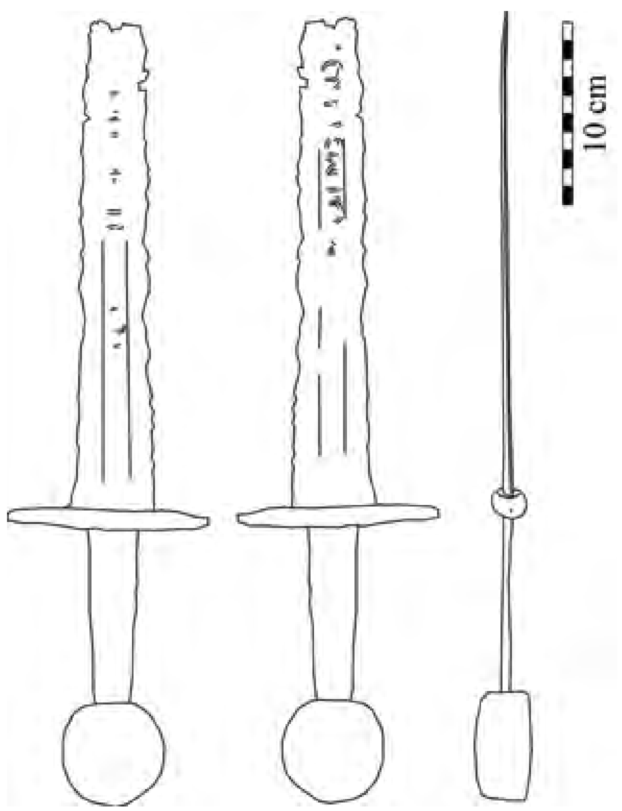
KM 5005 Janakkala, Kernaala, Vanaantaka

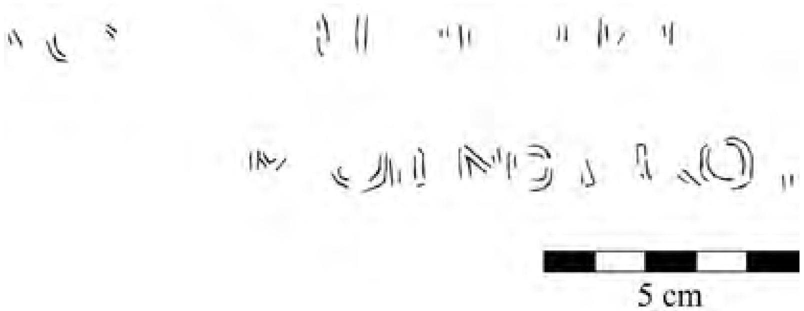
A fragmentary sword in poor condition and without the lower half of the blade. Weight: 642 g. On both sides the fuller contains fragmentary letter-like markings. The material of the inlays is steel rod, since the inlays have corroded more than the blade. The inlays were defined with the aid of radiograph no. 3519. Other radiographs: no. K29.

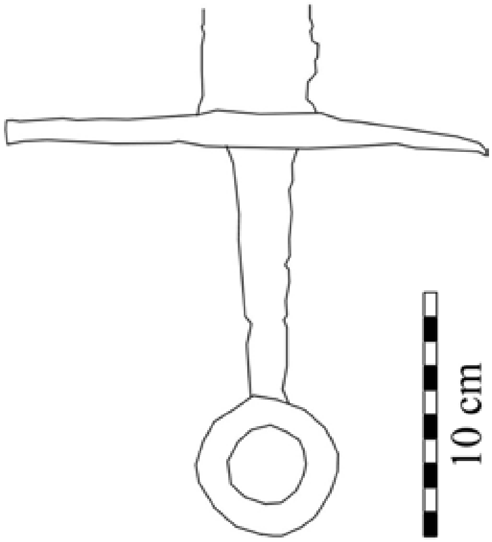
The hilt belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of undecorated iron.

The sword is a stray find from the field of Kernaala Manor, possibly from a destroyed burial cairn. The sword was donated to the National Museum in 1907.

Literature: Kivikoski 1951: 36; Tomanterä 1978: 26, 36–37, 61, 133.







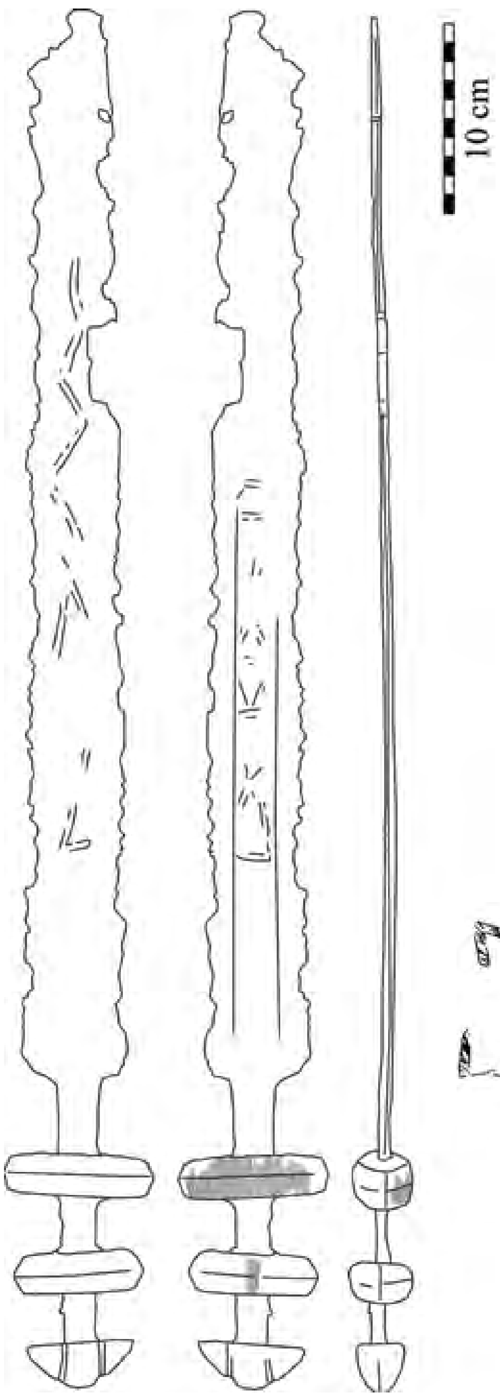
KM 5215 Parainen, Nauvo, Björkholm

A fragmentary sword with the lower half of the blade missing. On one side the fuller has a long lattice pattern. The material of the inlays is stated to be iron. This sword was not documented for this work, and the drawings are based on previous publications.

The hilt belongs to Tomanterä's type B or Oakeshott's type H. The parts of the hilt are of undecorated iron.

The sword is a stray find from a field from 1908.

Literature: Kivikoski 1951: 36; Tomanterä 1978: 52–53.



KM 5334:1 Eura, Kauttua

A fragmentary sword in poor condition and lacking the tip of the blade. The upper and lower guards have moved from their original position. Weight: 1,055 g. The fuller is marked on both sides with fragmentary, lattice-like lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3310. Other radiographs: no. 591.

The hilt belongs to the Mannheim-Speyer type similar to Geibig's type 4. The parts of the hilt are of iron and decorated with vertical inlays from brass wires (12 wires/cm).

The sword is a stray find from a hill near a factory, and was donated to the National Museum in 1909 (KM 5334:1–3).

Literature: Lehtosalo-Hilander 2000b: 191; Räty 1983: 24–25, 155, 217; Salmo 1952: 492.

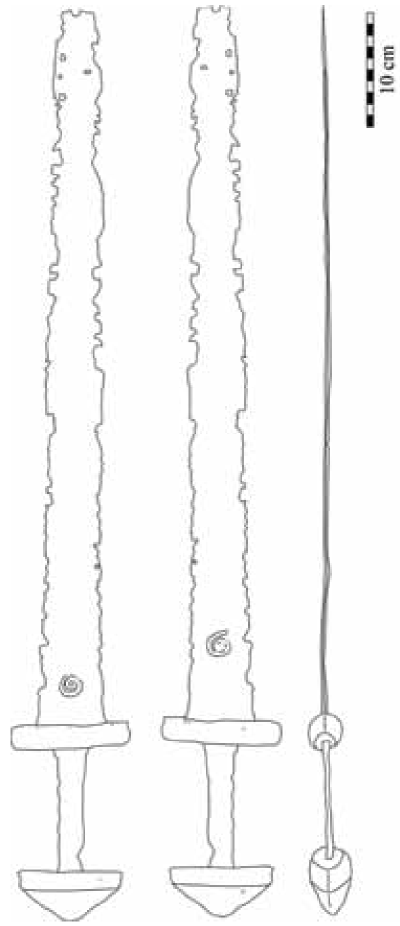
KM 5395:1 Mynämäki, Mietoinen, Valaskallio, Myllymäki

A complete sword in fair condition. Weight: 1,040 g. On both sides the fuller contains spiral-like figures. The material of the inlays is iron, since it is corroded less than the surrounding blade. The inlays were defined by surface examination and radiograph no. 3743. Other radiographs: no. 555.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical silver wire inlays (16 wires/cm).

The sword belongs to a group of artefacts recovered in 1909 while digging a pit in the property of Paavola farm (KM 5395:1–9), possibly from a cemetery or a cairn. The sword belongs to a group of artefacts sent to the National Museum in 1909 by K. A. Petterson (KM 5395:1–17).

Literature: Räty 1983: 38–39, 153, 227.



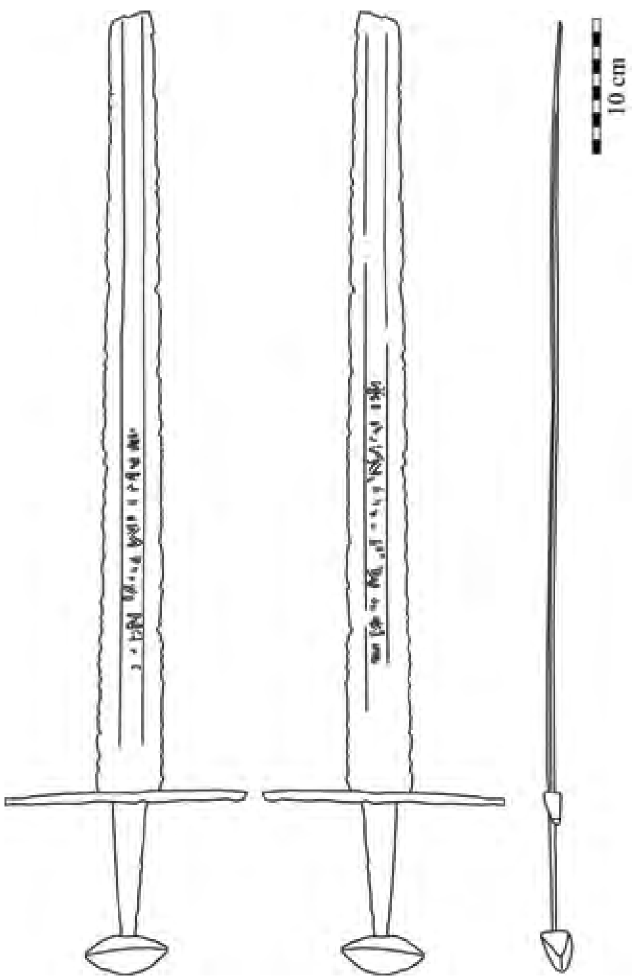
KM 5707:3 Metsäpirtti, Koukunniemi, Lääenmäki, Loponen

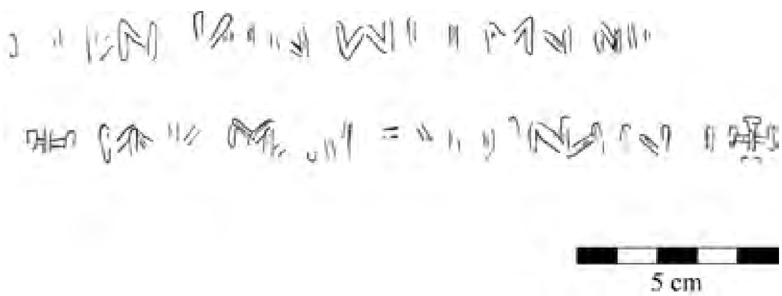
A fragmentary sword in good condition lacking the tip of the blade. Weight: 588 g. On both sides the fuller contains fragmentary letter-like marks, lined with cross potents on one side. The material of the inlays is steel rod, since the inlays have corroded more than the blade. The inlays were defined by surface examination and radiograph no. 3744.

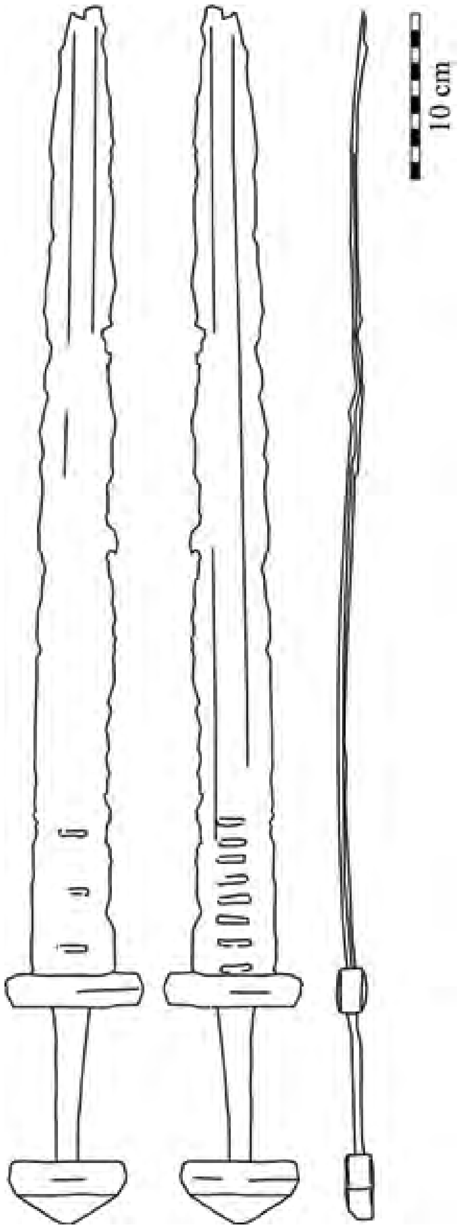
The hilt belongs to Oakeshott's type A and more accurately to Geibig's type 16.1. The parts of the hilt are of undecorated iron.

The sword is a stray find from a field from 1905 from the property of Loponen farm, possibly from a cremation cemetery or a cairn. The sword belongs to artefacts sent to the National Museum in 1910 (KM 5707:1–3).

Literature: Kirpichnikov et al. 2006: 54–55, 62; Kivikoski 1951: 36; Räty 1983: 131–133, 157, 295; Uino 2003a: 338.







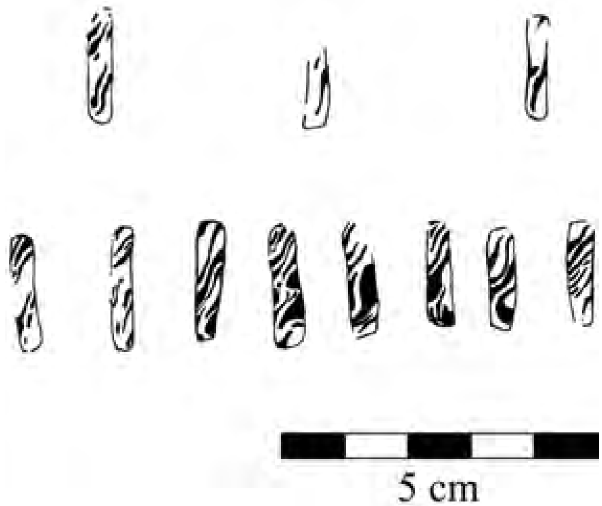
KM 5865:1 Vähäkyrö, Savilahti, Alhonmäki-Pahamäki

A fragmentary sword in fair condition and without the tip of the blade. Weight: 742 g. On both sides the fuller contains vertical lines, eight on one side and three on the other side. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3740.

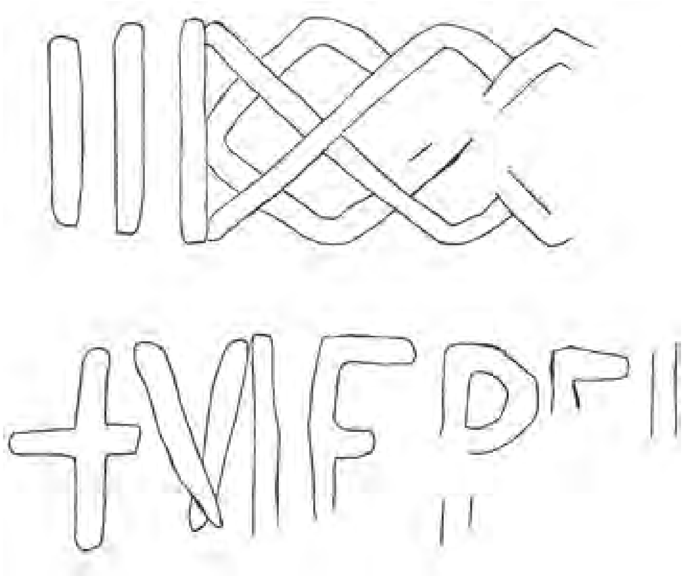
The hilt belongs to Petersen's type B. The parts of the hilt are of undecorated iron.

The sword was found together with a shield boss (KM 5865:1–2) while digging a pit near a stone cairn on the property of Housula farm in 1911. Both artefacts may belong to a cemetery instead of the cairn, and were sent to the National Museum in 1911.

Literature: Räty 1983: 18–19, 203; Salmo 1938: 53, 340.



KM 5868:80 Sastamala, Karkku, Palviala, Tulonen



A fragmentary sword in good condition. On one side the fuller is marked with the fragmentary inscription +VLFP…, and the reverse side contains a fragmentary lattice weave. The material of the inlays is stated to be pattern-welded. This sword was not documented for this work, and the drawings are based on previous publications.

The hilt belongs to Petersen's type I.

The sword is a cemetery find from a level-ground cremation cemetery, excavated by A. Hackman in 1911 (KM 5868:1–154).

Literature: Anteins 1973: 61; Leppäaho 1964: 40–41; Mikkola 1999: 48; Müller-Wille 1970: 79, 87; Räty 1983: 43–44, 155, 162–163, 236; Räty 1998: 33, 39–40, 47–48; Salmo 1952: 89, 493.

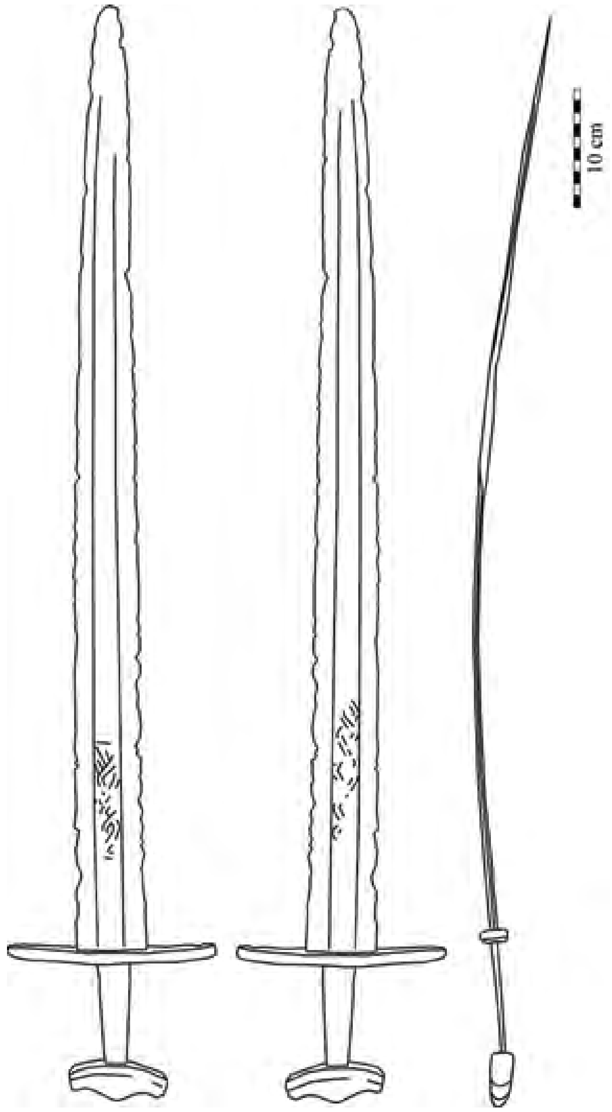
KM 5890:1 Lieto, Sauvala, Ylipää

A complete sword in good condition. Weight: 1,120 g. Balance point: 185 mm. The fuller has long lattice patterns on both sides. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3739. Other radiographs: no. 659.

The hilt belongs to Petersen's type Y. The parts of the hilt are of undecorated iron.

The sword is a cemetery find from a level-ground cremation cemetery. The sword was found together with a spearhead (KM 5890:1–2) in 1911 while levelling a road on a stony hill. Both artefacts were sent to the National Museum in 1911.

Literature: Kivikoski 1939: 211, Tl. 37:5; Kivikoski 1951: 15, Tl. 98:780; Kivikoski 1973: 113, Tafel 95:838; Räty 1983: 79–81, 268, 347; Tallgren 1931b: 205.

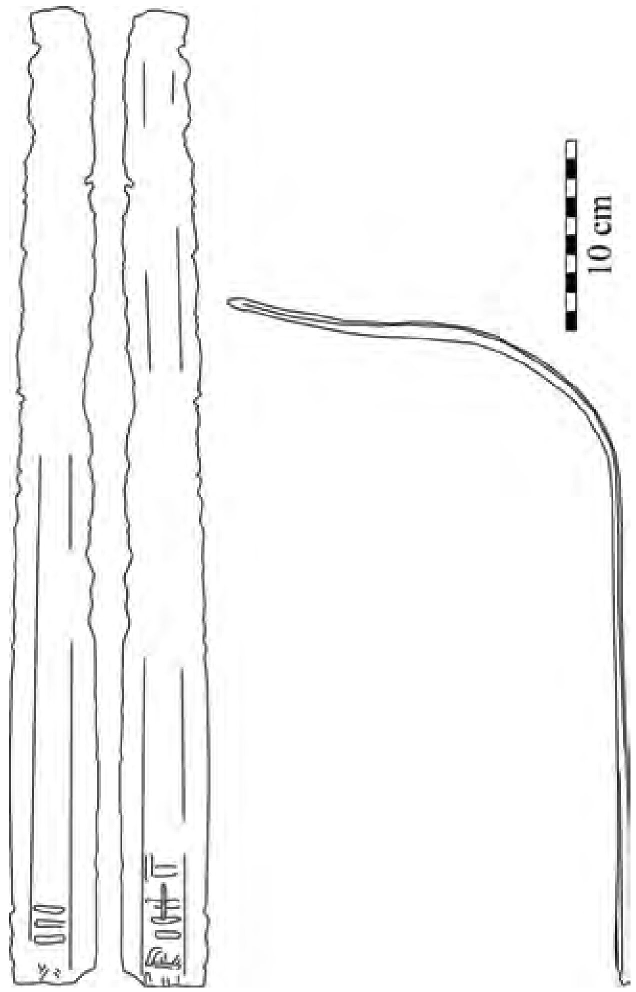


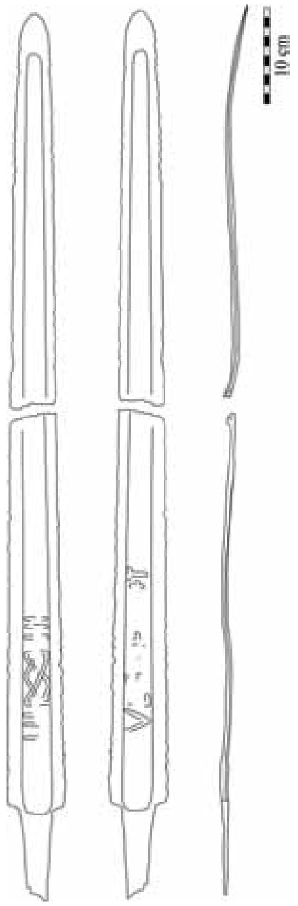
KM 5960:3 Hämeenlinna, Kalvola, Pahnainmäki

A fragmentary sword blade in fair condition and without the tang and the parts of the hilt. Weight: 326 g. On one side the fuller is marked with the fragmentary inscription ERH+T, and the reverse side contains fragments of a woven lattice and three vertical lines. The material of the inlays is straight pattern-welded rod, which most likely contains 3–5 layers. The inlays were defined with the aid of surface examination.

The sword is a grave find from a combined cremation and inhumation cemetery (KM 5960:1–21). Due to the condition of the sword, it is most likely from the cremation cemetery. Excavated by Hj. Appelgren-Kivalo in 1911 (KM 5960:2–54).

Literature : Leppäaho 1964b: 34–35; Räty 1983: 172–173, 278–279; Räty 1998: 43.



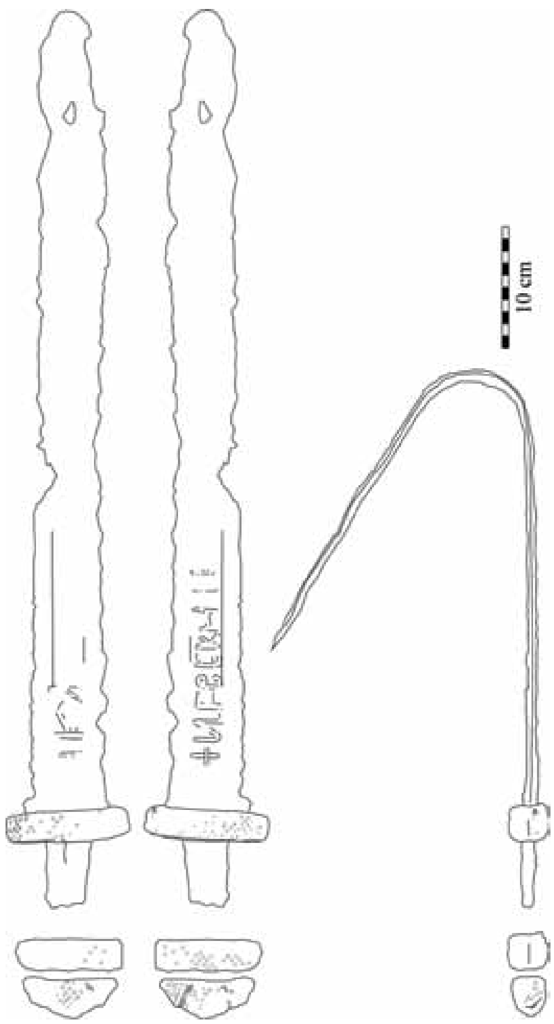


KM 6066:1 Tampere, Messukylä, Takahuhti, Toivola

A fragmentary sword blade in good condition and lacking the upper part of the tang and the parts of the hilt. Weight: 670 g. On one side the fuller is marked with fragmentary letters from which only V and T are identifiable. The reverse side contains a woven lattice and six vertical lines. The material of the inlays could be twisted pattern-welded rod or plain steel containing longitudinal slag inclusions. Most of the inlays are ground away at some stage. The inlays were defined by surface examination. Other radiographs: no. 1337 and 1348.

The sword is a stray find from a possible cemetery on the lands of Toivola farm (KM 6066:1–3). The sword was found from a garden next to a large rock, and was sent to the National Museum in 1912.

Literature: Anteins 1973: 61; Leppäaho 1964b: 44–45; Müller-Wille 1970: 79, 87; Räty 1983: 162; Räty 1998: 39, 41, 49; Salmo 1952: 104, 493, Williams 2009: 133, 167.



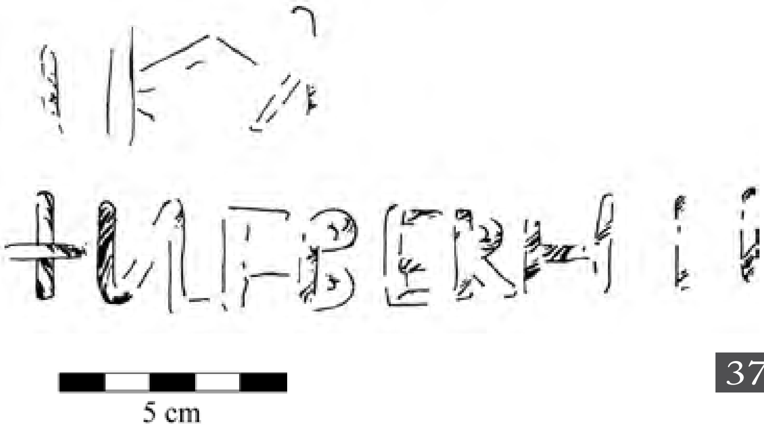
KM 6196:1 Åland, Saltvik, Kvarnbo, Rihagen

A fragmentary sword in poor condition. Weight: 1,098 g. The blade is strongly bent to resemble letter V. The tang is broken; there are four small pieces of iron which could be from the tang. The pommel is find KM 6196:20 and the upper guard is find KM 6196:3. On one side the fuller is marked with the fragmentary inscription +VLFBERH I I, and the reverse side contains pieces of possible vertical lines and a lattice. The material of the inlays is pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3200. Other radiographs: no. 624 and 3197.

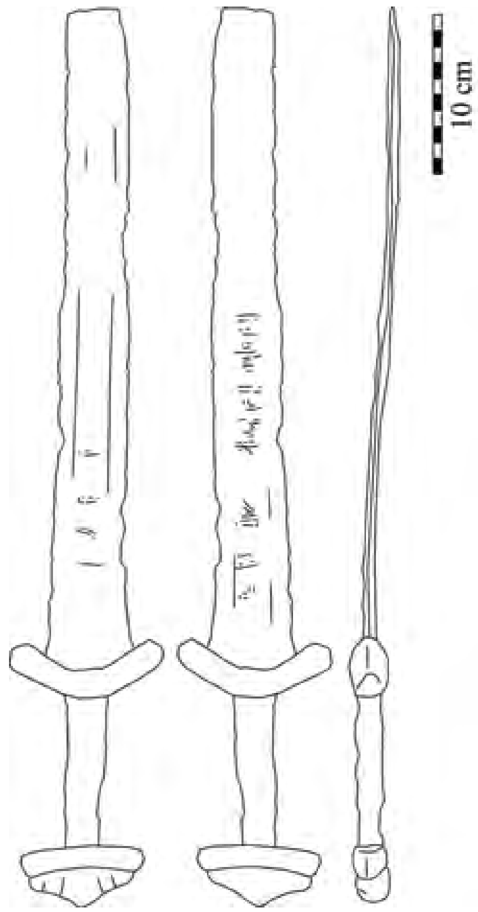
The hilt belongs to Petersen's type E. The parts of the hilt are of iron and decorated with silver wire inlays (22 wires/cm), round holes (3 mm in diameter), and twisted silver wires.

The sword is a grave find from a mound (no. 3), which contained a possible boat grave (KM 6196:1–41). The mound was excavated by B. Cederhvarf in 1912 (KM 6196:1–47).

Literature: Räty 1983: 30–32, 152, 206.



KM 6227:1 Sastamala, Tyrvää, Kaukola, Vänniä



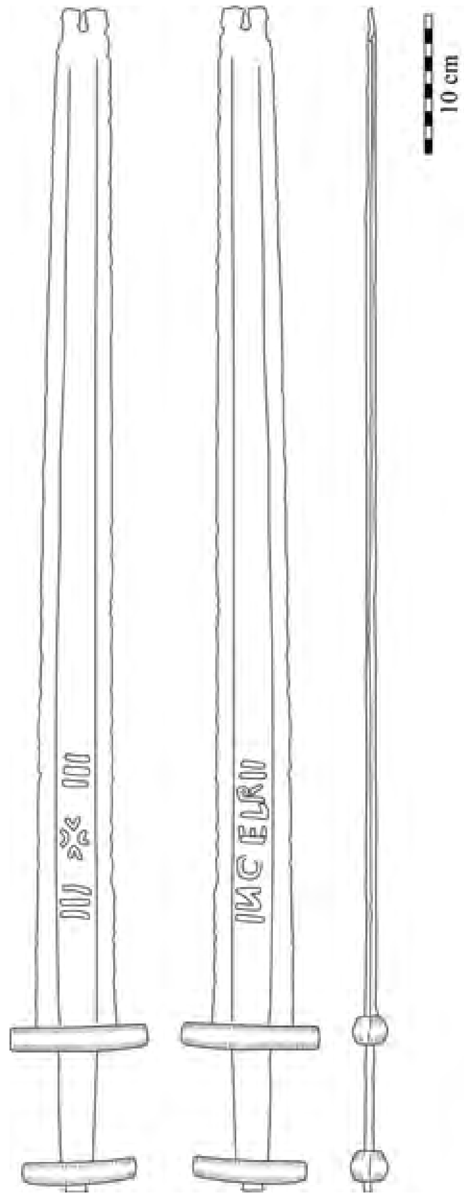
A fragmentary sword in poor condition. The lower half of the blade is missing. Weight: 766 g. On one side the fuller contains fragmentary letter-like inlays, and the reverse side contains fragments of vertical lines or some other inlays. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 2604. Other radiographs: no. 553, 695 and 2601.

The hilt belongs to Petersen's type Z. The parts of the hilt are of iron and have traces of silver-plating. The grip is a hollow iron tube.

The sword belongs to a group of finds from the garden of Vänniä farm (KM 6227:1–5), possibly from a cremation cemetery. The sword was claimed for the National Museum in 1912.

Literature: Kivikoski 1951: 15; Prusi 1949: 58; Räty 1983: 82–87, 140, 155, 162, 165, 276; Räty 1998: 34, 39–40, 47, 49; Salmio 1982: 104, Taulu XII:1; Salmo 1952: 82, 492.

KM 6245 A:1 Kangasala, Tiihala, Jussila

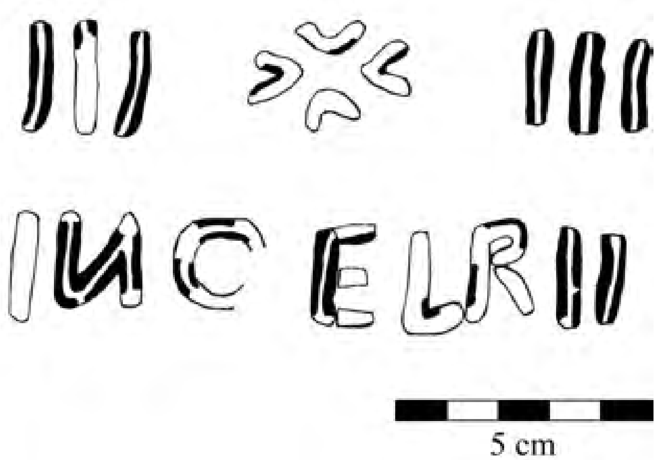


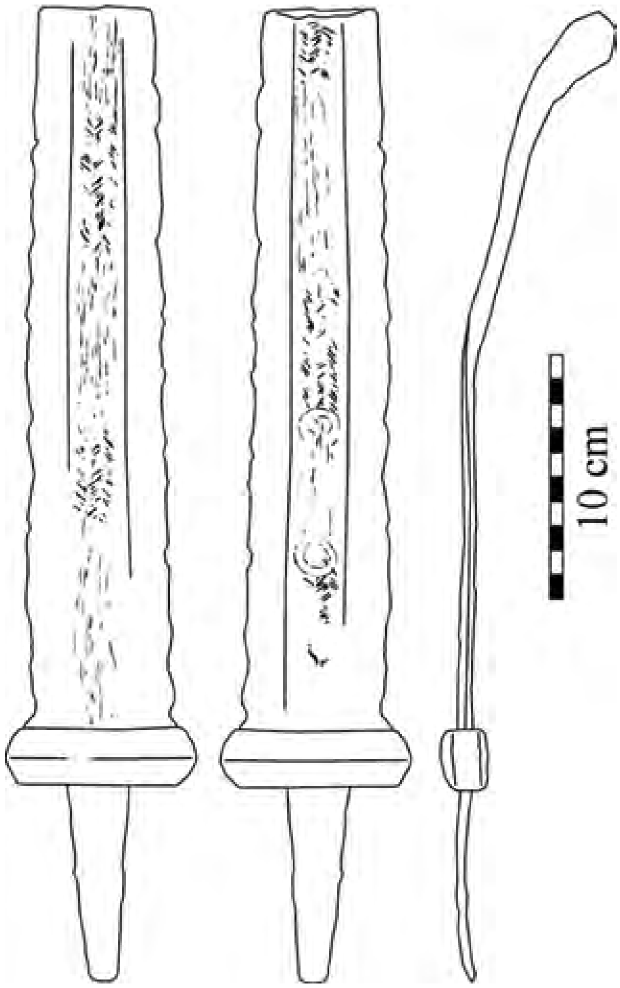
A fragmentary sword in good condition. The tip of the blade and the pommel are missing. Weight: 1,195 g. On one side the fuller has the inscription I┘GELRII, and the reverse side has a motif consisting of four arrow-like inlays and six vertical lines. The material of the inlays is non-twisted pattern-welded rod, which contains three layers (two of iron and one of steel). The inlays were defined by surface examination.

The hilt belongs to Petersen's type V. Both guards are of iron and decorated with inlays from silver and bronze wires (26 wires/cm). The wires are arranged to form diamond-like patterns.

The sword is a grave find from a hill in the yard of Jussila farm (KM 6245 A:1–3), possibly from a cremation in a mound. The sword belongs to artefacts collected from Tiihala village by H. Appelgren-Kivalo in 1912 (KM 6245 A:1–9).

Literature: Anteins 1973: 62; Hirviluoto 1992: 45; Leppäaho 1964b: 34–35; Peirce 2002: 60–62; Räty 1983: 43–44, 155, 172–173, 235; Räty 1998: 43; Salmo 1952: 108, 378, 492.





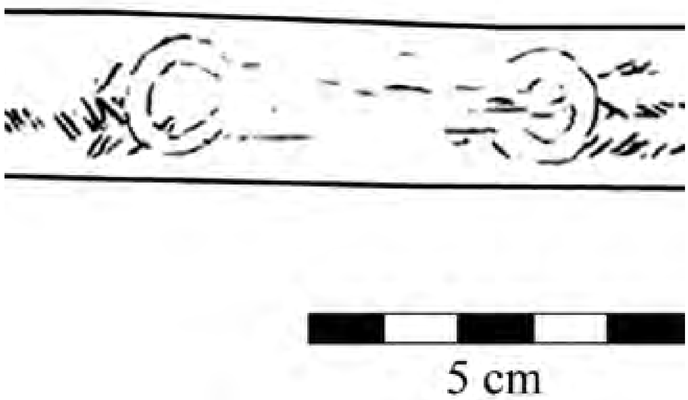
KM 6482 Turku, Maaria, Kaerla, Mulli

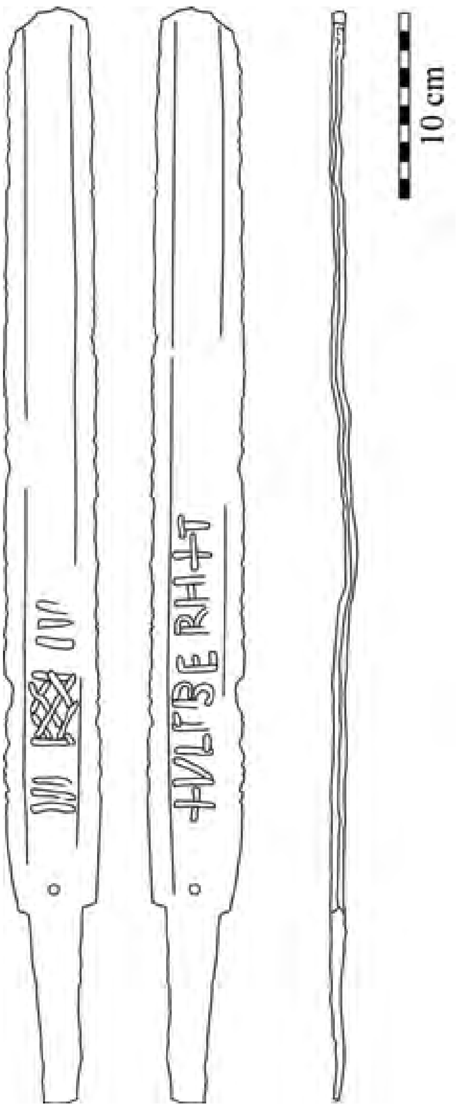
A fragmentary sword in poor condition, without the lower half of the blade, the upper guard and the pommel. Weight: 440 g. The fuller consists of six partially twisted, pattern-welded bars. On one side the fuller has two circular designs. The material of the inlays seems to be non-twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 667 and 3245.

The lower guard belongs to Petersen's type B. The guard is undecorated iron.

The sword is a stray find from Mulli farm while digging a cellar, possibly from a level-ground cremation cemetery. The sword was sent to the National Museum in 1913.

Literature: Kivikoski 1939: 11, 121; Räty 1983: 18–19, 200.





KM 6503:20 Hattula, Tyrväntö, Anttila

A fragmentary sword blade in poor condition and without the lower part of the blade and the parts of the hilt. Weight: 447 g. On one side the fuller has the inscription +VLFBERH+T, and the reverse side contains a woven lattice and six vertical lines. The material of the inlays is twisted pattern-welded rod. Most of the inlays have corroded away, indicating that they contained large amounts of carbon. The inlays were defined by surface examination.

The sword is a stray find from the lands of Anttila farm, possibly from a cairn cemetery. The sword belongs to a group of artefacts claimed for the National Museum in 1913 (KM 6503:1–40).

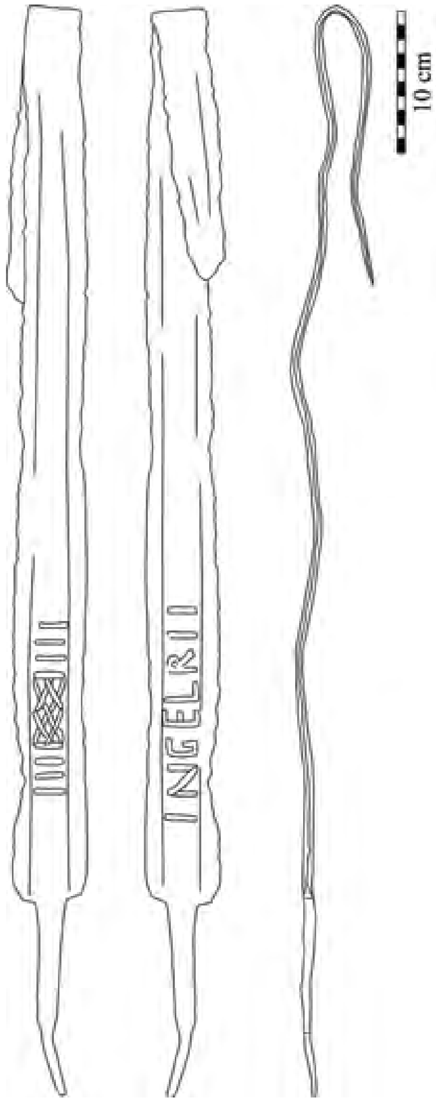
Literature: Anteins 1973: 44–45, 61; Hirviluoto 1992: 44; Leppäaho 1964b: 46–47; Müller-Wille 1970: 79, 87; Räty 1983: 162; Räty 1998: 39, 41, 49; Williams 2009: 136, 174.

KM 6689:2 Sysmä, Voipala, Hovila, Päivärinta

A complete sword blade in fair condition and strongly bent, lacking the parts of the hilt. Weight: 535 g. On one side the fuller contains the inscription INGELRII, and the reverse side contains a woven lattice and six vertical lines. The material of the inlays is pattern-welded rod, which contains 7–9 layers (more steel layers than iron). The inlays were defined by surface examination.

The sword is a stray find from Hovila farm in Voipala village, discovered in clearing a field in 1910 and possibly from a level-ground cremation cemetery. The sword was sent to the National Museum in 1914 (KM 6689:1–2).

Literature: Leppäaho 1964b: 38–39; Päijät-Hämeen kiinteät muinaisjäännökset 2008: 319; Räty 1983: 172–173; Räty 1998: 43.



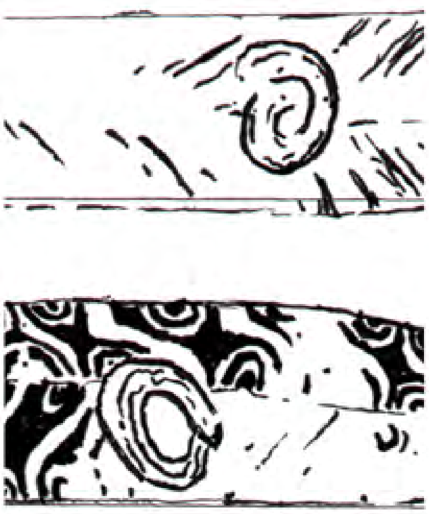
KM 6746:49 Turku, Kaarina, Ristimäki

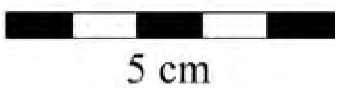
A complete sword in good condition, with the blade bent in two places to resemble a flattened circle. Weight: 1,260 g. The fuller consists of four twisted, pattern-welded bars, two on each side. Each bar contains seven layers (three of steel and four of iron). On both sides the fuller contains circular marks. The material of the inlays is iron rod. The inlays were defined by surface examination and radiograph no. 3737.

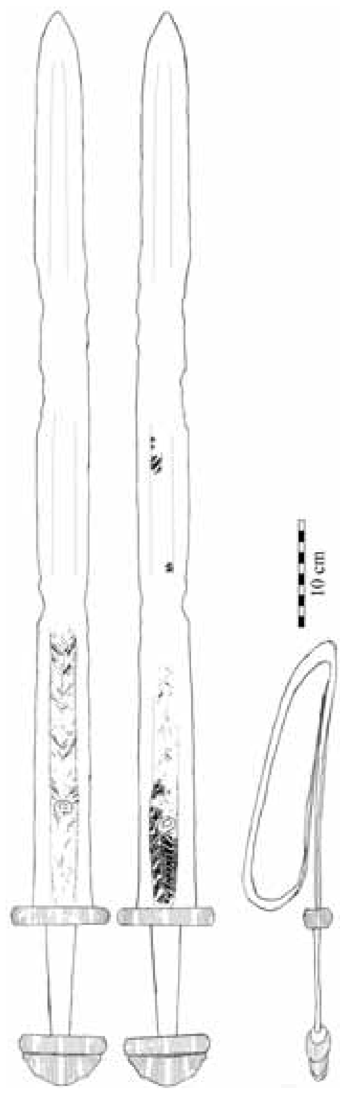
The hilt belongs to Petersen's special type 1. The parts of the hilt are of iron and decorated with vertical wire inlays from silver and bronze wires (9 wires/cm), which have been now melted by most likely the heat of the cremation pyre. The parts of the hilt also have wide bronze panels, of which have originally been possibly relief-decorated.

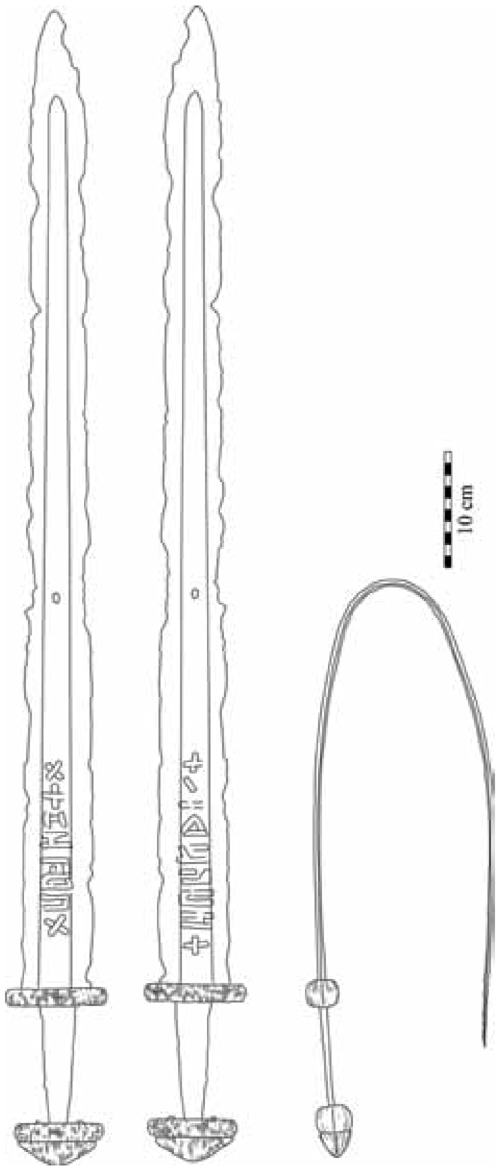
The sword is a cemetery find from a level-ground cremation cemetery at the Ristimäki school property (KM 6746:1–167) and belongs to a group of finds (KM 6746:49–56). Some of these finds were purchased (numbers 1–5) and some were excavated (numbers 6–167). The sword belongs to a group of finds, possibly a burial (KM 6746:50–56). The cemetery was excavated by A. M. Tallgren in 1914.

Literature: Anteins 1973: 60; Kivikoski 1939: 6, 122, Tl. 24:1; Kivikoski 1947: 52, Tl. 58:483; Kivikoski 1973: 76, Tafel 57:520; Räty 1983: 23–24, 153, 159, 204–205; Salmo 1938: 3, 61, 111–113, 340; Tallgren 1915: 50.









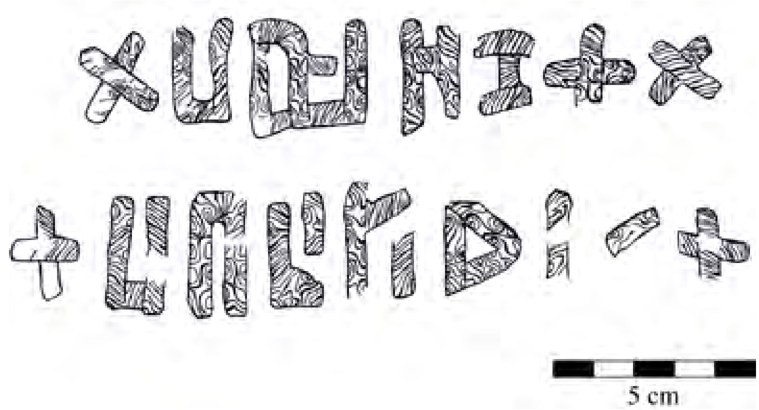
KM 6753:51 Turku, Kaarina, Ristimäki

A complete sword in good condition and bent to resemble the letter U. Weight: 1437 g. On both sides the fuller contains letter-like symbols between crosses. The material of the inlays is twisted pattern-welded rod, with nine layers (five of iron and four of steel). The inlays were identified by surface examination. Other radiographs: no. 656.

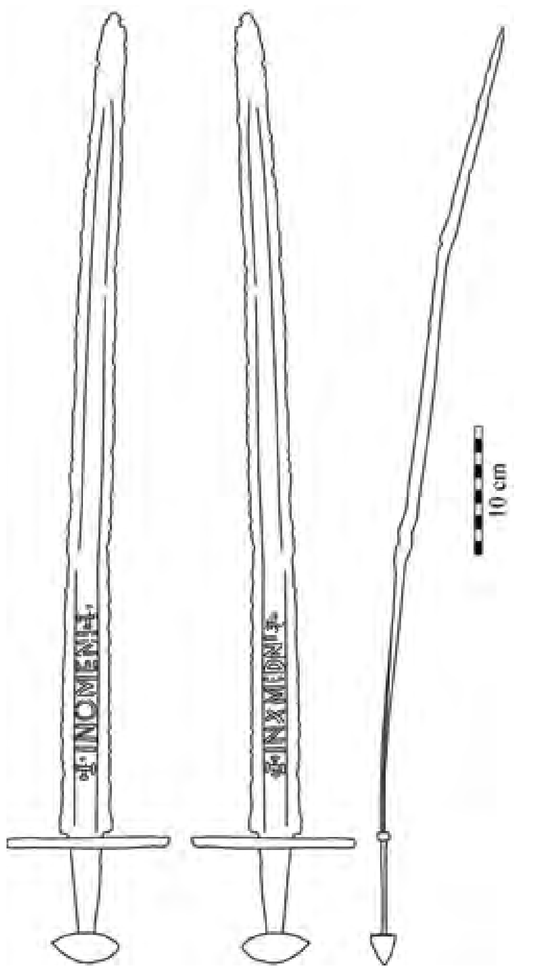
The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical silver wire inlays (12 wires/cm).

The sword is a cemetery find from a level-ground cremation cemetery at Ristimäki school (KM 6753:1-67), and it belongs to a group of finds (KM 6753:52–55). Some of these finds were purchase (numbers 1–12) and some were excavated (numbers 13–67). The sword belongs to a group of artefacts excavated by A. M. Tallgren in 1914.

Literature: Anteins 1973: 52, 62; Kivikoski 1939: 204, Tl. 37:1; Leppäaho 1964b: 6–7; Räty 1983: 38–39, 41, 153, 179–180, 222, 345; Salmo 1938: 61.



KM 6923 Sakkola, Lapinlahti, Naskalinmäki



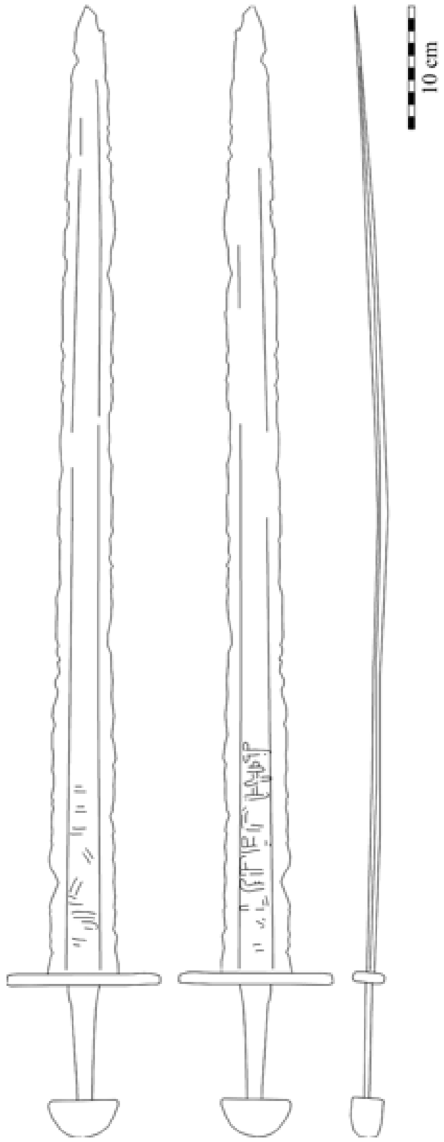
A complete sword in good condition. Weight: 956 g. Balance point: 200 mm. On one side the fuller contains the inscription +INXMIDNI+, and the other side contains the inscription +INOMENI+. The material of the inlays appears to be twisted pattern-welded rod, which contains large amounts of steel. The inlays were defined by surface examination.

The hilt belongs to Oakeshott's type A, and more accurately to Geibig's type 16.1. The parts of the hilt are of undecorated iron.

The sword is a stray find from a field close to the main building of Naskali farm in 1914. The sword was sent to the museum authorities of Finland by the order of the governor of the Province of Viipuri.

Literature: Kivikoski 1951: 36; Leppäaho 1964b: 16–17; Räty 1983: 131–133, 157, 177–178, 295, 349.

KM 7011 Kemiönsaari, Kemiö, Kila, Färi's croft



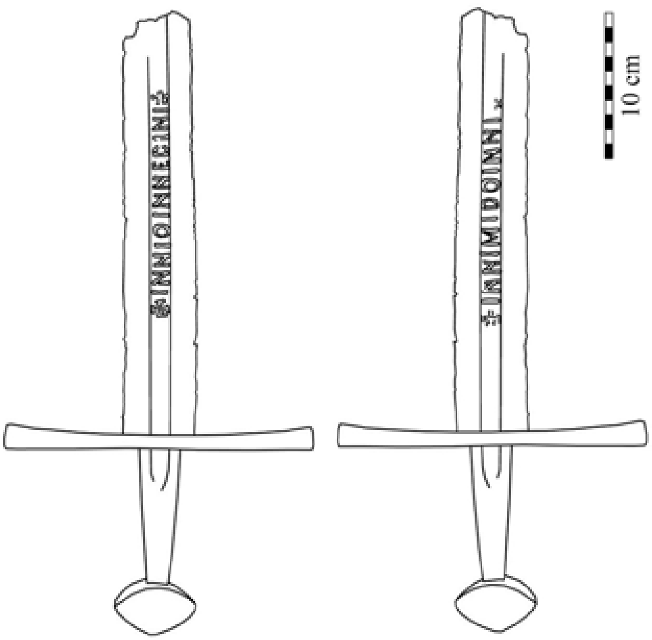
A complete sword in good condition. Weight: 810 g. Balance point: 130 mm. On one side the fuller bears a fragmentary VLFBERH+T inscription. The reverse side is marked with the remains of a lattice lined by vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3734. Other radiographs: no. 565 and 669.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword is a stray find from behind a croft. The sword was claimed for the National Museum in 1916.

Literature: Kivikoski 1951: 15; Räty 1983: 74–76, 153, 257.

KM 7134:1 Hämeenlinna, Hauho, Hahkiala

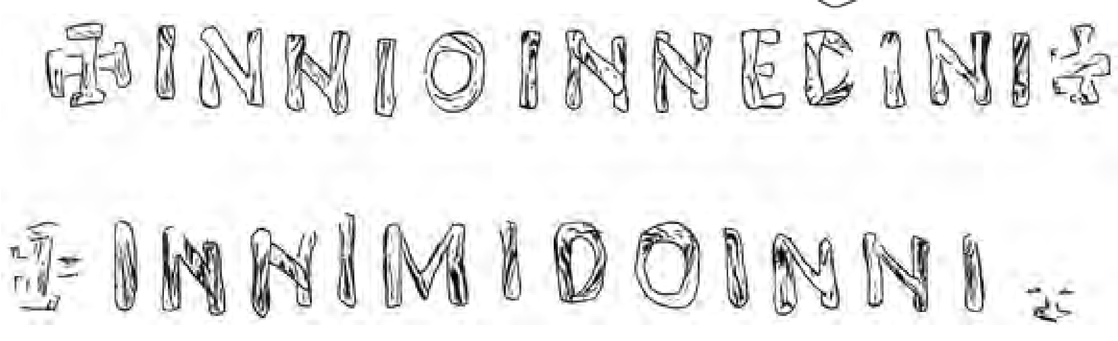


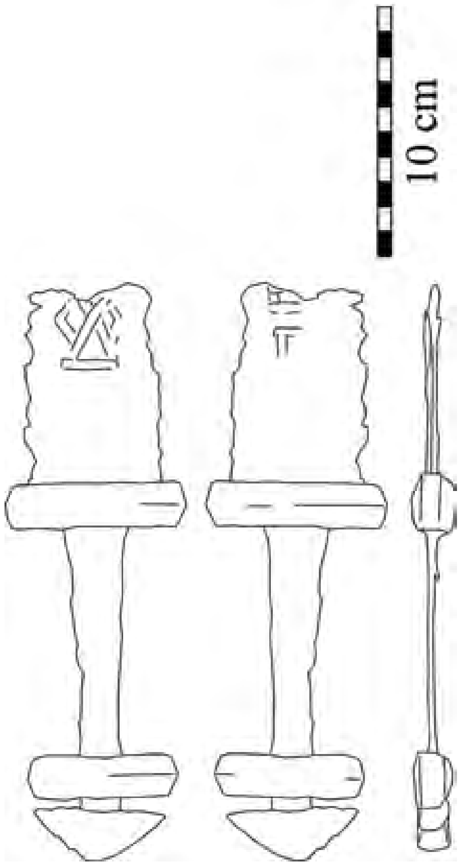
A fragmentary sword in good condition with the lower half of the blade missing. On one side the fuller is marked with the inscription +INNIMIDOINNI+, and the reverse side contains the inscription +INNIOINNEDINI+. The material of the inlays seems to be steel. This sword was not documented for this work, and the drawings are based on earlier publications.

The hilt belongs to Oakeshott's type B, and more accurately to Geibig's type 15. The parts of the hilt are of undecorated iron.

The sword is a stray find from the garden of Hahkiala farm in 1913. The sword was claimed for the National Museum in 1916 (KM 7134:1–2).

Literature: Anteins 1973: 49–50, 62; Hirviluoto 1992: 43, 45; Kivikoski 1951: 36; Kivikoski 1973: 142, Tafel 130:1163; Leppäaho 1964: 18–19; Oakeshott 1991: 46; Räty 1983: 131–133, 156, 177–178, 294.





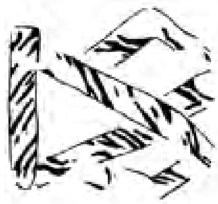
KM 7220:2 Nousiainen, Sontamala, Kyläprehtu

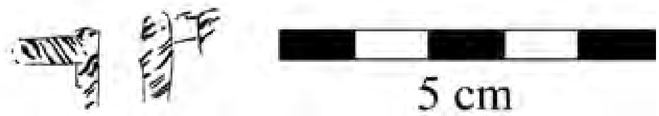
A fragmentary sword in poor condition and without the lower half of the blade. Weight: 312 g. On one side the fuller is marked with fragmentary letter-like marks. The reverse side contains a fragmentary woven lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3717.

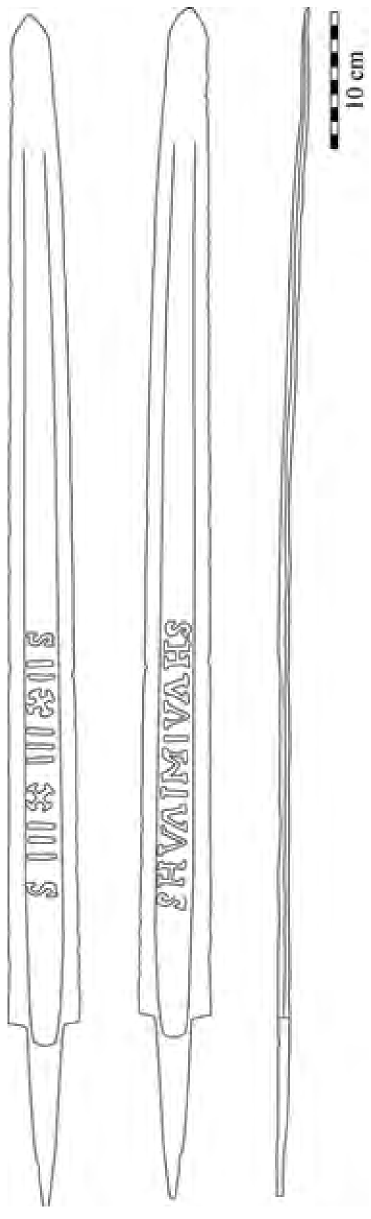
The hilt belongs to Petersen's type B. The parts of the hilt are of undecorated iron.

The sword is a stray find from a field in the property of Kyläprehtu farm in 1911 or 1912. Together with this upper portion of a sword also a lower part of a sword blade was found but was lost later. The sword belongs to artefacts sent to the National Museum in 1917 (KM 7220:1–2).

Literature: Räty 1983: 18–19, 201; Salmo 1938: 340.





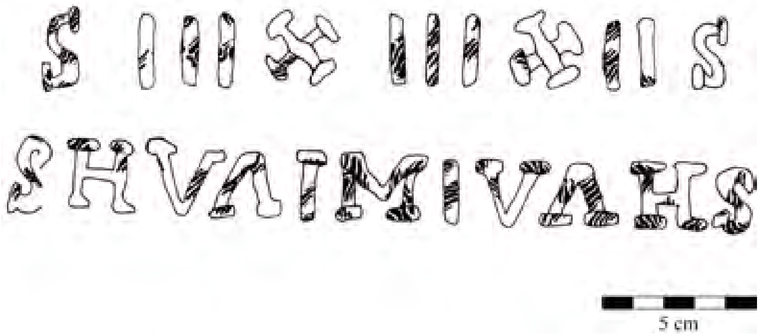


KM 7332 Finland (no accurate find-place)

A complete sword blade in good condition, without the parts of the hilt. Weight: 727 g. On one side the fuller is marked with the inscription SHV┴IMIV┴HS, and the reverse side has a motif consisting of crosses, vertical lines and two letters S. The material of the inlays seems to be twisted pattern-welded rod. The inlays have corroded away in most parts, so they must contain much steel compared with the blade. The inlays were defined by surface examination.

The sword has belonged to collections of the Finnish Literature Society and it is mentioned in the catalogue of F. J. Färling in 1929. No find context can be given.

Literature: Anteins 1973: 51, 62; Leppäaho 1964b: 30–31; Moilanen 2010a: 8–9.



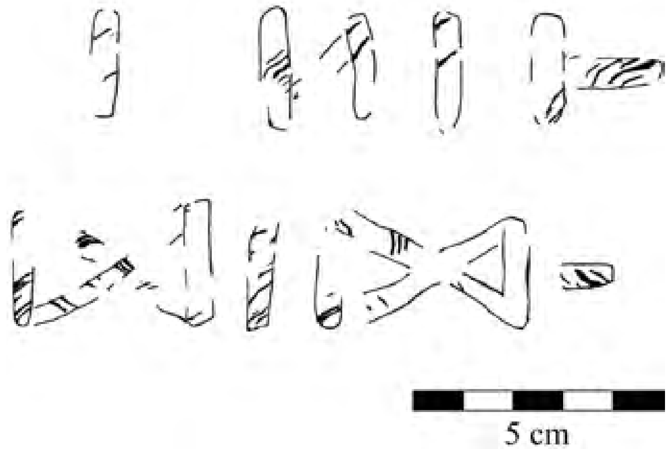
KM 7472:2 Vehmaa, Rahkamala, Matinantti

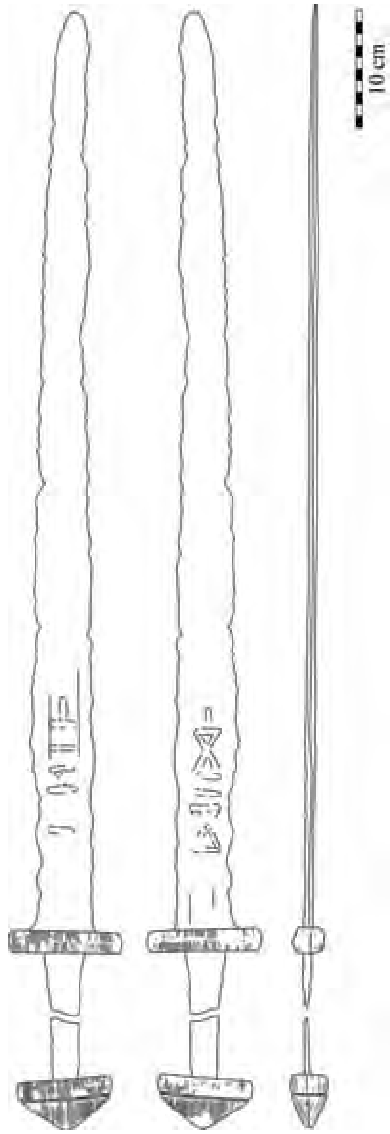
A complete sword in poor condition. Weight: 1258 g. Balance point: 165 mm. On one side the fuller is marked with two lattices and two fragmentary lines, and the reverse side contains the letter-like inlays I ⊣I followed by a T-shaped design. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 557 and 3158.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with inlays from brass wires (14 wires/cm).

The sword belongs to a group of finds from a cairn on the route of the Turku-Uusikaupunki railway line (KM 7472:1–5), which is probably a secondary group of finds. The site was excavated by A. M. Tallgren in 1918.

Literature: Mikkola 1999: 48; Räty 1983: 38–39, 41, 153, 162, 166, 230; Räty 1998: 39, 41, 49.





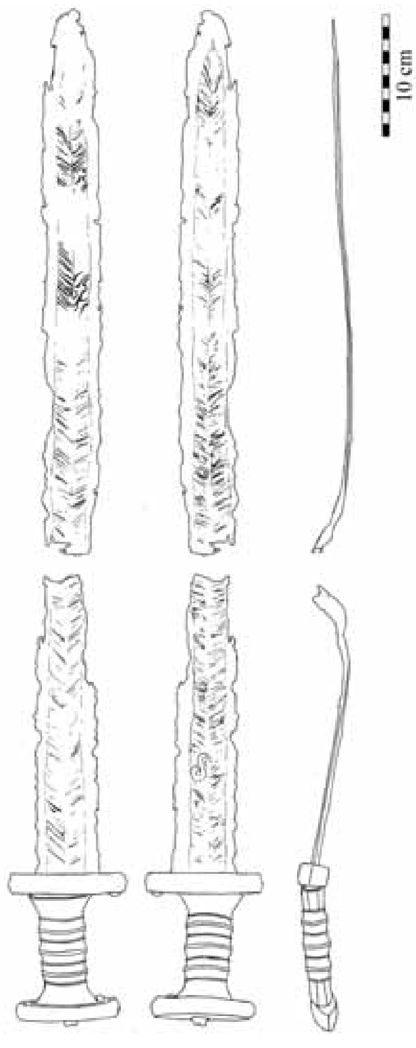
KM 7703:2 Isokyrö, Palonkylä, Pukkila

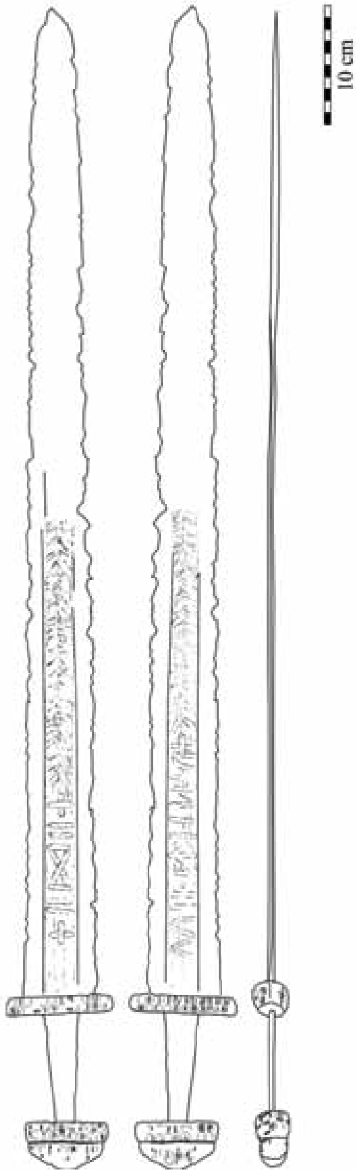
A fragmentary sword in poor condition, without the pommel and broken in the middle of the blade. Weight: 722 g. The fuller consists of two or most likely four twisted, pattern-welded bars. On one side the fuller is marked with an S-shaped figure. The material of the inlay is non-twisted pattern-welded rod. The pattern-welding and the inlay were defined with the aid of radiograph no. 3838.

The guards and the grip are hollow and cast in bronze, and belong to Behmer's type VI or the bronze-hilted Late Merovingian swords of Salmo's classification.

The sword belongs to artefacts found while digging the foundations of a house (KM 7703:2–11). It is part of a group of artefacts partly bought and partly excavated by S. Pälsi in 1920 (KM 7703:1–18).

Literature: Behmer 1939: 203, Tafel LIII:1; Salmo 1938: 94, 100, 339, Tafel XXXIV:2.





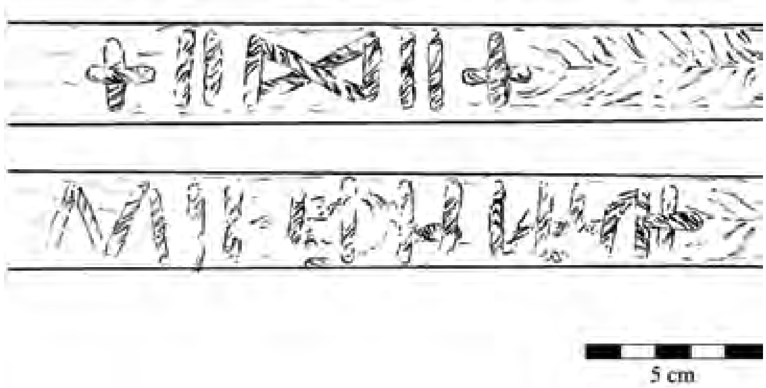
KM 7752:1 Salo, Perniö, Lupaja, Tiikkinummi

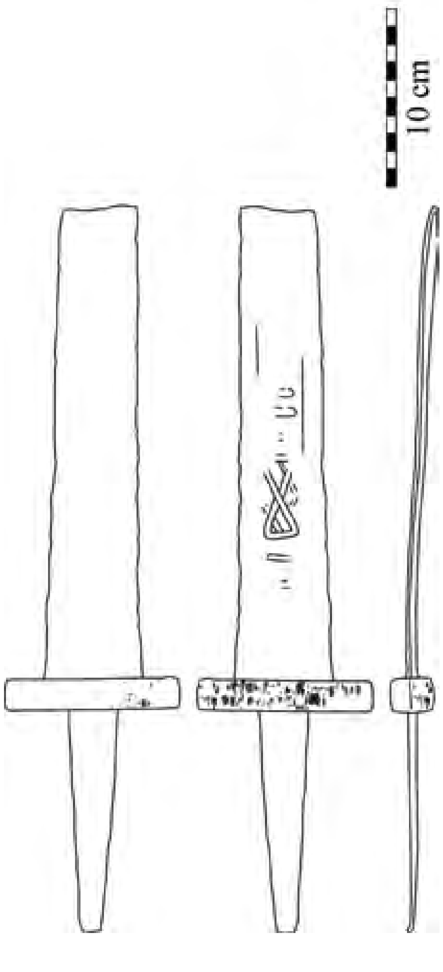
A complete sword in good condition. Weight: 1302 g. Balance point: 170 mm. The fuller consists of four twisted, pattern-welded bars, two on each side. The pattern is straight under the inlaid marks. On one side the fuller has letter-like marks. The reverse side has a geometrical motif consisting of a lattice lined by four vertical lines and two crosses. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3733.

The hilt belongs to Petersen's type E. The parts of the hilt are of iron and decorated with vertical wire inlays of silver and brass (6 wires/cm), and vertical as well as horizontal, elongated pits.

The sword is a cemetery find from a level-ground cremation cemetery. Sword belongs to a group of finds discovered while transporting rocks (KM 7752:1–6). The sword was catalogued together with the excavation finds of C. A. Nordman in 1920 (KM 7752:7–60).

Literature: Kivikoski 1939: 203; Kivikoski 1951: 14; Räty 1983: 29–30, 153, 207; Salmo 1938: 116–118, 340.





KM 7961:1 Mynämäki, Tursunperä, Raivomäki

A fragmentary sword in fair condition and lacking the lower half of the blade, the pommel and the lower guard. Weight: 470 g. On one side the fuller is marked with a fragmentary woven lattice and remains of vertical lines. The material of the inlays is twisted pattern-welded rod, which contains large amounts of steel. The inlays were defined by surface examination. Other radiographs: no. 671.

The lower guard may belong to Petersen's type V. The guard is of iron and decorated with silver wire inlays (26 wires/cm).

The sword is a stray find from rocky ground, possibly from a cremation cemetery. The sword was bought for the National Museum by C. A. Nordman in 1921.

Literature: Leppäaho 1964b: 44–45; Moilanen 2010a: 9; Räty 1983: 43–44, 153, 228.

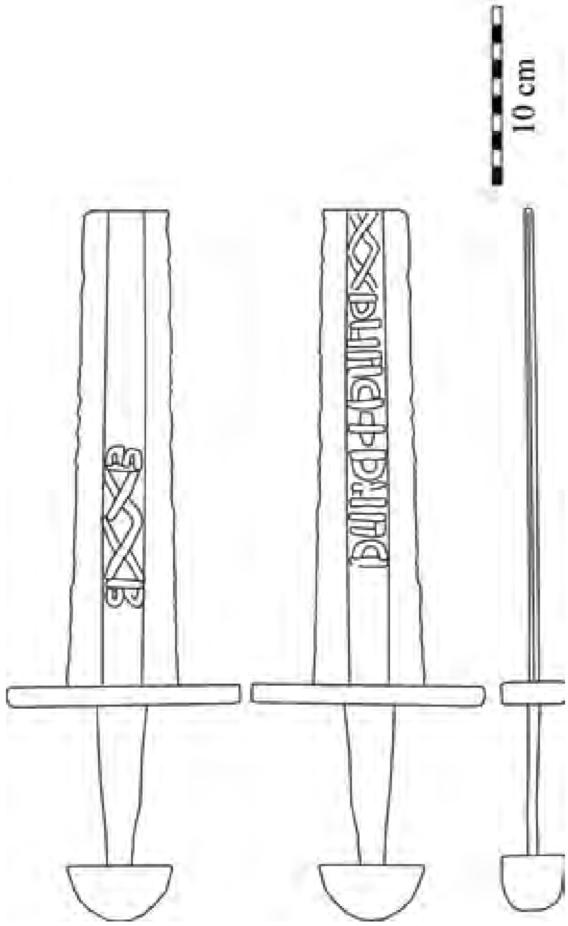
KM 8120:1 Hattula, Tyrväntö, Lepaa, Hinnonmäki

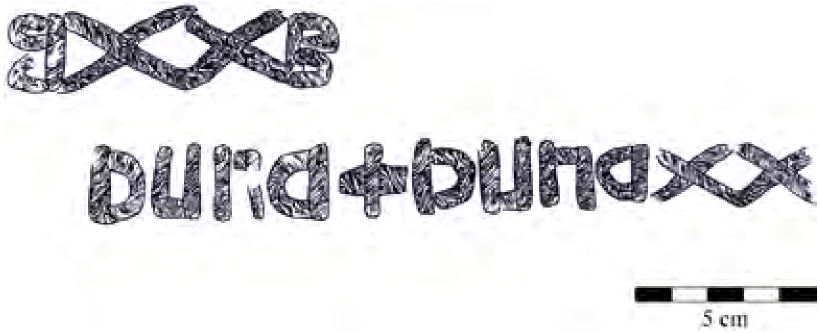
A fragmentary sword in good condition and lacking the lower half of the blade. Weight: 958 g. On one side the fuller is marked with the letters DU four times, followed by a woven lattice. The reverse side contains two B-like figures and a woven lattice. The material of the inlays is twisted pattern-welded rod of eleven layers (six of iron and five of steel). The inlays were defined by surface examination. Radiographs: no. 3612.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword belongs to a group of finds from a cairn (KM 8120:1–4). The sword was claimed for the National Museum in 1922.

Literature: Anteins 1973: 50, 62; Kivikoski 1951: 15; Leppäaho 1964b: 8–9; Oakeshott 1991: 67; Räty 1983: 75–76, 156, 179, 266, 347.



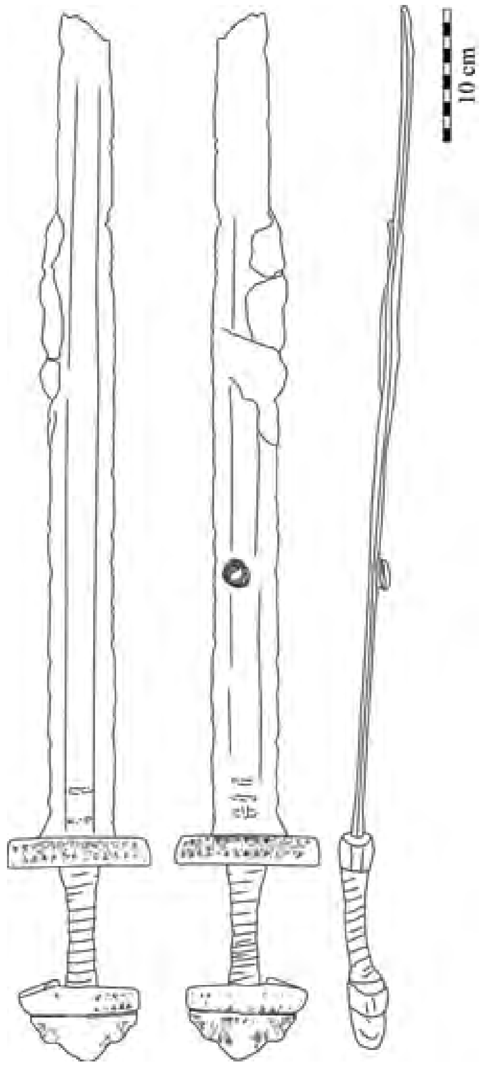


KM 8219 Uusikaupunki, Kalanti, Kallela, Päivölä

A fragmentary sword in fair condition, without the lower half of the blade and the parts of the hilt. Weight: 532 g. On one side the fuller is marked with the inscription +NNOMNEDMN+, and the reverse contains the inscription +AMEN+. The material of the inlays is twisted pattern-welded rod, which contains seven layers (three of steel and four of iron). The inlays were defined by surface examination.

The sword is a stray find from the lands of Päivölä farm. It was discovered in 1877 while planting a tree. The sword was claimed for the National Museum in 1923.

Literature: Anteins 1973: 49–50, 62; Jaakkola 1938: 48–49, 55; Leppäaho 1964b: 10–11; Vilkuna 1975: 79.



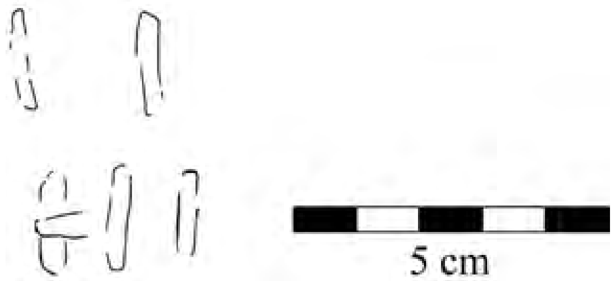
KM 8602:130 Köyliö, Vanhakartano

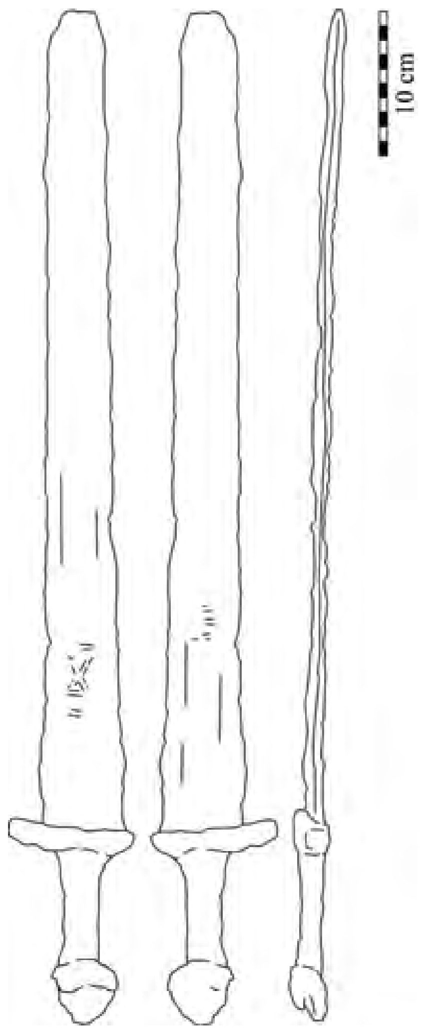
A fragmentary sword in poor condition and without the tip of the blade. Weight: 842 g. Remains of wood, textile and leather were found on the tang and the blade as remains of the grip and the scabbard. On one side the fuller contains inlays resembling the letters H and I, and the reverse side contains two fragmentary vertical lines. The inlays are very uncertain due to the poor preservation of the sword and its conservation method, which included grinding and reassembling with glue. The material of the inlays does not show any traces of pattern-welding. The inlays were defined by surface examination and radiograph no. 3156.

The hilt belongs to Petersen's type T2. The parts of the hilt are decorated with silver, copper and brass wires (23 wires/cm, grooves in two directions). The decoration was arranged to create rhomboidal and triangular patterns, also using silver and brass wires twisted together.

The sword is a grave find from the cemetery of Vanhakartano, from inhumation grave C I (KM 8602:130–137). The grave was excavated by A. Hackman in 1925 (KM 8602:37–195). Finds KM 8602:1–36 are stray finds from before the excavation.

Literature: Cleve 1978: 59, 160–164, Pl. 19; Kivikoski 1939: 207; Kivikoski 1951: 15; Räty 1983: 56–62, 250; Salmo 1952: 53, 492; Tomanterä 1972; Tomanterä 1978: 7.





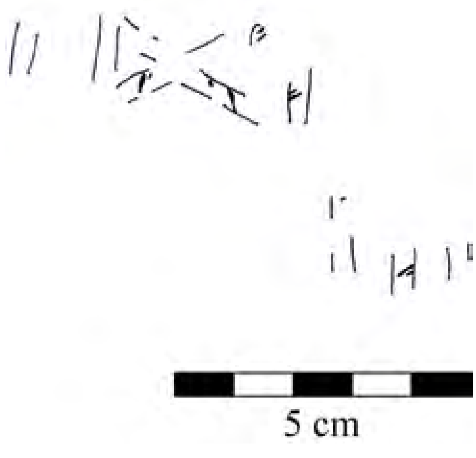
KM 8602 A:116 Köyliö, Vanhakartano

A fragmentary sword in poor condition. The tip of the blade is missing. Weight: 784 g. On one side the fuller contains fragmentary vertical lines, and the reverse side contains the fragments of a lattice. The material of the inlays could be twisted pattern-welded rod. The inlays are difficult to distinguish and are thus somewhat uncertain. The inlays were defined with the aid of radiograph no. 3216. Other radiographs: no. K57 and 3203.

The parts of the hilt are of undecorated iron. The pommel may be of disc-shaped form, but it is very badly corroded.

The sword is a grave find from the cemetery of Vanhakartano, from inhumation grave C 3 (KM 8602 A:116–125). The grave was excavated by A. Hackman in 1925 (KM 8602 A:1–125, from which numbers 1–36 and 77–89 are stray finds).

Literature: Cleve 1978: 22, 160–164; Kivikoski 1951: 15; Salmo 1952: 53, 380, 492; Räty 1983: 265–266; Tomanterä 1978: 8.



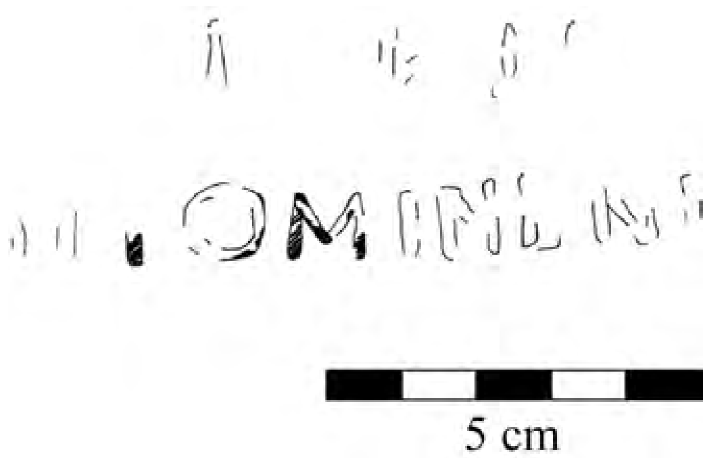
KM 8656 H23:1 Masku, Humikkala

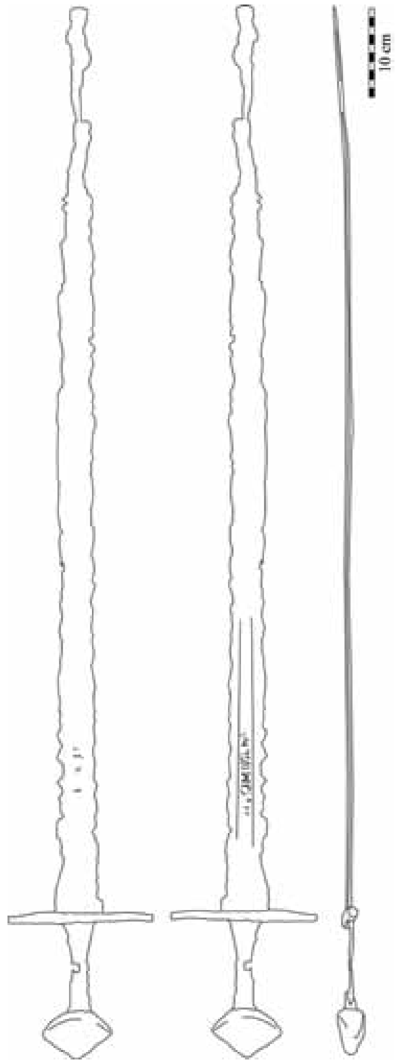
A complete sword in poor condition. Weight: 924 g. On one side the fuller contains the fragmentary inscription OMIN N and other fragmentary letters, and on the reverse side are fragmentary inlays, which could perhaps be letters. The material of the inlays could be twisted pattern-welded rod, which contains large amounts of steel. The inlays were defined by surface examination and radiograph no. 2894. Other radiographs: no. L63.

The pommel belongs to Oakeshott's type E and Geibig's type 19. The parts of the hilt are of undecorated iron.

The sword is a grave find from an inhumation cemetery and belongs to grave no. 23 (KM 8656 H23:1–3), excavated by S. Pälsi in 1925 (KM 8656 H1–48).

Literature: Kivikoski 1951: 36; Räty 1983: 131–133, 153, 292.





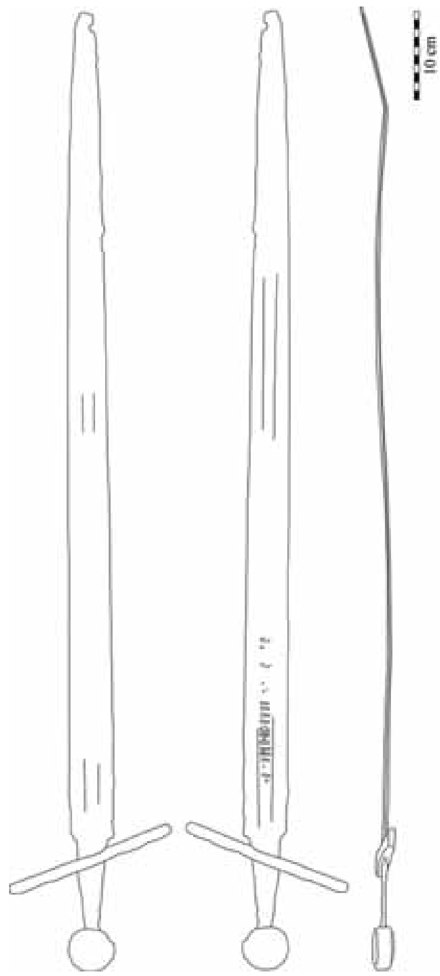
KM 8723:165 Köyliö, Vanhakartano

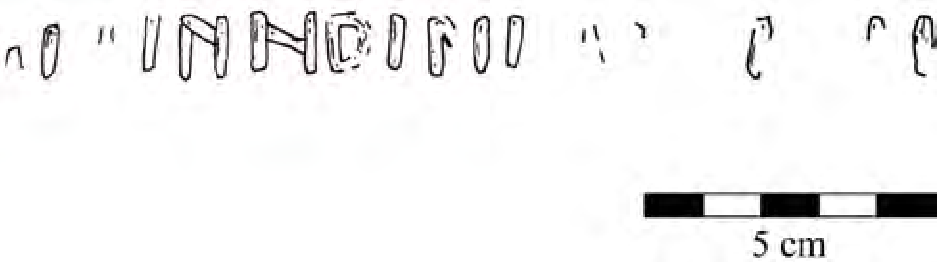
A complete sword in poor condition. Weight: 740 g. The cutting edges have been reconstructed during conservation. On one side the fuller is marked with the fragmentary inscription I INNDINI I I. The material of the inlays appears to be steel rod, which has corroded away in most parts. The inlays were defined with the aid of radiograph no 3219. Other radiographs: no. K32 and L32.

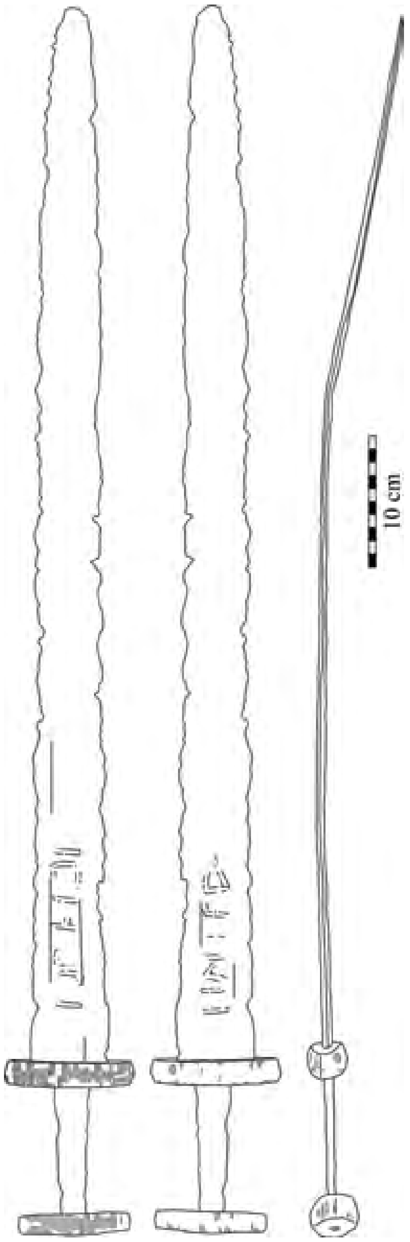
The hilt belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of undecorated iron.

The sword is a grave find from the inhumation cemetery of Vanhakartano and belongs to grave no. C 16 (KM 8723:165–193). These finds may have been mixed with finds from grave C 17. The site was excavated by N. Cleve and C. A. Nordman in 1926 (KM 8723:1–1190).

Literature: Cleve 1978: 31–33, 160–164, Pl. 5; Kivikoski 1951: 36; Salmo 1952: 54, 383, 492; Tomanterä 1978: 10, 16, 19–23, 25, 34, 58, 61, 126, 128.







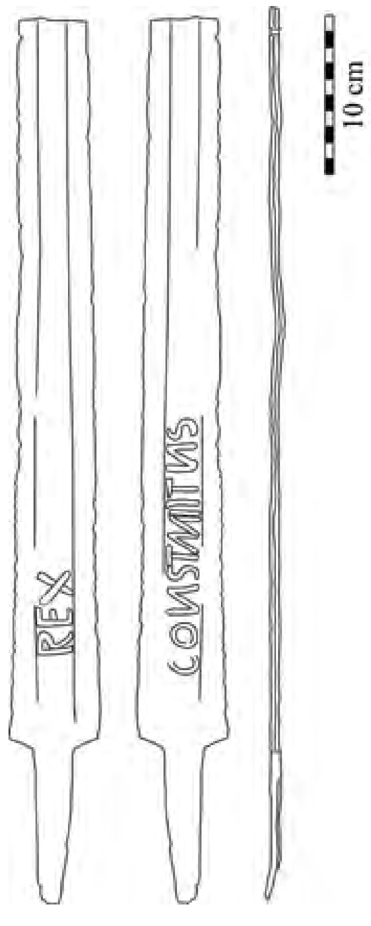
KM 8896:25 Raasepori, Tenhola, Rubacken, Västergård

A fragmentary sword in poor condition and without its pommel. Weight: 1025 g. On both sides the fuller contains letter-like fragmentary marks. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 2985.

The hilt belongs to Petersen's type H. The upper and lower guards are of iron and decorated with inlays from copper wire (13 wires/cm). The upper and lower faces of the lower guard appear to be faced with copper plates.

The sword belongs to a group of finds from 1927 from the property of Fastarby-Västergård (KM 8896:25–27). The find location was later excavated by A. Hackman in 1928 (KM 8896:28–68).

Literature: Räty 1983: 38–39, 42, 230.

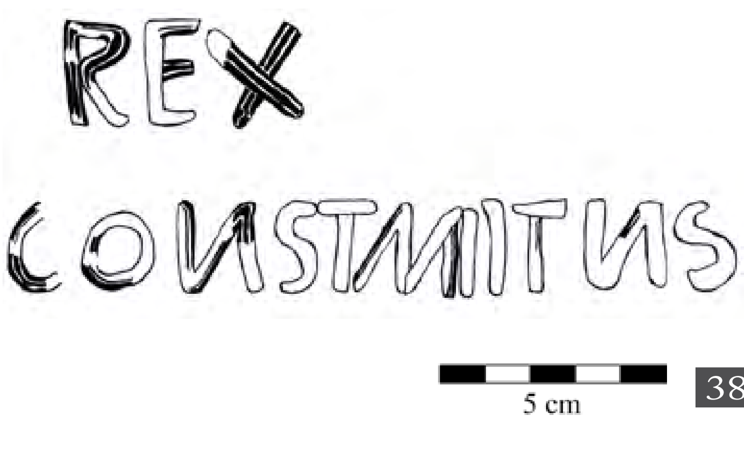


KM 8911:91 Mynämäki, Tursunperä, Franttilannummi

A fragmentary sword blade in good condition, without the parts of the hilt and the lower half of the blade. Weight: 362 g. The blade is laminated so that steel parts are near the surface of the blade, while iron remains in the core. On one side the fuller contains the inscription CO┴STMIIT┴S, and the reverse side contains the inscription REX. The material of the inlays is non-twisted pattern-welded rod, which contains 3–5 layers. The inlays were defined by surface examination.

The sword is a cemetery find from a level-ground cremation cemetery, excavated by H. Salonen in 1928 (KM 8911:1–167).

Literature: Anteins 1973: 49, 62; Lehtosalo-Hilander 1984: 365; Leppäaho 1952; Leppäaho 1964b: 38–39; Moilanen 2010a: 4–5; Moilanen 2010b: 48; Uino 2003a: 355; Williams 2009: 141–142, 181.

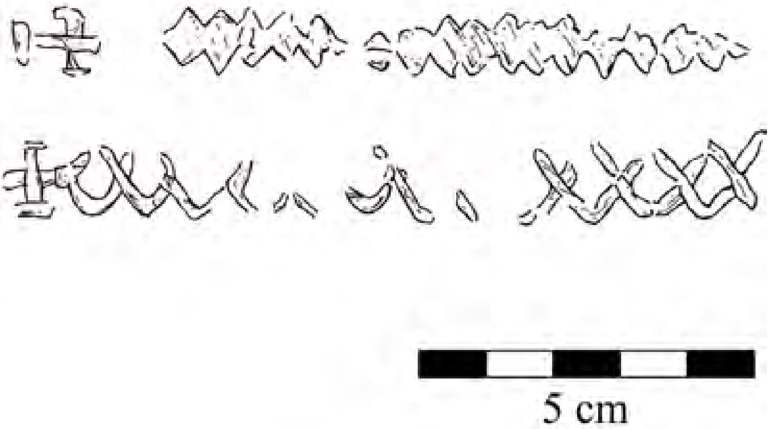


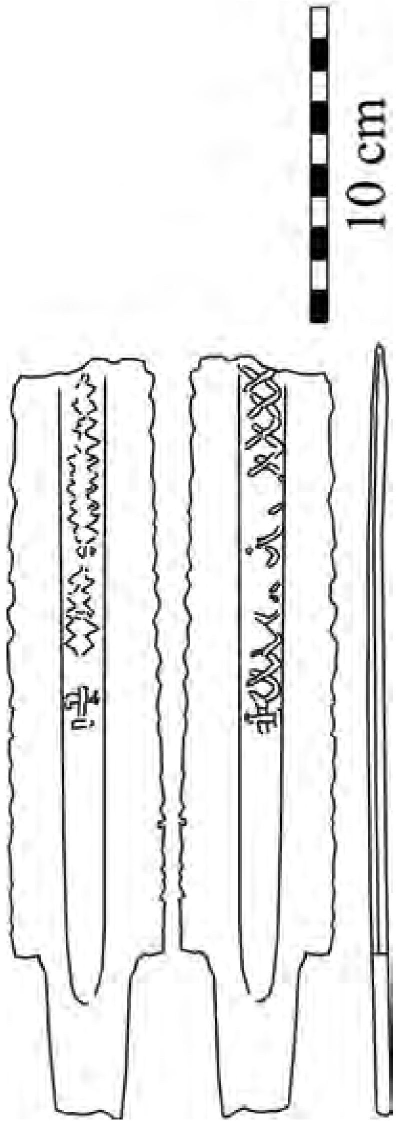
KM 9142:8 Nousiainen, Moisio, Myllymäki

A fragmentary sword in fair condition, without the lower half of the blade and the parts of the hilt. Weight: 230 g. On one side the fuller contains a fragmentary cross crosslet and a lattice pattern. The reverse side contains a fragmentary cross crosslet and a tooth-like diamond pattern. The material of the inlays seems to be iron rod, which has corroded less than the blade. The inlays were defined by surface examination. Radiographs: no. 3533.

The sword was found on the side of Myllymäki hill along with parts of skeletons and other small artefacts (KM 9142:1–6, 8–9, 11–13), probably belonging to an inhumation grave. The site was excavated by H. Salonen (KM 9142:7, 10, 13). The sword was brought to the National Museum in 1930.

Literature: Leppäaho 1964b: 32–33; Tomanterä 1978: 53–54.





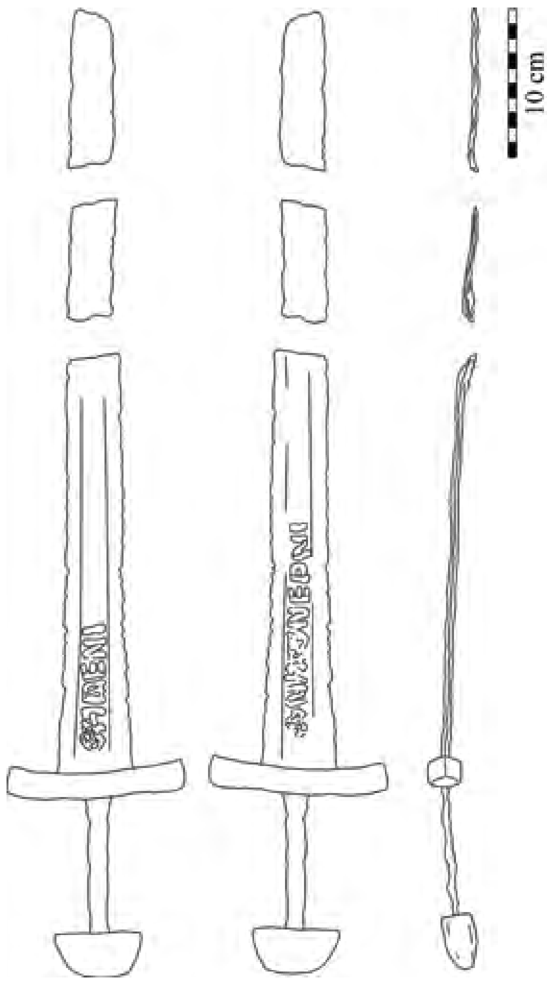
KM 9164:2 Eura, Pappilanmäki

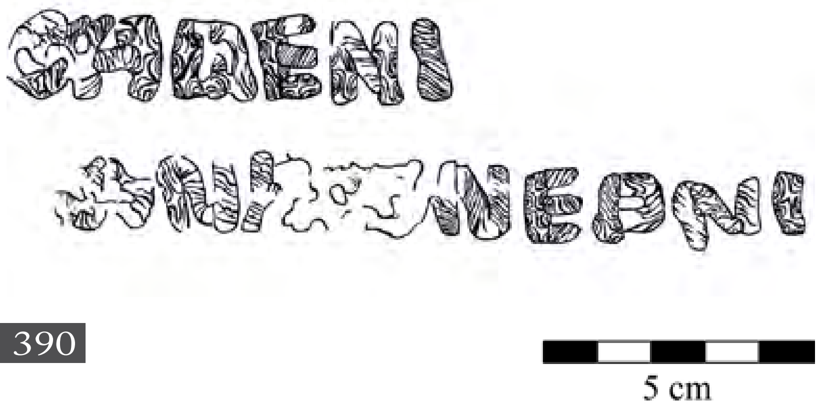
A fragmentary sword in poor condition and broken in three pieces. Weight: 679 g. On one side the fuller is marked with the fragmentary inscription N...NEDNI, and the reverse side contains the inscription AMENI. The material of the inlays is twisted pattern-welded rod, which contains thirteen layers (seven of iron and six of steel). The inlays were defined by surface examination. Other radiographs: no. 595.

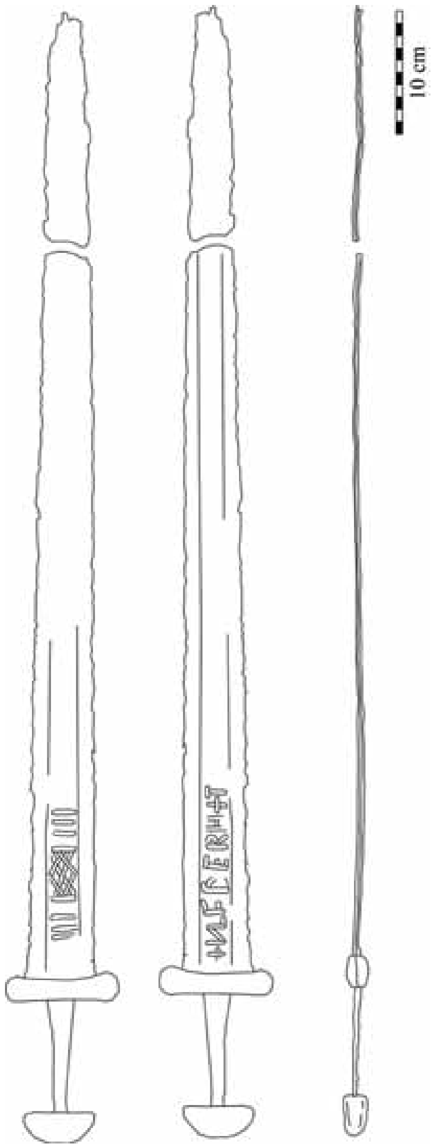
The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword is presumably a grave find from an inhumation cemetery in 1929 (KM 9164:2–7). The sword belongs to artefacts found from the same cemetery and sent to the National Museum in 1930 (KM 9164:1–7).

Literature: Anteins 1973: 49, 62; Kivikoski 1951: 15; Leppäaho 1964b: 10–11; Räty 1983: 73–76, 155, 177–178, 261–262; Räty 1998: 39, 41, 48; Salmo 1952: 45, 380, 492.







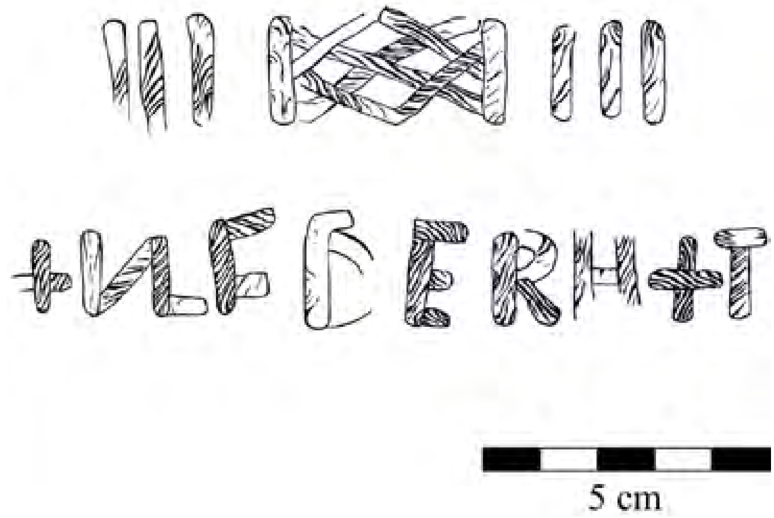
KM 9164:3 Eura, Pappilanmäki

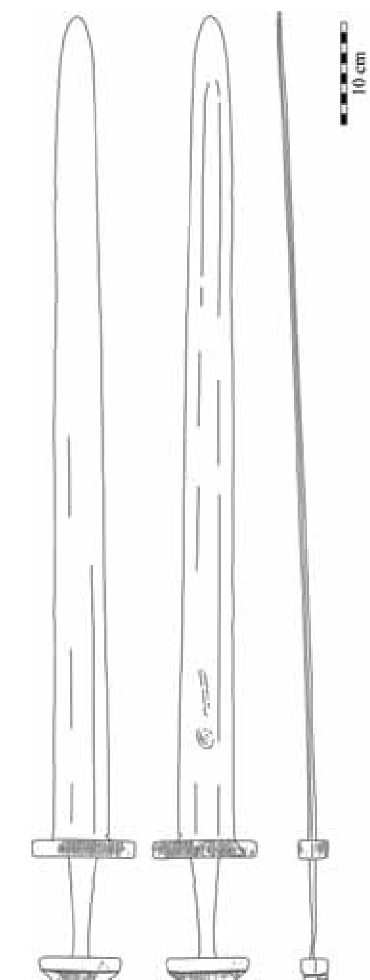
A complete sword in poor condition and broken in two pieces. Weight: 1024 g. Balance point: 170 mm. On one side the fuller contains the inscription +VLFBERH+T, and the reverse side contains a woven lattice and six vertical lines. The material of the inlays is both twisted and non-twisted pattern-welded rod, which most likely contains 7–9 layers. The inlays were defined by surface examination.

The hilt belongs to Petersen's type R or S (more likely R) according to its lower guard, and to the later variant of Petersen's type X according to its pommel. The parts of the hilt seem to be undecorated iron.

The sword is presumably a grave find from an inhumation cemetery in 1929 (KM 9164:2–7). The sword belongs to artefacts found from the same cemetery and sent to the National Museum in 1930 (KM 9164:1–7).

Literature: Anteins 1973: 61; Kivikoski 1951: 15; Leppäaho 1964b: 12–13; Moilanen 2010a: 8: Müller-Wille 1970: 79, 87; Räty 1983: 54–55, 74–76, 155, 162, 164, 247, 261–262, 346; Räty 1998: 39–40, 48; Salmo 1952: 45, 380, 492; Williams 2009: 127–128, 153.





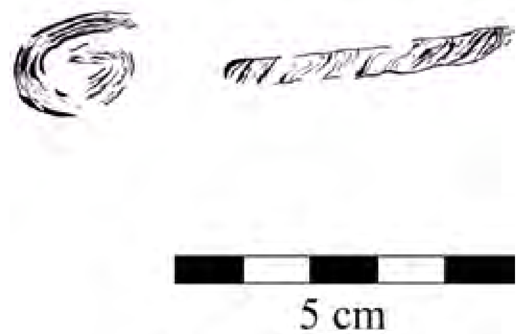
KM 9243:1 Sauvo, Mäenala

A complete sword in fair condition. Weight: 1150 g. Balance point: 175 mm. The cutting edges have been reconstructed during conservation. On one side the fuller contains a spiral-like inlay and a horizontal strip. The material of the inlays is both non-twisted and twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3154. Other radiographs: no. 670 and 3157.

The hilt belongs to Petersen's type I. The parts of the hilt are of iron and decorated with inlays from silver and copper wires (14 wires/cm), which are also twisted together to create a fish-bone pattern.

The sword belongs to a group of finds from roadworks (KM 9243:1–4). The sword belongs to artefacts brought to the National Museum by A. M. Tallgren in 1930 (KM 9243:1–5).

Literature: Kivikoski 1951: 14, Tl. 96:770; Kivikoski 1973: 112, Tafel 94:832; Räty 1983: 43–44, 229, 345; Tallgren 1931b: 99; Tomanterä 1984b: 386–387.



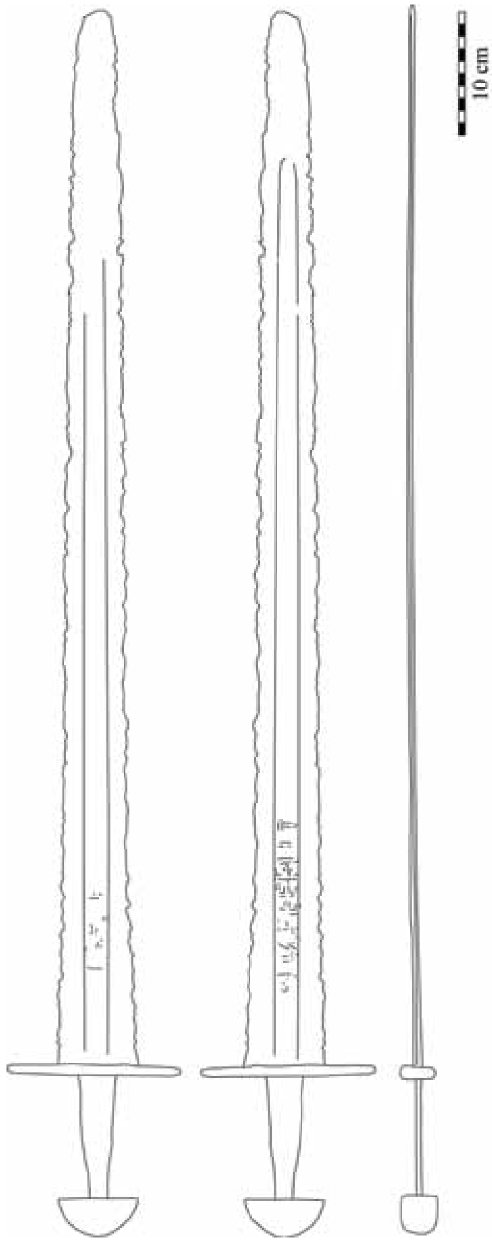
KM 9243:2 Sauvo, Mäenala

A complete sword in poor condition. Weight: 1244 g. Balance point: 190 mm. On one side the fuller is marked with the fragmentary inscription +VLFEERI I T, and the reverse side contains the remains of some kind of lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3153.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword belongs to a group of finds from roadworks (KM 9243:1–4). The sword belongs to artefacts brought to the National Museum by A. M. Tallgren in 1930 (KM 9243:1–5).

Literature: Kivikoski 1951: 14–15, Tl. 98:779; Kivikoski 1973: 113, Tafel 95:837; Lehtosalo-Hilander 1984: 361; Räty 1983: 74–76, 258; Tallgren 1931b: 99.

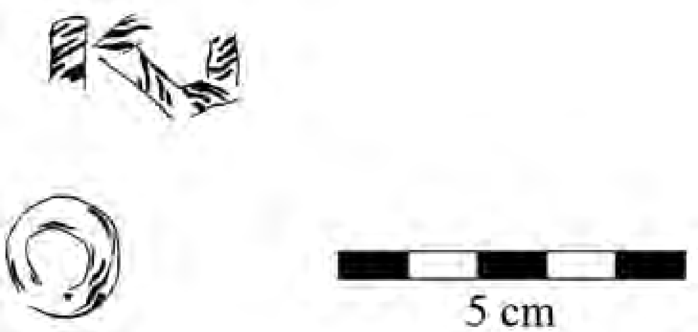


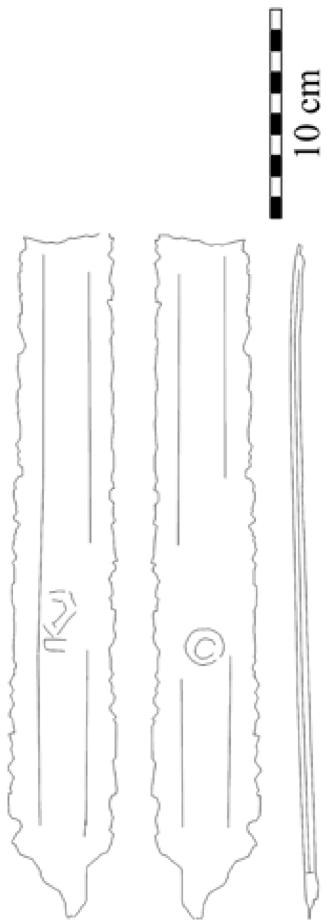
KM 9389:1 Salo, Halikko, Talola, Kaikumäki

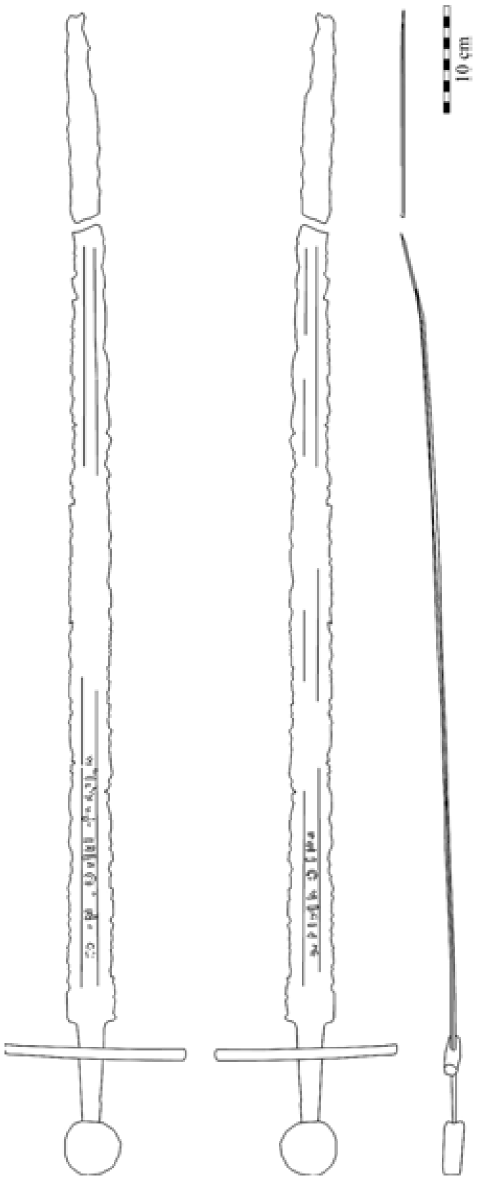
A fragmentary sword in poor condition, lacking the lower half of the blade and the parts of the hilt. Weight: 266 g. On one side the fuller contains a circle, and the reverse side contains fragments of a vertical line and a possible lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3821.

The sword belongs to artefacts found in the ground at Kaikumäki farm and sold to the National Museum in 1931 (KM 9389:1–28), possibly originating from a cemetery. According to the report, the sword originally had a separate hilt of Petersen's type X.

Literature: Kivikoski 1939: 209; Kivikoski 1951: 15; Räty 1983: 74–76, 153, 256.







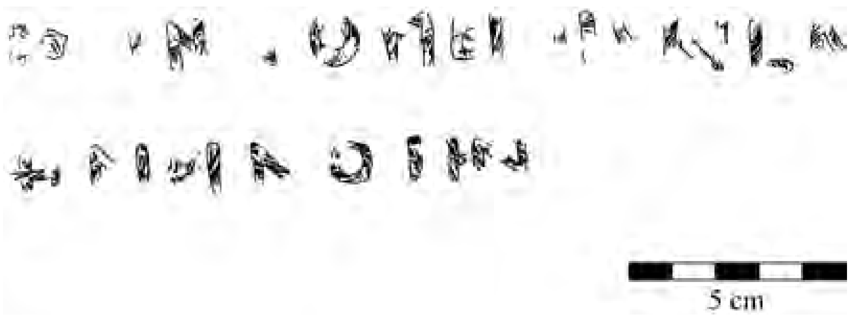
KM 9419 Salo, Uskela, Kavila

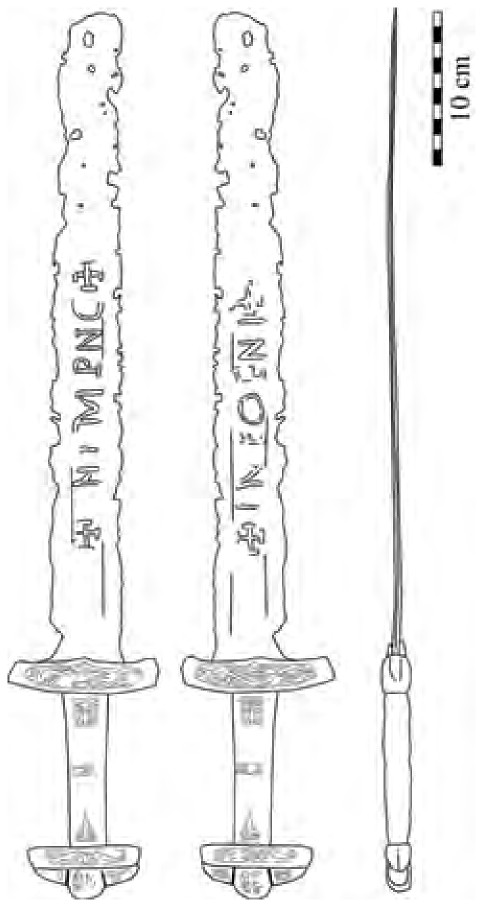
A complete sword in poor condition with the tip of the blade broken. Weight: 868 g. Balance point: 140 mm. On both sides the fuller is marked with the fragmentary inscriptions consisting of cross crosslets and Latin letters. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no 3828. Other radiographs: no. K6 and L6.

The hilt belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of undecorated iron.

The sword is a stray find from the lands of Kavila farm from 1931 and claimed for the National Museum in the same year. The find place has not been further investigated.

Literature: Kivikoski 1951: 36; Tomanterä 1978: 35–36, 61, 129.





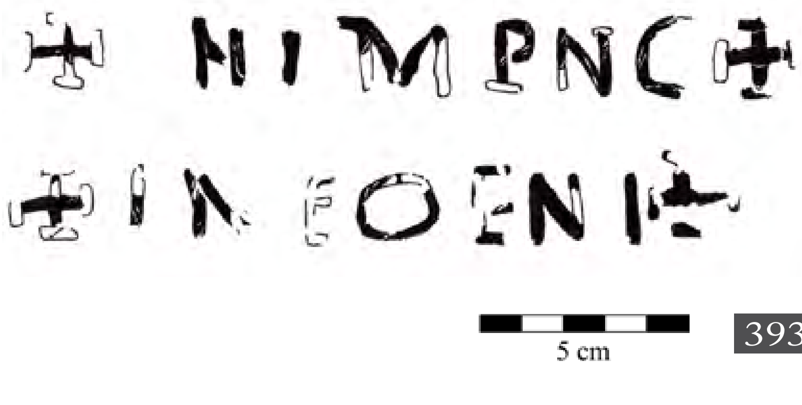
KM 9562:1 Lieto, Mäkkylä, Hulkkunanmäki

A fragmentary sword in poor condition and without the tip of the blade. Weight: 590 g. On one side the fuller is marked with the fragmentary inscription +IN EOENI+, and the reverse side bears the fragmentary inscription +NI MPNC+. The material of the inlays could be pattern-welded rod, as the inlays have slight colour differences. Most of the inlays have corroded away, so their material must have contained large amounts of carbon. The inlays were defined by surface examination.

The hilt belongs to the silver-plated type. The pommel has twisted silver wires in its grooves, and the silver surface has been decorated with engravings.

The sword belongs to a group of artefacts recovered under a large rock (KM 9562:1–7), which is catalogued as grave no. 1 in an inhumation cemetery (also KM 9695:5–12). The sword was claimed for the National Museum in 1932.

Literature: Kivikoski 1934: 193–194; Kivikoski 1939: 206; Kivikoski 1951: 15, Tl. 99:784; Kivikoski 1973: 114, Tafel 96:843; Lehtosalo-Hilander 1983: 293–294; Lehtosalo-Hilander 1985: 7; Leppäaho 1964b: 20–21, 70–71; Räty 1983: 105–106, 109–111, 153, 175–178, 280–281, 348; Räty 1998: 45; Tomanterä 1978: 69–70, 136.



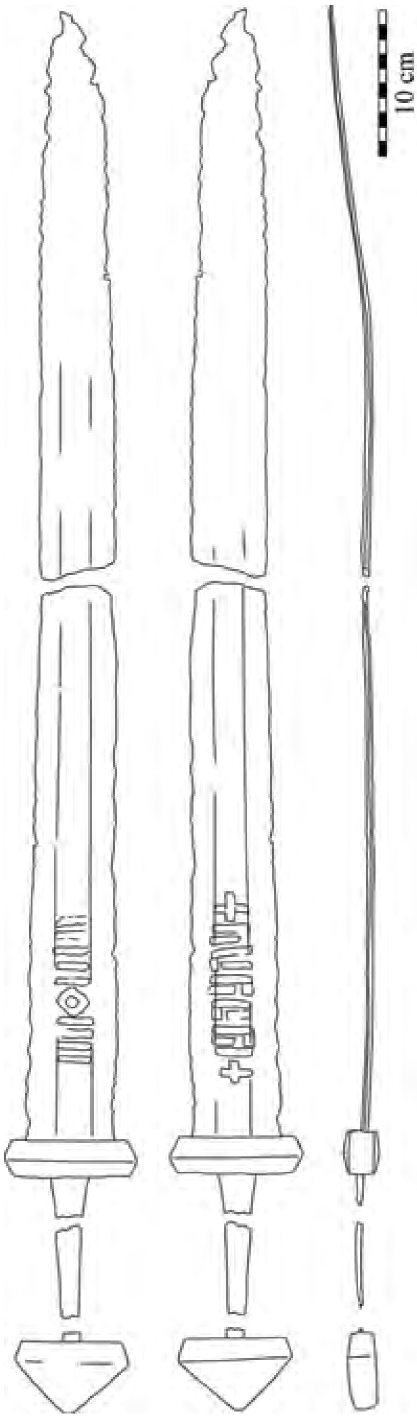
KM 9778 Kokemäki, Harola, Pajasaari, Huru

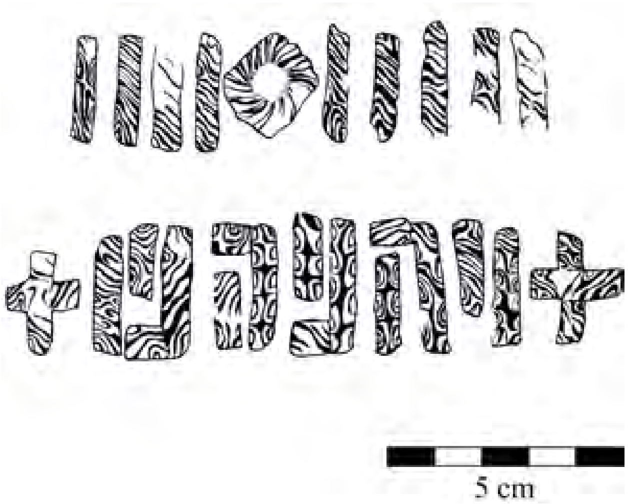
A fragmentary sword in good condition. The tang is broken in two places. The lower half of the blade is find KM 10020:1. Weight: 1468 g. On one side the fuller contains letter-like symbols, and the reverse side contains a square and nine vertical lines. The material of the inlays is twisted pattern-welded rod, which contains seven layers (four of iron and three of steel). The inlays were defined by surface examination. Radiographs: no. 3166 and 3167.

The hilt belongs to Petersen's type C. The parts of the hilt are of undecorated iron.

The sword is a stray find from a field at Huru farm and was claimed for the National Museum in 1933. The lower half of the blade (KM 10020:1) was found later. The sword is possibly from a level-ground cremation cemetery.

Literature: Anteins 1973: 52, 62; Kivikoski 1973: 112, Tafel 94:828; Leppäaho 1964b: 6–7; Mikkola 1999: 41; Räty 1983: 27, 155, 179–180, 205, 344, 350; Salmo 1938: 340; Salmo 1952: 68, 255, 474.





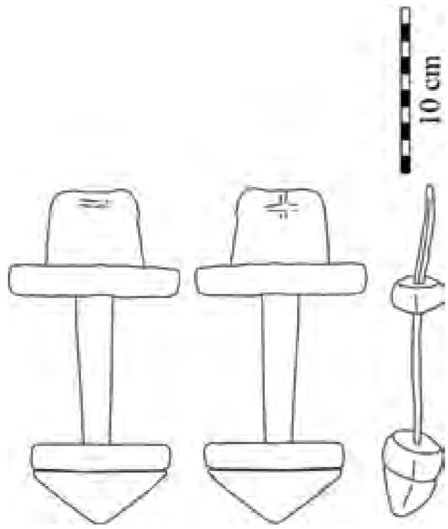
KM 9832 Laitila, Untamala, Raula

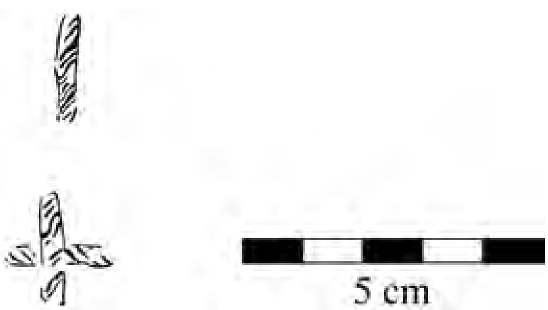
A fragmentary sword in poor condition, without the lower half of the blade. Weight: 802 g. On one side the fuller bears an inlaid cross, and the reverse side contains one vertical line. The material of the inlays is twisted pattern-welded rod with possibly seven layers (four of iron and three of steel). The inlays were defined with the aid of radiograph no. 3386.

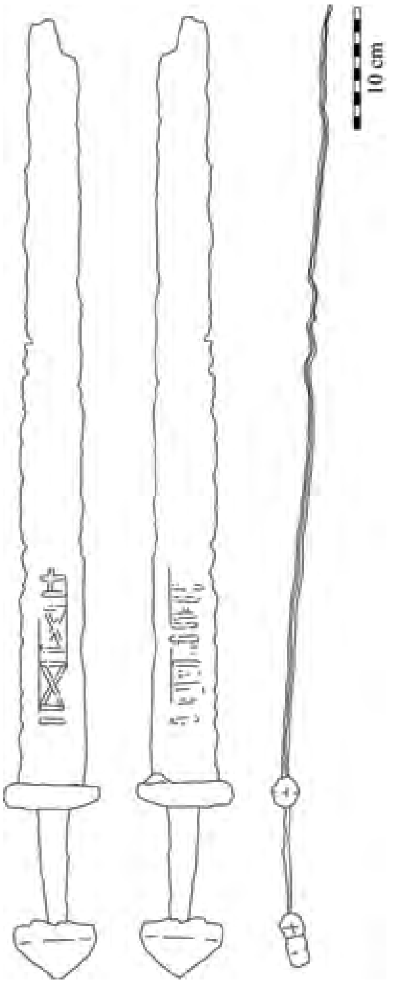
The hilt belongs to Petersen's type H. The parts of the hilt are of iron and no traces of decoration are visible any longer.

The sword is a stray find from Untamala ridge, from the northwest side of the road leading to Raula farm, from the edge of a gravel pit. The sword was sent to the National Museum in 1934.

Literature: Räty 1983: 38–39, 223.







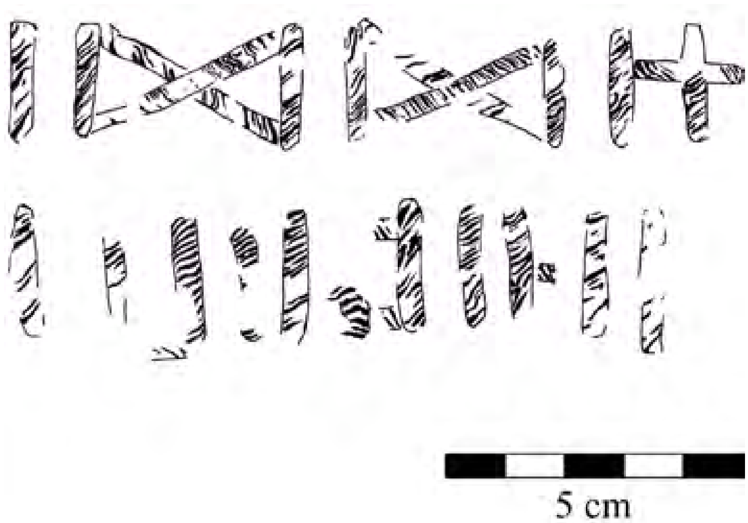
KM 10349:1 Nousiainen, Alakylä, Hinttermäki

A fragmentary sword in poor condition and without the tip of the blade. Weight: 868 g. On one side the fuller is marked with vertical lines and perhaps letter-like inlays, and the reverse side contains two lattices, vertical lines and a cross. The material of the inlays is twisted pattern-welded rod, which contains 7–9 layers. The inlays were defined by surface examination and radiographs nos. 582 and 3161.

The hilt belongs to Petersen's type B. The parts of the hilt are of iron and most likely undecorated.

The sword is probably a grave find from a mound which contained cremations (KM 10349:1–2). The sword was claimed for the National Museum in 1936.

Literature: Räty 1983: 18–19, 153, 162–163, 200; Räty 1998: 39–40, 49; Salmo 1938: 17–18, 340.



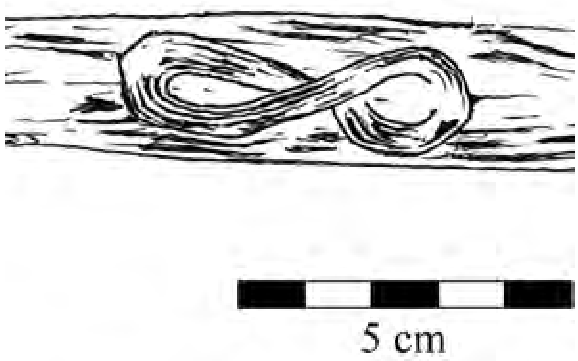
KM 10369:3 Nousiainen, Alakylä, Hinttermäki

A fragmentary sword in poor condition lacking the pommel and the upper guard. Weight: 794 g. The fuller consists of four twisted, pattern-welded bars, two on each side. The layer count of the bars is eleven (five of iron and six of steel). On one side the fuller contains a figure-8 symbol. The material of inlay is non-twisted pattern-welded rod with most likely the same layer count as the rods used for the blade. The pattern-welding and the inlay were defined by surface examination and radiograph no. 3770.

The lower guard is undecorated iron and belongs to Petersen's type B.

The sword is a probable grave find (KM 10369:1–8) from a cremation cemetery and belongs to a group of artefacts excavated by E. Kivikoski in 1936 (KM 10369:1–85).

Literature: Räty 1983: 158–159; Salmo 1938: 340.

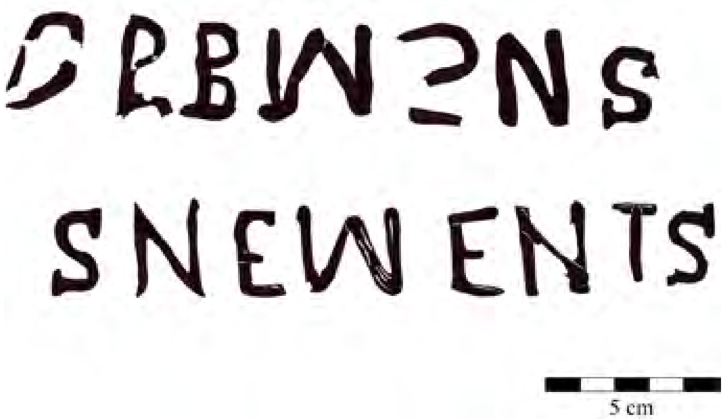


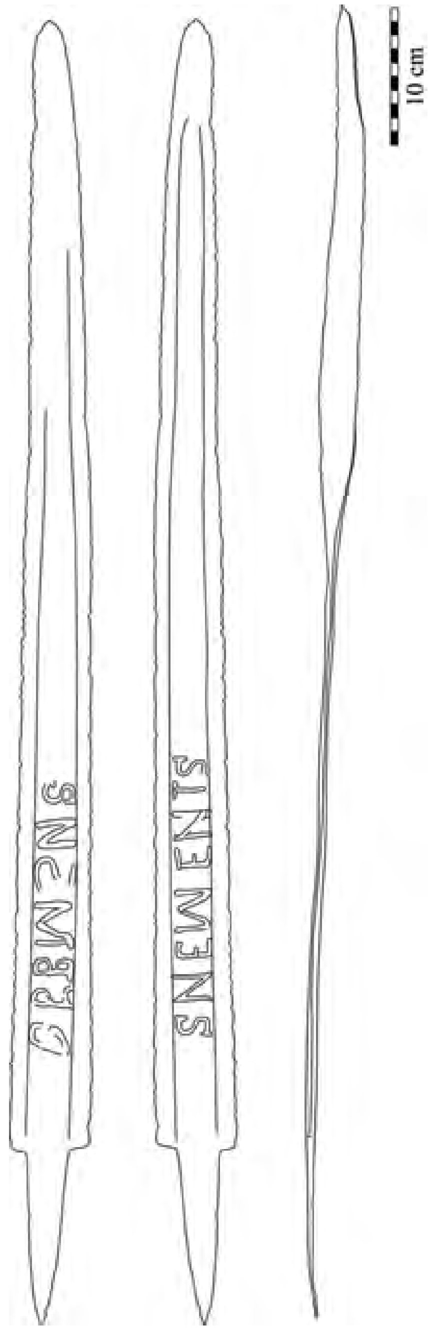
KM 10372:1 Kurkijoki, Kuuppala, Kalmistomäki

A complete sword blade in good condition, lacking the parts of the hilt. Weight: 671 g. On one side the fuller bears the inscription SNEWENTS, and the reverse side is marked with the fragmentary inscription ...BW...NS. The material of the inlays could be non-twisted pattern-welded rod or plain iron rod with longitudinal slag inclusions. The inlays were defined by surface examination. Radiographs: no. 2983.

The sword is a stray find from ploughing a field (KM 10372:1–3) and possibly derives from a cemetery. The sword was claimed for the National Museum in 1936.

Literature: Anteins 1973: 51, 62; Kirpichnikov et al. 2006: 46, 56, 64; Leppäaho 1964b: 30–31; Uino 2003: 333.





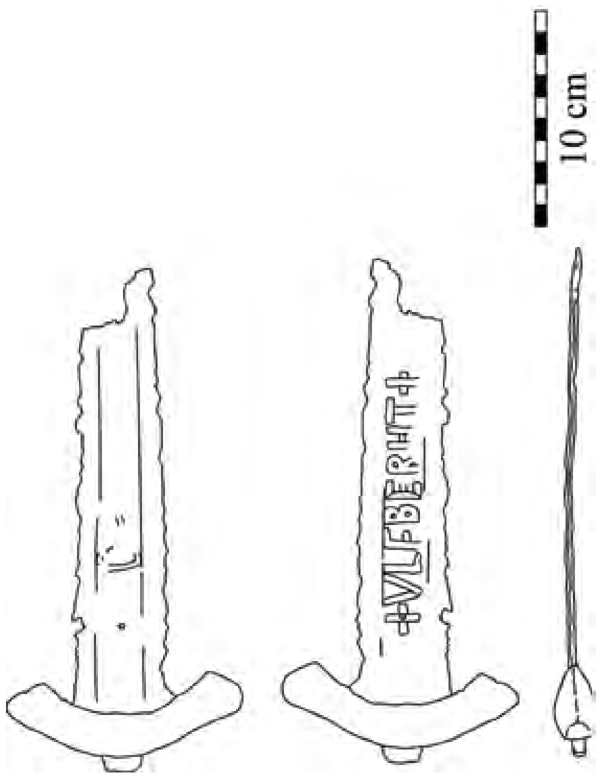
KM 10390:2 Vesilahti, Pörölä, Sassinsaari

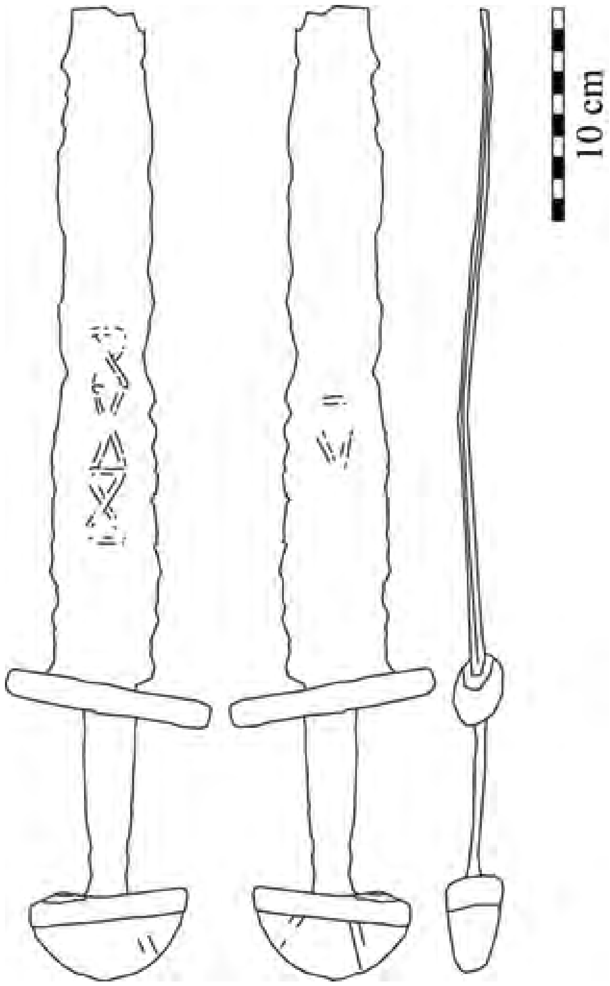
A fragmentary sword in poor condition, without the lower half of the blade. Weight: 209 g (without pommel). The pommel parts can be found under catalogue number KM 10409:1. On one side the fuller bears the inscription +VLFBERHT+, and the reverse side contains fragmentary parts of a lattice pattern. The material of the inlays is twisted pattern-welded rod, which contains eleven layers (six of steel and five of iron). The steel layers have corroded away in most parts. The inlays were defined by surface examination and radiograph no. 600.

The lower guard belongs to Petersen's type Z. The parts of the hilt are of iron and bear traces of silver decoration.

The sword is a cemetery find from a level-ground cremation cemetery or hoard, belonging to a group of finds (KM 10390:1–7). The sword was claimed for the National Museum in 1936. The pommel (KM 10409:1) was excavated by J. Voionmaa in 1936 (KM 10409:1–14).

Literature: Anteins 1973: 39, 61; Hirviluoto 1992: 44; Honka-Hallila 1984: 77; Kivikoski 1951: 15; Leppäaho 1964b: 42–43; Müller-Wille 1970: 79, 87; Räty 1983: 82–87, 155, 162, 165, 277; Räty 1998: 39–40, 49; Salmo 1952: 116–118; Williams 2009: 131, 161.





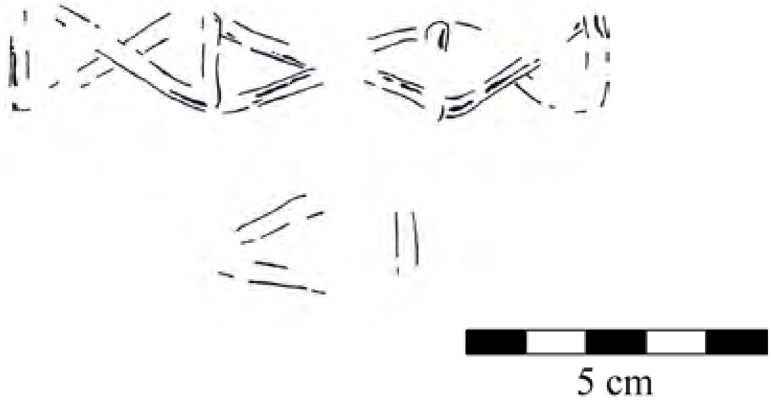
KM 10390:3 Vesilahti, Pörölä, Sassinsaari

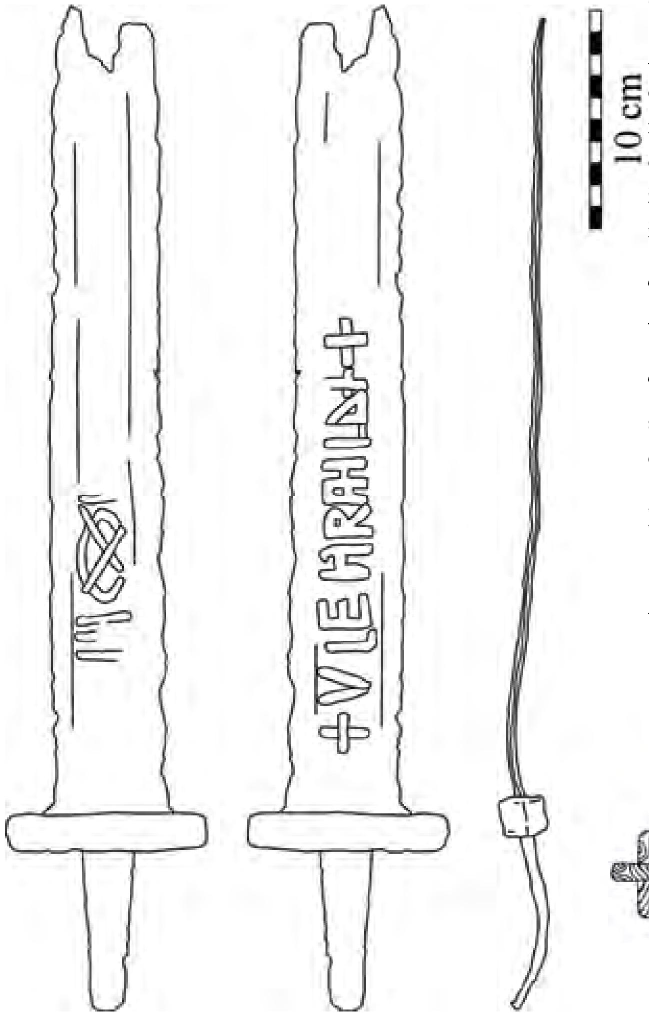
A fragmentary sword in poor condition and lacking the lower half of the blade. Weight: 590 g. On one side the fuller is marked with three lattices, and the reverse side contains fragments of a possible lattice. The material of the inlays seems to be steel rod, which is more corroded than the material of the blade. The inlays were defined by surface examination and radiograph no. 3439. Other radiographs: no. 581 and 3446.

The hilt belongs to Petersen's type U. The parts of the hilt are of iron and appear to be undecorated.

The sword is a cemetery find from a level-ground cremation cemetery or a hoard and belongs to a group of finds (KM 10390:1–7). The sword was claimed for the National Museum in 1936.

Literature: Honka-Hallila 1984: 77; Kivikoski 1951: 15; Räty 1983: 64–66, 155, 253–254; Salmo 1952: 118, 383, 492.





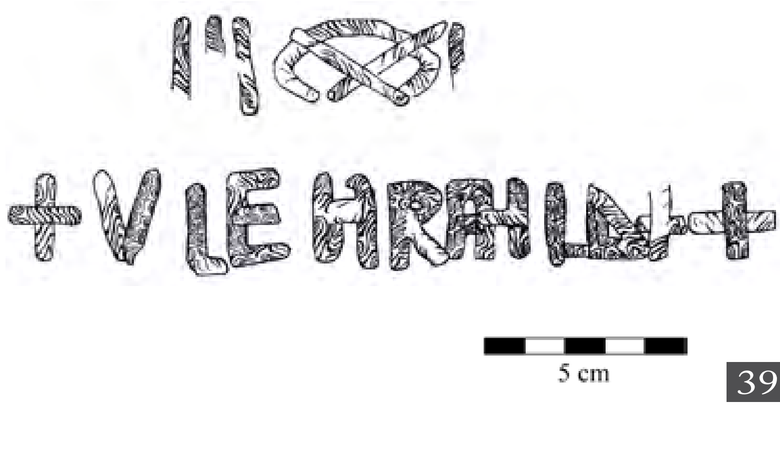
KM 10390:5 Vesilahti, Pörölä, Sassinsaari

A fragmentary sword in poor condition, lacking the pommel and most of the blade. Weight: 406 g. On one side the fuller is marked with the fragmentary inscription +VLEHRAHLDH+, and the reverse side contains a woven lattice and four vertical lines. The material of the inlays is twisted pattern-welded rod, which contains variably 7–13 layers. The inlays were defined by surface examination.

The lower guard may belong to Petersen's type V. No decoration is visible any more on the guard.

The sword is a cemetery find from a level-ground cremation cemetery or a hoard, belonging to a group of finds (KM 10390:1–7). The sword was claimed for the National Museum in 1936.

Literature: Anteins 1973: 51, 62; Honka-Hallila 1984: 78; Leppäaho 1964b: 42–43; Müller-Wille 1970: 79, 87; Räty 1983: 64–66, 155, 162, 165, 253–254; Räty 1998: 39–40, 49; Salmo 1952: 118, 383, 493; Williams 2009: 138, 177.



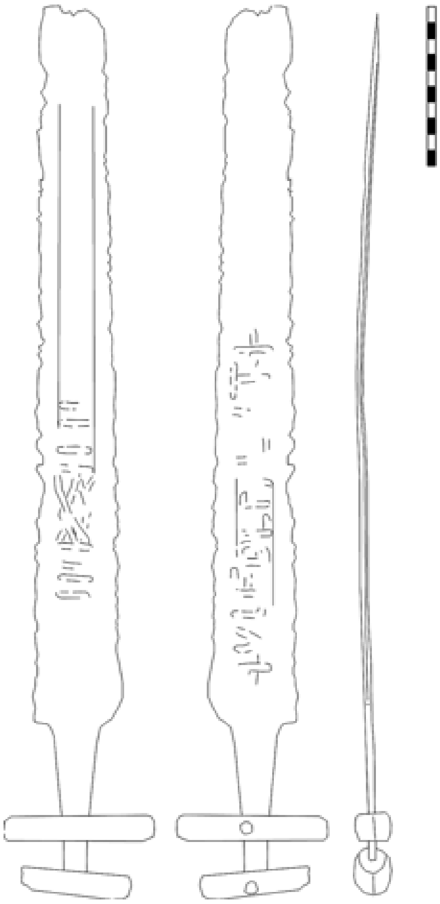
KM 10413 Lieto, Nautela, Kuivurinmäki

A fragmentary sword in poor condition and without the pommel and the tip of the blade. The lower guard has moved from its original position. Weight: 626 g. On one side the fuller is marked with the fragmentary inscription +VLFBE... T+, and the reverse side contains a woven lattice and six vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3833.

The guards are of iron and no decoration is visible due to corrosion. The guards may belong to Petersen's type H.

The sword is a stray find from the property of Nautela farm, either from the garden or from the hill next to it, probably from a cemetery. The sword was found in 1926, and it was donated to the National Museum in 1936.

Literature: Kivikoski 1939: 23, 204; Räty 1983: 43–44, 225.



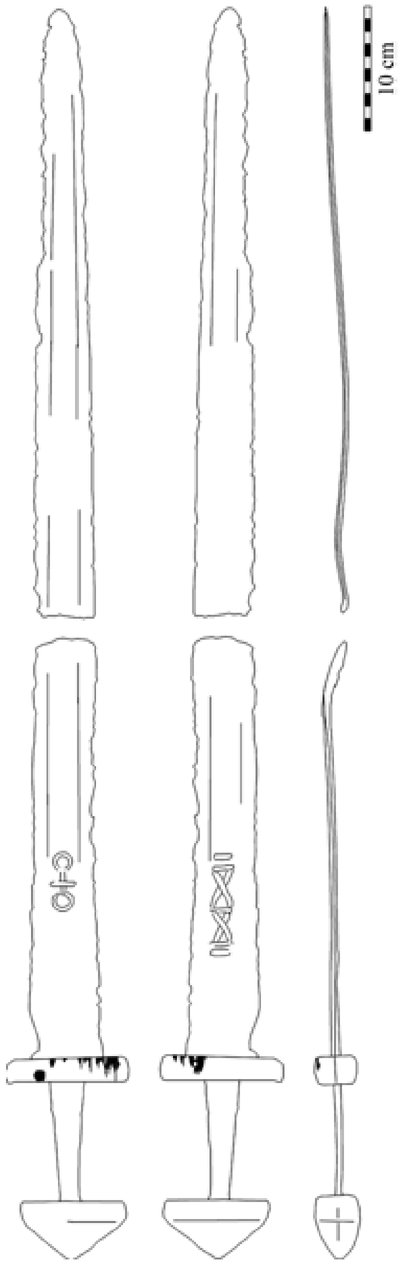
KM 10906:1 Nousiainen, Kaisela, Posti

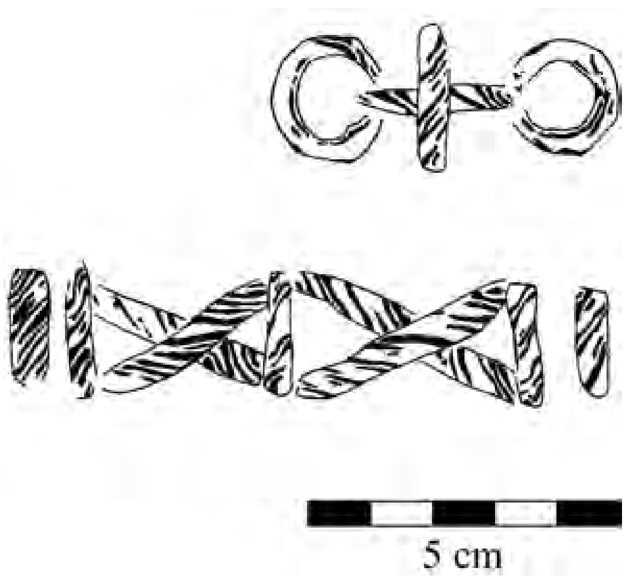
A fragmentary sword in poor condition and broken in the middle of the blade. Weight: 1430 g. On one side the fuller contains two lattices lined by two vertical lines, and on the reverse is a cross lined by two circles. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3830. Other radiographs: no. 580.

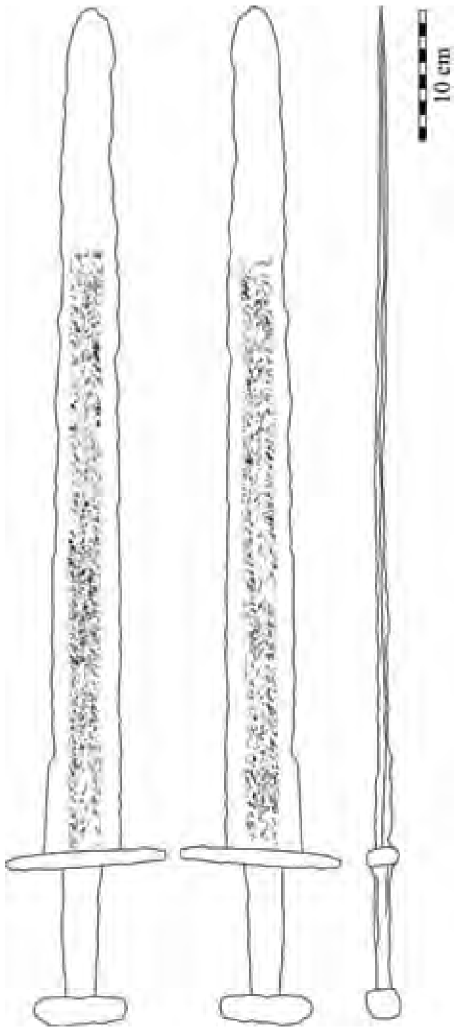
The sword belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical wire inlays.

The sword is a stray find from the property of Posti farm, from a sand pit in 1938, probably originating from a cemetery.

Literature: Räty 1983: 38–39, 153, 228.







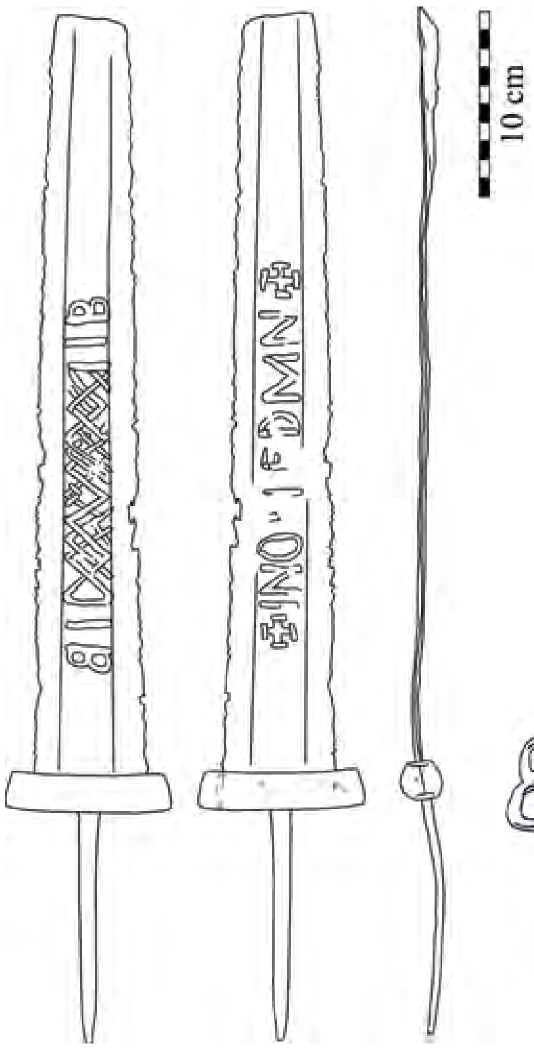
KM 11063:283 Eura, Pappilanmäki

A complete sword in poor condition. Weight: 956 g. The fuller consists of six twisted, pattern-welded bars, of which three appears on each side of the blade. Each bar contains possibly nine layers (five of iron and four of steel). On one side the fuller contains an S-shaped figure. The material of inlay is non-twisted pattern-welded rod, which has perhaps five layers (three of iron and two of steel). The inlays were defined with the aid of radiograph no. 3309. Other radiographs: no. 587.

The hilt may belong to Petersen's type N. The parts of the hilt are of iron and seem to be undecorated.

The sword is a find from grave no. IV (KM 11063:272–293) of the inhumation cemetery at the site. The cemetery was excavated by H. Salmo in 1939 (KM 11063:1–840).

Literature: Kivikoski 1951: 14; Moilanen 2010a: 8; Räty 1983: 48–49, 243; Salmo 1952: 42, 378, 492.



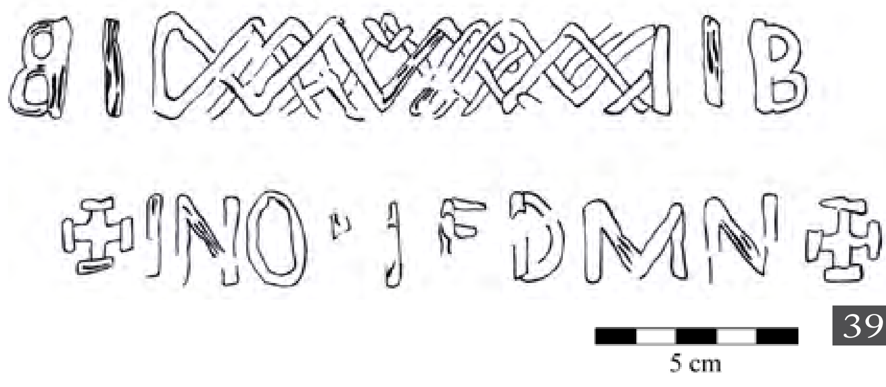
KM 11198 Lempäälä, Haurala, Henneri

A fragmentary sword in poor condition, lacking the pommel and the lower half of the blade. Weight: 579 g. Differential corrosion suggests that the blade was laminated. On one side, the fuller is marked with the fragmentary inscription +INO IFDMN+, and the reverse side contains a lattice weave between two letters B. The material of the inlays could be non-twisted pattern-welded rod with perhaps 3–5 layers, or plain iron rod with longitudinal slag inclusions or a corroded structure. The material of the inlays seems to be very similar to that of the blade. The inlays were defined by surface examination.

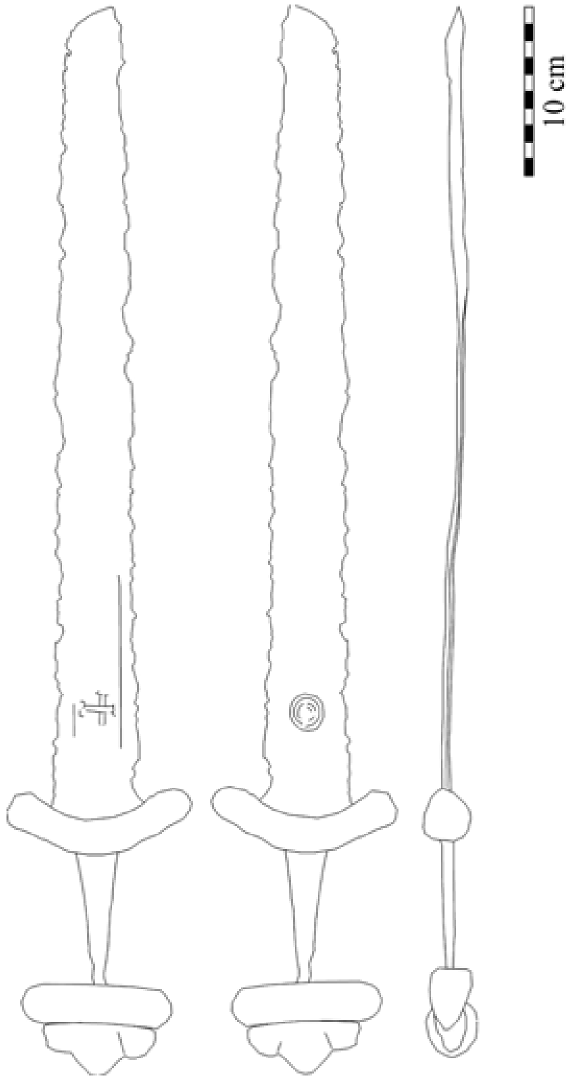
The lower guard belongs to the silver-plated type. The guard bears traces of silver-plating as well as a hatched surface (28 grooves/cm in two directions).

The sword is a grave find from a mound or a cairn, which was exploded by a bomb. The mound was situated in the yard of Henneri farm. The sword was given to the National Museum in 1940.

Literature: Hirviluoto 1992: 45; Honka-Hallila 1984: 43; Leppäaho 1964b: 32–33; Räty 1983: 56–62, 155, 177–178, 251; Salmo 1952: 125, 493.



KM 11242 Kangasala, Vehoniemi, Äkki-Kallio



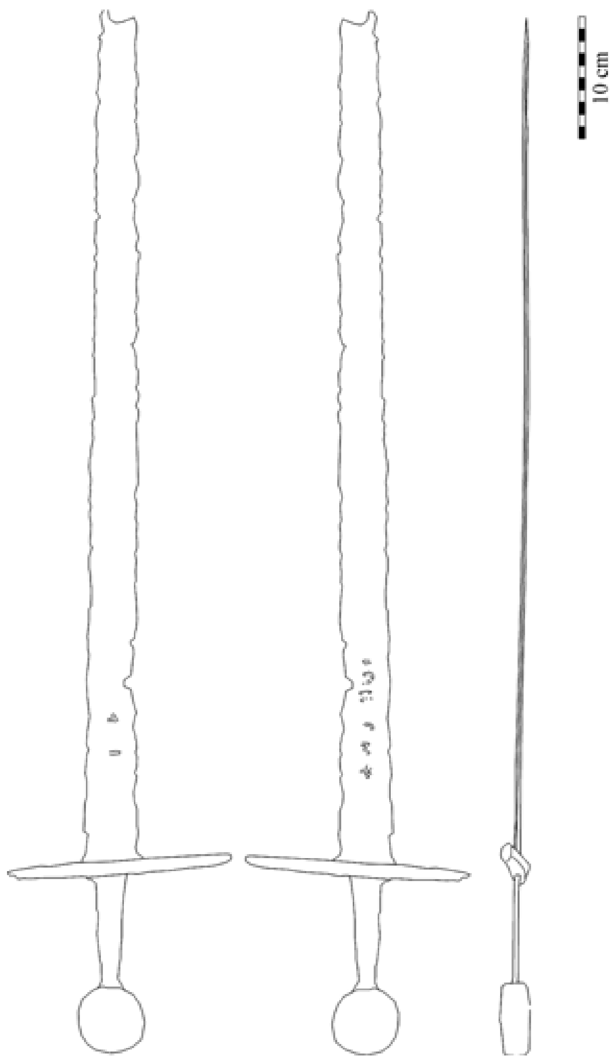
A fragmentary sword in poor condition without the tip of the blade. Weight: 826 g. On one side the fuller bears a spiral, and the reverse contains a cross crosslet. The material of the inlays may be steel with longitudinal slag inclusions. The inlays were defined by surface examination and radiograph no. 3826. Other radiographs: no. 1871 and 1873.

The sword belongs to Petersen's type Z. The parts of the hilt are of iron and no decoration is visible.

The sword is a stray find from the property of Äkki-Kallio farm in 1933, made while digging the foundation of a house. The sword was claimed for the National Museum in 1940.

Literature: Kivikoski 1951: 15; Räty 1983: 155, 182, 275; Salmo 1952: 492.

KM 11831 Masku, Humikkala

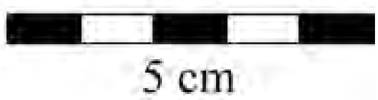


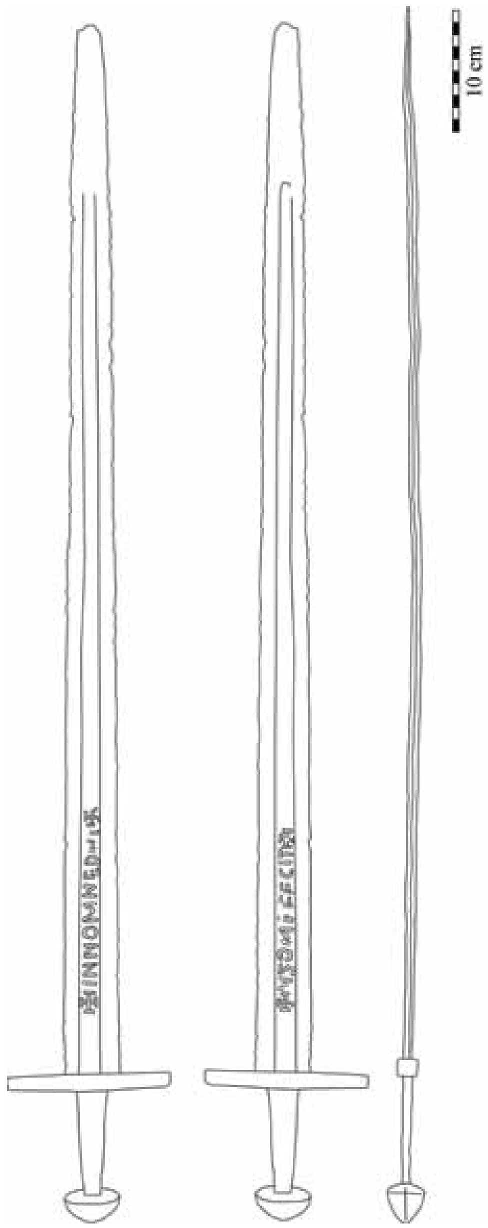
A fragmentary sword in poor condition and without the tip of the blade. Weight: 756 g. On one side the fuller contains fragmentary letters and a cross crosslet. The reverse side contains only two fragmentary marks, possibly letters. The material of the inlays is steel since the inlays have corroded more than the blade. The inlays were defined with the aid of radiograph no. 3759. Other radiographs: no. L8.

The parts of the hilt are of undecorated iron and belong to Tomanterä's type A. The pommel is disc-shaped.

The sword is a probable cemetery find from an inhumation cemetery. The sword has been kept in Masku Church, from where Nils Cleve brought it to the National Museum in 1948.

Literature: Kivikoski 1951: 36; Tomanterä 1978: 34–35, 61, 129.





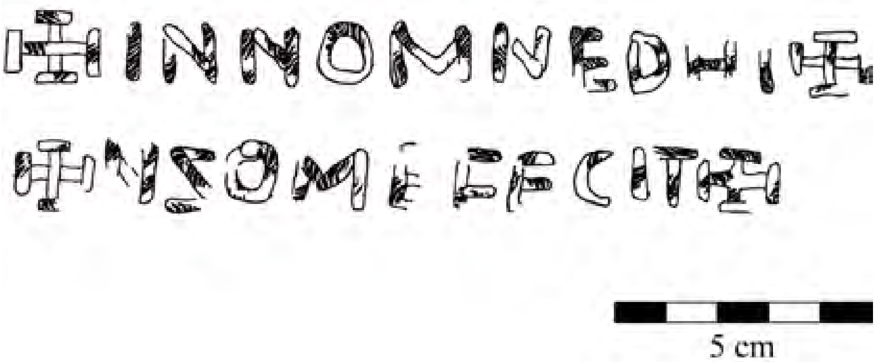
KM 11840 Sastamala, Tyrvää, railway station

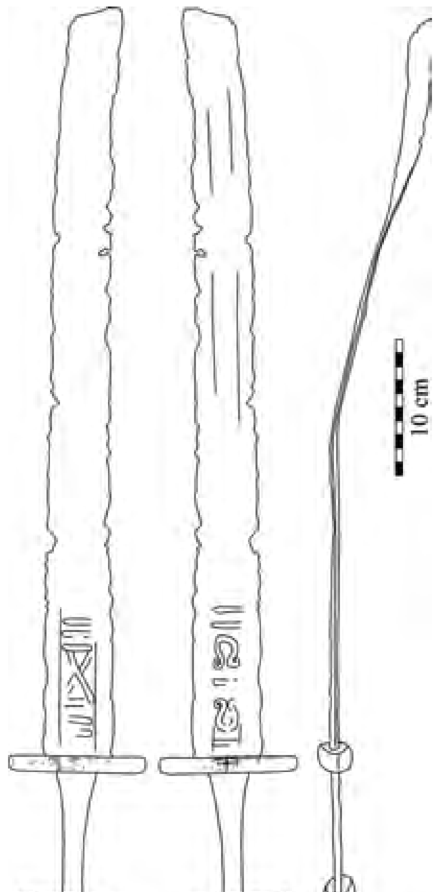
A complete sword in good condition. Weight: 998 g. Balance point: 180 mm. On one side the fuller contains the inscription +NZOMEFECIT+, and the reverse side contains the inscription +INNOMNEDHI+. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination.

The pommel belongs to Oakeshott's type B and more accurately to Geibig's type 15.5. The parts of the hilt are of undecorated iron.

The sword is a stray find while digging the foundations for the railway station of Tyrvää, possibly from a cemetery. The sword was exchanged from the Historical Museum of Turku in 1948.

Literature: Anteins 1973: 48, 62; Kivikoski 1951: 36; Leppäaho 1964b: 14–15; Peirce 2002: 132–133; Räty 1983: 131–133, 155, 174–175, 177–178, 293; Räty 1998: 26, 34–35, 44–45, 47; Salmo 1952: 383.





KM 11859:1 Mynämäki, Mynänummi

A fragmentary sword in poor condition, without the tip of the blade and the pommel. Weight: 690 g. On one side the fuller is marked with two volutes and possibly five vertical lines one of which is located under the lower guard. The reverse side contains four vertical lines and a lattice. The material of the inlays seems to be iron, which shows possibly longitudinal slag inclusions or a corroded structure. In some places perhaps a twisted structure can be seen. The material of the inlays seems to have a little lower carbon content than the blade, because the blade is more corroded. The inlays were defined with the aid of surface examination and radiograph no. 652.

The sword may belong to Petersen's type I. The parts of the hilt are of iron and decorated with silver and bronze wire inlays (20 wires/cm), which are arranged in alternating rows.

The sword belongs to a group of finds from the newer area of the cemetery of Mynämäki (KM 11859:1–10), possibly from a level-ground cremation cemetery. The sword was sent to the National Museum in 1948.

Literature: Räty 1983: 43–44, 153, 228.

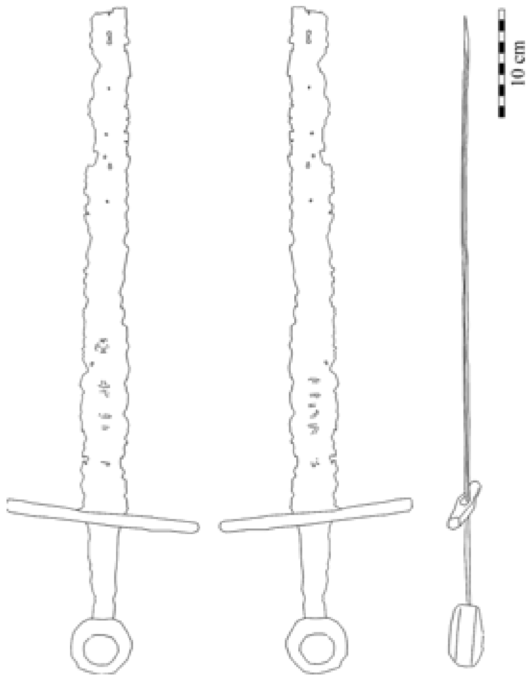
KM 12033 Salo, Halikko, Rikalanmäki

A fragmentary sword in poor condition and lacking the tip of the blade. Weight: 686 g. On one side the fuller contains possibly fragmentary letters, and the reverse side has marks of a similar kind and a cross crosslet. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3763. Other radiographs: nos. 17 and 35.

The parts of the hilt are of undecorated iron and belong to Tomanterä's type B. The pommel is disc-shaped.

The sword is a stray find from an inhumation cemetery discovered while digging a ditch at Tuominen farm. The sword was found before 1925 and it was donated to the museum in 1948.

Literature: Kivikoski 1951: 36; Tomanterä 1978: 38–39, 61, 132.



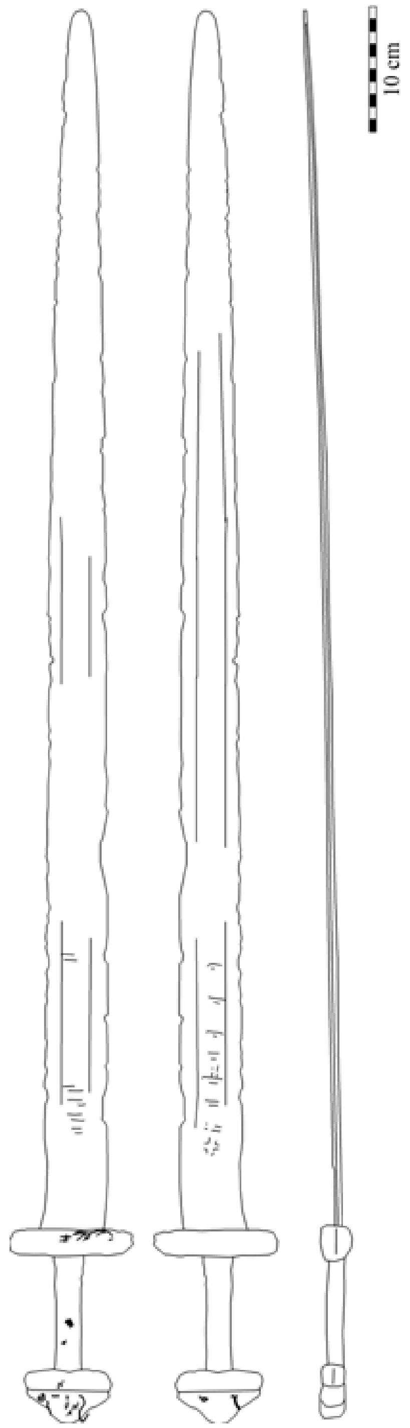
KM 12687:1 Turku, Kaarina, Kirkkomäki

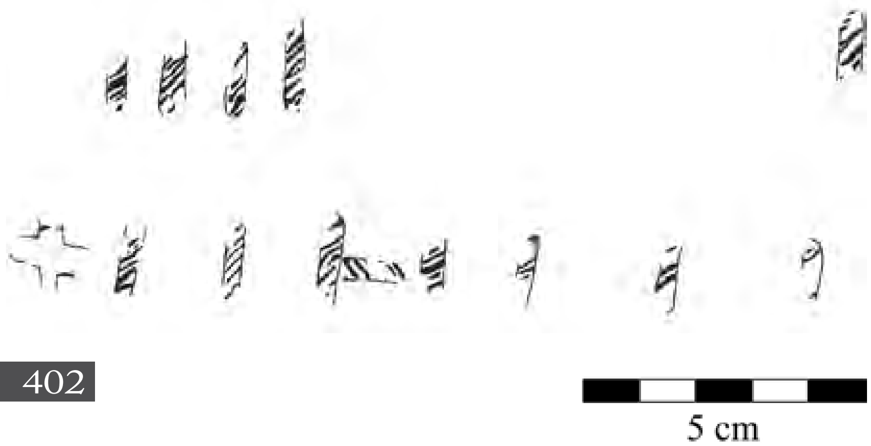
A complete sword in poor condition. Weight could not be measured due to the poor condition of the sword. On one side the fuller contains fragmentary unidentified marks and a cross, and the reverse side contains fragmentary vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3827. Other radiographs: no. 576, 696, 806, 809 and 810.

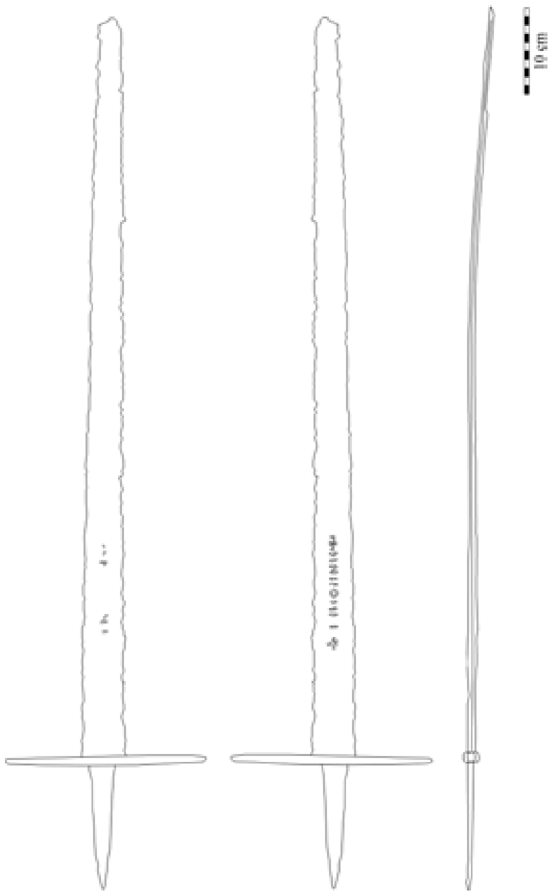
The hilt belongs to the silver-plated type. The parts of the hilt are of iron and decorated with silver-plating and engravings.

The sword belongs to artefacts found while digging a cable trench in the northeast slope of Kirkkomäki (KM 12687:1–3), and belong to an inhumation grave. The sword was catalogued together with artefacts partly claimed and partly excavated by H. Salmo in 1950 (KM 12687:1–20).

Literature: Lehtosalo-Hilander 1985: 11; Räty 1983: 105–107, 154, 162, 166, 280; Räty 1998: 39, 41, 48; Tomanterä 1978: 69, 136.







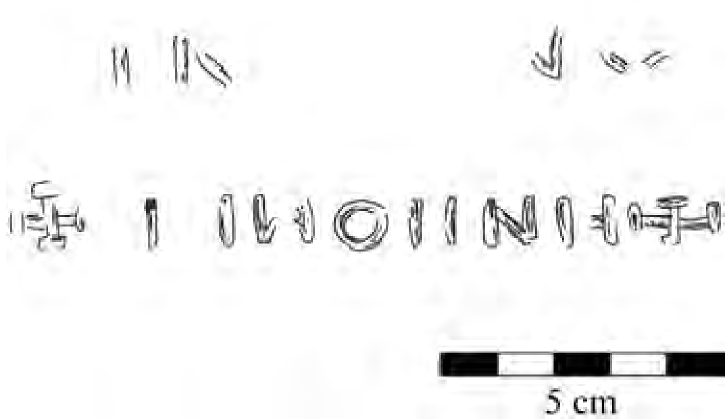
KM 12690:299 Salo, Halikko, Rikalanmäki

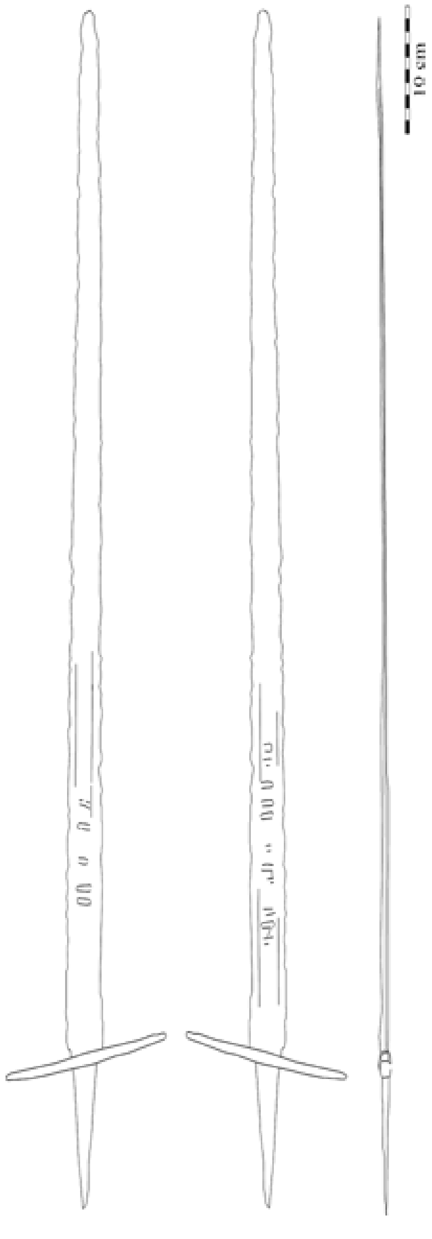
A fragmentary sword in poor condition and lacking its pommel. Weight: 754 g. On one side the fuller is marked with Latin letters lined by two cross crosslets, and the reverse contains fragments of possible letters. The material of the inlays is steel rod, since it is more corroded than the blade. The inlays were defined with the aid of radiograph no. 3837. Other radiographs: no. 9.

The lower guard is undecorated iron and is close to Geibig's type 13.2.

The sword is a grave find from inhumation grave V (KM 12690:294–348), excavated by J. Leppäaho in 1950 (KM 12690:1–438).

Literature: Tomanterä 1978: 26, 35, 58, 61, 129.





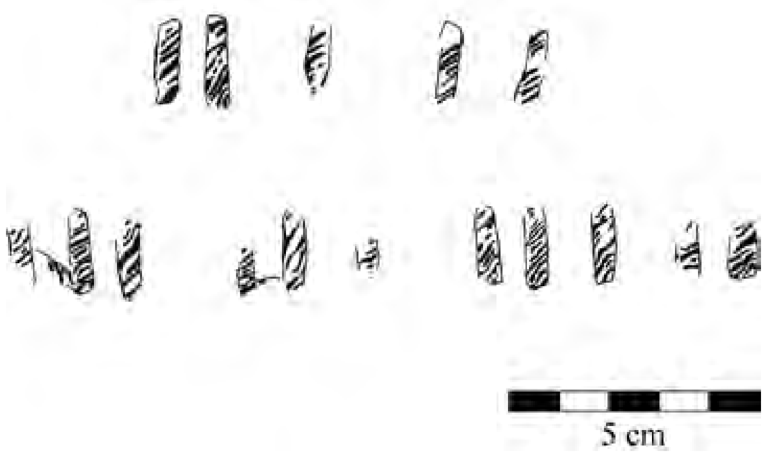
KM 13399:3 Masku, Määksmäki

A fragmentary sword in poor condition and without its pommel. Weight: 714 g. On both sides the fuller contains fragmentary marks, possibly letters. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3780. Other radiographs: no. K27 and 647.

The lower guard is undecorated iron and is close to Geibig's type 13.2.

The sword was found together with a scythe (KM 13399:6) and bridle bits (KM 13399:7) while digging foundations for a house in 1946. These artefacts were catalogued in 1954 along with other, later finds (KM 13399:1–7). The place is probably a level-ground cremation cemetery.

Literature: -



KM 13419:1 Turku, Maaria, Taskula

A complete sword in poor condition. Weight: 1534 g. Balance point: 70 mm. The fuller consists of four twisted, pattern-welded bars. Each bar contains nine layers (four of iron and five of steel). On one side the fuller has a lattice and a figure-eight symbol. The material of the inlays seems to be non-twisted pattern-welded rod, which most likely contains more layers than used in the blade. The inlays and the pattern-welding were defined by surface examination.

The sword belongs to Petersen's type E. The parts of the hilt are of iron and decorated with round stamps (2–3 mm in diameter) and vertical brass wire inlays (4 wires/cm).

The sword is a stray find encountered while digging a trench on the north side of Taskula vicarage (KM 13419:1–3). It is possibly from an inhumation cemetery. The sword was claimed for the museum in 1954.

Literature: Anteins 1973: 35, 60; Leppäaho 1964b: 64–65; Räty 1983: 30–32, 154, 159, 207.

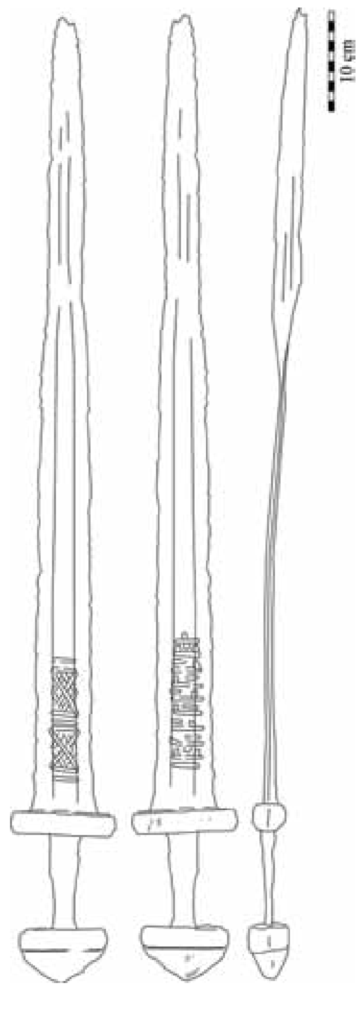
KM 13419:2 Turku, Maaria, Taskula

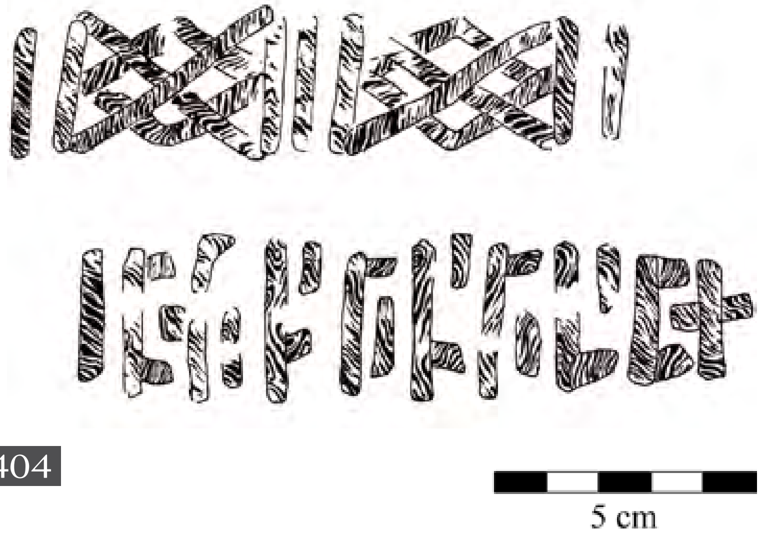
A complete sword in fair condition. Weight: 1498 g. Balance point: 105 mm. On one side the fuller bears letter-like symbols and a cross, and the reverse side contains vertical lines and two woven lattices. The material of the inlays is twisted pattern-welded rod, which contains large amounts of iron; steel layers are mostly corroded away. The inlays were defined by surface examination. Other radiographs: no. 550.

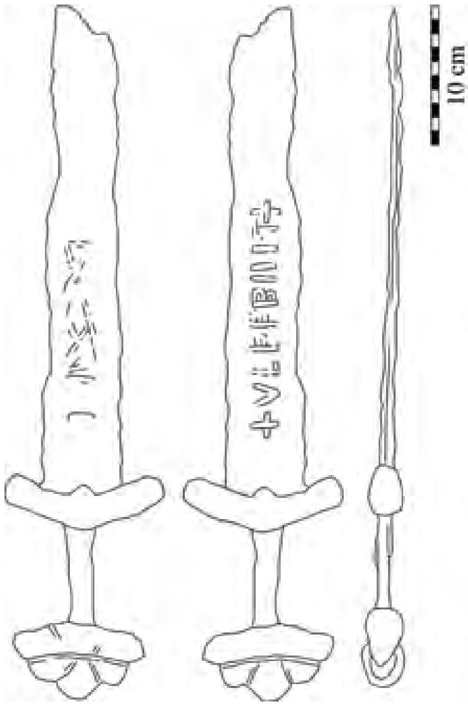
The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical wire inlays (22 wires/cm).

The sword is a stray find from digging a trench on the north side of Taskula vicarage (KM 13419:1–3), possibly from an inhumation cemetery. The sword was claimed for the National Museum in 1954.

Literature: Räty 1983: 38–39, 154, 179–180, 227.







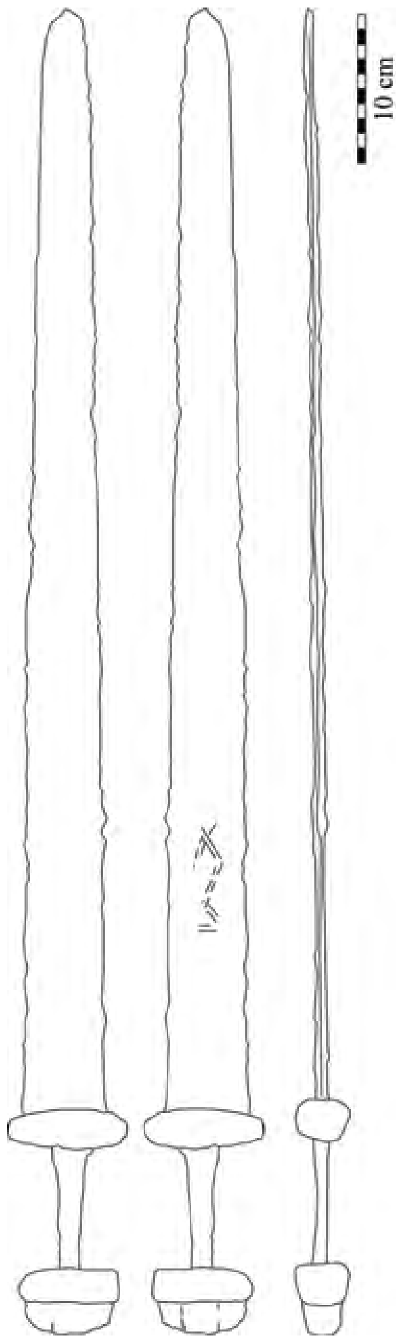
KM 13839:253 Pöytyä, Yläne, Anivehmaanmäki

A fragmentary sword in poor condition without the lower half of the blade. Weight: 838 g. On one side the fuller is marked with the inscription +VLEFBIIIT+, and the reverse side contains vertical lines and a simple lattice weave. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3554. Other radiographs: no. 251.

The hilt belongs to Petersen's type Z. The parts of the hilt are iron, and owing to corrosion no decoration is visible.

The sword is a grave find from an inhumation cemetery, grave no. 12 (KM 13839:201–362), excavated by A.-L. Hirviluoto in 1955 (KM 13839:1–385).

Literature: Räty 1983: 82–87, 154, 162, 273–274.



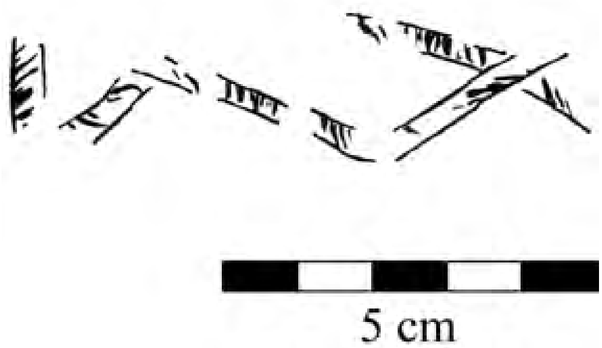
KM 13962:322 Pöytyä, Yläne, Anivehmaanmäki

A complete sword in poor condition. Weight: 1342 g. Balance point: 125 mm. On one side the fuller has a fragmentary lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3557. Other radiographs: no. 240.

The hilt belongs to Petersen's special type 2 and Geibig's type 2. The parts of the hilt are iron, and no decoration is visible due to corrosion.

The sword is a grave find from grave no. 33 of the inhumation cemetery at the site (KM 13962:318–328). Thee cemetery was excavated by A.-L. Hirviluoto in 1956 (KM 13962:1–576).

Literature: Räty 1983: 24–25, 217.



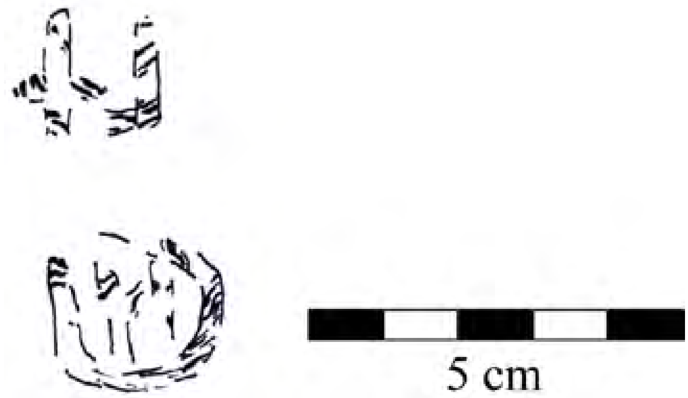
KM 14196:69 Pöytyä, Yläne, Anivehmaanmäki

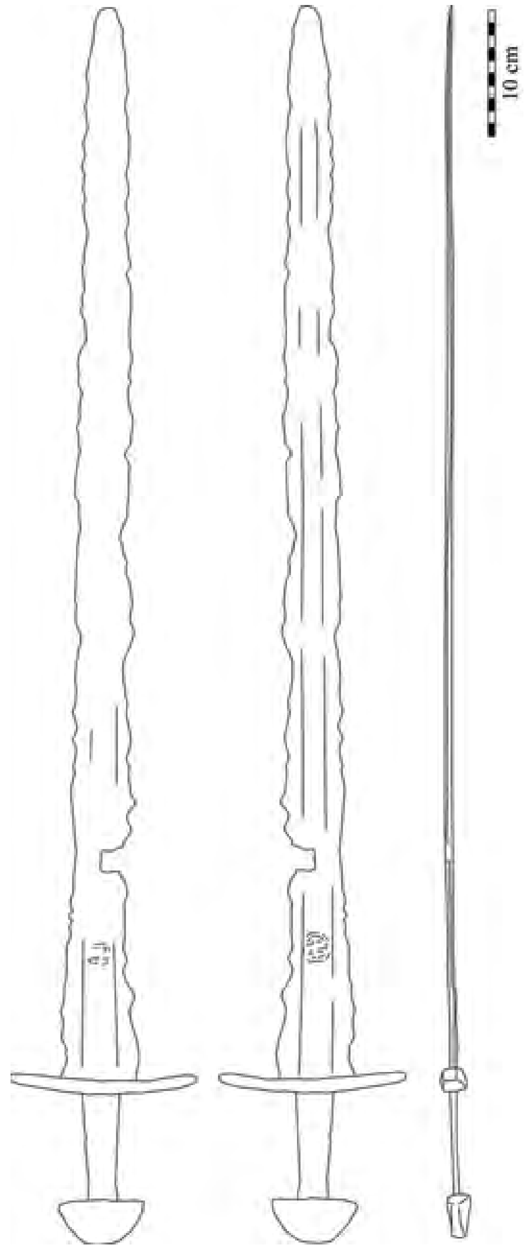
A complete sword in poor condition. The sword could not be weighed because its poor condition. On one side the fuller contains fragmentary lines within a circle, and the reverse side contains some fragmentary lines. The material of the inlays is pattern-welded rod. The inlays were defined with the aid of surface examination and radiograph no. 3215. Other radiographs: no. 3204.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword is a grave find from an inhumation cemetery, grave no. 48 (KM 14196:64–71), excavated by A.-L. Hirviluoto in 1957 (KM 14196:1–705).

Literature: Räty 1983: 76–78, 154, 182, 259.





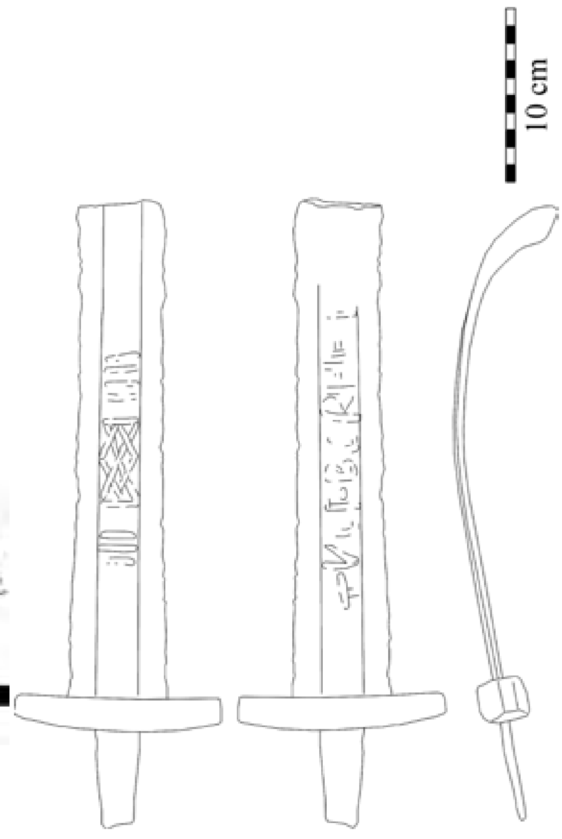
KM 14684 Hämeenkoski, Huljala, Järvikukkola

A fragmentary sword in poor condition and without the pommel, the upper guard and the lower half of the blade. Weight: 574 g. On one side the fuller bears the inscription +VLFBERH+I, and the reverse side contains a woven lattice lined by altogether seven vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3803.

The lower guard is undecorated iron and its type cannot be defined.

The sword is a stray find from 1959 from a field at Järvikukkola farm. The sword was delivered to the National Museum in the same year.

Literature: Räty 1983: 79–81, 156, 271.



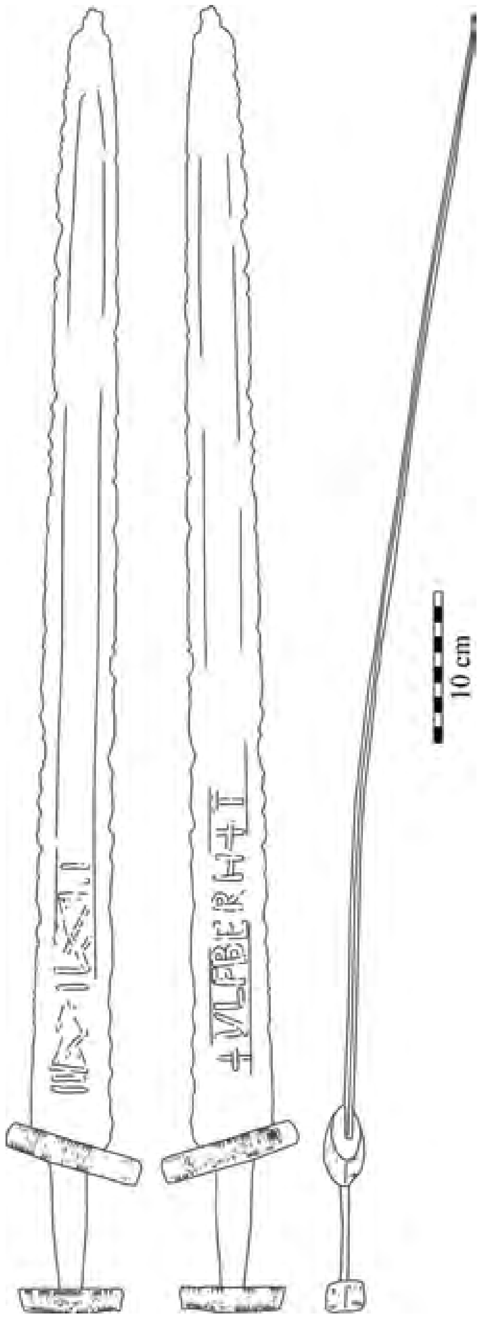
KM 15175:1 Tampere, Messukylä, Vilusenharju

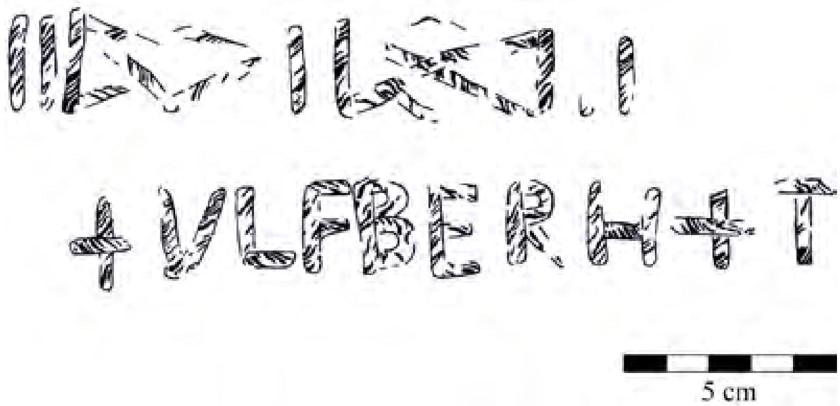
A fragmentary sword in fair condition lacking its pommel. Weight: 886 g. On one side the fuller contains the inscription +VLFBERH+T, and the reverse side contains two woven lattices and vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 2603 and 3528. Other radiographs: no. 2599.

The hilt belongs to Petersen's type V. Both guards are decorated with inlaid silver and brass wires (28 wires/cm), which are arranged in diamond-like patterns.

The sword belongs to a group of finds from a combined cremation and inhumation cemetery (KM 15175:1–2), and was found together with some burnt bone. The sword was claimed for the National Museum in 1961.

Literature: Nallinmaa-Luoto 1978: 127–130, Taulu XXIV:11; Räty 1983: 43–44, 237.





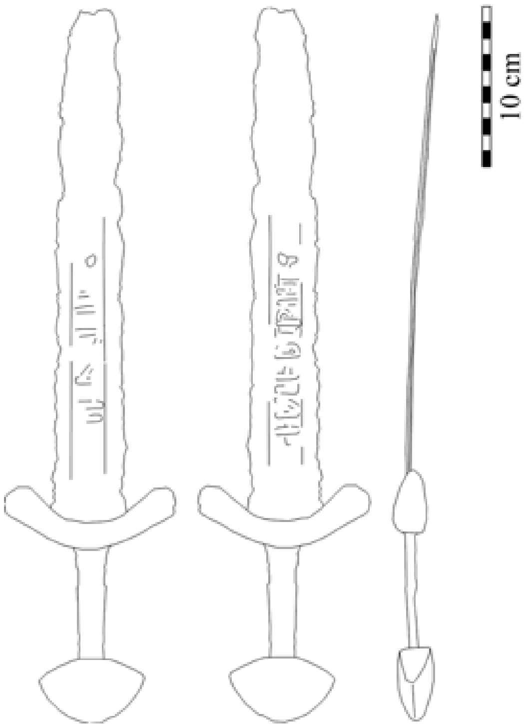
KM 15181:2 Akaa, (formerly Toijala), Kirkkomäki

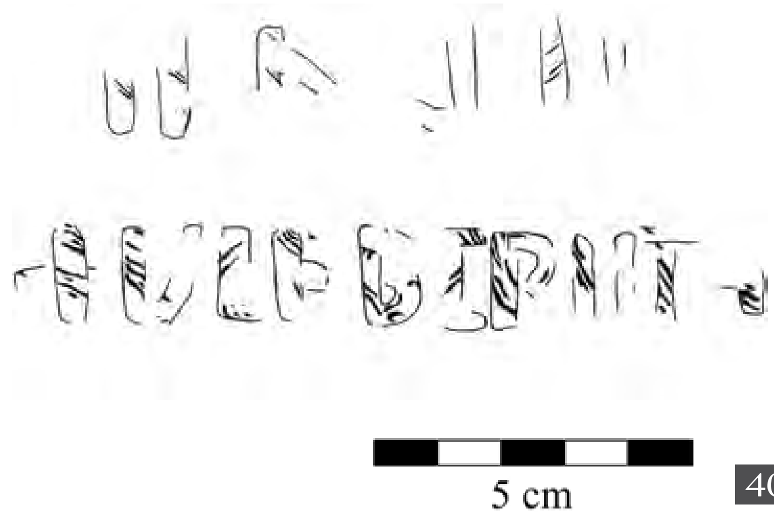
A fragmentary sword in poor condition and without the lower half of the blade. Weight: 542 g. On one side the fuller contains the inscription +VLFBERHT+, and the reverse side contains fragments of a lattice lined by four vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3764. Other radiographs: no. L46, K47 and 603.

The parts of the hilt are iron, and no decoration is visible. The lower guard belongs to Petersen's type Z, while the pommel is of brazil-nut shape but larger than usually.

The sword belongs to finds from the excavation of a cable trench in 1961 (KM 15181:1–5), and originate from a possible level-ground cremation cemetery.

Literature: Räty 1983: 76–78, 82–87, 156, 177–178, 266, 277.





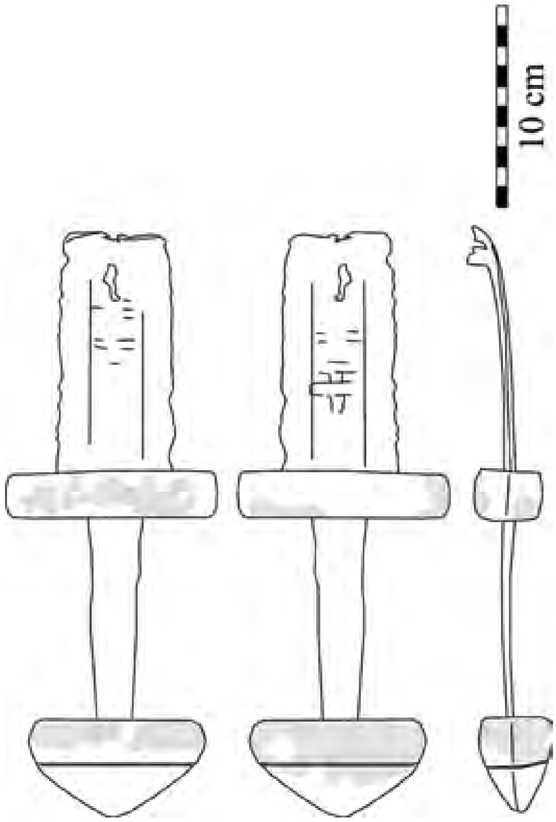
KM 15467 Raisio, Kirkonkylä, Laulumaa

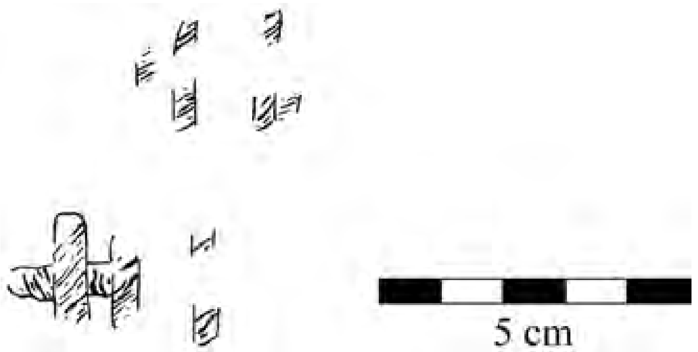
A fragmentary sword in fair condition and without the lower half of the blade. Weight: 940 g. On one side the fuller is marked with a cross and fragmentary vertical lines, and the reverse side contains only fragmentary vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3521.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical inlays from bronze wires (11 wires/cm).

The sword is a stray find from the garden of Laulumaa farm in Raisio, possibly from a level-ground cremation cemetery. The sword was delivered to the National Museum in 1962.

Literature: Räty 1983: 38–39, 154, 228.





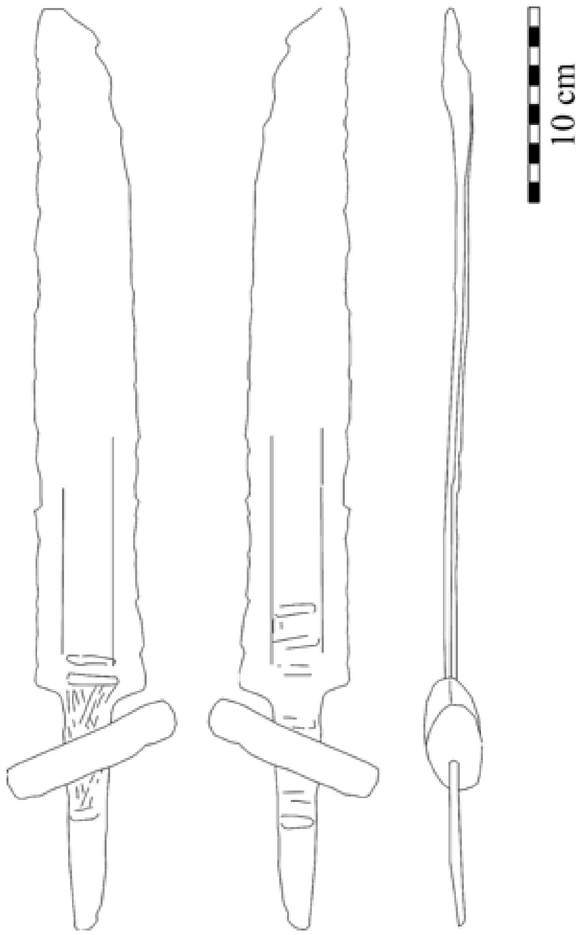
KM 16279 Hämeenlinna, Hauho, Kirkonkylä, Isopappila

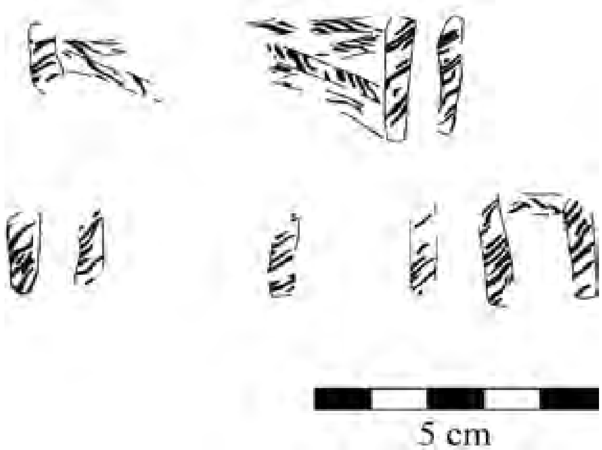
A fragmentary sword in poor condition, lacking the pommel and the lower half of the blade. Weight: 610 g. On one side the fuller contains unidentified fragmentary marks, and the reverse side contains a woven lattice and a vertical line. The inlays go under the lower guard on to the tang. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3772. Other radiographs: no. 577.

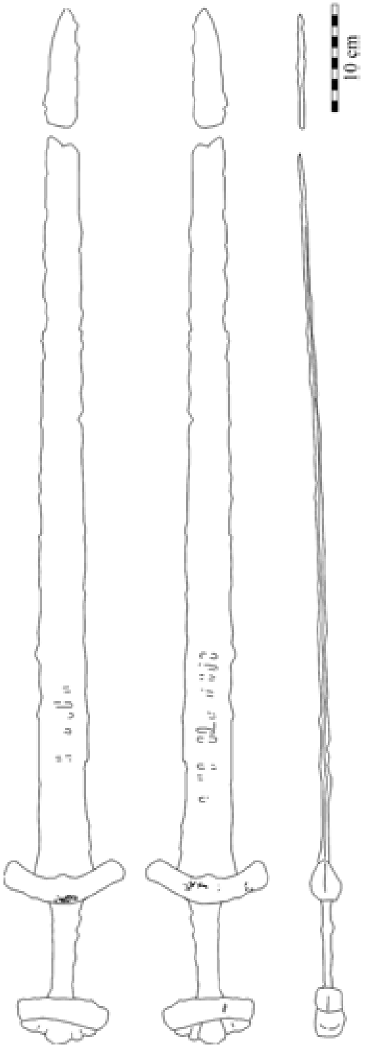
The lower guard belongs to Petersen's type H. No decoration is visible due to corrosion.

The sword is a stray find from 1964 from a ploughed field. The sword was sent to the National Museum in the same year.

Literature: Räty 1983: 43–44, 156, 238.







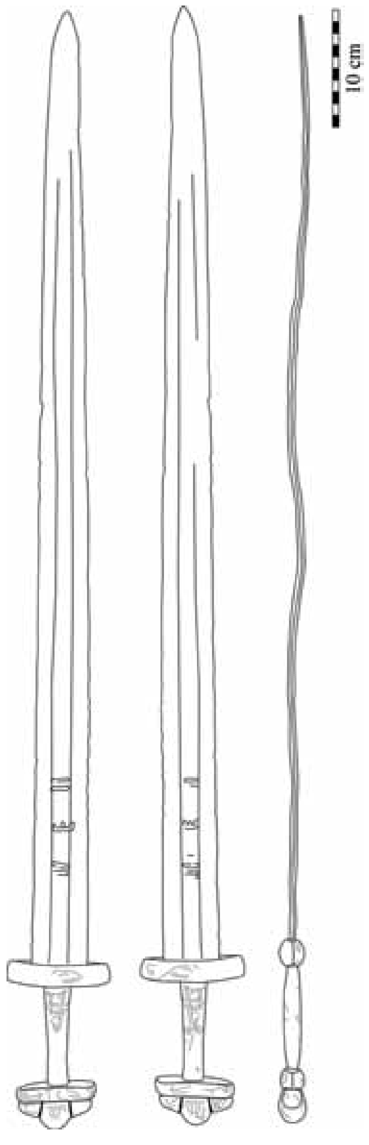
KM 17208:375 Tampere, Messukylä, Vilusenharju

A complete sword in poor condition with the tip of the blade broken. Weight: 996 g. On both sides the fuller contains unidentified fragmentary marks. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3762.

The hilt belongs to Petersen's type Z. The parts of the hilt show traces of silver and copper wires attached to a hatched surface (30 grooves/cm in three directions).

The sword is a grave find from inhumation no. 43 (KM 17208:352–398) in a combined inhumation and level-ground cremation cemetery. The sword was excavated by E. Sarasmo in 1962 (KM 17208:1–500).

Literature: Nallinmaa-Luoto 1978: 127–130, Taulu XVIII:1–2; Räty 1983: 82–87, 276.



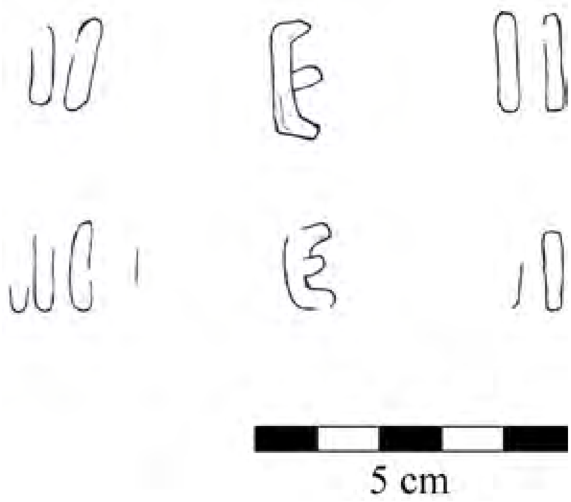
KM 17208:561 Tampere, Messukylä, Vilusenharju

A complete sword in fair condition. Weight: 843 g. Both sides of the fuller are marked with vertical lines and the letter E. The material of the inlays appears to be iron, which shows possibly longitudinal slag inclusions or a corroded structure. The material of the inlays seems to have lower carbon content than the blade, because the blade is more corroded. The inlays were defined by surface examination. Other radiographs: no. 2600.

The hilt belongs to the silver-plated type. The parts of the hilt are of iron and decorated with silver-plating on a hatched surface (30 grooves/cm in two directions). The silver was decorated with engravings. The pommel has twisted silver wires in its grooves.

The sword is a grave find from inhumation no. 12 in a combined inhumation and level-ground cremation cemetery. Inhumation grave no. 12 (KM 17208:549–575) is mixed with cremations, and was excavated by E. Sarasmo in 1961 (KM 17208:501–700). The sword also has a collection number in the Häme Museum (HM 2463:61).

Literature: Nallinmaa-Luoto 1978: 127–130, Taulu V:1; Räty 1983: 105–106, 111, 155, 284–285; Tomanterä 1978: 68–69, 136.



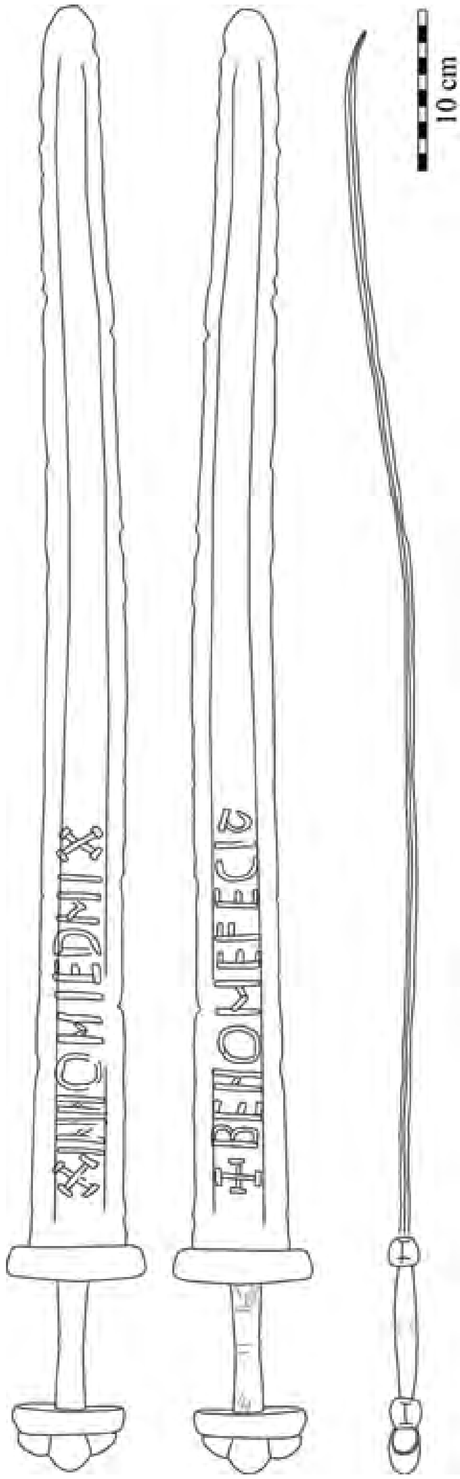
KM 17208:588 Tampere, Messukylä, Vilusenharju

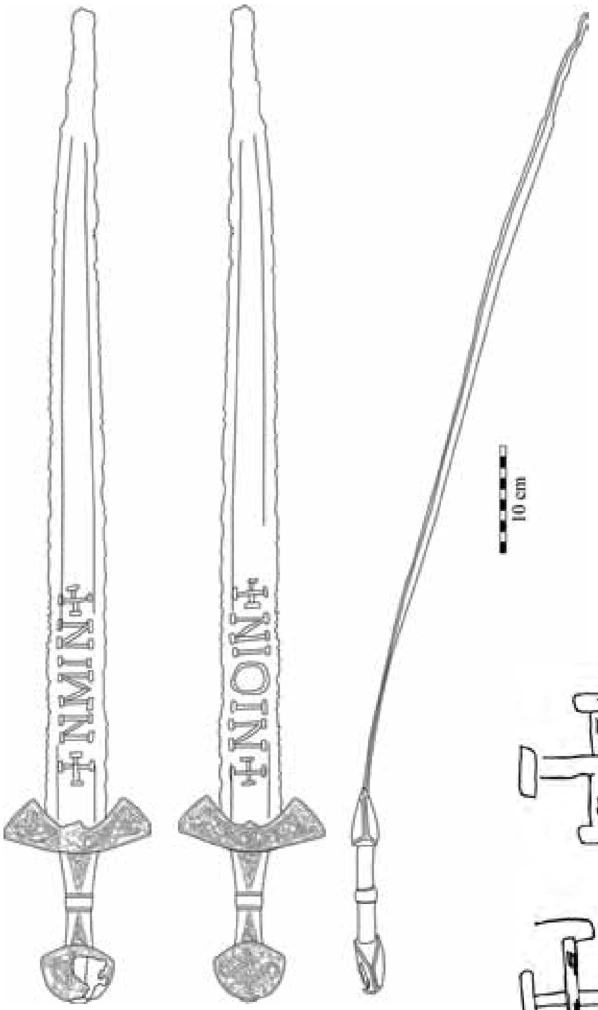
A complete sword in good condition. Weight: 938 g. Balance point: 180 mm. On one side the fuller is inscribed +BENOMEFECIT, and the reverse side bears the inscription +INNOMIEDMIX. The material of the inlays seems to be non-twisted pattern-welded rod or steel with longitudinal slag inclusions or a corroded structure. The material of the inlays contains large amounts of steel. The inlays were defined by surface examination.

The hilt belongs to the silver-plated type. The parts of the hilt are of iron and decorated with silver-plating on a hatched surface (30 grooves/cm in one direction). The silver was decorated with engravings.

The sword is a grave find from inhumation no. 12a (KM 17208:576–592) in a combined inhumation and level-ground cremation cemetery. The cemetery was excavated by E. Sarasmo in 1961 (KM 17208:501–700). The sword also has a collection number in the Häme Museum (HM 2463:88).

Literature: Hirviluoto 1992: 44–45; Moilanen 2010b: 48–49, 57; Nallinmaa-Luoto 1978: 127–130, Taulu VII:9; Räty 1983: 106, 111, 156, 173–174, 177–178, 285; Räty 1998: 44; Tomanterä 1978: 67–68, 136, 138; Tomanterä 1984a: 340.





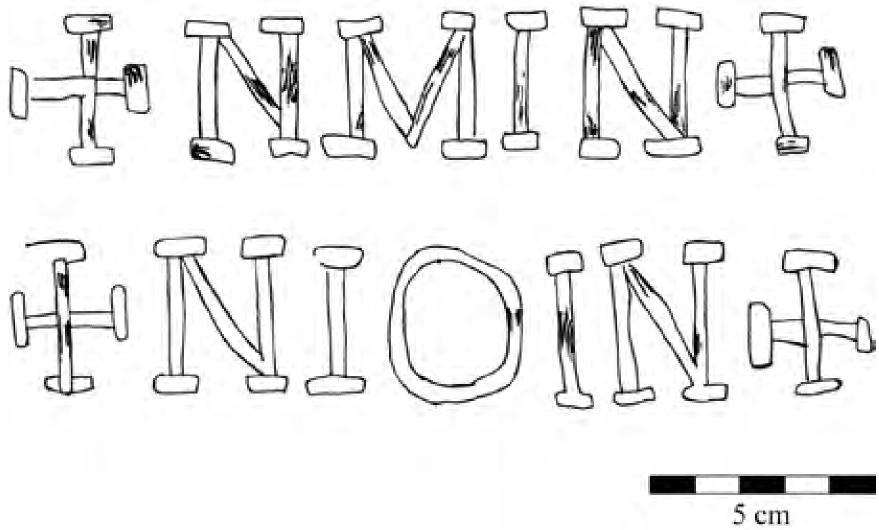
KM 17777:1 Hattula, Tyrväntö, Suontaka, Vesitorninmäki

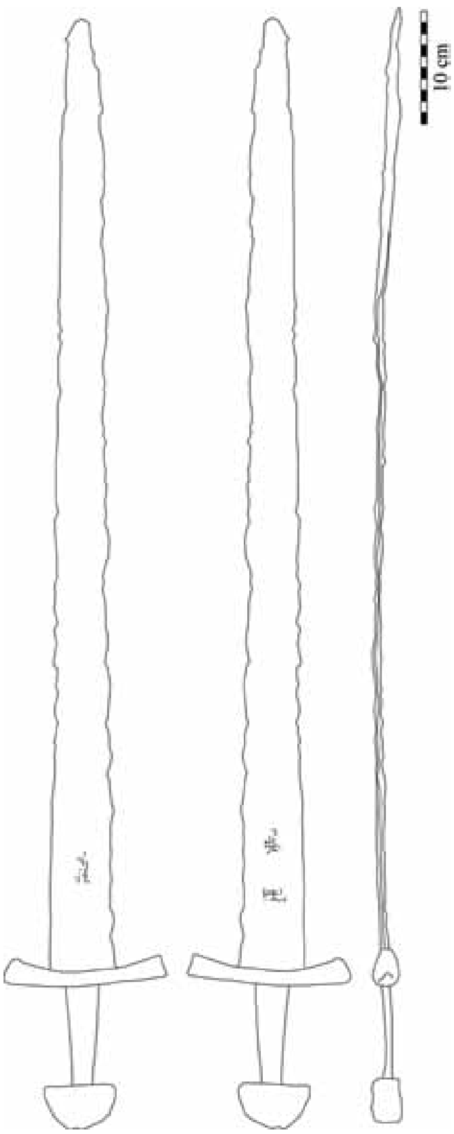
A complete sword in fair condition. Weight: 922 g. Balance point: 140 mm. On one side the fuller bears the inscription +NIOIN+, and the reverse side is inscribed +NMIN+. The material of the inlays seems to be non-twisted pattern-welded rod, or steel with longitudinal slag inclusions or a corroded structure. The material of the inlays seems to be of higher carbon content than the blade. The inlays were defined by surface examination and radiographs nos. 948 and 950.

The parts of the hilt are hollow cast bronze, resembling Petersen's type Æ.

The sword is a stray find from an inhumation cemetery, and belongs to the same collection number as finds excavated by O. Keskitalo in 1968 (KM 17777:2–9), possibly from a different grave.

Literature: Keskitalo 1969; Kivikoski 1973: 143, Tafel 132:1171; Lehtosalo-Hilander 1983: 295; Lehtosalo-Hilander 1984: 403; Moilanen 2010b: 55; Räty 1983: 94–102, 109, 156, 177–178, 279–280; Taavitsainen 1990: 91.

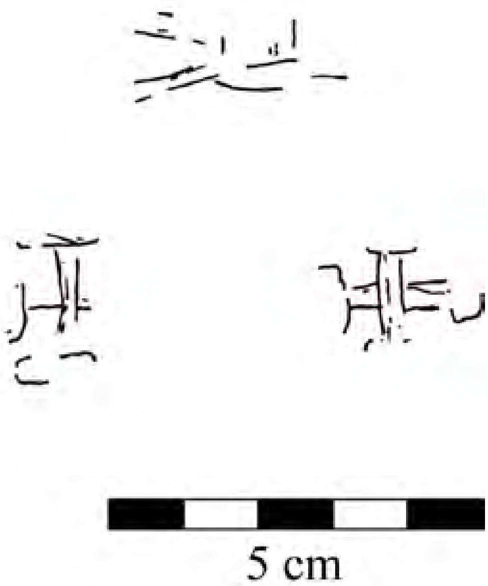




KM 18000:3170 Eura, Luistari

A complete sword in poor condition. Weight: 1016 g. Balance point: 160 mm. On one side the fuller shows two fragmentary crosses, and the reverse side contains unidentifiable fragmentary marks. The material of the inlays seems to be iron or steel rod. The inlays were defined with the aid of radiograph no. 3316. Other radiographs: no. K97.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.



The sword is a grave find from an inhumation cemetery, grave no. 281 (KM 18000:3154–3200). The cemetery was excavated by P.-L. Lehtosalo-Hilander in 1969-1972, 1977 and 1979 (KM 18000:1–4730).

Literature: Lehtosalo-Hilander 1982a: 186–188, Plate 70:17; Lehtosalo-Hilander 1982b: 13; Räty 1983: 73–74, 156, 259–260.

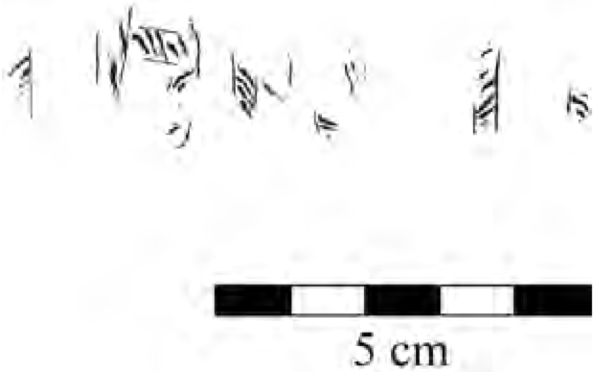
KM 18000:3880 Eura, Luistari

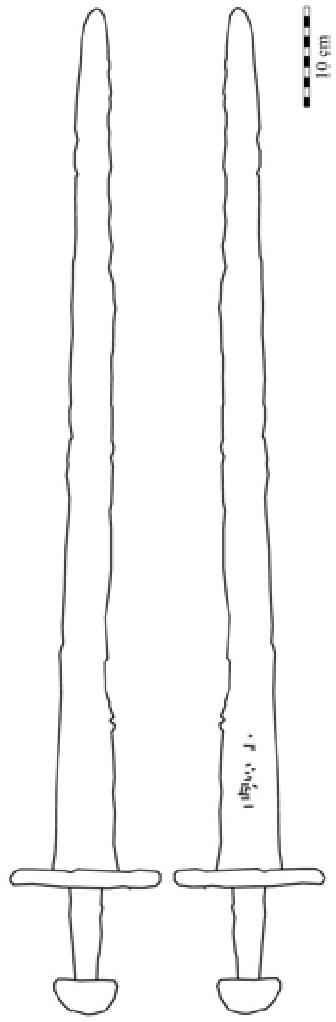
A complete sword in poor condition. The fuller bears highly fragmentary marks or letters in the form of vertical and diagonal lines. The material of the inlays is twisted pattern-welded rod. This sword was not documented for this work, and the drawings are based on earlier publications, except for the inlays, which were defined with the aid of radiograph no. 1340.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword is a grave find from inhumation cemetery, grave no. 348 (KM 18000:3871–3966). The cemetery was excavated by P.-L. Lehtosalo-Hilander in 1969-1972, 1977 and 1979 (KM 18000:1–4656).

Literature: Lehtosalo-Hilander 1982a: 237–238, Plate 96:10; Räty 1983: 74–76, 261.





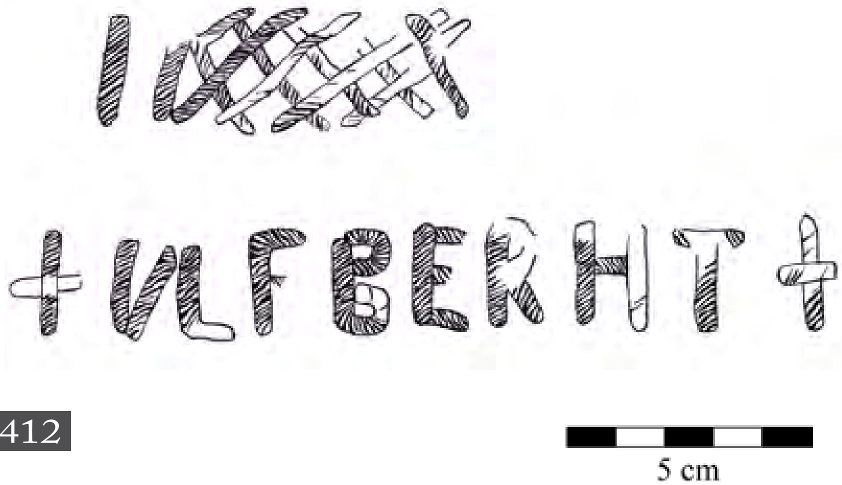
KM 18402:1 Hämeenlinna, Peltorinne

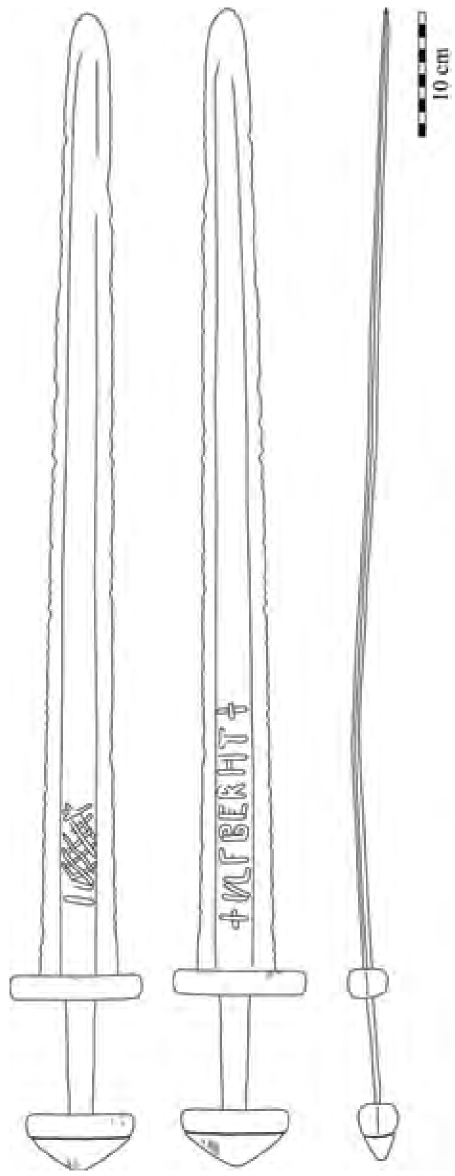
A complete sword in good condition. Weight: 1340 g. Balance point: 115 mm. The blade seems to have been broken and re-welded approximately 24 cm below the hilt. On one side the fuller is inscribed +VLFBERHT+, and the reverse side contains a vertical line and an incomplete lattice weave. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination. Radiographs: no. 578.

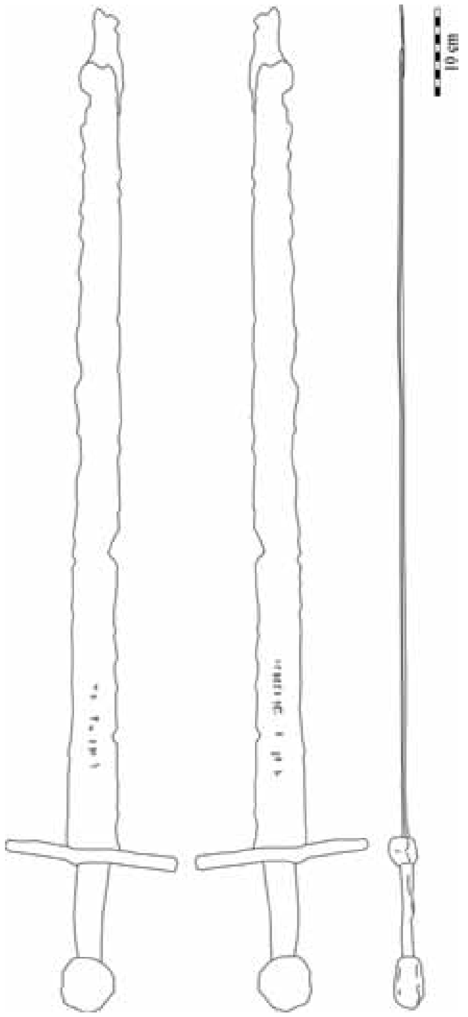
The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with inlays of silver and copper wires (24 wires/cm). The wires are arranged to form a chequerboard pattern.

The sword belongs to a group of finds from under a large rock (KM 18402:1–7), and was claimed for the National Museum in 1971.

Literature: Moilanen 2010a: 9; Peirce 2002: 54–55; Räty 1983: 38–39, 42, 156, 162–163, 238; Räty 1998: 39–40, 48; Williams 2009: 130, 159.







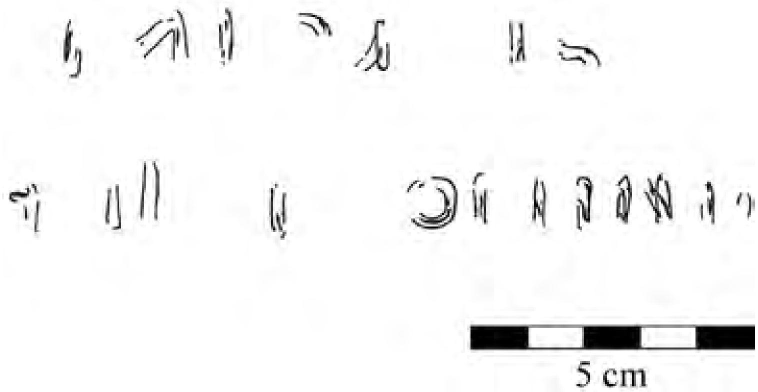
KM 19901:202 Ylöjärvi, Mikkola

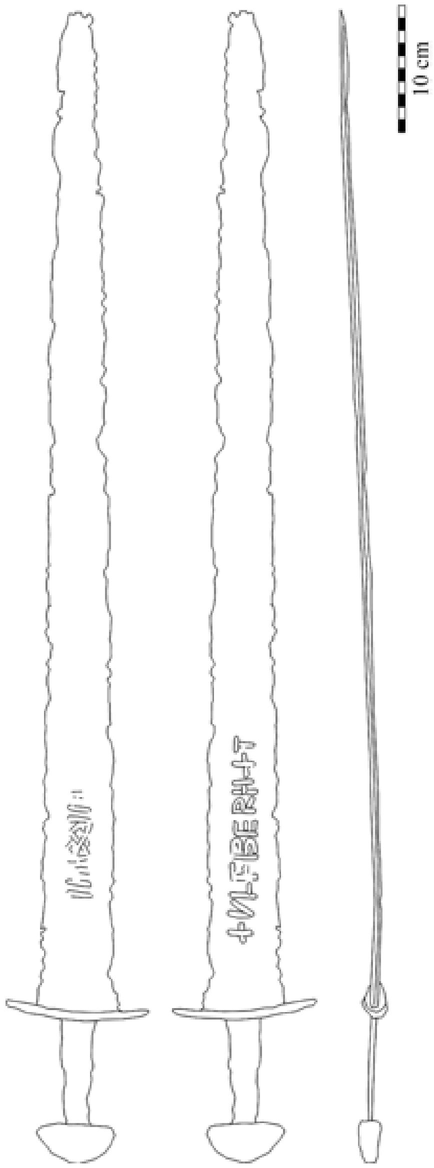
A complete sword in poor condition with the tip of the blade broken. The sword could not be weighed due to its poor condition. There are fragmentary marks and letters on both sides of the fuller. The material of the inlays could be pattern-welded rod, or plain steel rod, which has corroded away in most parts. The inlays were defined with the aid of radiograph no. 3274. Other radiographs: no. 689 and 745.

The pommel belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of undecorated iron.

The sword is a grave find from an inhumation cemetery, grave no. 1 (KM 19901:195–209), excavated by S. Sarkki in 1976 (KM 19901:1–246).

Literature: Sarkki-Isomaa 1986.





KM 20127 Kokemäki, Pelhola, Aarikka

A complete sword in poor condition. Weight: 724 g. Balance point: 210 mm. On one side the fuller contains the inscription +VLFBERH+T, and the other side contains a woven lattice lined by altogether five vertical lines. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 883 and 884.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword is a stray find from a field in the end of 1960s, and the sword was donated to the Emil Cedercreutz Museum in 1977, where it has the catalogue number ECM 6682.

Literature: Räty 1983: 76–78, 154, 162, 168, 263; Räty 1998: 39, 41, 48.

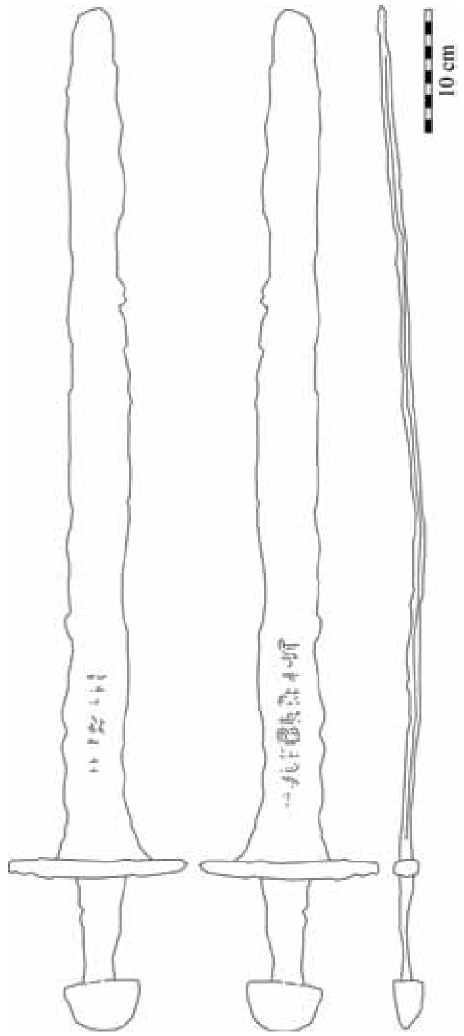
KM 22106:23 Uusikaupunki, Kalanti, Hallu, Pietilä

A fragmentary sword in poor condition and without the tip of the blade. The sword cannot be weighed due to its poor condition. On one side the fuller contains a fragmentary inscription -VLFBERH+T, and the reverse side contains vertical lines and the remains of a possible woven lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 1764. Other radiographs: no. 3205.

The hilt belongs to the later variant of Petersen's type X. The parts of the hilt are of undecorated iron.

The sword is a cemetery find from a level-ground cremation cemetery, excavated by M. Bergström and J. Laurén in 1983 (KM 22106:1–379).

Literature: -



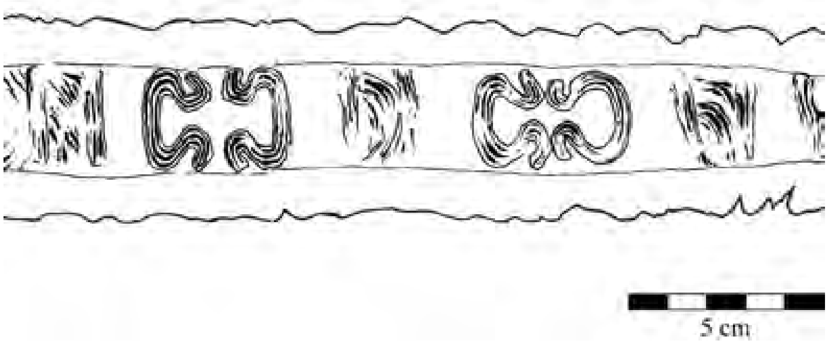
KM 22964:3 Laitila, Kodjala, Vainionmäki

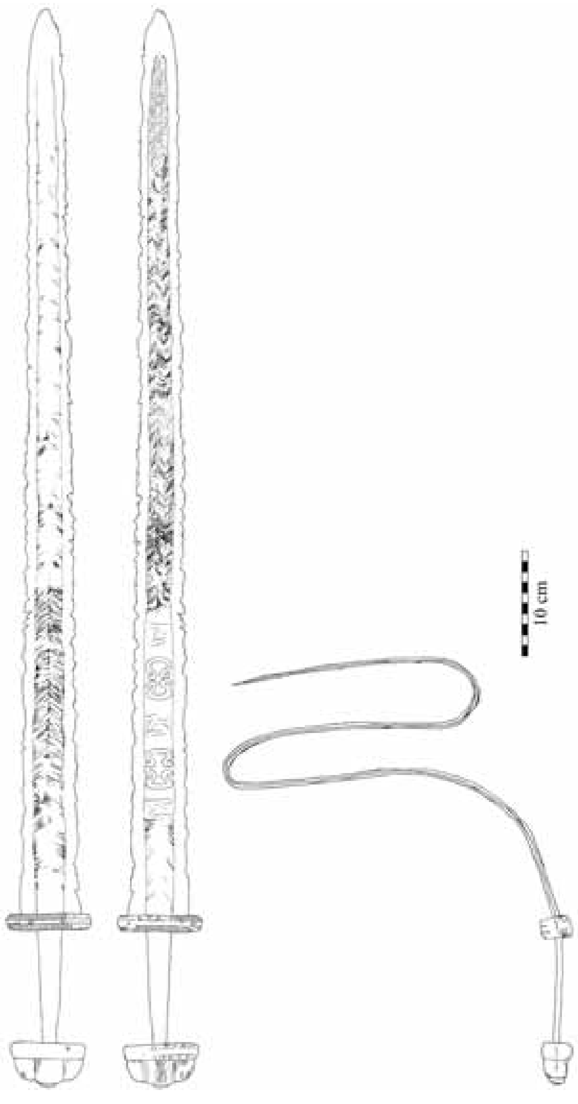
A complete sword in fair condition. Weight: 1092 g. The blade is markedly bent in three places. On one side the fuller consists of two twisted pattern-welded bars. On the other side the number of the twisted bars is three, except under the inlaid marks, which consist of altogether four volutes lined with N-like figures formed by vertical and diagonal bars. The material of the inlays is non-twisted pattern-welded rod, which contains seven layers (four of iron and three of steel). The inlays were defined by surface examination and radiograph no. 3797. Other radiographs: no. 2207.

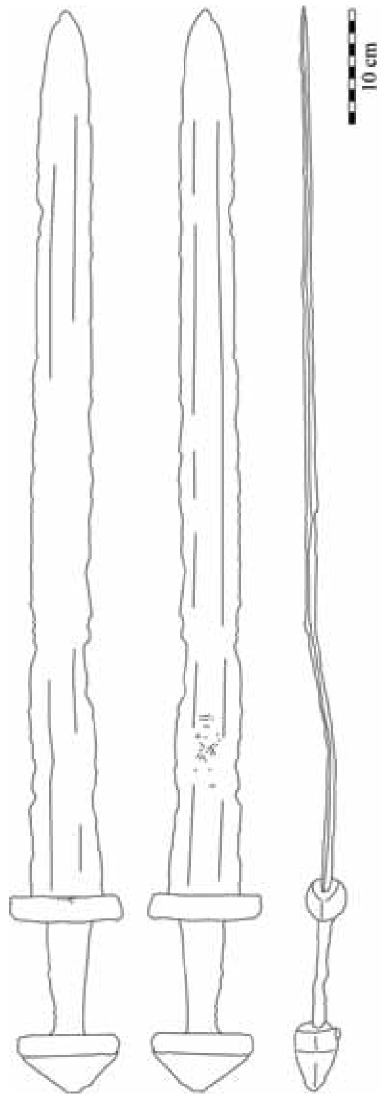
The hilt belongs to Geibig's type 3 or the so-called Mannheim type. The parts of the hilt are of iron and decorated with vertical wire inlays. The guards have an embossed, inlaid strip of non-ferrous decoration in the middle.

The sword is a find from a level-ground cremation cemetery. It belongs to a groups artefacts collected by M. Bergström in 1985 during a survey (KM 22964:1-45), and this particular sword belongs to items found by the landowner.

Literature: Schauman-Lönnqvist 1996: 55–56, 155, Plate 12:1.







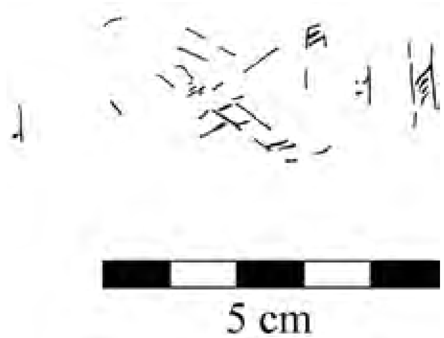
KM 23607:490 Eura, Luistari

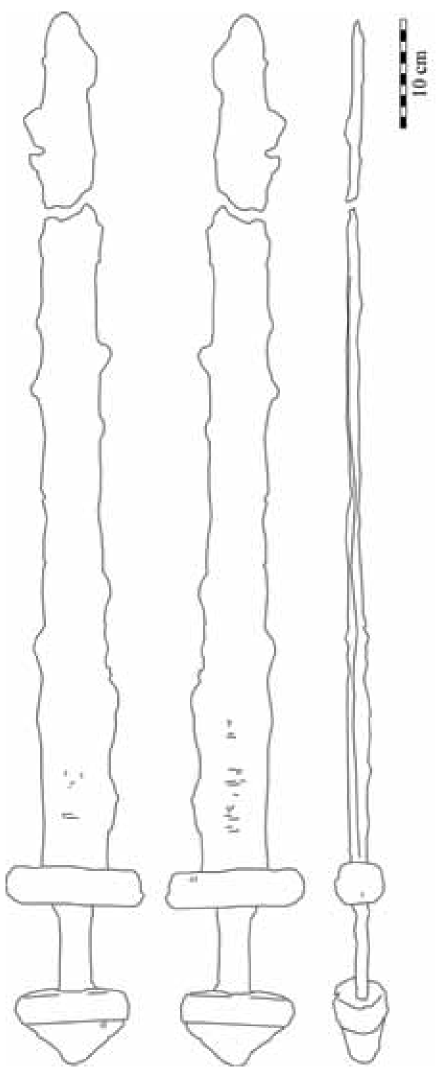
A complete sword in poor condition. Weight: 1205 g. On one side the fuller contains a fragmentary woven lattice and vertical lines. The inlays are difficult to distinguish and are thus somewhat uncertain. The material of the inlays seems to be twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 2984.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with inlays of brass wires (14 wires/cm).

The sword is a grave find from an inhumation cemetery, grave no. 740 (KM 23607:473–507), excavated by P.-L. Lehtosalo-Hilander in 1984 (KM 23607:1–522).

Literature: Lehtosalo-Hilander 2000a: 75–76, 190, Plate 25; Mikkola 1999: 48.





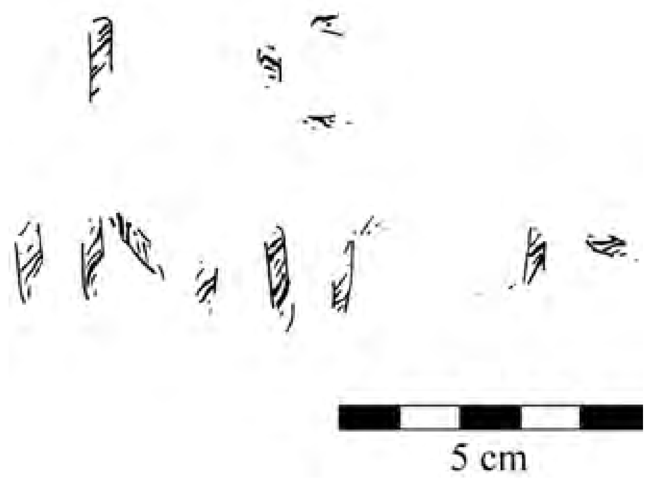
KM 24740:242 Eura, Luistari

A complete sword in poor condition. The blade is broken into two parts near the tip. Weight: 2362 g. The fuller contains fragmentary inlays on both sides. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3325. Other radiographs: no. 3306.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical wire inlays (22 wires/cm).

The sword is a grave find from an inhumation cemetery, grave no. 844 (KM 24740:230–269), excavated by P.-L. Lehtosalo-Hilander in 1989 (KM 24740:1–657).

Literature: Lehtosalo-Hilander 2000a: 103–104, 190, Plate 39. Lehtosalo-Hilander 2000b: 189.



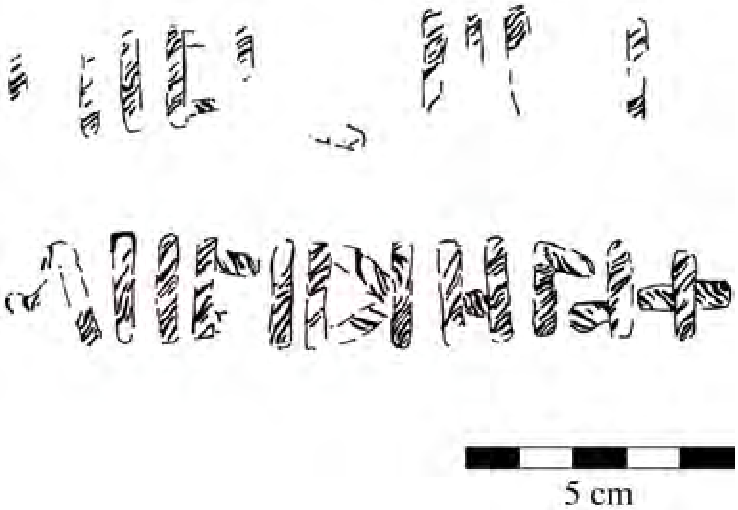
KM 26301 Pöytyä, Yläne, Anivehmaanmäki

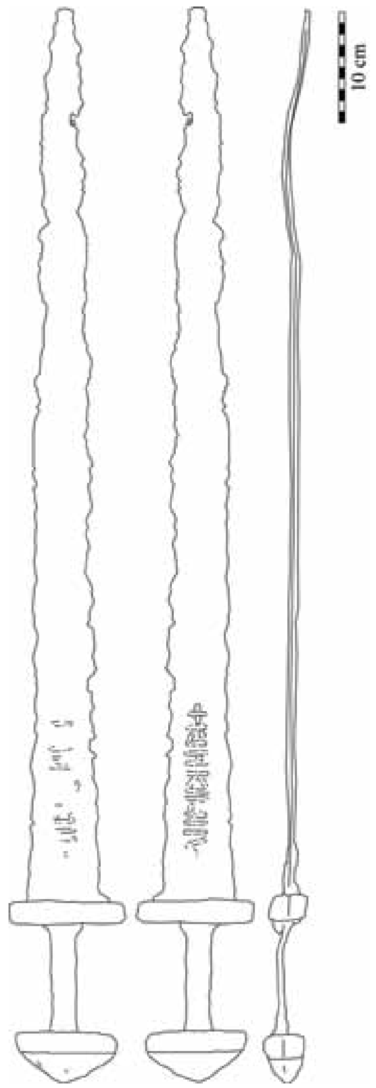
A complete sword in poor condition. Weight: 1569 g. On both sides the fuller contains letter-like inlays and on one side an additional cross. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 1673.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical wire inlays (18 wires/cm).

The sword is a stray find from 1990, discovered while deepening a trench in a field, from some distance of the excavated part of the Anivehmaanmäki inhumation cemetery. This sword is either from the same cemetery or from another one at a very close distance.

Literature: Mikkola 1999: 48; Räty 1998: 39, 41, 49.





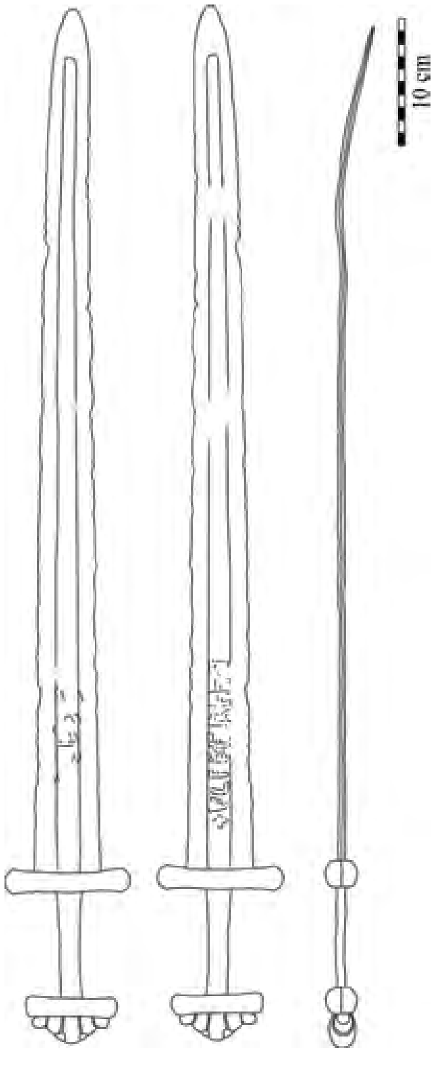
KM 27141:1 Hämeenlinna, Hauho, Ilmoila, Kalomäki

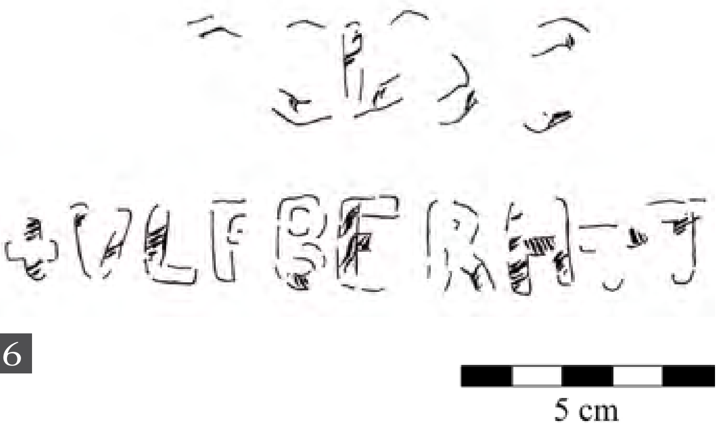
A complete sword in good condition and covered in fire patina. Weight: 821 g. Balance point: 105 mm. On one side the fuller bears the inscription +VLFBERH+T, and the reverse side contains vertical lines and a double lattice or a double woven lattice. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 1885. Other radiographs: no. 1809, 1886, 1887, 1888 and 1890.

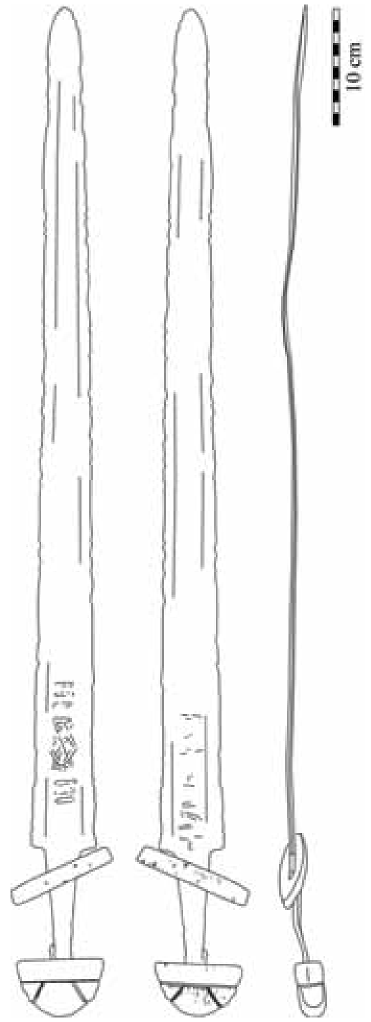
The hilt belongs to Petersen's type R. The parts of the hilt are of iron and bear traces of silver-plating.

The sword is a stray find discovered with a metal detector at Kalomäki hill in 1992 (KM 27141:1–2), and is possibly from a level-ground cremation cemetery.

Literature: Kirpichnikov et al. 2004: 28–29, 33; Kirpichnikov et al. 2009: 367–368; Moilanen 2010b: 49; Räty 1998: 39, 41, 48.







KM 30870:1 Asikkala, Salo, Ala-Pietilä

A complete sword in fair condition. Weight: 972 g. Balance point: 120 mm. On one side the fuller contains a woven lattice with six vertical lines, and the reverse side has fragmentary marks, which were mostly ground away by the finder. The material of the inlays seems to be twisted pattern-welded rod, which contains large amounts of steel on the basis of its corrosion. The inlays were defined by surface examination and radiograph no. 2509. Other radiographs: no. 2355.

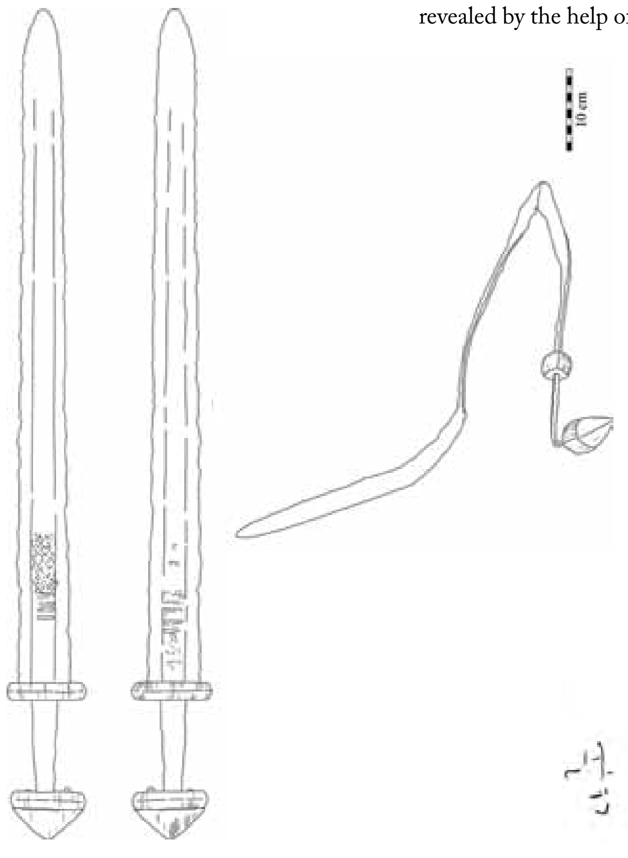
The hilt belongs to Petersen's type V. The parts of the hilt are of iron and decorated with silver and brass wires (25 wires/cm), which are inlaid in lozenge patterns. The grooves of the pommel are decorated with twisted silver wires.

The sword was found while building a house, together with a spearhead (KM 30870:2), originating possibly from a level-ground cremation cemetery.

Literature: Moilanen 2010a: 4; Päijät-Hämeen kiinteät muinaisjäännökset 2008: 33; Siljander 1998a.

KM 30985:1 Salo, Halikko, Puotila, Wuorenrinta

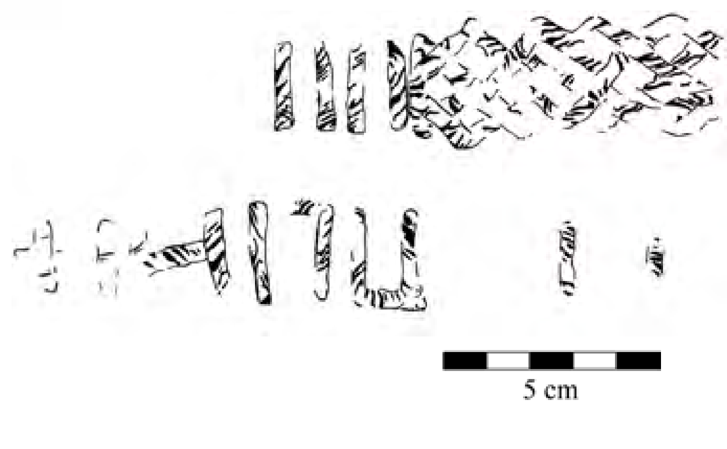
A complete sword in fair condition. Weight: 1753 g. The sword is strongly bent in three places, which possibly occurred when it was found. On one side the fuller contains the possible remains of a cross and the remains of letter-like marks. The reverse side contains a lattice weave and vertical lines. The inlays seem to continue beyond the bent point and could not be revealed by the help of radiography for this reason. The inlays of opposite sides are also difficult to distinguish from each other. The material of the inlays is twisted pattern-welded rod. The inlays were defined with the aid of radiographs nos. 2376 and 2423. Other radiographs: no. 2392, 2393, 2394 and 2424.



The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with inlays from bronze wires (16 wires/cm). Visible upper and lower faces of the guards are plated with bronze plates.

The sword belongs to a group of finds discovered while digging the foundations for a house known as Wuorenrinta in 1998. The artefacts are probably from a destroyed cemetery.

Literature: Kirpichnikov et al. 2004: 28–29, 31, 33; Kirpichnikov et al. 2009: 368; Mikkola 1999: 47–48; Mäntylä 2006b: 14.



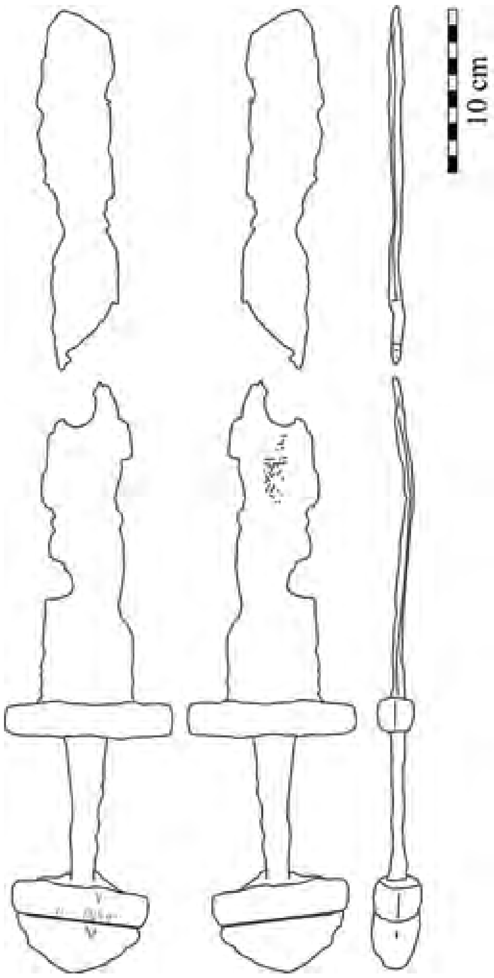
KM 31017:1 Sysmä, Haapasaari

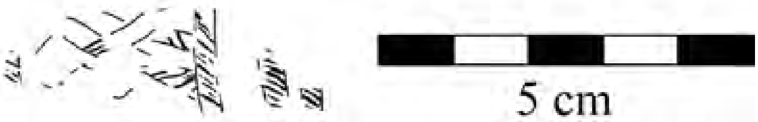
A fragmentary sword in poor condition. The sword could not be weighed due to its poor condition. The blade is broken in the middle. The blade was possibly laminated so that its centre is of iron and the bevels are of steel. On one side the fuller contains fragments of vertical lines and perhaps a woven lattice. The material of the inlays seems to be twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 2424. Other radiographs: no. 2397.

The hilt belongs to Petersen's type T2. The parts of the hilt are of iron and decorated with silver wire inlays (23 wires/cm). The decoration is applied to form diamond-like patterns.

The sword is a stray find discovered with a metal detector in a possible level-ground cremation cemetery in 1998.

Literature: Kirpichnikov et al. 2004: 28–29, 32–34; Kirpichnikov et al. 2009: 368–369; Päijät-Hämeen kiinteät muinaisjäännökset 2008: 284; Siljander 1998b.





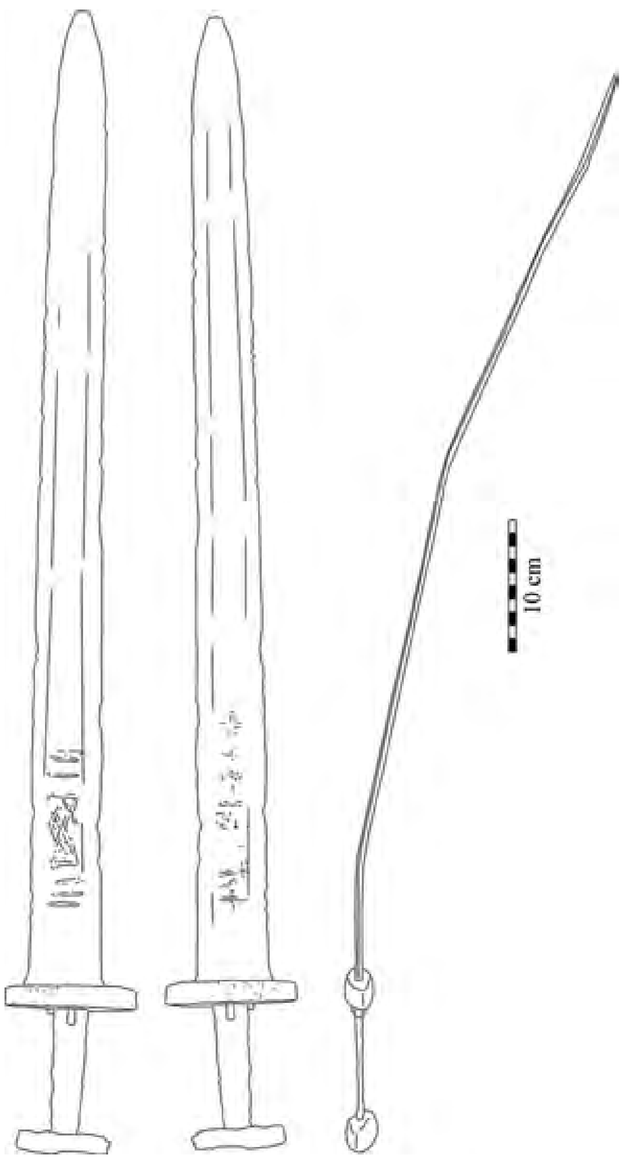
KM 31550:1 Jämsä, Viertiö

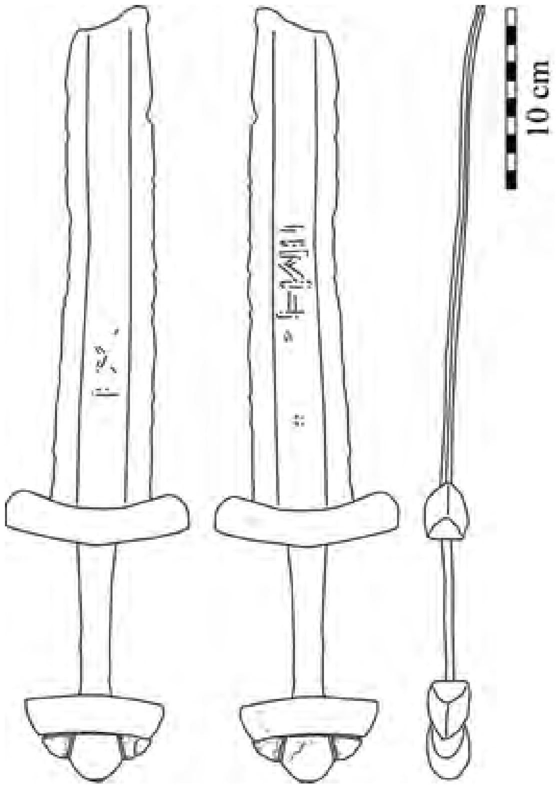
A fragmentary sword in fair condition and lacking its pommel. Weight: 868 g. On one side the fuller has a woven lattice and six vertical lines, and the reverse side contains fragmentary marks, which could indicate an ULFBERHT inscription. The material of the inlays seems to be non-twisted pattern-welded rod, or strongly corroded iron or steel containing a great deal of impurities. The inlays were defined with the aid of radiograph no. 2599.

The sword may belong to Petersen's type V. The parts of the hilt are of iron and decorated with silver and bronze wires (26 wires/cm), inlaid in lozenge patterns.

The sword is a stray find discovered with a metal detector on a rocky hill next to the lands of Viertiö farm in 1999. The sword is possibly from a level-ground cremation cemetery or a hoard.

Literature: Moilanen 2010a: 3–4, 6; Vanhatalo 2012: 49–51.





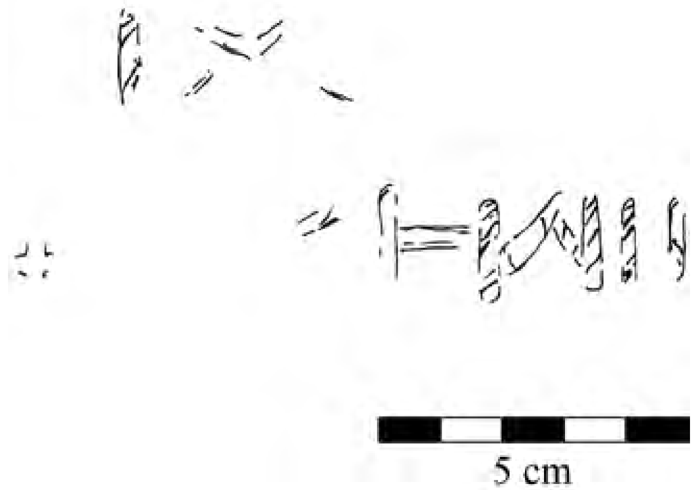
KM 37257 Pälkäne, Knaapi

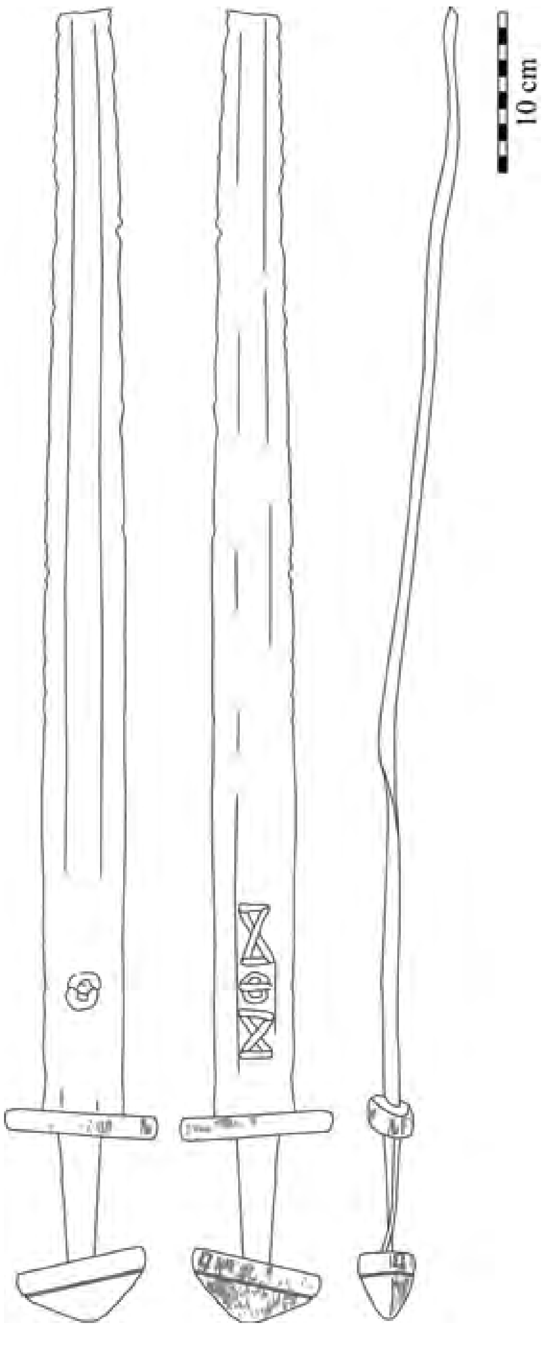
A fragmentary sword in good condition without the lower half of the blade. Weight: 722 g. On one side the fuller contains the remains of letter-like marks, and the reverse side contains fragments of a possible lattice. The material of the inlays could be twisted pattern-welded rod. The inlays were defined with the aid of radiograph no. 3227. Other radiographs: no. 3224, 3233 and 3234.

The hilt resembles Petersen's type Z and Kirpichnikov's local A type. The parts of the hilt are of iron and have traces of silver-plating in the form of molten lumps of silver. The iron surface is hatched (22 grooves/cm in two directions).

The sword is a stray find from 2008 from the yard of Knaapi farm, probably belonging to a cremation cemetery.

Literature: -





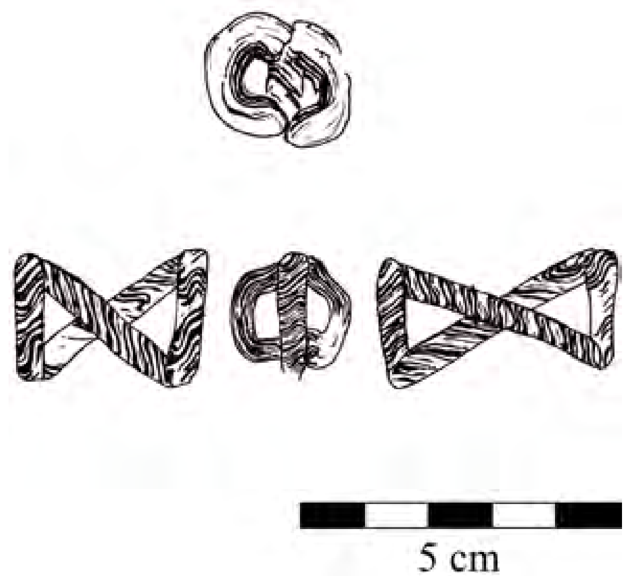
HM 3047 Nokia, Jutila

A fragmentary sword in good condition. The tip of the blade is missing. Weight: 1116 g. On one side the fuller contains two lattices and a spiral with one vertical line in the middle. The reverse side contains a spiral-like motif with one vertical line in the middle. The material of the inlays is both twisted and non-twisted pattern-welded rod, containing possibly seven layers (four of iron and three of steel). In some inlays the layer count seems to be doubled. The inlays were defined by surface examination. Other radiographs: no. 2600 and 2606.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical inlays from brass wires (12 wires/cm).

The sword is a stray find under a building at Jutila farm in 1970, possibly from a level-ground cremation cemetery.

Literature: Räty 1983: 43–44, 154, 182, 296.



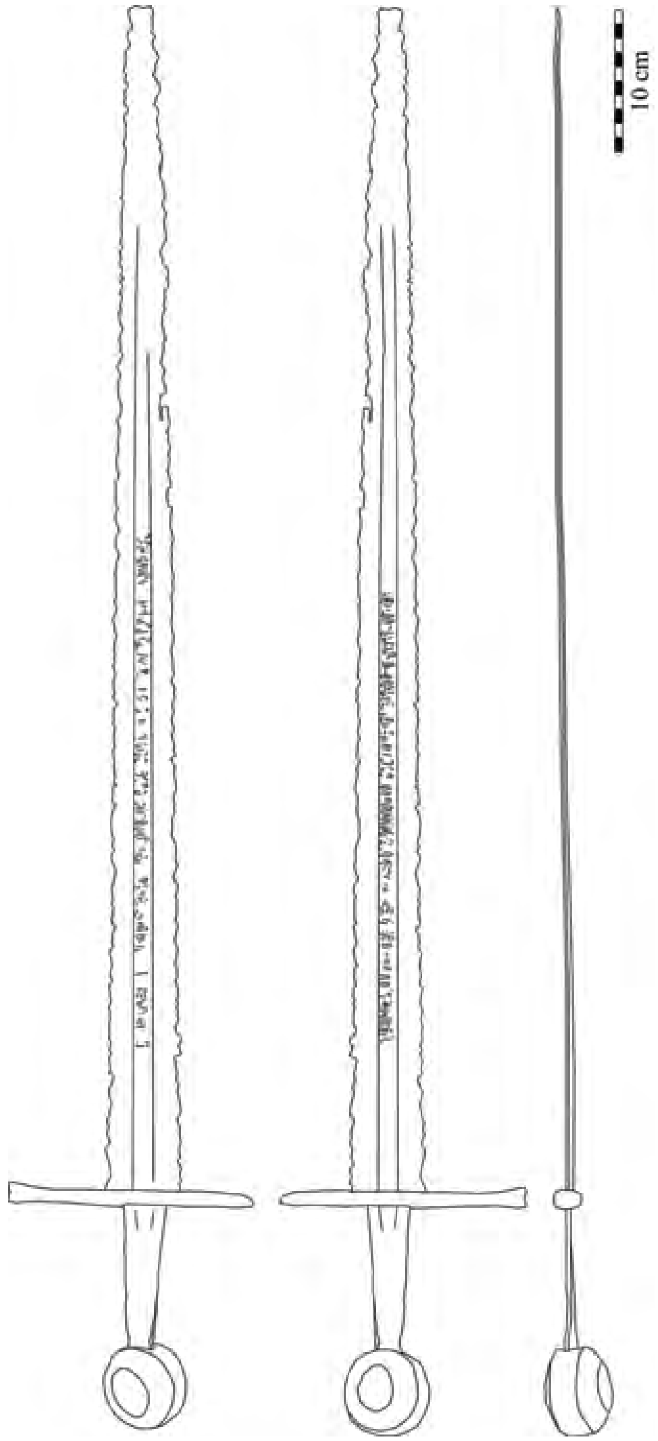
Huittinen, Church Huittinen

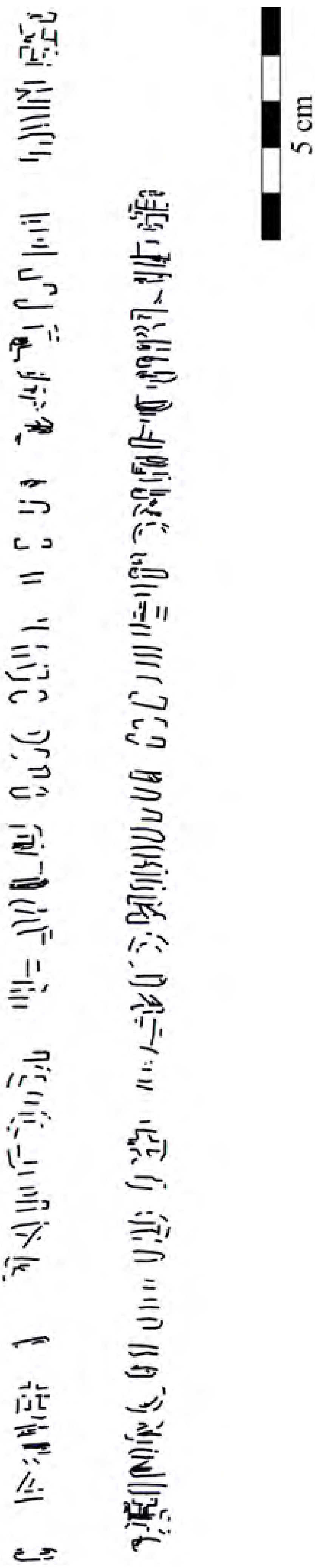
A complete sword in good condition. Weight: 1184 g. Both sides of the fuller bear fragmentary letter-like marks and cross potents. The material of the inlays seems to be steel rod, which has corroded away in most parts. The inlays were defined by surface examination and radiographs nos. 3411 and 3421.

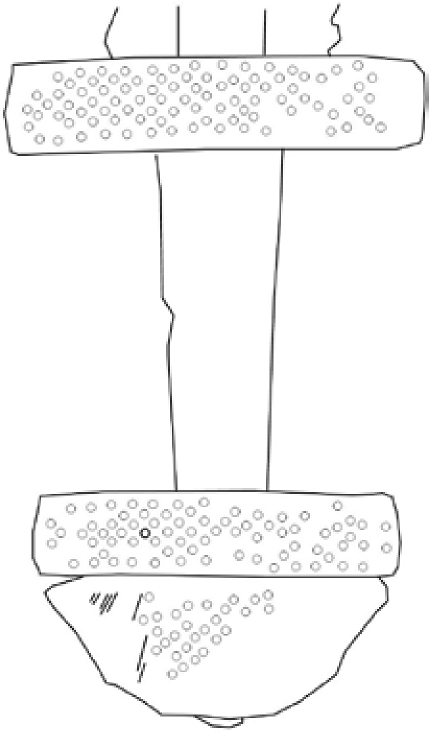
The pommel belongs to Tomanterä's type B, close to Oakeshott's type H. The parts of the hilt are of undecorated iron.

The sword was found in the medieval church of Huittinen during renovation work in 1959. The sword was placed behind the bench of a gallery. It was then hung on top of the sacristy door, where it is still situated. The sword may have been originally from an inhumation cemetery according to its condition.

Literature: Hiekkanen 2007: 220, 222; Moilanen 2009a.







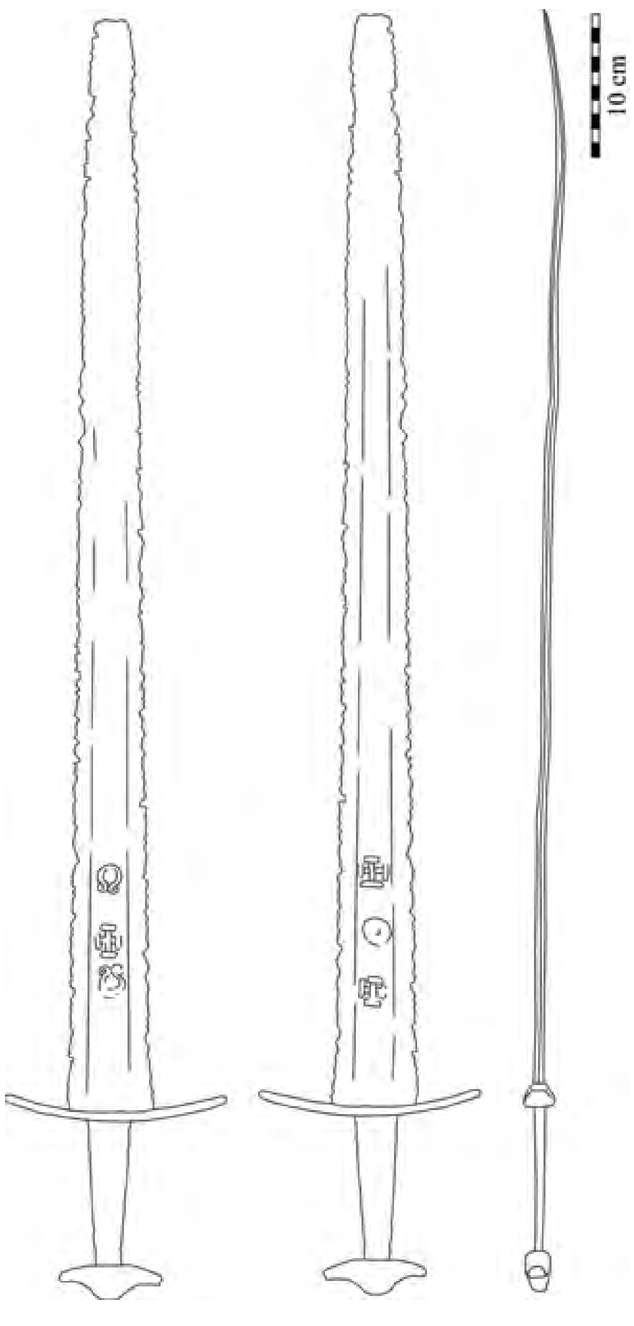
LiuM 26 Kangasala, Hyppärilä, Uotila

A fragmentary sword in good condition, with the lower half of the blade missing. On one side the fuller contains a fragmentary St. John's Arms design, and the reverse side contains a circular design. The material of the inlays is twisted pattern-welded rod. This sword was not documented for the present study, and the drawings are based on earlier publications.

The hilt belongs to Petersen's type E.

The sword is a stray find from the lands of Uotila farm.

Literature: Kivikoski 1939: 203; Kivikoski 1951: 14; Kivikoski 1973: 112, Tafel 94:829; Leppäaho 1964: 22–23; Räty 1983: 30–32, 154, 182, 210, 344; Salmo 1952: 492.



SatM 10330 Ikaalinen, Haapimaa

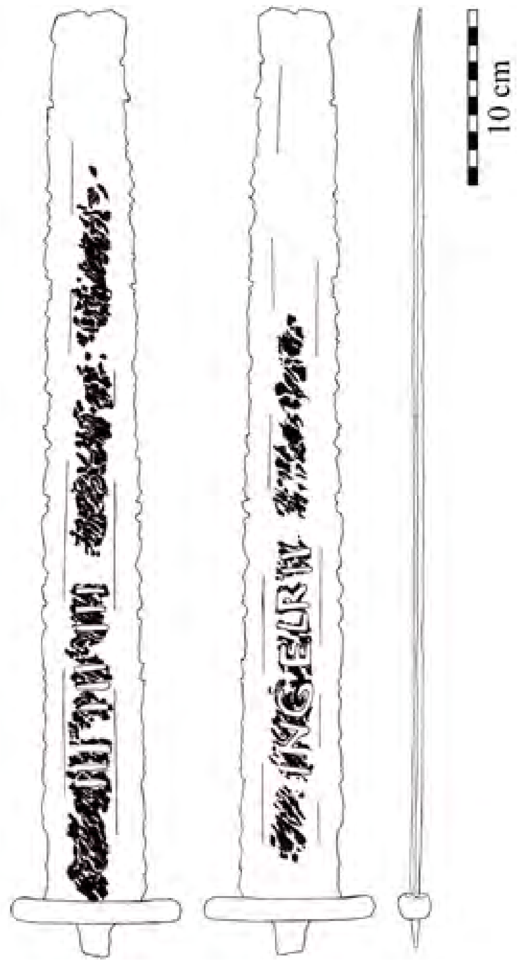
A fragmentary sword in fair condition. The tip of the blade is missing. Weight: 810 g. Balance point: 190 mm. On one side the fuller contains two crosses and a spiral, and the reverse side has two volutes and a cross. The material of the inlays appears to be steel, which shows possibly longitudinal slag inclusions or a corroded structure. The inlays were defined by surface examination. Radiographs: no. 2559 and 2566.

The hilt belongs to Petersen's type Y. The parts of the hilt are of undecorated iron.

The sword is a stray find from 1896 from a hill on the lands of Haapimaa farm.

Literature: Kivikoski 1939: 212; Kivikoski 1951: 15; Räty 1983: 79–81, 154, 271; Salmo 1952: 492.

SatM 12563 Kokemäki, Tulkkila, Alaparma

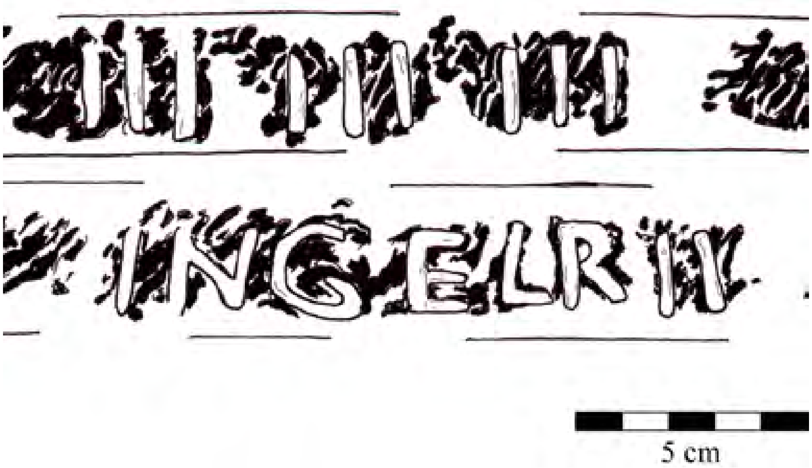


A fragmentary sword in fair condition. The lower half of the blade and the pommel are missing. Weight: 480 g. The blade seems to be some kind of pattern-welded material; there are differently coloured diagonal streaks in the middle portion of the blade. On one side the fuller bears the inscription INGELRII, and the reverse side contains nine vertical lines in groups of three. The material of the inlays seems to be iron, which shows possibly longitudinal slag inclusions or a corroded structure. The inlays were defined by surface examination. Radiographs: no. 2559 and 2565.

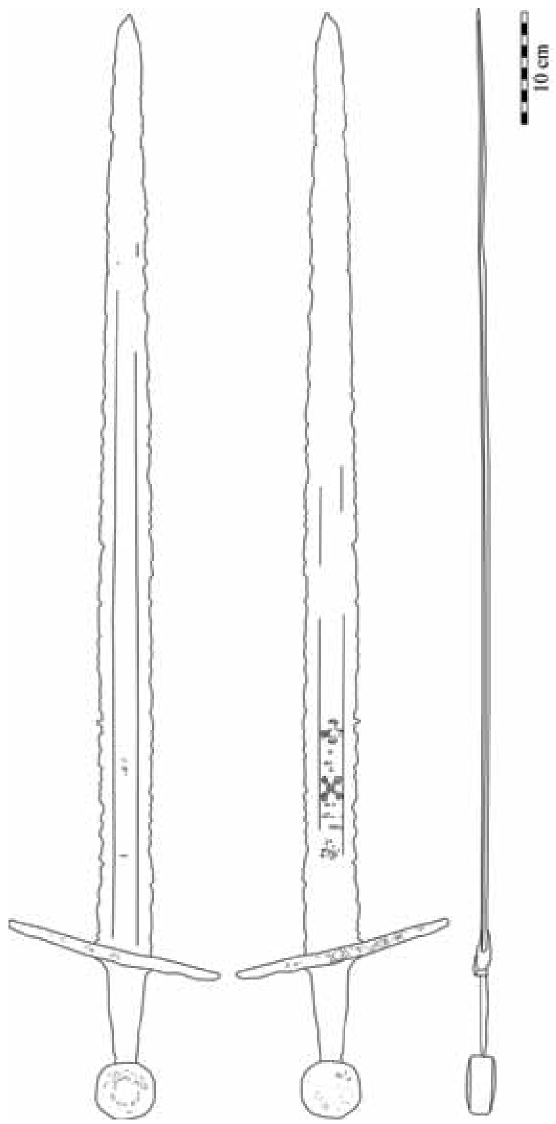
The hilt belongs to Petersen's type O. The lower guard is of iron and decorated with vertical inlays of bronze wires (25 wires/cm) covering the whole iron surface.

The sword is a stray find from 1927 from the lands of Alaparma farm.

Literature: Anteins 1973: 62; Leppäaho 1964b: 38–39; Räty 1983: 68–71, 154, 172–173, 255; Räty 1998: 42–43; Salmo 1952: 493.



TMM 13393 Turku, Maaria, Virusmäki, Mäkilä

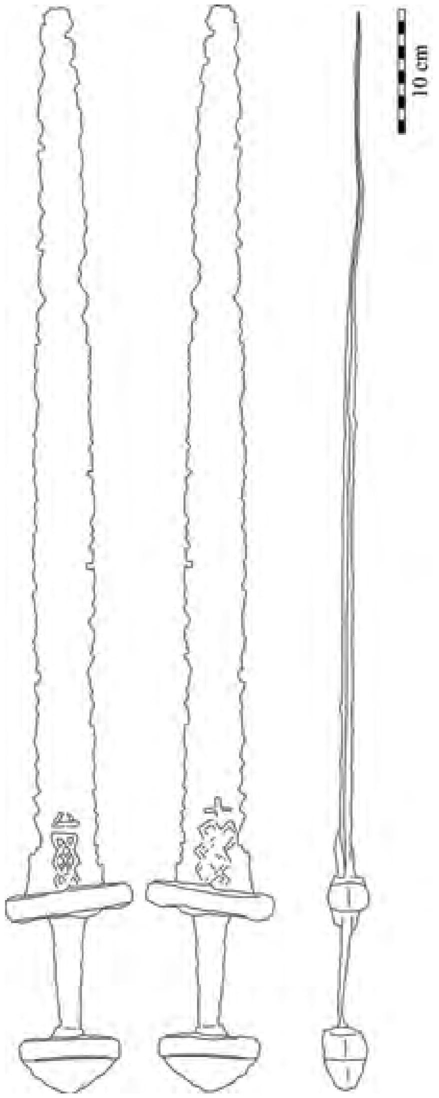


A complete sword in fair condition. Weight: 1062 g. On one side the fuller is marked with vertical lines and patterns resembling St. John's Arms, and the reverse side contains indefinite fragments of line inlays. The material of the inlays seems to be steel rod, which has corroded away in some parts, although there are very slight colour differences that could indicate twisted pattern-welded rod. The inlays were defined by surface examination and radiograph no. 3218. Other radiographs: no. 936, 937 and 3203.

The pommel belongs to Tomanterä's type A, close to Oakeshott's type G. The parts of the hilt are of iron and decorated with silver wire inlays on a hatched surface (27 grooves/cm in one direction).

The sword is a stray find from Laihasmäki hill from the garden of Mäkilä cottage. The sword was given to the museum in 1940.

Literature: Leppäaho 1964b: 88–89; Tomanterä 1978: 27, 61, 130.



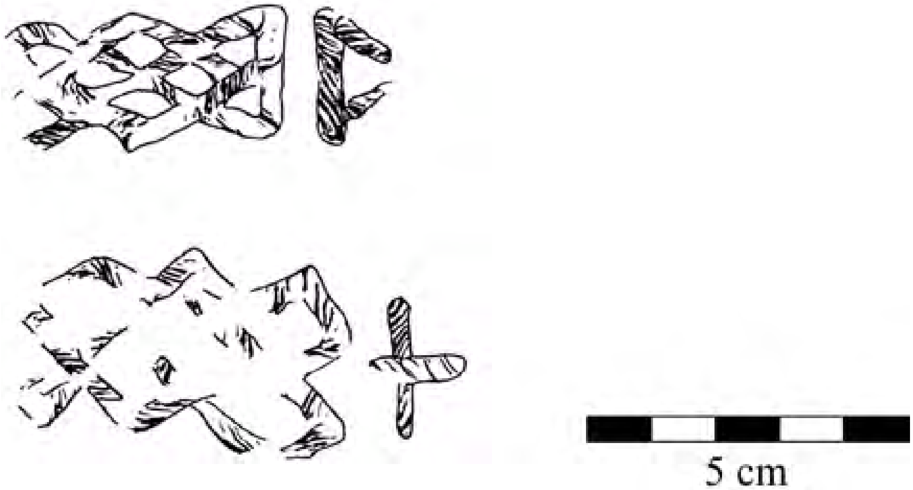
TMM 14105 Salo, hospital

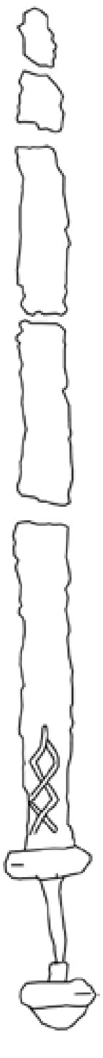
A complete sword in poor condition. Weight: 928 g. Balance point: 95 mm. On one side the fuller contains a woven lattice and a cross, and the reverse side contains a woven lattice and a D-shaped mark. The inlays seem to extend under the lower guard and there are no clear indications of inlays on the badly corroded tang. The material of the inlays is twisted pattern-welded rod. The inlays were defined by surface examination and radiographs nos. 941, 1148, 3237 and 3238.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertically inlaid wires.

The sword is a stray find from 1934 from the construction site of the hospital of Salo.

Literature: Moilanen 2010a: 8–9; Räty 1983: 38–39, 229.





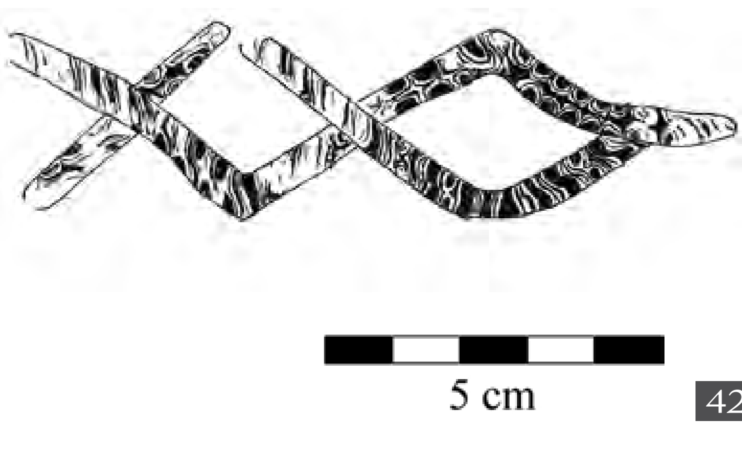
ÅL 336:292 Saltvik, Kvarnbacken

A complete sword in poor condition and broken into five parts. On one side the fuller contains a lattice pattern. The material of the inlays is twisted pattern-welded rod. This sword was not documented for this work, and the drawings are based on previous publications, except for the inlays, which were defined with the aid of radiograph no. 795.

The hilt belongs to Petersen's type B. The parts of the hilt are of undecorated iron.

The sword is a grave find from mound no. 62 (ÅL 336:292–302), excavated by E. Kivikoski.

Literature: Kivikoski 1963: 36, 105, Tl. 26:1, 1a; Räty 1983: 18–19, 152, 159, 195.



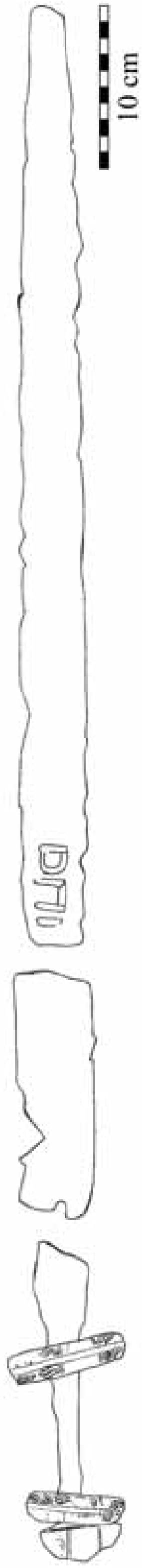
ÅL 337:106 Saltvik, Kvarnbacken

A complete sword in poor condition and broken into three parts. On one side the fuller has letter-like marks resembling the letters I U and D. The material of the inlays may be twisted pattern-welded rod. Since the inlays were in the lowermost fragment of the blade, some inlays certainly exist also near the hilt. This sword was not documented for this work, and the drawings are based on previous publications except for the inlays, which were defined with the aid of radiograph no. 1075.

The hilt belongs to the so-called Mannheim type, and is decorated with silver wire inlays.

The sword is a grave find from mound no. 30 of the Kvarnbacken cemetery (ÅL 337:106–141), which was excavated by E. Kivikoski.

Literature: Kivikoski 1963: 23, 105, Tl. 8:10, Tl. 9; Räty 1983: 213.



ÅL 337:106

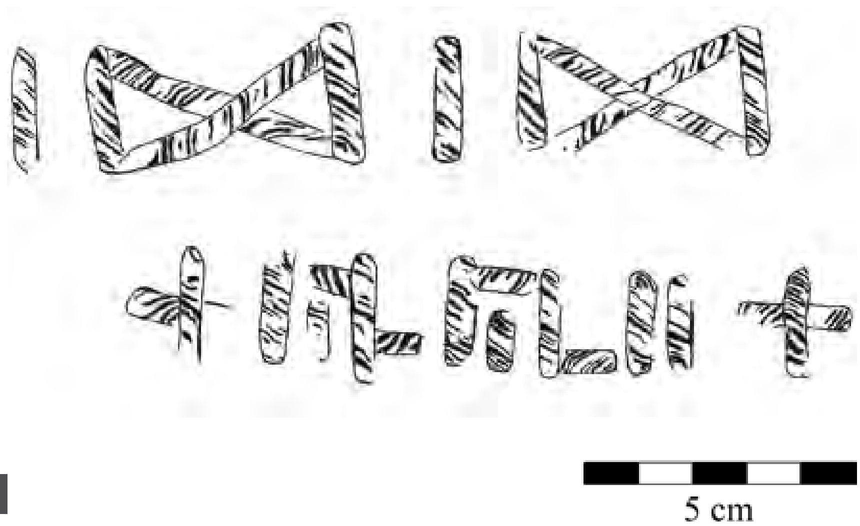
ÅL 337:229 Saltvik, Kvarnbacken

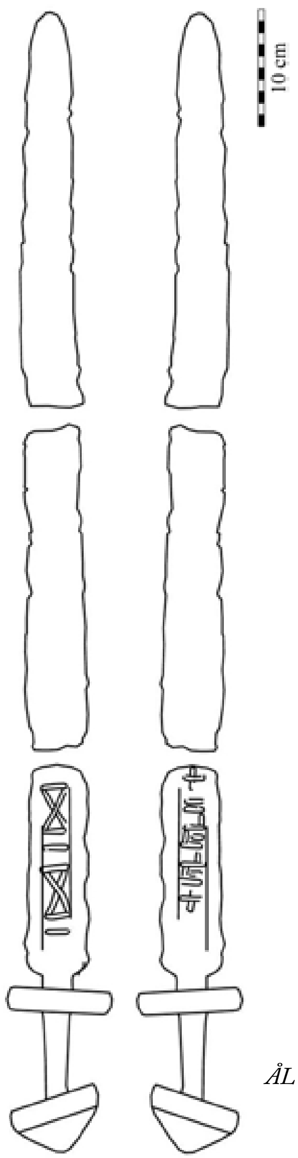
A complete sword in good condition broken into three parts. On one side the fuller contains letter-like marks between two crosses, and the other side contains two lattices lined with vertical lines. The material of the inlays is twisted pattern-welded rod. This sword was not documented for this work, and the drawings are based on previous publications except the inlays, which were defined with the aid of radiographs nos. 803 and 805.

The hilt belongs to Petersen's type H. The parts of the hilt are of iron and decorated with vertical inlays from brass wires.

The sword is a grave find from mound no. 64 of the Kvarnbacken cemetery (ÅL 337:229–249), excavated by E. Kivikoski.

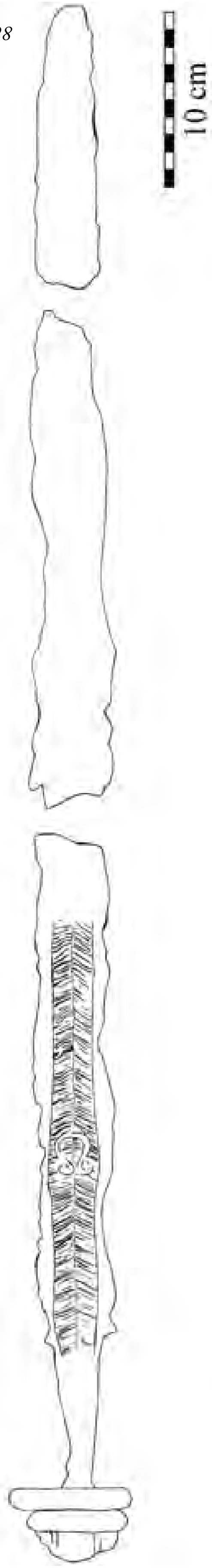
Literature: Kivikoski 1963: 37, 107, Tl. 27:5, 28:1.





ÅL 337:229

ÅL 337:528



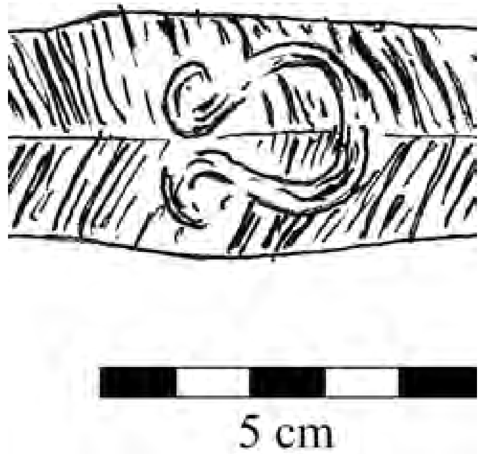
ÅL 337:528 Saltvik, Kvarnbacken

A fragmentary sword in poor condition and broken into three parts. The blade is pattern-welded from at least two twisted rods. On one side the fuller contains an omega-like design. The material of the inlays could be non-twisted pattern-welded rod. This sword was not documented for this work, and the drawings are based on previous publications except the inlays, which were defined with the aid of radiograph no. 791.

The hilt belongs to Petersen's special type 2 or Geibig's type 2. The parts of the hilt are of iron and the possible decoration has corroded away.

The sword is a grave find from mound no. 123 (ÅL 337:527–541), excavated by E. Kivikoski.

Literature: Kivikoski 1963: 57–58, 106, Tl. 56:1, 1a.



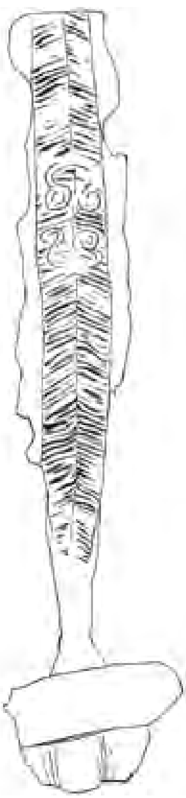
ÅL 345:113 Saltvik, Kvarnbacken

A fragmentary sword in poor condition. The blade is pattern-welded from at least two twisted rods. On one side the fuller contains two omega-like designs. The material of the inlays could be non-twisted pattern-welded rod. This sword was not documented for this work, and the drawings are based on previous publications except the inlays, which were defined with the aid of radiograph no. 790.

The hilt belongs to Petersen's special type 2 or Geibig's type 2. The parts of the hilt are of iron and decorated with silver wire inlays.

The sword is a grave find from mound no. 70 (ÅL 345:113–141), excavated by E. Kivikoski.

Literature: Kivikoski 1963: 41, 106, Tl. 38:1, 1a; Räty 1983: 24–25, 152, 215–216.



ÅL 345:113

APPENDIX 3

FIND CONTEXTS

This appendix summarizes the contexts of the studied finds. In order to fully understand the various contexts and their uses, they are first introduced at a very general level. The contexts mainly mean graves and cemeteries, for both cremation and inhumation, as well as more indefinite contexts and complete stray finds. The contexts are presented in order of their nature, i.e. finds from cremation and inhumation cemeteries, finds from other contexts and their possible interpretations, and stray finds.

1. On burial customs

Before presenting the find contexts of the studied swords, it is necessary to briefly describe the various burial customs in use during the Iron Age in Finland. The burials of the Early Iron Age were more diverse than later during this period, and they were partially adapted from Bronze Age customs. Cremation was the most common form of burial in Finland during the whole Iron Age from the beginning of the Roman era to the end of the Viking Age. During the Roman Iron Ages (from the birth of Christ to ca. 400 AD) burial cairns of mixed earth and stones continued the tradition that had emerged during the preceding Bronze Age and pre-Roman Iron Age. These cairns contained both cremations and inhumations, although cremation became increasingly common.[1] One grave form during the Roman Iron Ages was the so-called *tarand* grave, containing both inhumations and cremations in symmetrical enclosures made of stones. This kind of grave form was very typical in Estonia.[2] In Southwestern Finland there were so-called Kärsämäki type burials during the Roman Iron Age, in which the cremated remains were placed in a covered pit.[3]

The most common type of burial structure towards the end of the Roman Iron Age and in the Migration Period was a cairn made of mixed earth and stones containing a cremation.[4] In these contexts the remains of the funeral pyre were placed on the ground and a small cairn was built on top of them, sometimes having a large central stone.[5] Normally one cairn contained the remains and goods of one individual, but multiple burials in a single cairn have also been recorded, which leads to assume that these were e.g. family burials.[6] Earth-mixed cairns were actually longer in use, all the way to the end of the Viking Age, mostly in the Häme region and along the River Kokemäenjoki.[7] It must be stressed that these kinds of burial cairns are easily mixed with similar-looking cairns of different function.[8]

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1 E.g. Hiekkanen 2010: 294–295. Markus Hiekkanen's article (2010) presents an overview of Finnish burial customs from the Bronze Age to the Early Middle Ages.
2 E.g. Lang 2007; Wessman 2009: 74.
3 Raninen 2005; Wessman 2010: 64; Wickholm 2008: 93.
4 Hiekkanen: 2010: 296–297; Söyrinki-Harmo 1996: 102. In some rare cases inhumations are also known (Wessman 2010: 31 and references cited).
5 E.g. Wessman 2010: 31.
6 Wessman 2010: 31.
7 E.g. Wessman 2010: 31.
8 Some cairns may be e.g. sacrificial cairns, clearance cairns or other, even modern, markers.

The situation of the Åland islands must be mentioned in this context, since burials in this region consisted of cairns and mounds. Stone cairns were typical of the Early Iron Age, but after presumed colonization from Sweden in the 6th century, round and small burial mounds containing a cremation or several of them became a standard, although older cairn forms still existed side by side with the new ones.[9] The cremated bones and grave goods were sometimes placed on the surface of the ground as in mainland Finland, but also in pits and ceramic vessels or urns, in some cases when the burial was of one individual.[10] Cremation in mounds prevailed until the 11th century, when traces of burials vanished, perhaps as a sign of non-permanent settlement.[11]

On the Finnish mainland, cairns were normally in clusters, i.e. close to each other forming kind of cairn cemetery. One theory of the birth of the so-called level-ground cemeteries is the joining of adjacent cairns.[12] Towards the end of the Roman Iron Age, the first cremation cemeteries on level ground were taken into use.[13] This type of cemetery consists of a low, ground-level setting of stones, into which the remains of the cremated person – along with his or her grave-goods – were placed or scattered.

Level-ground cremation cemeteries became widespread during the Merovingian Period (ca. 600–800 AD),[14] except for some inhumation burials in the Satakunta region already in the 6th century, perhaps reflecting early Christian influence.[15] Through the Viking Age, cremation cemeteries on level ground were the common procedure, while inhumations were slowly spreading. No new cremation cemeteries were made during the Crusade Period, but some older ones were still in use for some time.[16] In addition to Finland, cremation cemeteries on level ground are found from Estonia, Latvia, Karelia and possibly from Central Sweden.[17]

Level-ground cremation cemeteries deserve special attention, since they were the prevailing type of burial during the time period considered in this study. As stated above, these kinds of cemeteries were in practice ground-level stone settings, irregular in form and construction, with the remains of the funeral pyre scattered directly on the stones or under or between them.[18] The size of the stones may vary, and usually the whole setting is covered with soil thus leaving the cemetery highly unnoticeable in the terrain today.[19] Some of these cemeteries are very large in area, and their use may have spanned several centuries.[20]

One subject of debate has been the distinction between burial cairns and level-ground cremation cemeteries.[21] Mainly this is caused by the structural similarities between these two grave forms, since cairns may appear in different sizes and heights, thus lower cairns being very similar to small level-ground cemeteries. Lately, the question has been of definition: what structures may be classified as cremation cemeteries on level ground? Also the topography of these burial types is quite similar.[22]

9 *E.g. Hiekkanen 2010: 302, 316; Wessman 2010: 32.*
10 *E.g. Hiekkanen 2010: 316.*
11 *E.g. Hiekkanen 2010: 320–322.*
12 *Söyrinki-Harmo 1996: 102 and cited references.*
13 *This cemetery type has been given various terms in Finnish. The Engish translations are cremation cemetery on level/flat ground and level- or flat-ground cremation cemetery. See Hiekkanen 2010: 305 for further references.*
14 *Hiekkanen 2010: 305; Söyrinki-Harmo 1996: 102; Wessman 2010: 34.*
15 *Lehtosalo-Hilander 1982a: 7.*
16 *Wessman 2010: 34.*
17 *Wessman 2010: 19 and references cited.*
18 *E.g. Hiekkanen 2010: 306–309; Söyrinki-Harmo 1996: 103; Wickholm 2005: 33.*
19 *E.g. Wessman 2010: 19–22.*
20 *E.g. Wessman 2010: 23–24; Wickholm & Raninen 2006: 151.*
21 *See e.g. Hiekkanen 2010: 306–307; Keskitalo 1979: 135; Kivikoski 1966: 50–52; Söyrinki-Harmo 1984; Taavitsainen 1991: 7–10; Tallgren 1931a: 113–114.*
22 *Söyrinki-Harmo 1996: 102.*

Since the cemetery is of collective nature,[23] it is difficult or even impossible to separate individual burials from each other, thus making dating difficult.[24] This view of collectivity has been criticized with reference to the fact that cemeteries could have been looted, already in the prehistoric past, thus mixing all possible individual burials, i.e. combinations of artefacts placed next to each other.[25] Even the nature of the cemetery has been questioned, if it is a cemetery at all. Jussi-Pekka Taavitsainen has suggested that at least some of these level-ground cremation cemeteries may have actually been some refuse heaps of some kind or remains of built structures from settlement sites.[26] Also the possibility of ritual deposits of some kind inside cremation cemeteries has been presented.[27]

During the Merovingian Period and the early Viking Age, some artefact combinations in level-ground cremation cemeteries may be interpreted as individual burials. These often consist of weapons, and the longest ones – swords and throwing spears (angons) – were bent and sometimes entwined, all the finds normally stuffed into a shield boss along with the fragments of cremated bones.[28] It must be stressed that this phenomenon of weapon burials ceased during the Viking Age, and the remains of the pyre ended up being merely scattered.[29] Most commonly these combinations of weapons are interpreted as graves of male warriors, but the notion of an elite wanting to distinguish itself from others has also been suggested.[30] Since cemeteries of this kind are numerous, it has been presented that each of them could belong to a single farm or settlement site.[31]

Some aspects of cremation also call for further comments, especially the funeral pyre itself. Firstly, the location of the pyre still remains unknown. One reason may be that the excavations of cremation cemeteries concentrate on the cemetery itself, while the pyre may have been located somewhere nearby.[32] It has also been suggested that at least in some cases the pyre was located in the cemetery itself.[33] Furthermore, the construction of the pyre is not known, although there are theories based on ethnological analogies, and some experimental work has been done on the subject.[34] After all, different construction alternatives may have been in use in different areas and at different times.

A further debated matter concerns the heat generated on the pyre. Mostly this question of maximum heat has been connected to the fragmentation, shrinkage and colour of the cremated bones.[35] It seems that the temperature of the pyre has been over 1000 degrees Celsius, since the body fat of the cremated corpse burns at this temperature.[36] Considering the subject of this work – the swords – this temperature has dramatic effects on these objects. First of all, the structure of steel is normalized (see Chapter 3.1), and thus in the case of edged weapons, the hardened structures vanish, and as a consequence, the modern researcher cannot say how the blacksmith

23 The term 'collective' may be understood in different ways. For example Miikka Haimila (2005) presents that collectivity may be small-scale or complete, small-scale meaning that a social group has been buried as one unit.
24 Lehtosalo-Hilander 1982a: 7; Söyrinki-Harmo 1996: 103; Wessman 2010: 23, 34, 57–61; Wickholm & Raninen 2006: 151.
25 E.g. Taavitsainen 1991.
26 Taavitsainen 1991.
27 Wessman 2010: 29.
28 E.g. Söyrinki-Harmo 1996: 103; Wessman 2010: 24, 62–65; Wickholm & Raninen 2006: 151.
29 E.g. Wessman 2010: 62.
30 Hiekkanen 2010: 309–310; Wessman 2010: 64; Wickholm & Raninen 2006.
31 E.g. Hiekkanen 2010: 311.
32 E.g. Söyrinki-Harmo 1996: 103.
33 E.g. Söyrinki-Harmo 1996: 108; Wessman 2010: 49.
34 E.g. Henrinksen 1991; Kaliff 1994; Moilanen et al. 2007; Sigvallius 1994; Werner 1990.
35 See e.g. Dokládal 1970; von Endt & Ortner 1984; Iregren & Jonsson 1973; Jonuks & Konsa 2007; Piontek 1976; Shipman et al. 1984.
36 Mays 2005: 207, 219–220; Moilanen et al. 2007: 45; Wessman 2010: 51–52. The heat of the pyre is also affected by the nature of the firewood, the size and construction of the pyre, and the climate of the pyre site, especially the magnitude of the wind.

had heat-treated the blade in the past. Secondly, non-ferrous decorations tend to melt away in this temperature. Thirdly, long and thin iron artefacts such as sword blades may be slightly bent by the effect of the heat.[37] Fourthly, iron and steel will gain a thin layer of oxidation on the surface (fire patina), which in some cases protects the object against post-depositional corrosion.

Another striking feature of cremations is the ritual destruction of grave goods, namely weapons. During the Iron Age, this custom may be seen in Finland already in the Kärsämäki type burials.[38] Typically, weapons were deliberately destroyed by bending and chopping them into smaller pieces, including both the blade and the hilt in the case of swords. Especially Merovingian Period sword hilts made of thin metal sheets and organic materials were cut into small pieces. Sometimes parts of the hilt were only detached from the blade and cast into the cemetery separately.

Various motives have been suggested for this deliberate breaking of artefacts, ranging from religious to practical ones. A common interpretation is that the object was to follow the deceased to the otherworld, or that namely weapons were broken as a precaution to prevent the dead from using them against the living.[39] As a practical explanation, large artefacts were possibly fitted into a smaller space as in Kärsämäki type pit cremations.[40] This may lead to suspecting that perhaps the tradition of deliberate destruction during the Late Iron Age derives from this earlier time period.[41] On the other hand, the objects may have been destroyed to prevent anyone from stealing them for re-use.[42]

As stated above, swords and other weapons were normally bent, twisted and even cut into smaller pieces. Sometimes the cutting edge of a sword is found hacked with some other blade, and this has been interpreted as one way to destroy a weapon.[43] They may, however, be also interpreted as traces of battle.[44] In any case, this kind of destruction of metal artefacts has been regarded as belonging to a blacksmith, who uses the heat of his or her forge to make the objects elastic enough e.g. to be bent.[45] Experiments, however, have shown that it is possible to make bends in sword blades and even wrench them into pieces when cold, most likely after the cremation has taken place.[46] Furthermore, the low quality of the steel (or iron) in some blades may allow the bending of the blade even before it was placed on the pyre.

The earliest inhumation burials in Finnish Iron Age date from the 6th century, as stated above. These emerge from the Satakunta region, in the vicinity of Lake Pyhäjärvi.[47] From this century on, inhumation seems to have been the most common form of burial in these localities, while elsewhere in Finland cremation prevailed more or less until the end of the Viking Age. The Crusade Period in Finland (ca. 1025–1200/1300 AD) witnessed the growing popularity of inhumation burial. For most of this period, these burials were not completely Christian, since grave goods continued to be given to the deceased.[48] Otherwise, the graves of the Crusade Period in Finland were approximately east-west oriented, with the head of the deceased pointing towards west.[49]

37 *See e.g. Moilanen et al. 2007: 44–45.*
38 *Karvonen 1998: 3; Wickholm& Raninen 2006: 154.*
39 *E.g. Lehtosalo-Hilander 1984: 309; Pälsi 1938: 32; Selirand 1989: 167.*
40 *Karvonen 1998: 6–7.*
41 *Hirviluoto 1976: 67.*
42 *James 1957: 141.*
43 *Karvonen 1997: 38.*
44 *Moilanen 2010a.*
45 *E.g. Creutz 2003: 263; Purhonen 1996: 122; Østigård 2006: 425–452.*
46 *Moilanen 2008b.*
47 *E.g. Wessman 2010: 33, 76.*
48 *E.g. Purhonen 1997: 373; Purhonen 1998: 114–115, 133.*
49 *E.g. Hiekkanen 2010: 334–335; Pälsi 1938; Purhonen 1998: 114, 121. Purhonen (1997: 373) has presented a three-phase division of the process of Christianization in Finland. In the first phase burials still contained grave goods, while in the second phase only dress ornaments were present. The third phase was then a burial with no grave goods at all.*

The earliest inhumations of the Crusade Period were placed on or beside an earlier Viking Age cremation cemetery, whereas the distance to these old cemeteries grew when pagan features, such as grave goods, were left out.[50] In most case, the pit for the deceased was dug through the cremation cemetery, causing the cremated artefacts to appear in the fillings of the grave.[51] The burial sometimes took place in a pit or a wooden coffin, which may have been constructed from planks or from a single log.[52]

The grave goods were placed next to or on top of the deceased. The swords were usually placed on one side of the deceased, although the position has varied from one cemetery to another, both during the Viking Age and the Crusade Period.[53] Multiple reasons for the deposition of the sword have been suggested. One generally considered idea is that the sword was considered as a very personal artefact, and it must therefore follow its owner to the grave.[54] This claim may be questioned by stating that we cannot know if the weapons were actually owned by the buried person, or whether they were given to the deceased according to the beliefs and customs of the society or social group in question.[55] It has also been claimed that weapon burials indicate war or restless times. On the other hand, if weapons were needed so much, why were they placed in graves instead of being used by the living?[56]

In connection with the find contexts it must be noted that in certain circumstances even Christian burials could contain a sword. In medieval Europe knights and kings were either buried with a sword, or the sword was placed near or above their tombs, which in most cases were situated inside churches.[57] Furthermore, swords may have been placed in churches also as votive offerings. Even in Finland there is known one instance, in Naantali to be exact, where a medieval nobleman was buried with a sword.[58] Christianity then did not cause armed burial to completely vanish, but to allow it for certain classes of society.

2. A classification of the contexts of the studied finds

2.1. Numbers of swords in certain contexts

The contexts of the studied swords are presented below in regional order (Fig. 1). Furthermore, each context is discussed individually. The contexts are presented as follows: stray finds, finds from cairns and mounds, swords from closed combinations in cremation cemeteries, scattered finds from cremation cemeteries, and finally inhumation burials. In each class there are certain and uncertain cases. Listed at the end are other contexts that do not fit into any of the above.

To present some numbers, sword finds seem to concentrate in the regions of Finland Proper (SW Finland), Tampere, Satakunta and Häme (Tavastia Proper), and in the major areas of Late Iron

50 *E.g. Wessman 2010: 25, 76–77. It must be noted here that the orientation of these inhumation graves within cremation cemeteries was more varied than in plain inhumation cemeteries (Wessman 2010: 80 and references cited).*
51 *E.g. Wessman 2010: 25, 77.*
52 *E.g. Aroalho 1978: 6; Hiekkanen 2010: 331–332; Wessman 2010: 77.*
53 *See e.g. Lehtosalo-Hilander 1982b: 17.*
54 *E.g. Mäntylä 2006a: 147.*
55 *E.g. Pader 1982: 57; Parker Pearson 2003: 83–86; Raninen 2005: 50–51.*
56 *E.g. Purhonen 1998: 133.*
57 *E.g. Oakeshott 1960: 248–249; Oakeshott 1991: 7.*
58 *Harjula 2010: 70–71.*

Age settlement in Finland (Fig. 2). Scattered finds from cremation cemeteries are most common (Fig. 3), but that comes as no surprise since this kind of burial was prevalent in the studied period in Finland. Stray finds are surprisingly common, but this may be connected to unsystematic research of the find locations back in the first half of the 20th century.

Finland Proper	56
Tampere Region	30
Satakunta	24
Tavastia Proper	14
Päijänne Tavastia	7
Ostrobothnia	2
Central Finland	1
Uusimaa	1
Northern Ostrobothnia	1
Lapland	1
Åland Islands	8
Ceded Karelia	5
Total	**151**

Figure 1. Region-specific numbers of studied swords with ferrous inlays.

2.2. Stray finds

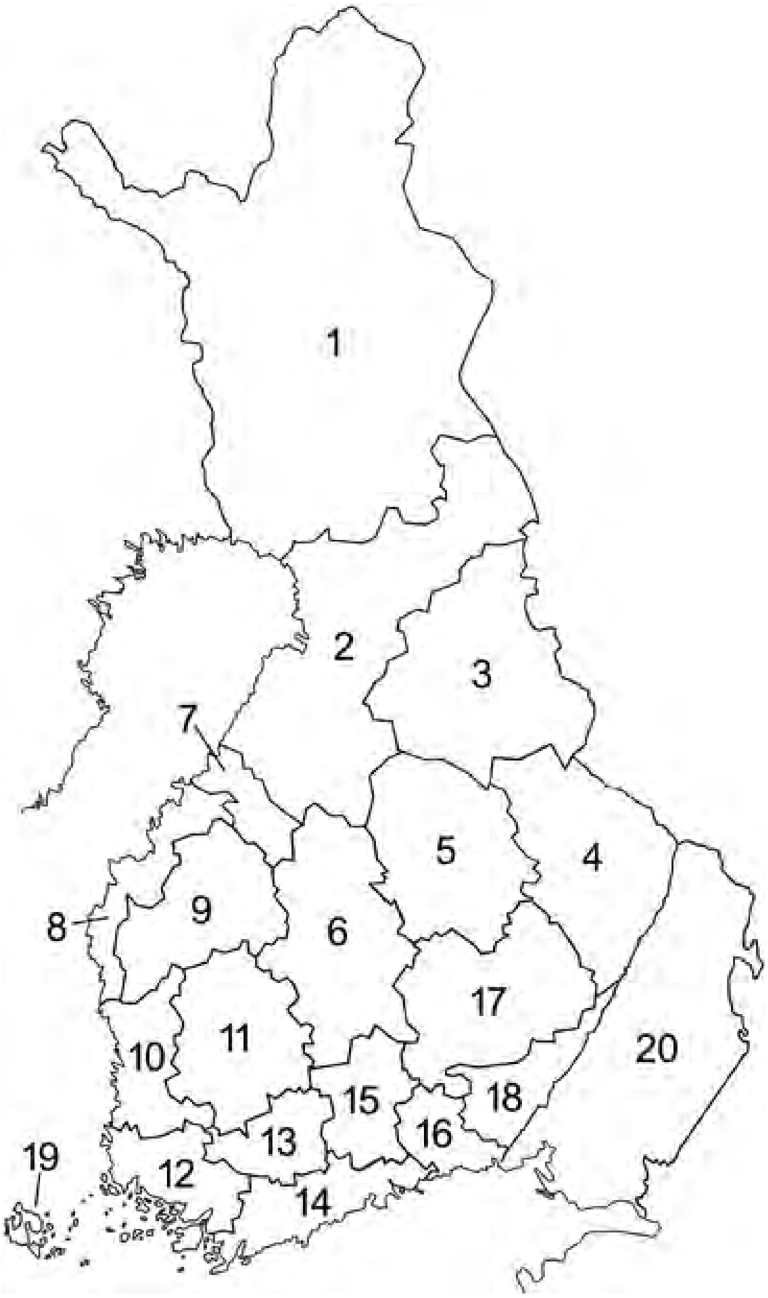
Surprisingly many of the inlaid swords, as well as other sword finds in Finnish areas, have been found separately as stray finds, having no association with other prehistoric artefacts or fixed remains such as burials. There 31 known stray finds of this kind.

Ten stray finds of inlaid swords or their fragments have been discovered in the region of Finland Proper. Two inlaid swords have been found as stray finds in the present-day municipality of Salo. One was found at Kavila farm in Uskela in 1931 (**KM 9419**), and claimed for the National Museum in the same year. The sword was near the surface of the earth on a sandy moor. The find location has not been investigated. The other sword was found at the construction site of the county hospital of Salo in 1934 (**TMM 14105**). No traces of fixed remains were observed at the location.

In the municipality of Uusikaupunki one inlaid blade is known from Päivölä farm in the former parish of Kalanti. This probably 11th-century blade fragment (**KM 8219**) came to light in 1877 while planting a tree, and it was not claimed for the National Museum until 1923. A fragmentary stray find is known also from Laitila. This sword **(KM 9832**) was found in 1934 on the northwest side of the road leading to Raula farm in the village of Untamala, more precisely from the edge of a gravel pit. At present the find location has been destroyed by continued gravel transport, and no indications of fixed remains such as a cemetery were ever found.

A total of three inlaid swords have been found as stray finds in the municipality of Mynämäki. Fragmentary sword **KM 2979:8** was found on a hillside on the lands of Junnila farm in the village of Tarvainen or Kukola, and was collected in 1894 by K. A. Bomansson (KM 2979:1–27). Although the sword was found with some pieces of charcoal, the find location cannot be connected with any known cemetery. Sword **KM 3052:2** is a stray find from the lands of Savu farm. Since the sword was sent to the National Museum ca. 30 years after it was found, the precise find location and year remain obscure. The sword belonged to a shipment of artefacts in 1895 (KM 3052:1–11). The third one, sword **KM 7961:1**, is a stray find from Raivomäki hill on a rocky ground without any more specified find location. It was bought for the National Museum by C. A. Nordman in 1921. It may be associated with the possible cremation cemetery of Kankare, situated about 850 metres southeast from the church of Mynämäki on a small hill, but this is not in any way certain.

There is one stray find from Nousiainen. Sword **KM 7220:2** was found in a field belonging to Kyläprehtu farm in 1911 or 1912. The sword was among artefacts sent to the National Museum in 1917 (KM 7220:1–2). Together with this upper portion of a sword also the lower part of a sword blade was found but had been lost. There were decayed wood and stones at the find location, but nothing more. Sword **KM 7011** is a stray find from the village of Kila in former



Kemiö parish, present-day Kemiönsaari. The exact find location of the sword remains unknown, except it was found behind a croft. The sword was claimed for the National Museum of Finland in 1916. Sword **KM 5215** from the municipality of Parainen (former Nauvo) is also a stray find, this time from a field near the seashore in 1908. No other signs of ancient remains were documented at the site.

Eight inlaid swords have been recovered from the Tampere Region as stray finds. Sword **KM 2986:4** is a stray find from the yard of the Kässä farm in Tampere (former Messukylä) and belongs to artefacts collected by S. Wilskman from Tampere in 1894 (KM 2986:1–6). No burial sites etc. are known from the vicinity of the find.

Three stray finds are known from the municipality of modern Valkeakoski (former Sääksmäki). The first (**KM 2767**) was found from a cattle-road near Rapola Ridge in 1891. Although the find location of the sword does not match any known prehistoric cemetery, it is located among other prehistoric remains dating from the Iron Age. The large area of Rapola contains several different kinds of ancient remains. The area is situated roughly 700 metres northwest from the medieval Church of Sääksmäki, and is about two square kilometres in size. The remains include a hillfort, over one hundred cairns, four cemeteries (Rupakallio, Voipaala, Hirvikallio and Matomäki), an ancient field, settlement sites and three cup-marked stones. The second stray find comes from the site of Rupakallio (**KM 3301:1**), collected by K. A. Petterson in 1896 (KM 3301:1–3). The site of Rupakallio has traditionally been interpreted as a cremation cemetery on level ground, but a settlement site with a smithy has also been seen plausible. The sword KM 3301:1 however appears to be undamaged by fire, so its context may be something else. The site of Matomäki is situated on a gravel ridge, about 300 metres east from the shore of Rautunselkä. The site was archaeologically excavated as late as the beginning of the 1960s, since the major finds were made in 1959. The finds may be dated from the 5th century to the beginning of the 11th century, the majority of the finds concentrating between 800–1000 AD. The overall dating of the site is thus ca. 400–1050 AD.[59] The third find is **KM 2886:10**, which was recovered in 1892 from a hill called Solberg near the village of Tarttila. There is no further information on this context.

Figure 2. Regions of Finland: 1. Lapland, 2. Northern Ostrobothnia, 3. Kainuu, 4. North Karelia, 5. Northern Savonia (Savo), 6. Central Finland, 7. Central Ostrobothnia, 8. Ostrobothnia, 9. Southern Ostrobothnia, 10. Satakunta, 11. Tampere region, 12. Finland Proper, 13. Tavastia Proper (Häme), 14. Uusimaa, 15. Päijänne Tavastia, 16. Kymenlaakso, 17. Southern Savonia (Savo), 18. South Karelia, 19. Åland islands, 20. Ceded Karelia.

Sword **KM 11242** is a stray find from 1933 from Äkki-Kallio farm in the municipality of Kangasala, made while digging foundations for a house. The sword was found at the depth of half a metre, on a rocky hill, but no indications of a cemetery was found. The sword was claimed for the National Museum in 1940. Another sword from Kangasala (**LiuM 26**) is a stray find from the property of Uotila farm in the village of Hyppärilä.

59 *Kivikoski 1973: 14.*

	Finland Proper	Tampere region	Satakunta	Tavastia Proper	Päijänne Tavastia	Ostrobothnia	Central Finland	Uusimaa	Northern Ostrobothnia	Lapland	Åland Islands	Ceded Karelia	Total
stray finds	10	8	6	2	2				1			1	31
certain finds from cairns and mounds	2	1									8		11
possible finds from cairns and mounds	3	4		3									10
finds from closed combinations from cremation cemeteries	3					1							4
scattered finds from cremation cemeteries	17	9	3	7	4	1		1				2	44
certain finds from inhumation burials	7	4	9										22
possible finds from inhumation burials	9		6	1									16
other contexts	5	4		1	1		1			1			13

Figure 3. Numbers of iron-inlaid swords in various find contexts as divided by Finnish regions.

Single stray finds have been recovered from various municipalities in the Tampere region. Sword **SatM 10330** was found in 1896 as a stray find on a hill situated in the northwest part of the property of Haapimaa in Ikaalinen. The farm of Haapimaa is located ca. 4.3 kilometres southwest of the Church of Ikaalinen, on the south side of Lake Keminselkä. The site has traces of activity from historical times, as well as a possible Iron Age cemetery, although there is no evidence speaking of this function. The site is at least partially destroyed. Sword **HM 3047** was recovered as a stray find under a building in 1970 at Jutila farm in Nokia. The existence of a level-ground cremation cemetery has been suggested but with no grounds. The preservation of the sword suggests that it has not been in fire.

Six stray finds are known from the region of Satakunta. Three of these are from Eura. Sword **KM 2361** is a stray find made in 1857 near the possible cemetery of Vähä-Vahe situated 50 metres west from the River Eurajoki and beside the road leading from the Church of Eura to the village of Kauttua. Shallow east-west oriented depressions can be seen in the yard of a house at the site, and thus interpreted as possible inhumation graves. It is not, however, stated that the sword in question would belong to this cemetery. In addition to this above-described sword, two more are known from the village of Kauttua. Sword **KM 5334:1** is a stray find from a hill near a factory, and was donated to the National Museum in 1909. The exact find location is beside a railway line on a hill on the left shore of the River Eurajoki. Another sword, **KM 70**, was reported to have been found also near the same factory already in 1849, but a more precise find location is not known.

A special case is a disc-pommeled sword that was found in the **medieval Church of Huittinen** during renovation in 1959. The sword was placed behind a bench in a loft, from where workmen discovered it. The sword was then hung on top of the sacristy door, where it is still situated. The condition of the sword suggests that it had originally been found underground. Also, it appeared that if the sword was originally from a burial, it must have been an inhumation since no fire patina was present and the sword was not bent. The cemetery in which the sword was originally discovered has remained a mystery. One guess is the inhumation cemetery of Takkula in the village of Sammu, dating from the 7th and 11th centuries.[60] Alternatively, the sword may be found in the Crusade Period inhumation cemetery of Yli-Jaakkola in the village of Loima.[61] Other Iron Age cemeteries nearby are older, dating from the Viking Age or even earlier.[62]

Two swords are known from Kokemäki. The find location of Aarikka is situated 8 kilometres northwest from the church of Kokemäki. The place is a crop field belonging to Aarikka farm. Sword **KM 20127** is a stray find from this field from the end of 1960s, and the sword was donated

60 *Kivikoski 1973: 11.*
61 *Moilanen 2009a.*
62 *See Kivikoski 1973: 11.*

to the Emil Cedercreutz Museum in 1977 (catalogue number ECM 6682). Another sword, **SatM 12563**, is a stray find from the lands of Alaparma farm in Kokemäki in 1927. It, too, cannot be connected to any known cemetery or other site.

There are two stray finds from the region of Häme (Tavastia) Proper. Sword **KM 16279** is a stray find from a ploughed field in 1964 in Hauho, present-day Hämeenlinna. No investigations have taken place at the find location. The second find is also from Hauho. Sword **KM 7134:1** was found in the garden of Hahkiala farm in 1913. Since the sword was bought from the finder, no further information is available of the find location.

There are two stray finds also from the Lake Päijänne region of Häme. The first one, discovered in 1959 (**KM 14684**) is from the municipality of Hämeenkoski, in a field at Järvikukkola farm in 1959. The second one (**KM 3383:2**) is a stray find from the floor of a cowshed at Tylppölä farm in Padasjoki (discovered in 1895). The sword was sent to the National Museum in 1897 together with finds KM 3383:1-6. No further investigations have taken place at either of these find locations in Hämeenkoski and Padasjoki.

Only one inlaid sword is known from the region of Northern Ostrobothnia, and it happens to be a stray find. Sword **KM 2508:124** is a stray find from the municipality of Pudasjärvi and its original location is given as Kurjenkoski. The sword was recovered for the National Museum of Finland by A. H. Snellman and belongs to artefacts originally collected from Oulu parish (KM 2508:1–131).

A stray find is also known from the territory of Ceded Karelia. Sword **KM 6923** is a stray find from a field close to the main building of Naskali farm in the village of Lapinlahti in Sakkola parish from 1914. The sword was sent to the museum authorities of Finland by order of the governor of Viipuri Province.

There is still one hiltless sword having the status of a stray find. This sword (**KM 7332**) has belonged to the collections of the Finnish Literature Society and it is mentioned in a catalogue drawn up by F. J. Färling in 1929. No find context can be stated, but it is said to have been found in Finland.

2.3. Swords from cairns and mounds

There are eleven definite finds from cairns and mounds, eight of them from Viking Age burial mounds in the Åland islands. Three of these swords are under Finnish collection numbers, and have been recovered from the cemeteries of Saltvik. A possible Petersen type H sword (**KM 287**) was found in a mound in the cemetery of Kvarnbo, and was accompanied by a fragmentary spearhead mostly resembling Petersen's type A. Petersen considered the type A spearhead to date from the 8th century,[63] but in Finnish contexts some of them date at least from the first third of the Viking Age.[64]

An inlaid, pattern-welded sword **KM 293** was found in the cemetery of Bertby. The mound from which the sword was recovered contained three separate cremations. KM 291 included four fragmentary spearheads, a knife fragment, a fragment of a small scramasax and a penannular brooch. KM 292 consisted of a sword and two fragmentary spearheads. The sword in question belongs to the third cremation (KM 293), which contains, in addition to the sword, a spearhead

63 *Petersen 1919: 181.*
64 *Lehtosalo-Hilander 1985: 13; Salmo 1938: 248–250.*

of Petersen's type B, a sickle, a knife and two whetstone pieces. Petersen dates type B spearheads to the beginning of the Viking Age.[65]

Sword **KM 6196:1** is a grave find from a mound (no. 3) situated in Kvarnbo, Rihagen, containing a possible boat grave (KM 6196:1–41). The finds from the same grave include a fishing spear, upper guard of a sword, a spearhead of Petersen's type E, iron knives, bronze fibulas, iron fragments, fragmentary belt mounts, fragments of bone combs, pieces of iron chain, a sword pommel, pieces of charcoal, and bronze rivets. Of the above-mentioned finds, the upper guard (KM 6196:3) and the pommel (KM 6196:20) belong to sword KM 6196:1. The dating of the spearhead of Petersen's type E is very broad. While Petersen dated these spearheads to the transition between the Merovingian Period and the Viking Age, these seem to be later in Finland, mainly corresponding to the dating of the whole Viking Age.[66] The sword may date according to its hilt and blade inlays close to the middle of the Viking Age.

Altogether five inlaid swords are known from the cemetery of Kvarnbacken in Saltvik parish, Åland islands. Kvarnbacken is a Late Iron Age mound cemetery in the village of Bertby. The cemetery consists of 140 burials, thirty of which may be dated to the Viking Age; the rest are from the Merovingian Period. The cemetery was totally excavated in the 1950s and 1960s. A total of seventeen swords or their parts have been recovered from altogether fifteen mounds.

Sword **ÅL 336:292** is a grave find from mound number 62 (ÅL 336:292–302), excavated by Ella Kivikoski. The sword was found together with another sword of Petersen's type B, two spearheads of Petersen's type A, a bronze mount, potsherds, an iron nail and an iron rivet, and burnt bone.[67] Kivikoski dates this mound to ca. 800 AD according to the sword hilts.[68]

Sword **ÅL 337:106** is from grave mound number 30 (ÅL 337:106–141). Other finds recovered from the mound were a spearhead of Petersen's type A, bronze mounts and their fragments, a spiral finger-ring, pieces of iron mounts, potsherds, iron rivets and some burnt bone.[69] Kivikoski dates this burial to ca. 800 AD according to the type of the sword and the decoration of the bronze mounts.[70]

Sword **ÅL 337:229** is from mound number 64 (ÅL 337:229–249), also including fragments of Petersen's type A spearhead, fragments of bronze finger-rings, pieces of a bronze plate, fragments of bone combs, iron fragments, potsherds, iron nails and rivets, and burnt bone.[71] This mound has been dated roughly to the Viking Age.[72]

Sword **ÅL 337:528** belongs to artefacts excavated from mound number 123 (ÅL 337:527–541), other finds including a spearhead of Petersen's type A, a bronze buckle and mount from a belt, a carnelian bead, a blue glass bead, fragment of a bone comb, piece of an iron rod, potsherds and burnt bone.[73] Kivikoski dates this burial to 800 AD according to the type of the sword.[74]

65 Petersen 1919: 181.
66 Lehtosalo-Hilander 1985: 13.
67 Kivikoski 1963: 36–37.
68 Kivikoski 1963: 125.
69 Kivikoski 1963: 23–24.
70 Kivikoski 1963: 125.
71 Kivikoski 1963: 37.
72 Kivikoski 1963: 126.
73 Kivikoski 1963: 57–58.
74 Kivikoski 1963: 126.

Sword **ÅL 345:113** belongs to finds recovered from mound number 70 (ÅL 345:113–141). Other finds are as following: two spearheads of Petersen's type A, a bronze mount, a fragmentary bronze finger-ring with a middle shield, fragments of iron artefacts such as a sickle, potsherds, iron rivets and burnt bone.[75] Kivikoski dates this burial to ca. 800 AD according to the sword.[76]

The remaining three swords found from cairns are from the regions of Finland Proper and Tampere. Sword **KM 3316:13** from Salo (former Halikko) was found in a cairn or a mound together with a bronze finger-ring dating from the early medieval period following the Crusade Period in the Finnish chronology.[77] The site also revealed Viking Age finds, as well as finds from the medieval period.

Another sword from Finland Proper, **KM 7472:2**, belongs to a group of finds from a cairn in Rahkamala, Vehmaa (KM 7472:1–5), demolished in the building of the Turku-Uusikaupunki railway line. A total of two swords were found in the north side of the cairn, while traces of fire could be found in the middle of the cairn, as observed by A. M. Tallgren in 1918. The finds, including a socketed spearhead close to Petersen's type G, and an iron knife date the cairn to around the year 800 AD.[78] Petersen's type G spearheads are dated to the 10th century and to the beginning of the 11th century,[79] while in Estonia and Russia the dating extends to the 12th century and even further,[80] leading to assume that the cairn is actually slightly later, maybe from the first half of the Viking Age. A sword with a pattern-welded blade and an identical type H hilt (KM 7472:1) supports this date.

Sword **KM 11198** is a grave find from a mound or a cairn, which was exploded by a bomb in 1940, revealing no other finds, or at least they were not preserved. The site, Henneri in Lempäälä parish, in the Tampere region, included originally thirteen cairns of mixed earth and stones, six of which have been destroyed and three are probably modern. The Iron Age cairns and their finds date from the Viking Age.[81] Two other inlaid swords are known from the site (KM 1996:73 and KM 4254), but they have been catalogued as stray finds. According to typologies, all these three swords date from the second half of the Viking Age or from the very end of the period.

In addition to the six finds described above, ten more may have been originally in burial cairns or mounds. Three are from the region of Finland Proper. Sword **KM 3575:1** is from a possible cairn situated in Ristenkömppä in Laitila. The sword was found prior to excavations along with a spearhead of Salmo's type "Aspelin Fig. 1651", shears and a spiral finger-ring.[82] This combination, together with the Petersen type B hilt of the sword in question, dates from the latter half of the Merovingian Period, or to the very beginning of the Viking Age.

Two inlaid swords have been recovered from Hinttermäki in Nousiainen, one of which is from a probable mound, which contained cremations. Along with this sword (**KM 10349:1**) a bronze finger-ring was found.[83] The grave dates roughly to the Merovingian Period.[84] A third sword in this category from Finland Proper comes from Vehmaa parish. Sword **KM 2022:1** belongs to a group of artefacts (KM 2022:1–13) recovered from a cairn in the village of Huolila. The cairn was situated on a hill, and it was found while clearing the area for fields in 1880. Today this cairn is

75 *Kivikoski 1963: 41–42.*
76 *Kivikoski 1963: 125.*
77 *Mikkola 1999: 43.*
78 *Kivikoski 1973: 15.*
79 *Petersen 1919: 29–30.*
80 *E.g. Selirand 1974: 110–111; Uino 1997: 380.*
81 *Kivikoski 1973: 12.*
82 *Salmo 1938: 10.*
83 *Salmo 1938: 17.*
84 *Kivikoski 1973: 13.*

completely destroyed. Altogether three double-edged swords, one straight-backed scramasax, a large knife, three large bladed angons, a short bladed angon, horse bits and two shield bosses of Salmo's "Late Merovingian" type were found,[85] indicating that the cairn probably contained the belongings of more than one deceased person, if it even was a burial cairn. The finds are dated to 550–800 AD, i.e. the Merovingian Period.[86]

Altogether four swords from the Tampere region belong to this group of possible mound or cairn finds. Sword **KM 439:1** was found near the sites of Pajalahdenranta and Riihimäki in Vesilahti. The sword was delivered to the museum with spearheads (Petersen's types K and M[87]), arrowheads, a sickle, beads, axes, brooches, arm ring fragments and a weight (KM 439:2–23). The artefacts date from both the Viking Age and the Crusade Period, and reports do not provide any specific information on the find. The brazil-nut shaped pommel of the sword suggests a date to the Crusade Period. The Riihimäki site consisted of thirty burial cairns made of mixed stones and earth, most of which were destroyed during field clearance at the end of the 19th century. The only three examined cairns dated to the Merovingian Period. To the west of these cairns, there are three more, still unexcavated.

Sword **KM 11840** was found separately while digging the foundations for the railway station of Tyrvää, in present-day Sastamala. According to the inspection conducted in 1898, a cairn was situated at the site, but was already back then partly destroyed. The construction of the railway station as well as all other later land-use has demolished the whole cemetery, if such existed. The site has been dated to the Viking Age.[88]

Sword **KM 6245 A:1** possibly originates from a cremation in a mound since also burnt bone was found, along with a spearhead of Petersen's type E. A date to the second half of the Viking Age seems plausible according to both the spearhead and the sword hilt of Petersen's type V, not to forget the inscription on the blade. The site consists of both level-ground cremation cemetery and burial cairns and mounds. The cremation cemetery dates from the Merovingian and Viking Ages.[89]

Sword **KM 4923:1** belongs to a group of finds (KM 4923:1–12, which are not all are from the same precise location) discovered at Härmä in Urjala in 1907. These finds are possibly from one or several burial cairns dating from the Merovingian Period to the Late Viking Age. In addition to the sword in question with its Petersen type X hilt, other sword finds include a fragment of a single-edged sword blade (KM 4923:2), a lower guard of Petersen's type Y (KM 4923:3), and a sword of Petersen's type H (KM 5360:2), all of which also date from the Viking Age. The site is situated around the main building of Härmä farm, on the southern side of former Lake Vanhajärvi, On the south side of the house there was a cairn, which has been lost due to field clearance. Also four other cairns have been destroyed, while one still remains on the northeastern side of the main building. This cairn is mixed with turf and it was piled between two larger stones.

Three more possible cairn finds emerge from the region of Tavastia Proper. Sword blade **KM 6503:20** is a stray find from the lands of Anttila farm in Hattula (former Tyrväntö). The origin of this sword may be the cairn cemetery on the southeast side of the main building of the farm, comprising about ten burial cairns, six of which still remain, the rest having been cleared away. The find material dates the cemetery roughly to the Viking Age and the Crusade Period.

85 Salmo 1938: 23.
86 Kivikoski 1973: 15.
87 Lehtosalo-Hilander 1985: 14.
88 Kivikoski 1973: 14.
89 Kivikoski 1973: 12.

Sword **KM 8120:1** belongs to a group of finds from Hinnonmäki in Hattula (KM 8120:1–4). The site is a small hill, also known as Surmanmäki. This site has mostly been destroyed by cultivation, but small part of the cemetery may still remain untouched in the northeastern part of the area. According to the National Museum's journal of finds, the group of finds including the sword in question was found in a cairn, together with a round brooch and two bronze bracelets. The cairn has possibly contained a cremation, since some burnt bone has also been found at the site. Otherwise the site has been described as an inhumation cemetery, mostly destroyed by cultivation. It is dated to the Viking Age.[90] Also a fragmentary sword of Petersen's type H with an undecorated blade was found at the site (KM 2218:168).

Sword **KM 5005** is a stray find from the field of Kernaala Manor in Janakkala. It is possible that this sword is from a destroyed burial cairn, since a cemetery consisting of burial cairns was situated near the manor of Vanaantaka, now the site of a modern road. The first finds were made during the construction work of the road in 1864, and this is the time when the majority of the cemetery was demolished. It is believed that two or three cairns were situated here beside each other. The cemetery has been dated to the Viking Age.[91] The sword itself is of later date since the pommel is disc-shaped and the inlays are small, characteristic to the Crusade Period.

2.4. Swords from cremation cemeteries

Swords recovered from level-ground cremation cemeteries, referred here as plain cremation cemeteries, may be divided into two distinct categories. The first one comprises swords from presumably individual graves, in practice found from a single location along with other artefacts, clearly forming a group deposited at the same instant. The second group consists of swords found as scattered from cremation cemeteries, thus being harder to date since no other typologically datable finds were found in the vicinity.

Four swords have been found in individual graves, all dating from the latter half of the Merovingian Period, or to the early Viking Age. Furthermore, three of these are from the region of Finland Proper. Two inlaid swords have been recovered from the site of Ristimäki in Turku municipality (former Kaarina). The larger cremation cemetery of this site (Ristimäki I), from which these swords were excavated in 1914, is dated to between 550–900 AD. The site houses also cremations from the Viking Age, as well as 11th and 12th century inhumation burials.[92] Sword **KM 6746:49** with Petersen's special type 1 hilt belongs to a group of finds, perhaps a burial, including also a spearhead of type "Salmo Taf. XIV:1", a "Finnish" scramasax, iron horse bits, a knife tang or an arrowhead, a piece of a bronze ring, an iron strap mount, and various iron mounts from straps, perhaps belonging to some horse gear (KM 6746:50–56).[93] Nils Cleve dates this combination to ca. 750–800/825 AD.[94] Another sword from the Ristimäki cremation cemetery, **KM 6753:51**, was found under a rock together with a spearhead of Petersen's type A, Salmo's tanged long bladed spearhead, a straight-backed scramasax, and a bronze penannular brooch with faceted end knobs.[95] The finds are again broadly associated with the end of the Merovingian Period and the beginning of the Viking Age.

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90 *Kivikoski 1973: 14.*
91 *Kivikoski 1973: 11.*
92 *Kivikoski 1973: 11.*
93 *Salmo 1938: 3.*
94 *Cleve 1943.*
95 *Salmo 1938: 4–5.*

The third sword from a combination in a cremation cemetery in Finland Proper comes from Nousiainen. The site of Hinttermäki is situated on a hill in a yard, on the south side of the River Hirvijoki, and the place had probably been a cemetery with no traces above the ground. Along with this sword (**KM 10369:3**) were found three socketed spearheads, two of which belong to Helmer Salmo's type "XIV:1", bridle bits, a knife, a bronze strap end mount, and a molten bronze object, probably from a large Baltic-type bow fibula. All these finds (KM 10369:1–8) were found in a single location. Salmo's type "XIV:1" spearheads are considered as Merovingian Period or very early Viking Age.[96] Nils Cleve has dated this combination of artefacts to his phase III, ca. 750–800/825 AD.[97] Fragments of an undecorated sword blade (KM 10369:11), a complete pattern-welded sword blade (KM 10369:28), and a complete undecorated sword blade (KM 10369:74) have been recovered from the site.

One find from an individual cremation grave is known from Ostrobothnia. The burial site of Pukkila in Isokyrö is a Merovingian Period and Viking Age cremation cemetery situated on the northern bank of the River Kyrönjoki on Pernulantie road, under the old main building of Pukkila farm and also in the yard and garden of the farm. The site was found in 1920 during construction works, and a part of the cemetery may still be intact around and even under the main building. Sword **KM 7703:2** belongs to artefacts acquired by Sakari Pälsi in 1920 (KM 7703:1–18). Some of these artefacts were excavated and some were bought from the finder. The sword was among the items found by the landowner while digging foundations for a house (KM 7703:2–11). Other finds include a sword blade without a hilt (KM 7703:3), a scramasax, a socketed spearhead of Salmo's "Pukkila" type, a spearhead socket, a tanged arrowhead, a shield-boss of Helmer Salmo's Late Merovingian Period type, fragmentary bridle bits, a small scythe and a knife. Nils Cleve dates this combination of artefacts to his phase III, i.e. ca. 750–800/825 AD,[98] which seems plausible even today and is supported by the dating of the sword hilt and blade in question. There are three other sword parts datable to the Merovingian Period from the same site, and in addition two complete blades have been found (KM 7703: 3 and 13, KM 7729:9, 78 and 88).

Other inlaid swords found from cremation cemeteries on level ground have been discovered as scattered with no certain association to other artefacts. All in all, 44 finds of all the items examined here were of this kind of context. Some of these swords were found in the vicinity of some other objects, but it cannot be stated for certain, that they were deposited at the same time. Mostly these swords are from cemeteries datable to the Viking Age, thus lacking individual burials as observed above. Proceeding one region at a time, the region of Finland Proper (Southwest Finland) is discussed first. Altogether seventeen swords have been found in certain or possible cremation cemeteries on level ground in this region.

On the north side of the River Vähäjoki there is an almost completely investigated Iron Age cemetery at Marttila farm in former Maaria parish, present-day Turku. It contained both cremations on level ground and also four inhumation burials dating from the Viking Age to the Crusade Period. As a whole, this cemetery has been dated to between the Birth of Christ and 1150 AD.[99] Some of the cemetery may still remain unexcavated on the west/southwest part of the site and on the southeast and west side of the main building of the farm. Sword **KM 4566:12** is among the artefacts excavated by Juhani Rinne in 1905 (KM 4566:1–126) and probably belongs to the cremation cemetery since the sword was broken by bending. The lower half of the blade (KM 7275:1) was recovered by A. M. Tallgren in the excavations of 1917 (KM 7275:1–287).

96 *Lehtosalo-Hilander 1982b: 23; Salmo 1938: 238–241.*
97 *Cleve 1943: Tabell 3.*
98 *Cleve 1943: Tabell 3.*
99 *Kivikoski 1973: 13; Purhonen 1998: 255.*

Sixteen other swords and their fragments have been catalogued from this site, and in addition one is discussed below as a possible find from an inhumation grave at the site.

There is also another sword from former Maaria parish. The site of Mulli is situated on a slope north of Markulantie road and revealed finds from both a settlement site and a level-ground cremation cemetery. Burial cairns have been found nearby. The site dates from between 550–1050 AD.[100] Sword **KM 6482** is a stray find in 1913 from the yard of Mulli farm while digging a cellar. A lower guard of another sword was also found at the site (KM 8588).

Sword **KM 7752:1** was found in a level-ground cremation cemetery of Tiikkinummi at Salo (former Perniö). The ridge called Tiikkinummi is situated on the eastern side of the River Perniönjoki and consists of both grave settings and a level-ground cremation cemetery. The settings are of so-called Lupaja type grave settings, a total of 30, only four of which have been excavated. These settings date roughly between 200 and 400 AD.[101] The level-ground cremation cemetery dates from the Merovingian Period. In addition to these, also two cup-marked rocks and a possible settlement site are known near the cremation cemetery. The sword in question may belong to a group of finds including a "Finnish" type scramasax, three spearheads of type "Salmo Taf. XIV:1", and a nail rivet.[102] Although these finds are all from the late Merovingian or early Viking Age, they were not found in archaeological excavations, thus the existence of a single burial is not certain. Two other swords with pattern-welded blades and Late Merovingian or early Viking Age hilts have been found in the same cemetery (KM 7752:37 and 53).

The site of Laulumaa or Laulumaa-Römpötti is situated along the Pyölintie road on a steep forested slope, about 800 metres southeast from the church of Raisio. The site is possibly a level-ground cremation cemetery, which can also be found on the neighbouring property of Römpötti. The cemetery dates from the Viking Age according to its few recovered finds. Sword **KM 15467** is a stray find from the garden of Laulumaa farm in 1962, possibly from the cremation cemetery. Other finds from the site include a spearhead of Petersen's type E (KM 14771), a lower guard of a sword of Petersen's type H (KM 14910:1), and possibly a fragment of an axe (KM 14910:2).

In the former parish of Kalanti in the municipality of Uusikaupunki the Pietilä level-ground cremation cemetery is located in the yard of Pietilä farm on the western bank of the River Sirppujoki, At present the cemetery is completely destroyed. The cemetery dates roughly between 550–1050 AD.[103] Two inlaid swords are known from this cemetery. Sword **KM 3336:31** belongs to finds excavated by T. Schvindt in 1896 (KM 3336:1–210), and sword **KM 22106:23** was recovered during the excavations by M. Bergström and J. Laurén in 1983 (KM 22106:1–379). Seven other swords and their fragments are known from the same cemetery.

The site of Vainionmäki in Laitila includes two cremation cemeteries, one of which (A) is dated to the Merovingian Period, and the other (B) to the Viking Age. Sword **KM 22964:3** belongs to artefacts found by the landowner prior to excavations, including four swords, three spearheads, two shield-bosses, a bridle bit, two knives, an iron mounting and a rim sherd of a clay vessel (KM 22964:1–13, 17, 18). Naturally, these all do not belong to a single burial, but some may, since no accurate find locations were recorded. Altogether the finds date similarly from the latter part of the Merovingian Period, and belong to the cremation cemetery A. Twelve complete swords or blade fragments have been recovered from this cemetery, as well as several fragments of Merovingian Period hilt parts.

100 Kivikoski 1973: 13.
101 Kivikoski 1973: 13.
102 Salmo 1938: 20.
103 Kivikoski 1973: 11.

Several swords have been found in the level-ground cremation cemetery of Rukoushuone-Kansakoulunmäki in Laitila, which is located in the centre of Laitila in a schoolyard. At the western part of the hill burial mounds of the so-called Untamala type has been known, but they were all demolished in the 1930s when gravel was dug from the hill. Fortunately the site was excavated on several occasions, since the western side of the hill has been completely removed as gravel. In general the cremation cemetery dates from between 550–1050 AD, while the cairns are from the period from the Birth of Christ to ca. 550 AD.[104] Three inlaid swords (**KM 2548:196**, **KM 2548:277** and **KM 2548:839**) were recovered in the excavations of Theodor Schwindt in 1887. No other finds could be associated with sword KM 2548:196. From the same location with sword KM 2548:277 was found a bronze penannular brooch with funnel-shaped ends (KM 2548:278). Sword KM 2548:839 was found with finds KM 2548:840–843, consisting of a hemispherical shield-boss of Viking Age type, a bronze bracelet, a piece of bronze plate and a blue glass bead. None of the finds, however, can be definitely associated with the swords. Eleven other swords and their parts have been excavated from the cemetery.

Sword **KM 5890:1** from the Ylipää cremation cemetery in Lieto was found together with a spearhead of Petersen's type E (KM 5890:2) while levelling a road on a stony hill. The dating of this type of spearhead is discussed above and together with this Petersen's type Y sword they are both from the second half of the Viking Age. Again it must be stressed that due to the nature of the cemetery, the finds may not have necessarily been deposited at the same time. The level-ground cremation cemetery of Ylipää is situated on the southern side of a rocky hill surrounded by fields, four kilometres southwest of the Church of Lieto. The cemetery has been almost completely excavated and it is roughly dated to the Merovingian Period and the Viking Age. The cemetery contained a large number of swords; a total of sixteen swords or their parts have been catalogued.

Another sword from Lieto, from the site of Kuivurinmäki is known. The site is situated approximately 5 kilometres north of the Church of Lieto, ca. 200 metres north of the main building of Nautela Manor. The site is a hill, which contained a layer of burnt soil as well as finds suggesting a cemetery as well as a dwelling site. On the eastern slope of the hill there are several cup-marked stones. Sword **KM 10413** is a stray find from the property of Nautela farm, either from the garden or from the hill next to it, possibly from the cremation cemetery. The sword was found in 1926, and it was donated to the National Museum in 1936. In addition, a sword with a Petersen type B hilt and an undecorated blade was found in the same place (KM 10278).

Sword **KM 13399:3** was found together with a scythe (KM 13399:6) and bridle bits (KM 13399:7) from a probable level-ground cremation cemetery at Määksmäki in Masku in 1946. The multi-period site of Määksmäki is situated 1.1 kilometres west/southwest of the Church of Masku, on steep-ridged sandy hill in the middle of cultivated fields. The site includes burial cairns, a level-ground cremation cemetery, stone settings, a settlement site, a historical village site, and some unidentified fixed remains. The dating of the site is Iron Age and the historical era. The finds recovered along with the sword in question date from the end of the Viking Age or more probably from the 11th century. Again, the finds may not necessarily be from the same combination. Another sword blade (KM 14165) and a brazil-nut shaped pommel (KM 14424:3) have been found at the site.

The Franttilannummi site is situated near the centre of Mynämäki, 600 metres south of the Church of Mynämäki, and consists of a level-ground cremation cemetery, cremation pits, an inhumation cemetery, and also finds referring to settlement sites at nearby Junttilannummi. Overall the site dates roughly from the Early Roman Iron Age to the Crusade Period, while the inhumations are

104 Kivikoski 1973: 12.

from the 11th century.[105] Sword **KM 8911:91** was recovered from the level-ground cremation cemetery in excavations conducted by Helmer Salonen in 1928 (KM 8911:1–167). One complete sword blade (KM 8374:1) and two blade fragments (KM 8806:2 and KM 8911:144) have also been found at the site.

Another sword from Mynämäki, **KM 11859:1**, belongs to a group of finds from a level-ground cremation cemetery in Mynänummi. Other finds include a fragment of a sword blade (KM 11859:2), a fragmentary disc-pommeled sword (KM 11859:3–4), two silver-decorated spearheads of Petersen's type G,[106] two different-sized axes of Petersen's type M, a sickle, and a fragment of a scythe. The finds date from the second half of the Viking Age, while the whole site comprises finds from throughout the Iron Age.[107] Since the above-mentioned finds are from the cremation cemetery, they were not necessarily deposited at the same time. The cemetery site of Mynänummi is situated in the expansion from the 1920s of the cemetery next to Mynämäki Church. The graveyard is a low ridge beside the church, on the west side of the River Mynäjoki. The ancient cemetery consists of a cremation cemetery on level ground, cremation pits and a kettle burial.

Two possible cremation cemetery finds are known from Nousiainen. Sword **KM 3699:3** is a stray find among charcoal on the northern side of the main building of Mikkola farm in the village of Kärmälä (KM 3699:1–9), possibly from a level-ground cremation cemetery. The sword was sold to the National Museum in 1899, and the site has never been excavated. Sword **KM 10906:1** is a stray find from the property of Posti farm, discovered in a sand pit in 1938. Slightly later more artefacts were found at the same pit (KM 10906:2–5) but from a different location. These finds include a fragment of a twisted neck-ring, a spiral finger-ring with a middle shield, bronze spirals, and potsherds. The finds date from the first half of the Viking Age and possibly originate from a level-ground cremation cemetery.

Nine swords from cremation cemeteries have been found in the Tampere region. The cemetery site of Vilusenharju in Tampere is the largest cemetery of the area. This cemetery was situated at the top of a ridge, 450 metres southwest of the western end of Lake Kaukajärvi, and 2.1 kilometres southeast of the old Church of Messukylä. The first archaeological observations were made in 1961, after which the site was immediately excavated in 1961 and 1962, though it was largely destroyed by then. Located at the site was a Viking Age cremation cemetery on level ground, started during the 9th century or more likely at the beginning of the 10th century, having witnessed some inhumation burials until the beginning of the 12th century.[108] Sword **KM 15175:1** was found together with burnt bone (KM 15175:1–2), and was the first find from the site, which lead to the excavations. The sword was claimed for the National Museum in 1961 and belongs to the cremation cemetery. Four sword parts have been found at the site sword parts, in addition to which three complete swords are known from inhumation graves, and are discussed below in more detail.

Sword **KM 3423** was sent to the National Museum as a stray find, but the lower half of blade (**KM 3451:4)** belongs to a group of finds (KM 3451:1–7), recovered from the same site, Kirmukarmu in Vesilahti. The finds catalogued along with the lower half of blade **KM 3451:4** are as follows: a gilded bronze pommel, a fragment of a spearhead of Salmo's wide-bladed type, a tang of an angon of Salmo's "Finnish" type, a fragment of a single-edged sword blade, a fragment of a bronze spiral bracelet, and some burnt bone. The finds date mainly from the Merovingian Period. The sword with its ULFBERHT inscription was clearly not deposited with these above-described artefacts.

105 *Kivikoski 1973: 13.*
106 *Lehtosalo-Hilander 1985: 31.*
107 *Kivikoski 1973: 13.*
108 *Kivikoski 1973: 13; Nallinmaa-Luoto 1978: 240.*

The cemetery at the site is a level-ground cremation cemetery, having finds dating from between 550–1050 AD.[109] The cemetery is situated 300 metres east from the shore of Kirkkolahti Bay on a hill surrounded by fields. Most likely the cemetery was completely demolished. Other sword finds include two pommels (KM 3005:6 and KM 3451:1) and two blades (KM 3007:25 and KM 3451:5).

Two swords have been found from the cairn site of Henneri in Lempäälä. Swords **KM 1996:73** and **KM 4254** have been catalogued as stray finds, and accordingly there is no definite connection with the cairns. In any case, the swords exhibit some fire patina, and are thus from a cremation, either a cairn or a level-ground cremation cemetery in the vicinity.

Sword **KM 6227:1** belongs to a group of finds from Vänniä in Sastamala (former Tyrvää). Other finds include a spearhead of Petersen's type E, an axe resembling Petersen's type L, a fire-steel, and five fragments of an unburnt human skull (KM 6227:1–5).[110] The level-ground cremation cemetery of Vänniä is situated in the yard of Vänniä farm, about 3.5 kilometres southwest of the Church of Vammala, and was found while making a garden for the house. The cemetery has been largely destroyed by the buildings. The cremation cemetery of Vänniä is part of the large Kaukola area of ancient sites, consisting mainly of over 388 burial cairns on both sides of the River Kokemäenjoki. The cairns date from the Late Roman Iron Age to the 11th century, and some of them are earth-mixed while some were piled solely from stones. The cremation cemetery dates from the Viking Age.[111] A blade tip fragment (KM 4301:77) and a fragmentary sword of Petersen's type E (KM 13410) have also been recovered from the site.

Another sword from a cremation cemetery in Sastamala is known, namely **KM 5868:80** from the yard of Tulonen farm in the village of Palviala. The site is a rich Viking Age cremation cemetery on level ground, with also prehistoric cairns south of the cemetery. The site has been excavated on several occasions, and the sword in question was recovered in the excavations conducted by Alfred Hackman in 1911.

Sword **KM 15181:2** was found in the level-ground cremation cemetery of Kirkkomäki in Akaa (former Toijala) and belongs to finds made in 1961 (KM 15181:1–5). The artefacts were recovered while excavating a cable trench, and in addition to the sword they include a spearhead, a scythe, and two pieces of bronze objects, possibly from a penannular brooch and a bracelet. The site of Kirkkomäki is situated 200 metres east from the church of Akaa, on the southeastern slope of Kirkkomäki hill, in the yard of an apartment building. The site possibly included a level-ground cremation cemetery from the beginning of the 11th century.

A similar kind of case is sword **KM 3131:6** from Hallamäki also in Akaa. This sword belongs to finds made during construction works, including a socketed spearhead, a round brooch, three fragments of a bronze chain, two massive bronze bracelets and a scythe (KM 3131:1–6). The finds date from the Viking Age. All the finds are not from the same exact place, and, according to the report, the sword was found separately from the other finds in a trench. Hallamäki is a level-ground cremation cemetery situated 800 metres north of the Church of Akaa, on the south slope of a hill next to the southwestern bank of the River Lontilanjoki, at present a yard area. Roughly half of the cemetery has been destroyed during the construction of apartment buildings.

109 *Kivikoski 1973: 15.*
110 *Salmio 1982: 37–38.*
111 *Kivikoski 1973: 14.*

Sword **KM 37257** was delivered to the museum in 2008, and it was found somewhere from the yard of Knaapi farm, situated 8.8 kilometres west of the Church of Luopioinen, on the western shore of Lake Kouvalanjärvi, in the modern municipality of Pälkäne. Two spearheads of Petersen's type F, a sickle, an arrowhead, a bridle an axe of Petersen's type M, and an axe close to Petersen's type B with cross-shaped extensions were found already in 1883 (KM 2201:690a–g) when digging trenches for house foundations in the middle of a field. It is also said that a human skeleton was found in the field in the 1930s. Later the top of a human skull was found, but was lost. All the above-mentioned finds date the site to the Late Viking Age or to the beginning of the Crusade Period. The sword in question is possibly from a cremation cemetery, since it is broken, and the silver decoration on the hilt has melted.

Next is the region of Satakunta, where only three swords from cremation cemeteries have been found, all from Kokemäki. Swords **KM 1174:2** and **KM 1174:3** belong to finds made while ploughing a field in 1870. Two blade fragments under catalogue number KM 1174:34 belong to sword KM 1174:3. All these finds were from the site of Leikkimäki in the village of Äimälä, on the southern bank of the River Kokemäenjoki in the yard and fields of a summer villa. The site was characterized as a level-ground cremation cemetery. According to trial excavations made in 1960 part of the cemetery may still be intact. The dating of the whole cremation cemetery is ca. 550–1150 AD.[112] In addition to the above, one more complete sword (KM 1174:1) and two loose hilt parts from different swords (KM 1174:4 and KM 2001:5) have been recovered from the same cemetery.

The third sword from Kokemäki, **KM 9778**, is a stray find recovered in 1933 from the field of Huru farm in Kokemäki. A spearhead had previously been found in the same location, and was said to be kept in a local museum at Kokemäki. The lower half of the blade of the sword in question (KM 10020:1) was found later together with a spearhead of Salmo's type "Aspelin Fig. 1651". The site, also known as Pajamäki or Pajasaari, is possibly a level-ground cremation cemetery with also the remains of a possible smithy of a later date. Since no systematic excavations have taken place, a partly intact cemetery should still remain. The Iron Age parts of the site date from between 550–1050 AD.[113] Two Petersen's type H swords with pattern-welded blades have also been catalogued from the site (KM 11540:1 and 2).

A total of seven swords have been recovered from cremation cemeteries from the region of Häme Proper. Two of them are from the site of Katinen, also known as Radanvarsikalmisto, situated in Hämeenlinna, former Vanaja. This now completely demolished level-ground cremation cemetery was situated 400 metres southwest of the manor of Katinen and 120 metres east of the present shoreline of Luukkaanlahti Bay in Lake Vanajavesi. The cemetery was destroyed during the building of the railway from Helsinki to Hämeenlinna in 1859. At that time the terrain at the site was not flat but a small hill, which had to be levelled. The cemetery dates from between 550–1050 AD.[114] The finds recovered from the site (KM 368–403) consisted of the following: fragments of bronze penannular brooches, swords of Petersen's types Y (**KM 369**) and V (**KM 370**), both of which are inlaid with iron, eleven socketed spearheads, four complete and two fragmentary tanged spearheads, a large sax-like knife, a dagger blade, two sickles, two axes, parts of horse bits and eight complete and two fragmentary knife blades.

Haaksivalkama is a possible Iron Age cremation cemetery situated on the eastern shore of Lake Pyhäjärvi, ca. 2.5 kilometres northwest of the Church of Tuulos, at present in the City

112 Kivikoski 1973: 12.
113 Kivikoski 1973: 12.
114 Kivikoski 1973: 15.

of Hämeenlinna. No precise find locations of the artefacts are known, but the area called Haaksivalkama is situated 420 metres southwest from the Etu-Laurila property. Some of the artefacts have been recovered from the sand of the beach during low tides, and some finds are from a small nearby hill which has not been precisely located. The nature of the finds indicates that the site could have been a level-ground cremation cemetery. Two inlaid swords are known from there. Reovered in 1868 along with the sword **KM 708** were an axe, a tanged long bladed spearhead as defined by Salmo, a harpoon, two sword pommels, another sword blade and some bronze fibulas. Only one of the pommels could be connected to another find, i.e. the sword in question, and the pommel was attached to the upper guard of the sword during conservation. In addition, sword **KM 1869:81** is a stray find collected by A. O. Heikel in 1877 (KM 1869:1–84), also possibly belonging to the same cremation cemetery.

In the former municipality of Kalvola, the level-ground cremation cemetery of Pahnainmäki is located in the middle of large fields. The first finds were made in 1911 while clearing stone cairns at the site, and this led to the first excavations revealing a cremation cemetery dating from the Viking Age and the Crusade Period.[115] In addition, two Crusade Period inhumations were found. Sword **KM 5960:3** is a grave find from one of these inhumations (KM 5960:1–21). Other finds, some of which were from the same grave, include two other swords, a silver coin (Otto-Adelheid type, ca. 983/991–1040 AD[116]), a bracteate (unidentified), a glass bead, small bronze brooch, a penannular brooch with faceted end-knobs, two oval convex brooches, two bronze chain holders and bronze chain, two chain rods, a knife with its sheath, an ear-spoon of bronze, a bronze bear-tooth pendant, a spiral finger-ring, bronze rod, loose spirals, a fragment of spiral decoration from an apron, and fragments of scissors. Since sword KM 5960:3 is strongly bent and broken, and exhibits some fire patina, it is more likely originally from the cremation cemetery.

Sword **KM 27141:1** is a stray find made with a metal-detector at Kalomäki hill in Hämeenlinna (former Hauho) and originates from a level-ground cremation cemetery, since the sword is covered with fire patina. Found along with the sword was a fragment of another sword blade (KM 27141:2). The cremation cemetery dates from between 400–1050 AD,[117] and the site also includes some mainly later and mostly unfurnished inhumation burials and finds characteristic of a settlement site. Kalomäki is a field surrounded by fields 200 metres west of Lake Ilmoilanselkä, next to the Hämeenlinna-Tampere highway, and about 10 kilometres northwest of the Church of Hauho.

Discovered together with sword **KM 2345:1** were a silver-decorated spearhead of Petersen's type G,[118] a sickle, horse bits and a single-edged sword of Petersen's type Z. These finds were made in Ilomäki in Loppi, originating from a possible cremation cemetery. According to the finds, the site dates from the Viking Age.[119] The hill of Ilomäki is situated to the north of Santamäki Manor, approximately 8.8 kilometres northeast of the Church of Loppi. There was also a croft on the hill, which is now in ruins. The Late Iron Age finds were made in 1884 while ploughing a field on the northeast side of the croft. At the time, the place was interpreted as a burial cairn. Today the cemetery has presumably been completely destroyed. Other sword finds from the site include two swords of Petersen's type Z (KM 2345:5 and KM 2448), one of which has a single-edged blade.

Four swords from cremation cemeteries have been found from the Lake Päijänne region of Häme: one from Asikkala, one from Hollola, and two from Sysmä. The cemetery of Ala-Pietilä

115 *Kivikoski 1973: 11.*
116 *Talvio 2002: 193.*
117 *Kivikoski 1973: 11.*
118 *Lehtosalo-Hilander 1985: 31.*
119 *Kivikoski 1973: 13.*

in Asikkala is situated in the island of Salo, on the northern side of a peninsula called Kylänpohja, about 200 metres from the shoreline. On the hill in the middle of fields there is a level-ground cremation cemetery which was discovered in 1971. The house at Ala-Pietilä was built in 1990s, and the sword **KM 30870:1** was found during the digging of the foundations, together with a spearhead. These finds belong to the cremation cemetery, while several earth-mixed cairns may be found on the southern part of the hill. The finds date from the Viking Age.

Sword **KM 3601:2** was found along with a pattern-welded sword blade (KM 3601:1) in the field of Taka-Tommola (former Nokkola) farm in the municipality of Hollola in 1898. The find location is ca. 250 metres north from the main building of the farm, and the site has been interpreted as a possible cremation cemetery on level ground.

The site of Päivärinta in Sysmä is situated in a field of Päivärinta farm, on the western shore of Antialanlahti bay, close to the settlement concentration near the medieval Church of Sysmä. Sword **KM 6689:2** was found in 1910 while clearing a field, and was sent to the National Museum in 1914 along with a Stone Age axe (KM 6689:1–2). Other finds from the site include bracelets, a round brooch, glass beads and fragments of bone. The find location is interpreted as a level-ground cremation cemetery dated to the Viking Age. Cup-marked stones were also found near the site.

Another sword from Sysmä, **KM 31017:1**, belongs to the stray finds recovered with a metal detector in 1998 from the site of Haapasaari, a small hill on the south side of the water purification plant of Sysmä, ca. 300 metres northeast of the medieval church. The place was a small island still in 1990s, before the bay was partly filled with earth. The trial excavations of 1999 suggested that the site is a level-ground cremation cemetery from the Viking Age.

One sword has been found from the region of Ostrobothnia, from the site of Alhonmäki-Pahamäki in Vähäkyrö. The site was also called Housula according to the nearby farm. There are twelve burial cairns at the site, two of which have been excavated. Near the cairns can be found traces of four settlements. Some finds near the cairns may indicate the presence of a level-ground cremation cemetery. The site is dated to the Migration and Merovingian Periods, and it was partly destroyed during gravel transport. Sword **KM 5865:1** was found together with a "Vendel" shield boss, as defined by Salmo[120] (KM 5865:1–2) while digging a pit near a stone cairn, possibly at the location of a cremation cemetery on level ground. Nils Cleve dates these finds to his phase III (750–800/825 AD), although their connection with each other is uncertain.

Also one find is known from Uusimaa region. Sword **KM 8896:25** belongs to a group of finds (KM 8896:25–27) from the property of Fastarby-Västergård in Raasepori (former Tenhola). Along with the sword were found a spearhead of type "Salmo Taf. XIV:1", and a spearhead of Petersen's type E. The site consists of a level-ground cremation cemetery as well as traces of settlement such as a hearth. The cemetery has largely been destroyed by cultivation and excavations, and dates from the Viking Age.[121]

Lastly, two swords have been catalogued in Finnish collections from cremation cemeteries situated in the territory of ceded Karelia. Sword **KM 10372:1** was recovered from the same location as a fragmentary spearhead of Petersen's type M and horse bits. These finds were from Kalmistomäki hill in Kurkijoki. According to the finds the site includes a level-ground cremation cemetery, an inhumation cemetery, and finds typical of settlement sites. The earliest settlement finds are

120 *Salmo 1938: 52–53.*
121 *Kivikoski 1973: 14.*

from the Neolithic Stone Age and the beginning of the Bronze Age, the younger finds are from the Late Iron Age and the Middle Ages. There could have been an Iron Age smithy at the site, although the finds could just as well be from the cremation cemetery. The cremation cemetery dates from approximately 800–1050 AD, although some finds may be as late as the 13th century. The inhumations, ca. twenty in number, are from the Crusade Period and the Early Middle Ages.[122]

Another sword from Karelia is from the site of Loponen in Metsäpirtti. The site is situated on the northern side of the yard of Lääenmäki farm. A stone paving was found at the site, possibly indicating a level-ground cremation cemetery. The site has been dated to 1000–1200 AD. The stone cairns near the site have been dated to 1100–1300 AD.[123] At the site, sword **KM 5707:3** was found from a field in 1905. The sword belongs to artefacts sent to the National Museum in 1910 (KM 5707:1–3).

2.5. Swords from inhumation graves

Altogether 37 swords have been found as grave goods in inhumation cemeteries. Of these, 22 are definitely from inhumation graves, while sixteen may probably have originally belonged to such a grave. Swords found in inhumation graves clearly concentrate in the regions of Finland Proper and Satakunta.

Sixteen swords from inhumation graves or possible ones are known from Finland Proper. Sword **KM 4429:14** from Turku (former Maaria) was found together with a silver-decorated spearhead of Petersen's type G[124] (KM 4429:15), both artefacts possibly belonging to an inhumation grave. The cemetery of Marttila from which the artefacts were recovered dates from the Viking Age and the Crusade Period in most parts, and includes a cremation cemetery on level ground, the finds from which are discussed above.

The inhumation cemetery of Taskula is located on the west side of the River Vähäjoki in the middle of housing and industrial areas. A partly destroyed inhumation cemetery was found during trench digging. Excavations have revealed at least 19 graves and one uncertain burial, almost all having traces of wooden coffins. Outside the inhumation cemetery, a level-ground cremation cemetery is known, dating from Merovingian Period and the Viking Age, more precisely 550–1050 AD.[125]A small part of the cemetery may still remain untouched on a slope in the eastern part of the site. The inhumations date from the 11th and 12th centuries.[126] Two inlaid swords, **KM 13419:1** and **KM 13419:2**, were found together with a tanged spearhead resembling Petersen's type E. The swords are likely from inhumations since no fire patina is present, and the non-ferrous decoration has been preserved. Altogether five sword parts or fragments were found at the site (KM 10833:1, 2 and 2a, and KM 10842:34 and 39).

Sword **KM 12687:1** belongs to artefacts (KM 12687:1–3) found while digging a cable trench on the northeastern slope of Kirkkomäki hill in Turku (former Kaarina). All the finds originate from an inhumation grave and include a spearhead of Petersen's type G and a battle-axe. The artefacts date from the second half of the 10th century or to the 11th century. The sword has been catalogued with artefacts partly claimed and partly excavated by Helmer Salmo in 1950 (KM 12687:1–20).

122 *Uino 1997: 245–247.*
123 *Uino 2003a: 272–273.*
124 *See Lehtosalo-Hilander 1985: 32.*
125 *Kivikoski 1973: 13.*
126 *Kivikoski 1973: 13.*

The inhumation cemetery of Kirkkomäki is situated 100 metres north of the Church of Kaarina, on the southern side of the River Aurajoki and on the northern and eastern slopes of a hill. In addition to the Crusade Period inhumation cemetery, signs suggesting a settlement site have been found. The cemetery consists of 35 graves, all of which have not been thoroughly excavated. Some of the deceased were buried in wooden coffins. Other sword finds include a pommel belonging to a later variant of Petersen's type X (KM 19272:293) and a sword with a pommel of Tomanterä's type A (KM 22078:2).

Sword **TMM 13393** is a stray find from Laihasmäki hill from the garden of Mäkilä cottage in Turku, former Maaria. The nearby level-ground cremation cemetery of Virusmäki, containing three inhumation burials, dates from the 11th century.[127] The Virusmäki site is situated on the western side of the River Vähäjoki, ca. 1.7 kilometres north of Turku Cathedral. The condition of the sword in question suggests an inhumation, while no other evidence of this has been found.

Sword **KM 2939:1** was found together with an axe and a spearhead, both of which are fragmentary and unfortunately cannot be classified. The artefacts possibly belong to the same inhumation grave, but this cannot be definitely stated. The site, Yliskylä in Salo (former Perniö) is in the graveyard of the Chapel of Yliskylä, ca. 3.5 kilometres from the train station of Perniö. The first finds, a fire-steel and an axe, were made in 1893 while enlarging the graveyard. These finds led to excavations revealing eleven inhumation graves and one cremation. The only known cremation was placed in a small rock-filled mound containing altogether 74 artefacts and 850 nail rivets, most likely from a boat. The cremation is from ca. 600 AD.[128] The later inhumation burials dating from the Crusade Period[129] were dug into sandy ground, the heads of the deceased pointing west.

Two swords with ferrous inlays are known from the Rikalanmäki cemetery in Salo, former Halikko. Rikalanmäki is a rocky hill situated on the western bank of the River Halikonjoki. It is a multi-period site, in use from the Bronze Age to end of the Iron Age, and most likely onwards to the medieval period. The ancient remains of the hill have been partly destroyed in construction works, and partly excavated. The best-known complex at Rikalanmäki is the Crusade Period inhumation cemetery. In addition, indications of settlement sites and a Merovingian Period–Viking Age cremation cemetery have been found. Also a cup-marked stone and similarly marked rock surfaces have been found in recent surveys. A total of ten swords with disc-shaped pommels and one with brazil-nut shaped pommel have been recovered from the site, and in addition to these, two loose hilt parts and two blade fragments are known. Other sword finds contain non-ferrous inlays on their blades.

The first sword from Rikalanmäki is **KM 12033**, which is a stray find from the Tuominen property, made while digging a trench. The exact find location is no longer known, but the sword may have belonged to a subsequently destroyed inhumation grave. The sword belongs to the same inhumation cemetery as the finds excavated by Jorma Leppäaho in the 1950s. The sword was found before 1925 and it was donated to the National Museum in 1948.

Another sword from Rikalanmäki is **KM 12690:299**, which belongs to inhumation grave V (KM 12690:294–348), excavated by Jorma Leppäaho in 1950 (KM 12690:1–438). Other finds from the same grave include a fragment of a silver bracteate (Swedish, Svealand, 1167–1196 AD[130]), a yellow glass bead, a bronze strap buckle, a piece of possibly bog iron ore, bronze spirals from a veil, a pommel of Tomanterä's type A (KM 12690:300, probably from sword KM 12690:299),

127 Kivikoski 1973: 13.
128 Kivikoski 1973: 13.
129 Kivikoski 1973: 13.
130 Talvio 2002: 168.

a bronze bracelet, a bronze spiral finger-ring, silver- and copper-decorated fragments of a spearhead socket, a copper-plated iron weight, two pieces of flint, a knife with a bone handle, a silver penannular brooch of faceted ends, a silver filigree bead, a silver coin with remains of a loop (Anglo-Scandinavian imitation, ca. 997–1003 AD[131]), eight bronze bells, a piece of leather, a silver finger-ring, a two strap dividers with two strap mounts each, small bronze mounts and groups of them from a belt and some still having leather intact, a bronze sheet probably from a strap end, three bronze strap-end mounts, a piece of wood, pieces of a human hip joint and thigh bone, a small piece of birch bark, and a fragment of an iron chain. All in all, the grave may date from the second half of the 12th century.

Sword **KM 30985:1** belongs to a group of finds from the Wuorenrinta site, also in former Halikko. Other finds were as follows: small silver cross pendant, a sickle, three bronze bear-tooth pendants, a fragmentary bronze pendant, a bronze mount, molten bronze, a small rivet, two large nail-rivets and some iron nails. The condition of the sword and its intact copper-alloy decoration of the hilt as well as the wool thread found on the cross-pendant both suggest an inhumation dating from end of the Viking Age or even younger.[132] It must be noted that the sword was bent during the digging. The Wuorenrinta property is located on the topmost part of Kihistenmäki hill, on the northwestern side of Rikalanmäki hill. According to the finds, the site dates from 10th and 11th centuries, and the condition of some of the finds as well as the sooty soil also suggest a level-ground cremation cemetery, although no burnt bone was found.

Sword **KM 9562:1** from Hulkkunanmäki in Lieto municipality belongs to a group of artefacts catalogued as grave no. 1 in the Hulkkunanmäki inhumation cemetery. Other finds from this possible grave include two spearheads of Petersen's type G (one silver-decorated),[133] a fragment of a bronze balance, a weight, fragment of a curved iron knife, a fragment of a fire-steel (under KM 9562), and a fragment of a Germanic silver coin (unidentified[134]), a small piece of leather and a small rivet, a fragment of a bronze penannular brooch, a small piece of a mussel shell, a small fragment of an acanthus-ornamented silver artefact, some charcoal, a horseshoe-nail, and a badly corroded artefact, perhaps a knife (under KM 9695). The finds date from the 11th century, as also the whole cemetery.[135] Hulkkunanmäki hill is situated on the north side of the River Aurajoki, in the middle of cultivated fields. On the western and northern sides of the cemetery Stone Age settlement sites can be found (sites known also as Tuomola), along with two cup-marked stones (sites Hulkkuna 1 and 2).

The inhumation cemetery of Humikkala is located in the vicinity of the Church of Masku, on a nearby hill. The cemetery was found during gravel transport in 1925 and it was immediately excavated, revealing a total of 56 graves. According to coin finds and artefact typologies, the cemetery was in use during the first half of the Crusade Period, possibly between 1025 and 1150 AD.[136] The site was excavated later, showing some signs of a Viking Age cremation cemetery at the same location and in the vicinity of the bell tower and on the west side of the church. A penannular brooch of iron was found in 1998, belonging to a small cairn-type structure, also containing pieces of burnt tiles in a trial pit. Altogether eight swords are known from this cemetery.

Sword **KM 8656 H23:1** is a grave find from closed grave no. 23 in the Humikkala cemetery. Other finds from the grave include an iron knife and four round, fragmentary metal artefacts,

131 Talvio 2002: 168.
132 Mikkola 1999: 46–50.
133 Lehtosalo-Hilander 1985: 31.
134 Talvio 2002: 170.
135 Kivikoski 1973: 13.
136 Kivikoski 1973: 13.

previously categorized as buttons (KM 8656 H23:1–3). Riitta Rainio, who has studied Finnish Iron Age bells and bell pendants has catalogued these examples as beads resembling small bells.[137] They were made in a similar manner to bells, but they do not have holes for producing the sound. Altogether the type of the sword as well as the beads, characterized as an eastern type by Rainio, suggest a dating to the 12th century. Another iron-inlaid sword, **KM 11831**, is a probable grave find from the inhumation cemetery. Its exact find location or find year is not known, since the sword was kept in the Church of Masku, from where Nils Cleve brought it to the National Museum in 1948.

A total of four inlaid swords are known from the Anivehmaanmäki inhumation cemetery in Pöytyä, former Yläne. Three of these were found in closed graves along with other artefacts. The Anivehmaanmäki site is located on the western bank of the River Yläneenjoki on a forested hill and in the area of a modern sawmill. The site dates from the Viking Age and consists of altogether 83 graves, excavated in 1955–57. It is possible that the cemetery has not been totally excavated, since some finds have been found outside the excavated area further away. It is also possible that the later finds, i.e. a sword and a tanged spearhead, belong to some other nearby cemetery. The cemetery dates from between 550–1150 AD.[138] Altogether eight swords and the tip of a sword blade have been recovered from the site.

The first sword from Anivehmaanmäki, **KM 13839:253**, belongs to grave no. 12 (KM 13839:201–362). Other finds from this grave include iron nails and their fragments, iron rivets, potsherds, bronze spiral decorations and their fragments, an iron handle of a pot cover, fragments of iron rods and sheets, a bronze finger-ring with a middle shield and fragments of another one, bronze belt mounts, pieces of bronze sheets, pieces of textile, a bronze belt buckle, a bronze bell, a bronze strap divider, an iron lock, a fire-steel, an arrowhead, fragments of a leather pouch, bronze-coated weights of iron and lead, a bronze balance in its box, an amber bead, a bronze bead, pieces of amber, a piece of a Samanid coin (imitation, 913–932 AD), pieces of English silver coins (ca. 991–997, 997–1003, 978–1018), other unidentifiable fragments of German silver coins,[139] and an axe with an elongated shaft-hole. These finds date from the very end of the Viking Age or the first half of the 11th century.

The second sword, **KM 13962:322**, belongs to grave no. 33 (KM 13962:318–328). Other grave finds include a bronze penannular brooch with rolled ends, potsherds, a clay vessel, pieces of leather, pieces of iron, a socketed spearhead mostly resembling Petersen's type A, a tanged spearhead resembling Petersen's type E, a piece of a bronze knob, and iron shears. The grave may be dated to the transition of the Merovingian Period and the Viking Age, most likely to the beginning of the 9th century.

The third sword, **KM 14196:69**, was excavated from grave no. 48 (KM 14196:64–71). Other finds from this grave include bronze spiral fragments, a silvered bronze finger-ring with a middle shield, a club-shaped bronze mount with some leather, pieces of leather straps, a penannular brooch with flat ends, and a spearhead of Petersen's type E. This grave illustrates long time of use of Petersen's type E spearhead, since according to other finds and especially the type of the sword hilt (later variant of Petersen's type X), the grave dates from the very end of the Viking Age.

The fourth sword from Anivehmaanmäki, **KM 26301**, was found in 1990 while deepening a trench in the field. The exact find location of this sword was ca. 100 metres north of the excavated

137 Rainio 2010: 43.
138 Kivikoski 1973: 15.
139 Talvio 2002: 177–178.

cemetery. Either this sword also belonged to the same cemetery, or then to another one at a very close distance. The depth of the find, ca. 60–70 centimetres, however, refers to a grave find from an inhumation grave.

Four inlaid swords are known from the Tampere region. Three of these are from the cemetery of Vilusenharju, including both a cremation cemetery and inhumations presented earlier in Chapter 2.4 of this Appendix in connection with a find from the cremation cemetery. Sword **KM 17208:375** was found in grave no. 43 (KM 17208:352–398). The other finds included a hooked piece of iron, twenty-two complete and fragmentary iron nails, a possible miniature axe pendant made of iron, a deformed bronze object, three bronze spirals, a small bronze ring from a piece of clothing, pieces of burnt bone, a bronze penannular brooch with funnel ends, small piece of bronze sheet with some intact leather, a piece of iron with some intact leather, an iron trammel hook, a bone comb, a bronze scabbard chape with intact leather and wood (KM 17208:374), a socketed spearhead of so-called East-Baltic type,[140] potsherds, small iron fragments, a fragment of a spearhead socket, five iron rivets, a small fragment of a bronze pipe, a small bronze ring with some leather intact, and a molten piece of bronze. According to Nallinmaa-Luoto, the dating of this grave is problematic, since the sword and the penannular brooch are much earlier than the silver-decorated East-Baltic spearhead, giving a possible date to the end of the 11th century.[141]

The two other inlaid swords found from the Vilusenharju graves are problematic. Sword **KM 17208:561** is a grave find from inhumation no. 12 (KM 17208:549–575), which was mixed with cremations. The cremated artefacts were found outside the wooden coffin and were as follows: the sword in question, a sword pommel of Tomanterä's type A, two narrow bladed spearheads of so-called East Baltic type,[142] horse bits and an arrowhead. In addition, the coffin was sealed with a nail, a knife and an arrowhead. Only a bearded axe of Estonian type seems to have been belonged to the inhumation, while all the other finds were brought to the place by a bulldozer, thus originating from the cremation cemetery. These finds include a bronze bracelet, an arrowhead, a knife, a bronze penannular brooch with rolled ends, an iron pipe, a sword scabbard chape, a bucket handle, iron fragments, a fire-steel and potsherds.[143]

Similarly, sword **KM 17208:588** from grave no. 12a (KM 17208:576–592) was from a mixed context of finds. The other finds include a fire-steel, an iron hook, a piece of flint, three spearheads of Petersen's type G, a knife, three narrow bladed spearheads of so-called East Baltic type, a lower guard of a sword (11th century), kettle hangers, an axe with large extensions on the sides of the shaft-hole, an iron nail, potsherds and some burnt bone. Although the sword in question is included as belonging to the inhumation grave, in reality it was recovered from the cremation cemetery along with the loose lower guard, a knife, all six spearheads and kettle hangers, which were all placed in a pile while digging the inhumation grave.[144] Also the fire-steel, iron hook and the piece of flint originate from the cremation cemetery because they were found in the fill of the grave.[145] The axe was probably the only artefact belonging to the inhumation grave, since part of its wooden handle was still intact.

The fourth sword found from an inhumation burial is from the inhumation cemetery of Mikkola in Ylöjärvi. This cemetery is situated along Mikkolantie road, about one kilometre south/southeast of the Church of Ylöjärvi. The site contains both cremations and inhumations dating

140 Nallinmaa-Luoto 1978: 136–137.
141 Nallinmaa-Luoto 1978: 242.
142 Nallinmaa-Luoto 1978: 136–137.
143 Nallinmaa-Luoto 1978: 11–13.
144 Nallinmaa-Luoto 1978: 15, 129.
145 Nallinmaa-Luoto 1978: 15.

from the Viking Age and the Crusade Period, the inhumation dating from the 11th and 12th centuries.[146] Some of the cemetery may still be intact in the yard of the Mikkola property. Sword **KM 19901:202** is a grave find from inhumation cemetery, grave no. 1 (KM 19901:195–209), and excavated by Seija Sarkki in 1976 (KM 19901:1–246). Other finds include an iron nail, three spearheads of Petersen's type G, iron rivets, a knife, an iron rod, potsherds, burnt bone, a piece of clay slag, human skull fragments, and complete and fragmentary teeth. The grave may be dated to the 11th century. From the same site two other swords have been recovered, KM 3038:1 and KM 14553:1, of which the latter contains non-ferrous inlays and a silver-plated hilt.

The Satakunta region is the richest area with regard to swords recovered from inhumation burials. Swords with ferrous inlays have been found a total of fifteen, the majority of them from the present municipality of Eura. Pappilanmäki is an Iron Age inhumation cemetery located near the centre of Eura, The cemetery has been partially excavated by archaeologists and partially demolished during various construction works. Finds have been made already during the 1750s and it was excavated on several occasions mainly before the 1950s. Presumably some untouched graves still exist on the northern sides of the vicarage since finds have been made everywhere while renovating the foundations and cellars of the building. The overall dating of the Pappilanmäki cemetery is 550–1150 AD.[147]

Altogether twelve swords and a blade fragment have been recorded from the site. Of these, a total of six have been found to contain ferrous inlays. Swords **KM 1822:1** and **KM 1822:2** were recovered in 1876 with four complete spearheads (Petersen's type E and a spearhead resembling type "Salmo Taf. XIV:1", and a broken one). All these may not be from the same grave. In similar fashion, swords **KM 9164:2** and **KM 9164:3** are presumably grave finds from the year 1929 recorded with a third sword (KM 9164:1), a spearhead of Petersen's type M, a spearhead close to Petersen's type E, a penannular brooch with funnel ends, and an enamel bead.

Sword **KM 1120:1** was found during the excavations at Pappilanmäki and Käräjämäki in 1870 (KM 1120:1-5), and it probably belonged to a single inhumation grave also containing spearheads of Petersen's types E and F,[148] a peg-ornamented penannular brooch, a spiral-ring with a middle shield, fragments of other spiral-rings, nail rivets, horse bones and charcoal. Sword **KM 11063:283** is also a grave find, this time from grave no. IV (KM 11063:272–293) revealed by archaeological excavations in 1939 led by Helmer Salmo. Finds from this grave include potsherds, bronze mounts and their fragments, scissors, a scythe, two bronze finger-rings, a spearhead of Petersen's type E, iron nails, a penannular brooch with funnel-shaped ends, bronze spiral decoration in the form of a star along with some fabric, fragments of bronze spirals, a knife, and a piece of iron slag.

Käräjämäki-Osmanmäki is another inhumation cemetery in Eura; the site also included a cremation cemetery and a so-called judge's ring containing two cremations inside it. The site is situated on the eastern side of the River Eurajoki, on a sandy ridge ca. 600–700 metres southeast of the Church of Eura. The site is split by a road, and the southern end is called Käräjämäki and the northern end Osmanmäki, the two having originally been parts of the same hill. The judge's ring with its burials is on the Käräjämäki side, as well as two mounds and 169 shallow depressions as indicators of inhumation burials dating from both the Merovingian and Viking Ages. Also at Osmanmäki there are both Merovingian Period and Viking Age inhumation graves and some of

146 Kivikoski 1973: 15.
147 Kivikoski 1973: 10.
148 Lehtosalo-Hilander 1985: 14.

them have been excavated. The inhumations at Osmanmäki have been dated to between 600–1150 AD,[149] the oldest ones dating possibly from the 5th century.[150]

Two swords with ferrous inlays have been discovered in the inhumation burials of Osmanmäki. Sword **KM 4633:145** is a grave find from find location no. 20 in Hjalmar Appelgren's report from the excavation of 1905, an inhumation grave (KM 4633:140–158). The grave belonged to a man and the head of the deceased was oriented to the southwest. Other finds include a round brooch, pieces of wood, a penannular brooch with pegs, a bronze belt buckle, a piece of leather, three bronze mounts from a leather strap, a bronze spiral finger-ring, a nail rivet, a blade from a spearhead, a knife, a bronze spiral finger-ring with a middle-shield, potsherds, and two iron nails. The finds date the grave most likely to the second half of the Viking Age.

Sword **KM 4633:165** is a stray find from a pit, probably from an inhumation in Osmanmäki (KM 4633:165–183). Sword belongs to artefacts recovered before the above-mentioned archaeological excavations. Finds from the same pit are as follows: a fragmentary spearhead, a penannular brooch with faceted end knobs, fragments of a large bronze penannular brooch, a Viking-period equal-armed brooch, a small penannular brooch with rolled ends, bronze spirals, two bronze pieces from a knife sheath, a silver ring, a glass bead, a knife, three nail rivets, four nails, a small clay vessel and fragments of other vessels, an English silver coin (ca. 1003–1006 AD[151]), a spiral finger-ring and a large bronze penannular brooch. It is not, however, certain that all the artefacts are from a single grave.

Yet another large inhumation cemetery is known from Eura, namely the cemetery of Luistari, which is situated on the crossroads of the Eura-Laitila road and the old road to Laitila, 180 metres west of the River Eurajoki, ca. 2.2 kilometres southeast of the Church of Eura. The site houses an inhumation cemetery and burial cairns from the Iron Age, as well as one Bronze Age cairn and a settlement site in a former field and hill area. Over 1,300 inhumations were unearthed, dating from the end of 6th century onwards, the most active age being from ca. 800 AD to ca. 1100 AD. Some empty graves may even be of later date. The site has been almost completely examined in excavations conducted since 1969.

Eleven complete swords or hiltless blades, four loose hilt parts, and some fragments of blades were recovered from the cemetery of Luistari. Of these, four sword blades were found inlaid with iron, all in excavations led by Pirkko-Liisa Lehtosalo-Hilander. Sword **KM 18000:3170** is a grave find from inhumation grave no. 281 (KM 18000:3154–3200). Other finds from the grave are bronze spirals, iron nails, three spearheads of Petersen's type E, a scythe, two bronze rings, scissors, two knives, a penannular brooch with funnel ends (ca. 800–950 AD), a scramasax, two spiral rings, two human teeth, a dog skull and bones, pot fragments and nine lumps of iron slag.[152] This grave contained two deceased persons, both perhaps men, and a dog, placed in some kind of wooden frame, the heads of the deceased pointing to west/southwest.[153] Lehtosalo-Hilander has dated the grave to the Luistari phase V II consisting of the Middle Viking Period, ca. 880–950 AD.[154]

Sword **KM 18000:3880** was found in grave no. 348 (KM 18000:3871–3966). Other finds include iron nails, clay vessels spiral ornaments and their parts, an iron lock, a pouch, a ringed pin, a seax, a knife, a whetstone, two spearheads (one of Petersen's type E), complete and fragmentary silver

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149 *Purhonen 1998: 238.*
150 *Kivikoski 1973: 10.*
151 *Talvio 2002: 185.*
152 *Lehtosalo-Hilander 1982a: 187–188.*
153 *Lehtosalo-Hilander 1982a: 186–187.*
154 *Lehtosalo-Hilander 1982b: 185–186; Lehtosalo-Hilander 1982c: 11.*

coins (five Samanid coins dating between 897/8–926/7 AD[155]), bronze weights, a spiral finger-ring, a scythe, shears, as well as various organic remains including bones and teeth. The deceased was placed inside a wooden frame with his head towards the west. Some animal, perhaps a dog, was buried in the northern part of the grave, and the sword was placed with other artefacts on the left side of the corpse.[156] Lehtosalo-Hilander has dated this male grave to phase V II,[157] the coins giving the earliest possible date as 897 AD.

Sword **KM 23607:490** belongs to grave no. 740 (KM 23607:473–507). The other finds are as follows: a human tooth, spearheads of Petersen's types E and F (ca. 850–900 AD), a bronze ring, shears, a clay vessel, a knife, a bronze penannular brooch, a firesteel, flint pieces, a spiral finger-ring, a ring, nails, iron fragments, a bead, a piece of an Islamic silver coin (unidentified[158]), potsherds, bones and slag.[159] The grave has been interpreted as a male grave dating from ca. 900–950 AD.[160]

Sword **KM 24740:242** was found in grave no. 844 of Luistari (KM 24740:230–269). The other finds in the grave include two spearheads of Petersen's type E, a spear ring, a scythe, iron nails and rivets, bronze strap-dividers, two bronze penannular brooches with pegs (ca. 900–950 AD), a knife (from the end of the 9th century to ca. 950 AD), a piece of flint, a firesteel with a bronze handle (ca. 925–950 AD), a finger-ring with a flat middle shield, a tin pendant, iron fragments, potsherds, burnt clay, bones and slag.[161] The overall dating of this male grave is ca. 900–950 AD.[162]

In the municipality of Köyliö, the cemeteries of Vanhakartano are distinct from other prehistoric remains. The inhumation cemeteries of Vanhakartano are situated in the island of Köyliönsaari or Kirkkosaari as it is sometimes called. There are three inhumation cemeteries A, B and C on the island. Cemetery A is located at a distance from the others in a field 700 metres north/northwest of Vanhakartano Manor, and dates according to the find material from the end of the 6th century to the end of the 8th century.[163] Nils Cleve excavated 21 inhumation graves and two cremations in cemetery A. Other cemeteries are located near the buildings of the manor. Cemetery B, which dates from the latter half of the 7th century, consisted of sixteen graves and was located near the dairy of manor. Cemetery C, the so-called Lalli cemetery, is situated beside the cattle shed or cowhouse, with altogether over 60 graves and generally dating from the Viking Age to the Crusade Period,[164] more precisely from the end of the 900s to the beginning of the Crusade Period. The majority of the graves were archaeologically excavated, while the first 16–17 found graves were demolished during construction works, although the connections of the finds with graves could be established.

Swords and their parts have been recovered from the cemeteries under altogether 23 collection numbers. Three swords with ferrous inlays on their blades have been found, all from cemetery C. Sword **KM 8602:130** is from inhumation grave C I (KM 8602:130–137), excavated by Alfred Hackman in 1925. Found along with this sword were two fragments of silver coins (unidentified),

155 *Talvio 2002: 182.*
156 *Lehtosalo-Hilander 1982a: 237–240.*
157 *Lehtosalo-Hilander 1982b; 186.*
158 *Talvio 2002: 184.*
159 *Lehtosalo-Hilander 2000a: 75–76.*
160 *Lehtosalo-Hilander 2000a: 76.*
161 *Lehtosalo-Hilander 2000a: 103–104.*
162 *Lehtosalo-Hilander 2000a: 104.*
163 *Kivikoski 1973: 12.*
164 *Kivikoski 1973: 12.*

five iron weights, a bronze object, spiral finger-ring, scythe fragment, a seax, pieces of wool, peas and other organic remains.[165] Nils Cleve dated this grave between 1025–1150 AD.[166] Sword **KM 8602 A:116** is from grave C 3 (KM 8602 A:116–125). Also discovered with this sword were a spearhead of Petersen's type G, a bronze button, two spiral finger-rings, knife, two bronze spirals and organic remains.[167] Cleve dated this grave to between 975–1025 AD.[168]

Sword **KM 8723:165** is also a grave find belonging to grave no. C 16 (KM 8723:165–193). excavated by Nils Cleve and Carl Axel Nordman in 1926. These finds may have been mixed with finds from grave C 17. Found together with the sword were coffin nails (KM 8723:166), catalogued under grave no. C 16. The finds from grave no. C 17 are as follows: a sword of silver-plated type (KM 8723:194), a silver-decorated axe of Petersen's type M, two spearheads of Petersen's type G, a gold-ornamented glass bead, a niello-decorated silver finger-ring, a knife and its sheath, and coffin nails (KM 8723:194–200).[169] Both graves were dated by Cleve to between 1025–1150 AD.[170]

One inlaid sword from an inhumation burial has been found from the region of Häme Proper. Sword **KM 17777:1** was a stray find to ignite the investigations of Vesitorninmäki in Hattula. This site is located ca. 200 metres south from the manor of Suontaka and 17 metres northwest from the water tower of the manor, approximately 8 kilometres northwest from the old church of Hattula. On the site an inhumation burial was found in 1968. It is speculated that the sword in question is from a different grave than the one investigated, thus the cemetery being larger, although no signs of other graves were identified.[171] This only discovered burial (KM 17777:2–9) consists of the following finds: a silver-inlaid sword without hilt, a knife, two oval brooches and human femora. The finds date the burial to the 11th century.[172] It has been speculated that the grave belonged to a woman, leading the sword 17777:1 to be easily interpreted as also belonging to this deceased person. Another possibility is that this was a twin burial.[173]

Two inlaid swords are known from inhumation burials in ceded Karelia. The cemetery of Kekomäki in Kaukola is an inhumation cemetery dating from 1100–1250 AD.[174] It is situated on a hill in the middle of a field, ca. 300–400 metres northeast of the inhumation cemetery of Kulhamäki. The first finds were made in 1884, leading to excavations in 1886 and 1888, revealing a total of six inhumation graves with grave goods. A total of four swords are known from the cemetery, two of which were inlaid with iron, and are discussed below.

Sword **KM 2489:121** belonged to a very large grave (no. 1, KM 2489:1–239) containing the remains of two women and two men in a wooden frame and covered with ochre-painted birch bark. Datable finds include spearheads of Kirpichnikov's type IIIB and Petersen's type K, and two pairs of oval convex brooches. The dating of the grave is suggested as 1150/1200–1250 AD.[175] Sword **KM 2489:280-281** was found in grave no. 3 (KM 2489:277–377), which contained a woman and a man with following finds: a long-socketed spearhead, knives with their sheaths, a

165 *Cleve 1978: 59.*
166 *Cleve 1978: 196–197.*
167 *Cleve 1978: 22–23.*
168 *Cleve 1978: 195.*
169 *Cleve 1978: 31–33.*
170 *Cleve 1978: 196.*
171 *Nylén 1973: 165.*
172 *Keskitalo 1969: 95; Kivikoski 1973: 14; Taavitsainen 1990: 91.*
173 *E.g. Taavitsainen 1990: 91.*
174 *Uino 1997: 231–233.*
175 *Uino 1997: 233.*

penannular brooch of Salmo's convex Karelian type, a fire-steel and a pouch, belt parts, finger-rings, a cross pendant, a kettle, a scythe, an axe, a wheel-shaped brooch, shears and textile fragments. The deceased were covered with red birch bark, some fragments of which were preserved. The contemporaneity of the two deceased persons is not certain. The grave has nonetheless been dated to 1150–1250 AD.[176]

2.6. Other contexts

The category of other contexts consists of swords found along with other artefacts, but with no clear indications of certain fixed remains, such as a cemetery of any kind. The nature of these contexts remains somewhat unclear, although guesses may be made, such as hoards or sacrifices. Other artefacts recovered with the sword finds in question may be used to obtain a date also for the sword, but with reservation, since the nature of the sites remains obscure.

First is the region of Finland Proper, where five inlaid swords are known from these unclear contexts. Sword **KM 5395:1** from the Myllymäki site in Mynämäki parish belongs to group of artefacts also including two willow-leaf shaped spearheads, an axe, scissors, a small piece of iron, a fragmentary wheel-shaped brooch made of bronze, and two band-shaped fibulas of bronze (KM 5395:1–9). The artefacts were found while digging a pit, and they were sent to the National Museum in 1909. The nature of the site is not exactly clear. It has been suggested to have been a cairn, a cemetery or even a sacrificial site, dating however from the 9th century.[177] The site is situated at Paavola farm, next to a field at the bottom of the western bluff of Myllymäki hill, ca. 700 metres from the shore of the River Laajoki. Also an undecorated lower half or tip of a sword blade (KM 5391:1) has been recovered from the same site.

Sword **KM 9142:8** was found in the Myllymäki cemetery in Nousiainen, located on a hill 2.7 kilometres southwest of the Church of Nousiainen. The place has been extensively excavated altogether five times during 1930s. The sword was found along with parts of skeletons, spearheads and other small artefacts (KM 9142:1–6, 8–9, 11–13). The types of spearheads are as follows: a variant of Petersen G with animal-shaped wings, a silver-decorated narrow bladed spearhead,[178] two spearheads close to Petersen's type G3, a small twisted socketed spearhead (corroded and fragmented), and a fragmented angon resembling Salmo's "Finnish" form. Other finds include an unidentified iron object, a hemispherical bronze cup, a bronze strap mount, and two large bronze buttons. The cremation cemetery and the inhumations found on the place date from the Viking Age and the Crusade Period.[179] None of the above-mentioned finds can be strictly associated with the sword in question, thus making the dating more difficult, and it cannot be known if the sword fragment is from a cremation or an inhumation. Altogether, swords and sword parts have been listed under eleven catalogue numbers.

Sword **KM 9389:1** from Halikko (modern Salo), Kaikumäki more precisely, was recovered together with fragments of scramasaxes, a large knife, two axes, eight spearheads of Petersen's type E, a spearhead resembling Petersen's type E, a spearhead of Petersen's type F, fragments of spearheads, and three small knives. The dating of these finds is roughly the 10th century. These finds belong to a possible hoard, maybe of a weapon-trader, since no traces of any kind of burial have been detected. The finds include a sword of Petersen's type X, four fragments of seaxes, a knife, two axes, seven spearheads of Petersen's type E, a spearhead of Petersen's type F, fragments

176 *Uino 1997: 233.*
177 *Kivikoski 1973: 13.*
178 *See Lehtosalo-Hilander 1985: 15; this spearhead does not fit into any specific type.*
179 *Kivikoski 1973: 13.*

of whetstones, three penannular brooches with rolled ends, and fragments of spearheads and sword blades. According to the report, the inlaid sword originally had a loose hilt of Petersen's type X. The site itself is situated ca. 9 kilometres west of the Church of Halikko, on the east side of the River Lokkilanjoki and on the northwestern slope of Puhalonmäki hill. A sword blade fragment is also known from the site (KM 10329:2).

Swords **KM 9243:1** and **KM 9243:2** belong to a group of finds (KM 9243:1–4) from roadworks in 1930. All the items are from the Viking Age,[180] including a pommel and upper guard of Petersen's type E (KM 9243:3), the bronze part of what may have been a lash-shaft, and a fragment of a spear blade, in addition to the above two swords. Since no traces of fixed remains or burial structures have been recorded, the nature of the find could be something else, possibly a hoard. Four iron-inlaid swords with unclear contexts are recorded from the Tampere region. One sword (**KM 6066:1**) is from Tampere (former Messukylä), from the lands of Toivola farm. The sword was found together with a spearhead close to Petersen's type F, and a fragmentary spiral bracelet (KM 6066:1–3). The artefacts were recovered from the garden of the farm, next to a large rock. This context remains unclear, although it has been presented as a possible cemetery.

The other three swords from the Tampere region were from the same site, Sassinsaari in Vesilahti. It is situated on a rocky slope and a field surrounded by swampy areas, ca. 6.3 kilometres southeast of the church of Vesilahti. The site may have been an island at some stage, as also indicated by the place name. The artefacts recovered in the 1930s were found in the field on the eastern side of the slope. This was followed by an excavation in 1936, but no constructions suggesting a cemetery or anything else were found. The site has been interpreted as either a cemetery or a hoard. The suggested dating is the 11th century.[181] The artefacts from this hoard consist of swords and their parts, suggesting the possible hoard of a weapon trader. Of these swords three were inlaid with a ferrous material (**KM 10390:2**, **KM 10390:3** and **KM 10390:5**), and the pommel of sword KM 10390:2 (KM 10409:1) was recovered in later excavations. The finds include three other swords with undecorated blades, and a number of blade fragments.

One sword in this category of contexts is known from Häme Proper. A group of finds (KM 18402:1–7) was discovered in 1971 under a large rock about 4.6 kilometres southeast of Hämeenlinna Castle and 1.1 kilometres southeast of the Church of Vanaja. The site is known as Peltorinne in Hämeenlinna. Inlaid sword **KM 18402:1** was found along with a small knife. After this, a trial excavation was conducted, revealing some more finds. The site was destroyed by building work and it contained no definite evidence of a cemetery. Among the recovered finds a small blade fragment is also known (KM 18402:3), indicating the presence of another sword.

Similarly, one sword is known from the Lake Päijänne region of Häme. The find location of sword **KM 2033:1** is situated near the Viking Age cremation cemetery of Karolanmäki and also near the Iron Age dwelling site of Kapakka, in Padasjoki. The sword was found with a bearded axe of Northeast Baltic type in 1878.[182] The find location of these artefacts is at the same place where pieces of ceramics, quartz and bronze plate were found in 2003. The nature of this site, too, remains obscure.

Only one inlaid sword is known from Central Finland, and it is from an unclear context. Sword **KM 31550:1** was found with the help of a metal detector in the summer of 1999 in Viertiö, Jämsä. At the same time, about thirty metres north from the find location of the sword, an axe and a knife

180 Kivikoski 1973: 14.
181 Kivikoski 1973: 15.
182 See Paulsen 1956: 25.

were found next to a large rock. The site was excavated in 2001 but the test pits and trenches did not display any structures suggesting a cemetery.[183] The location has thus been interpreted as a hoard. The site itself is situated on a rocky island surrounded by cultivated fields, about 200 metres north of the border of Jämsä and Jämsänkoski.

Only one inlaid sword has ever been recovered from Lapland. The find location of sword **KM 3631:1** is at the top of a hill called Marikkovaara in Rovaniemi, on the northeastern side of Lake Viiksjärvi. The sword belongs to a group of artefacts recovered in 1891 from under small rocks almost at the surface (KM 3631:1–4). A socketed pattern-welded spearhead, a tanged barbed spearhead and a bearded axe were found together with this sword.[184] The find combination is dated to the Crusade Period[185] or slightly later, to the 13th century, having no connection with any fixed prehistoric remains known from the territory, and thus permitting multiple explanations.

183 *Vanhatalo 2012: 49–51.*
184 *Sarvas 1973.*
185 *Kivikoski 1973: 14.*

APPENDIX 3

GLOSSARY OF TERMS RELATED TO SWORDS, METALLURGY AND IRONWORKING

Alpha iron (α iron) – A metallurgical term for pure iron (*ferrite*) and also an allotropic, magnetic form of iron that forms when iron is continuously cooled below 912 °C. The crystal structure is of body-centred cubic form.

Annealing - A technique of *heat treatment,* in which steel is heated to *critical temperature,* and is cooled very slowly to make the steel softer for *cold-forging*, filing and grinding.

Austenite – See *gamma-iron*.

Banding – See *collaring*.

Bellows – Primitive air pumps used to blow air into a *forge* in order to raise the temperature temporarily.

Bevelling – See *chamfering*.

Blade – This term may be used to refer to a) to the edged portion of the sword extending from the hilt, or b) to a hiltless sword composed of the edged portion and the *tang*.

Blank – Roughly shaped material for making an artefact or an unfinished object.

Bloom – The product of the *smelting process* of iron. The composition of the smelted bloom is heterogeneous with variable carbon content and a great deal of impurities. This bloom had to be further refined by folding and *forge-welding* to get rid of the impurities and to homogenize its structure as much as possible.

Bloomery process – see *smelting process*.

Bradding – A blacksmithing technique, which means flattening the end of a bar, for example a rivet, to prevent it from being pulled through a hole.

Carburization – A process in which iron in its *austenitic* state absorbs certain amount of carbon to become *steel*. In prehistoric times, carburization could be done in numerous ways, such as straight from the smelted *bloom*, by quickly cooling a sparkling piece of iron in water or snow, or by *cementing*.

Cast iron – Iron with a carbon content of 2–6 % as achieved by melting and casting.

Cementing – A manner of *carburization,* in which thin pieces of iron are heated at a temperature of over 912 ˚C and among some carburizing agent such as bones, horns or skin, in an airtight container. Over the course of a few hours carbon is absorbed into the iron from the surface towards the centre.

Cementite – A hard and brittle mixture of iron and carbon formed when cooling *hypereutectoid steels*.

Chamfering – A blacksmithing technique in which a diagonal surface is hammered to an edge or an end of an iron bar. For example the bevels of blade edges are made by chamfering. This technique is also known as *bevelling*.

Cold-forging – See *work-hardening*.

Collaring – A joining technique in which a piece of hot iron is wrapped around a cold one. The hot iron then shrinks and the two pieces are attached to each other. This technique is also known as *banding*.

Critical temperature – The temperature at which the structure of a material changes. For example in ferritic iron this temperature is 771 °C, and it is the border between *ferrite* and *austenite* formation. *Steel* must be heated to at least critical temperature in order to apply *annealing* and *hardening*.

Crossguard – See *lower guard*.

Crucible steel - A technique of steel-making in which steel is formed by melting it in a crucible with some carbonising agent, resulting in *hypereutectoid*, high-carbon steel. This technique was in use in some regions of Asia, and is also called *damascening* and *wootz* in India.

Currency bar – Iron and steel bars shaped for trade. Certain kinds of iron and steel were forged into certain forms to let the traders know the quality of the material instantly. Different kinds of currency bars were in use during the Middle and Late Iron Ages and onwards and in various geographical areas.

Cutting – A blacksmithing technique in which hot iron is cut by striking it with a cold chisel or similar tool.

Damascening – See *crucible steel*.

Drawing out – A blacksmithing technique in which an iron bar is forged longer and thinner with hammer blows on opposite sides.

Drifting – A blacksmithing technique in which a hole in hot iron is enlarged or shaped with the help of moulds called drifts.

Etching – A decorative technique used to make patterns on the surface of metal artefacts by eroding them with some acidic substance. The same method has been used to reveal the patterns of *pattern-welded* artefacts.

Eutectoid steel – Steel with carbon content of 0.8 %. See also *hypoeutectic* and *hypereutectoid* steel.

Ferrite – See *Alpha iron*.

Fibring – A phenomenon occurring in wrought iron showing longitudinal streaks caused by slag inclusions, folding and *forge-welding*, and indicating the directions of *forging*.

Flattening – A blacksmithing technique meaning simply the flattening of the surface of the forged object. *Fuller* grooves, in particular, are flattened in order to achieve a wider surface.

Flux – A welding compound which prevents the oxidation of the welded pieces and helps remove slag from the welding seam. Traditionally fine-grained quartz sand has been used, being allowed to melt around the hot joint during heating.

Forge – A furnace in which metal is heated for *forging* and welding operations. A forge is accompanied by *bellows*.

Forge-welding – A joining technique of pressure welding in which the iron pieces to be joined are heated in a forge to a temperature between 1100 and 1300 ˚C, until the surfaces of the welded pieces are beginning to melt. The pieces are then quickly hammered against each other on an anvil to fuse the melted surfaces together. The technique is also known as *hammer-welding*. In forge-welding a so-called *flux* is used to prevent the oxidation of the welding seams.

Forging – A method of shaping in which material is not removed but shifted from one place to another with the help of hammer blows. Iron is forged at certain *forging temperatures* to make iron elastic and to prevent the material from cracking. During forging, iron crystals are *packed*.

Forging temperature – A range of temperatures at which a material is in such an elastic form that *forging* is possible. In the case of iron, forging temperature ranges from 770 ˚C upwards. The temperature of the forged piece is judged by the colour of the heated metal.

Fuller – In the case of swords, the fuller is the concave groove/grooves running lengthwise in the middle of the blade to make the blade lighter and tougher, and to enable the blacksmith to produce a wider blade from a smaller amount of material. In blacksmithing, the fuller is a convex tool, with which the blacksmith can strike concave grooves in order to make the forged piece wider. The term fullering derives also from this tool.

Gamma iron (γ iron) – A non-magnetic, allotropic form of iron with a face-centred cubic crystal structure, created when iron cools below 1395 °C. This form of iron is also known as *austenite*.

Grip – Term used for the handle of the sword.

Hammer scale – Thin, magnetic layers of *iron oxide*, which form and come loose from the surface of hot iron when it is worked. Sometimes hammer scales are left in forged artefacts as *slag* inclusions.

Hammer-welding – See *forge-welding*.

Hardening - A technique of *heat treatment*, in which steel is heated to a *hardening temperature* and is cooled very quickly by *quenching* the hot blade in a liquid. The technique has also been called quench-hardening. As a result, the crystal structure becomes hard *martensite*.

Hardening temperature – A temperature in which the *hardening* of *steel* takes place. This temperature is dependent on the carbon content of the steel.

Hardness measurements – Testing and giving the relative hardness of metal artefacts. Hardness values are given in the Rockwell, Brinell or Vickers scales. Hardness measurements may give clues to the composition of the metal as well as *heat treatments*.

Heat treatment – Altering the properties of, for example, steel by heating it at different temperatures and letting it cool at various rates. Heat treatments include *normalizing*, *annealing*, *hardening* and *tempering*.

Hematite – An iron ore which is a crystallized, mineral form of iron oxides, occurring in waterlogged environments or in the soil.

Hilt – The portion of the sword consisting of the *lower guard*, *upper guard*, *pommel* and *grip*.

Hypereutectoid steel – Steel with carbon content higher than 0.8 %.

Hypoeutectic steel – Steel with carbon content lower than 0.8 %.

Inlaying – A decorative technique in which one type of metal is inserted in a groove in another type of metal.

Iron oxide – A thin layer formed on the surface of hot iron, when it reacts with the oxygen in the air. This oxidation is greater at high temperatures and in an oxidizing atmosphere.

Laminating – A blacksmithing technique in which an object, often a blade with a cutting edge, is forge-welded from several longitudinal parts of different qualities. For example, a double-edged sword blade can be laminated from one central soft part and two harder steel parts for the cutting edges.

Limonite – Iron ore consisting of iron oxides found in lakes and bogs.

Lower guard – Term used for the transverse part of the hilt near the edged portion of the blade, used to protect the hand holding the sword. This part has also been called a *crossguard* in medieval swords, because the guard is longer and more slender than in Iron Age swords, making the whole sword resemble a large cross.

Magnetite – An iron ore which is a highly magnetic mineral form of iron oxides and occurs in rocks.

Manganese – A *trace element* which increases the hardness of iron but still does not prevent the diffusion of carbon.

Martensite – A hard and brittle crystal structure of *steel*, created in *hardening* when *austenite* transforms into martensite due to the fast rate of cooling.

Microstructure – Internal microscopic structure of an alloy composed of crystals of different size and form depending on the composition and working temperature of the alloy.

Normalizing – A technique of *heat treatment*, in which steel is heated to the *critical temperature*, and is let to cool in the air, relieving the internal stresses caused by *forging*.

Packing – During *forging*, the crystals of the shaped material are flattened and *packed*.

Pattern-welding – Partly functional and partly decorative technique of ironworking, in which plates of two different kinds of irons or steels are packed in alternating layers, welded as one piece, and then worked by filing, grooving and twisting to create tougher material and decorative patterns on the surface of the ready object. The patterns are made visible by etching the polished surface with an acidic substance. Colloquially, pattern-welding has been sometimes referred to as *damascening*, although it is a distinct technique of its own.

Pearlite – A tough iron alloy of mixed *ferrite* and *cementite* created as a result of slow cooling of *hypoeutectic steels*.

Phosphorus – A *trace element*, which – as diffused into iron – makes iron more brittle for *cold-forging*. It also makes iron easier to *forge-weld*, and increases resistance to corrosion. For this reason phosphorus-rich iron has been used in *pattern-welding*, since it remains bright after *etching* and thus creates a contrast with the darker patterns. Phosphorus-rich ores are not suitable for steel-making, since phosphorus prevents the diffusion of carbon.

Pig iron – Iron with carbon content between 3.5 % and 4.5 %, a product of the *smelting process* of iron when using high-carbon fuel.

Pommel – The uppermost part of the hilt used to balance the sword and prevent the hand from sliding off from the grip. During the Iron Age, the pommel was accompanied by the upper guard, whereas in later times the shape of the pommel changed, leaving the upper guard out of use.

Punching – A blacksmithing technique in which a hole is made in hot iron by striking it with a punch.

Quenching – See *hardening*.

Reagent – A chemical compound, which reacts with metals in the same way as acids, namely attacking different kinds of alloys by corroding them at different rates and/or colouring them in various manners. See also *etching*.

Reduction process – See *smelting process*.

Riveting – A joining technique in which the pieces to be joined all have a similar hole, into which a rivet is then pushed and *bradded* in order not to come loose.

Roasting – A preliminary phase of the *smelting process*, in which iron ore is dried and roasted on an open fire to get rid of soil and crystal water, and to make the bits of ore more fragile.

Shrinking – A joining technique in which a cold piece of iron is inserted into a hole in a hot iron. When hot iron cools, it will shrink and grasp the cold iron tightly.

Slag – Term for a by-product of the *smelting process*, normally consisting of oxides and other impurities. Not only created in the smelting furnace during the process, slag also gets trapped in the bloom as small inclusions, some of which still remain after the bloom has been forged into an object. Additional slag may be incorporated by *forge-welding*, where slag may be trapped into welding seams.

Smelting process –Also known as the *reduction process*, this a direct way to reduce oxides from iron ores. Smelting took place in certain kinds of furnaces, where ore and crushed charcoal were heated together, resulting in a sponge-like, heterogeneous iron *bloom* and liquid iron *slag*.

Steel – A modern term for iron, which has carbon alloyed in it, making it harder and more brittle than non-carbon iron. Steel should contain over 0.4 % and less than 2 % of carbon to remain workable and be suitable for *heat treatments*.

Tang – The part of the *blade* on which the parts of the *hilt* are attached.

Tempering - A technique of *heat treatment*, in which steel is heated to a low temperature (ca. 225–325 ˚C) for a short time to make the *martensitic* structure softer and less prone to crack. The correct temperature is estimated by the colours of the polished steel.

Trace element – Elements which are present in only very small quantities. They are normally interpreted to give indications of, for example, the geological provenance of ores.

Troostite – A crystal structure of steel, which results from *hardening* at a rate of quenching that is too slow. *Austenite* does not form into *martensite* but instead into fine *pearlite*.

Upper guard – Term for the transverse part of the hilt near the pommel used to balance the sword together with the pommel and to prevent the hand from sliding off the hilt.

Upsetting – A blacksmithing technique in which an iron bar is made thicker by hammering its ends.

Wrought iron – Low-carbon iron, which contains less than 0.2 % carbon and some slag. The term is derived from the fibrous appearance of this type of iron.

Wootz – See *crucible steel*.

Work-hardening – A blacksmithing term for the hardening of soft iron by having its crystals packed under stress without heating, for example hammer blows, to make it harder and more brittle. Work-hardening may occur also in some tools under use, for example hammer and anvil faces are work-hardened. Intentional work-hardening, for example of blades, is known as *cold-forging*.

Marks of Fire, Value and Faith explores swords with ferrous inlays found in Finland and dating from the late Iron Age, ca. 700–1200 AD. These swords reflect profound changes not only in styles and fashion but also in the technology of hilts and blades. This study explores how many of these kinds of swords are known from Finland, how they were made and where, what their status was in Late Iron Age Finland, and where the Finnish finds stand in accordance with other areas of Europe.

The swords are studied through multidisciplinary research, including traditional typologies as well as research methods from the natural sciences and also experimental archaeology. While the weight of this work lies in the inlays and their meanings, this study also inspects the swords not only from the surface but also from inside to achieve a thorough picture of the life cycle of iron inlaid swords. The colourful finds from Finland are presented in a catalogue at the end of this work.

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