# CRAFTING BONE – SKELETAL TECHNOLOGIES THROUGH TIME AND SPACE

## Proceedings of the 2nd meeting of the (ICAZ) Worked Bone Research Group

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Participants in the WBRG 1999 Budapest conference (left to right): Ülle Tamla, Elisabeth Brynja, Tina Tuohy, Liina Maldre, Karlheinz Steppan, Heidi Luik, Gitte Jensen, John Chapman, Alice Choyke, Janet Griffitts, Andreas Northe, Noëlle Provenzano, Jörg Schibler, Nerissa Russell, Colleen Batey, Lyuba Smirnova, László Daróczi-Szabó, Daniella Ciugudean, Mária Bíró, Kordula Gostenčnik, Eszter Kovács, Christopher Morris, Sabine Deschler-Erb, Ans Nieuwenberg-Bron, Katalin Simán, Isabelle Sidéra, Mickle Zhilin

# CRAFTING BONE - SKELETAL TECHNOLOGIES THROUGH TIME AND SPACE

## Proceedings of the 2nd meeting of the (ICAZ) Worked Bone Research Group

Budapest, September 1999

## Introduction

Archaeologists and Archeozoologists, both study worked osseous materials (bone, antler and tooth, including ivory, in short all referred to as "bone"). Such reports, however, are often buried at the very back of faunal analyses appended to site reports. Furthermore, the two groups of specialists have had little chance to interact, even within Europe since they tend to attend different conferences and write for different fora.

At the root of this problem lay the arbitrary, largely institutional division between pre- and proto-historians, often imposed on bone manufacturing experts by nothing but formalism in research tradition. The most exemplary series of studies n this field is entitled: "*Industrie de l'os neolithique et de l'age de metaux*" (Bone industry *from the Neolithic and Metal Ages*). Another classic, a book, is sub-titled "The Technology of Skeletal Materials *since the Roman Period*". In very early prehistoric assemblages, attention is often focused on the question of whether a particular piece of bone was worked or not. In later assemblages, it is the intensity of manufacturing that often renders objects zoologically non-identifiable, so that important aspects of raw material procurement, including long distance trade, remain intangible.

The history of raw material use, however, is continuous and many of the constraints and possibilities inherent in skeletal materials are the same whether one is dealing with Paleolithic or Medieval artifacts. Indubitably, the organization of manufacture, the function and value of bone artifacts (as well as some technological innovations such as the regular use of metal tools or lathes), differ substantially between simple and complex societies through time. On the other hand, fundamental questions of tensile characteristics, procurement strategies, style and certain technological requirements are not only similar diachronically, but also open up new vistas when apparently unrelated periods are compared. The function of these objects as social markers, for example, remains remarkably constant through time, even if details vary. The papers in this volume reflect these conceptual similarities and differences as did the papers delivered at the conference itself.

The first meeting of what was to become the Worked Bone Research Group (WBRG) was organized by Dr. Ian Riddler in the **British Museum, London, in January 1997**. The committment and enthusiasm of that first workshop has greatly inspired subsequent efforts in recruiting a wide range of bone specialists, capable of contributing to discussions concerning bone manufacturing.

In keeping with the aims of the Worked Bone Research Group, since 2000 an official working group of the International Council for Archaeozoology (ICAZ), an effort was made to present these papers on the basis of what *connects* them rather than segregating them by archaeological period or region. Contributions mostly include articles based on papers delivered in September 1999 at the second Worked Bone Research Group meeting in Budapest, organized by the editors with the unfailing support of the Aquincum Museum (Budapest) and its staff. Several people who were unable to be present at this conference were also asked to contribute papers. Finally, five of the studies in this volume, originally delivered at a symposium on bone tools organized by Dr. Kitty Emery and Dr. Tom Wake, entitled "*Technology of Skeletal Materials: Considerations of Production, Method and Scale*", at the 64th Annual Meeting of the Society for American Archaeology (Chicago 1999), were added thereby expanding the academic spectrum both in terms of research tradition and geographic scope.

There are a total of 36 papers in this volume. Research was carried out on materials from Central and North America to various regions of Europe and Southwest Asia. The authors represent scientific traditons from Estonia, Hungary, Romania, and Russia, European countries in which, until recently, ideas developed in relative isolation. Other European countries represented include Austria, Denmark, France, Germany, Great Britain, Greece, and Switzerland. Last but not least, the North American scholarly approach is also represented here.

Schools of thought may be said to be exemplified by what used to be Soviet research, well known for pioneering works on taphonomy, experimentation and traceology. Bone manufacturing was first brought to the attention of Western scholars by the publication in 1964 of the translation of S. A. Semenov's *Prehistoric Technology*, published originally in 1957. Scholars in France have also carried out decades of co-ordinated work on operational chains in the manufacturing process from the selection of raw materials to finished products, with special emphasis on prehistoric modified bone. An entire working group, "Unspecialized Bone Industries/Bone Modification", is directed by Marylene Patou-Mathis. This working group itself is part of a larger research program on bone industry "*La Commission de Nomenclature sure l'Indistrie de l'Os Prëhistorique*" headed my Mme. H. Camps-Fabrer. Several specialists such as Jörg Schibler in Switzerland, have created laboratories where ground laying work has been carried out for years on worked osseous materials, especially from Swiss Neolithic Lake Dwellings and Roman Period sites. Language barriers have often prevented these important bodies of work from being as widely disseminated as they deserve. Arthur MacGregor in England, writing in English, has had a decisive influence on specialists working on more recent Roman and Medieval worked bone assemblages in Europe.

The work of all of these groups as well as certain individual scholars is well known within limited circles. Otherwise, however, the overwhelming experience of most researchers on worked bone have been feelings of isolation and alienation from most archaeological or archaeozoological work related, most importantly, to the absence of an international forum where their often specialized work can be presented and problems discussed.

In spite of the fact that there have been many practical obstacles to information flow between specialists in this field, there are really remarkable similarities of approach which should ultimately lead to the development of more compatible paradigms in research. Agreement on methodologies will have a positive feedback on communications, helping the field to grow and develop properly.

It seems that, at last, archaeologists and archaeozoologists and other specialists are talking to each other and sharing methodologicial points of view. One striking example of this can be seen in the the emphasis on raw materials studied in parallel to types found in the majority of papers in this volume. Previously studies often concentrated on typo-chronological questions, ignoring the questions of raw material morphology and availability. The series published by the *Centre National de la Recherche Scientifique*, edited by Mme. Henriette Camps-Fabrer in France is largely to be credited for beginning this new trend. It contains many papers concentrating on understanding manufacturing sequences and, indeed, from Europe to North America there are papers which explicitly deal with manufacturing sequences in individual assemblages.

There is also a consistent emphasis on experiment and manufacturing techniques present in much of the work in this volume. The related but fraught question of function continues to tantalize and frustrate most specialists. A number of articles attempt to apply techniques of hard science, such as scanning electron microscopy or light microscopy, together with experiment to get objective, "processual" answers to this important group of questions. Other researchers rely deductively on analogy, archaeological context, gross morphology, and textual sources as they try understanding how these objects were used.

When editing the volume, we tried to concentate on the underlying main concepts represented by each paper rather than grouping them diachronically or by geographical region. As a result, contributions follow a line from the theoretical through the problems of raw material selection, manufacturing techniques, experimental work, technical function and socio-cultural interpretations. Obviously many of these papers deal with several of these aspects simultaneously. Finally, analyses of assemblages are grouped to show the current state of general application of these principles as illustrated in papers in the rest of the volume. Reports on bone tool types will ultimately benefit from more unified typologies and also provide researchers with comparitive databases from regions beyond their own.

Finally, a word on the organization of papers in this volume. Although the editors have tried to group these papers by what they see as the main theoretical and methodological thrust of the authors it should be understood that most papers, to a greater or lesser extent, overlap between these artificial sub-titles. Happily, almost all these works include considerations of raw material exploitation, manufacturing and functional analyses and all make some attempt to consider the social context from which these artifacts emerged. It is exactly this cross-cutting of boundaries which allows us to hope that the study of worked osseous materials is well on the way to developing into a discipline in its own right.

In addition to the generous support given by our sponsors and technical editors for this volume, organizing the conference would not have been possible without the active help of numerous colleagues. Special thanks are due to Paula Zsidy, Director of the Aquincum Museum, Katalin Simán, archaeologist and two students from the Institute of Archaeological Sciences (ELTE, Budapest): László Daróczi-Szabó and András Markó. The Hotel Wien, Budapest and its efficient manager provided a comfortable setting for our discussions at a reasonable price. Last but not least, help with abstract translations by Cornelia Becker, Noelle Provenzano as well as Marjan Mashkour and Turit Wilroy should also be acknowledged here.

# ARTEFACTS OF BONE, ANTLER AND CANINE TEETH AMONG THE ARCHAEOLOGICAL FINDS FROM THE HILL-FORT OF VARBOLA

Ülle Tamla and Liina Maldre

**Abstract:** The article presents the archaeozoological determinations of artefacts made of bones, antlers and canine teeth of domestic and wild animals, collected during the excavations at the Varbola hill-fort, Estonia. This hill-fort, one of the biggest and best fortified in the Baltic region, has been dated to the $11^{th}$-$13^{th}$ centuries. The possibilities of identifying bone objects and the analysis of manufacturing techniques are introduced.

**Key words:** Estonia, Varbola, bone, antler, canine artefacts, archaeozoological determination, local bone manufacturing

**Résumé:** Cet article présente les déterminations archéozoologiques des ossements, bois de cervidés et dents d'animaux domestiques et sauvages recueillis dans la fouille de la colline fortifiée de Varbola, en Estonie. Ce dernier, un des plus importants de la Baltique quant à son étendu et à ses fortifications, a été daté des XIe-XIIIe siècles. Cet article aborde la possibilité d'identifier les objets en os et d'analyser leurs techniques de fabrication.

**Mots-clés :** Estonie, Varbola, objets façonnés en os, bois de cervidé et dents, identification archéozoologique, fabrication locale

**Zusammenfassung:** Der vorliegende Beitrag befaßt sich mit der archäozoologischen Bestimmung von Knochen-, Geweih- und Zahnartefakten, die aus Wild- und Haustierknochen angefertigt und während der Ausgrabungen in der befestigten Höhensiedlung von Varbola/Estland aufgesammelt wurden. Diese Höhensiedlung aus dem 11.-13. Jahrhundert ist eine der größten und am stärksten befestigten in der gesamten baltischen Region. Es wird eine Einführung in die Möglichkeiten der Bestimmung dieser Funde und in die Untersuchung des Herstellungsprozesses geboten.

**Schlüsselworte:** Estland, Varbola, Knochen-, Geweih- und Zahnartefakte, archäozoologische Identifizierung, lokale Knochenverarbeitung

## Introduction

Due to their fragility and poor preservation, prehistoric artefacts of bone, antler and canine are comparatively rare finds from archaeological sites in Estonia as well as in the neighbouring countries. One of the reasons for the rarity of bone artefacts even from the sites where organic matter is well preserved in a particular cultural layer, is the complicated craft of bone and antler processing. It has been presumed that already by the Roman Iron age, but certainly since the Viking period at the latest, only specialised craftsmen dealt with the manufacturing of combs, needles and needle-cases, knife handles, dice and other widely used bone artefacts. The existence of such masters is proven most convincingly by the remains of bone-manufacturing workshops and numerous bone artefacts, scrap bone and half-finished products found in several early towns and ancient trading centres in Europe (e.g. Birka, Ribe, Hedeby, Dorestad, York, Wollin, Kiev, Novgorod, Staraya Ladoga, etc.; Ambrosiani 1981; Davidan 1977; Hrubý 1957; Kolčin 1985; MacGregor et al. 1999; Rybakov 1948; Ulbricht 1984).

In Estonia, no prehistoric workshops for bone manufacturing have yet been discovered. The earliest data indicating the existence of a workshop where, along with the casting of smaller bronze objects, bone artefacts were also made, dates from $14^{th}$ century Tallinn. In 1996, material indicating the presence of a bone-manufacturing workshop was discovered on the premises of a house in a medieval suburb of Tallinn. From the burned layer, dated to the $14^{th}$ century, objects of bone and antler, e.g. composite combs, bone buttons and spindle-shaped buttons, together with half-finished products, scrap bone and tools indicating bone manufacturing, were found scattered within a relatively small area (Sheveljov 1977; Sokolovski 1977). It is interesting to note that in the written sources of the $14^{th}$ century, bone manufacturers have not been mentioned among the craftsmen of Tallinn (Kaplinski 1980).

Bone artefacts found at Estonian prehistoric settlements and hill-forts have not been studied and published by find complex. Only the bone combs, the majority of which date from the Middle Ages, have been discussed in detail (Luik 1998; Piirits 1995). Thus, a remarkable source for the investigation of the ancient craft of bone manufacturing still lies unexploited.

The aim of the present article is to publish the first results of the archaeozoological investigation of the bone artefacts from Varbola, one of the mightiest hill-forts in the Baltic countries, situated in western Estonia (fig. 1) and dated to the $11^{th}$-$13^{th}$ centuries. The finds gathered during the archaeological excavations at this hill-fort within the nearly 2 ha area of the enclosure (fig. 2), form one of the most representative complexes from Estonian hill-forts and settlements of the last centuries of the prehistoric period. The 114 objects of bone, antler and canine teeth comprise ca 2 % of the total finds from Varbola. They also include about ten bone fragments with traces of cutting, polishing, sawing, boring and ornamention (fig. 3), discovered in the osteological collection, bones clearly distinguishable from the bones broken by meat chopping. Most likely they are either scrap bone, unfinished products, or objects broken during processing. Since most such bones were found in the excavations in the eastern and north-eastern part of the hill-fort which had been closely built over in the $12^{th}$-$13^{th}$ centuries (Tamla & Tõnisson 1983; 1986), these finds indicate most clearly the existence of local bone processing.

**Raw material identification and production technologies**

Most of the information about raw materials is obtained by studying scrap bone and objects either unfinished or broken during processing. There are probably three reasons why such finds are relatively few in the Varbola archaeological material. First, bone objects were not produced here in such large numbers as to leave adequate amounts of scrap bone. Second, the bone material is quite poorly preserved, so discriminating between scrap bone and remains of meat chopping is difficult. The third reason may be connected with the primitive level of local bone-processing, i.e. the simplest way of making bone objects produces almost no scrap bone.

In the choice of the raw material for bone objects, having ample size and thickness of the compact bone layer is most important. Hence, bones from different parts of the skeleton can be used, especially for making smaller objects. This, in turn, complicates the identification of raw material of well-finished (e.g. well-polished) objects. Owing to their rather large size and thick compact layer, cattle metacarpal and metatarsal bones have been among the most favoured material for making bone artefacts. Forelimb bones and tibiae have also been used quite often. The merit of these bones is the relative straightness of the diaphysis. As for metacarpal and metatarsal bones, they have little flesh on them so that they are seldom used for food and are usually not chopped (Nilsson 1995). Elk and horse bones resemble those of cattle and are as suitable for manufacturing although they were less frequently available.

Before making bone objects, the bone had to be cleaned. First, the soft tissues were removed. Then bones were boiled for some hours. The ends of the long bones bearing the traces of processing are usually sawn off (Ulbricht 1984, 17 ff.). Probably this was done before boiling, to help remove grease and marrow from inside the bone as well as from the outer surface.

Analysing the scrap bone, it appears that the division scheme of the prepared bone was more or less the same with all long bones. After removing the epiphyses, the diaphysis was cut into the required lengths. Next, the bone was cut longitudinally so that the pieces were suitable for manufacturing (op. cit., fig. 2). The find material from Varbola proves that here, too, the epiphyses were cut off first. The most vivid example of this is a 13 cm distal end of a cattle forelimb bone (fig. 4: A). It bears clear traces of sawing, and no other signs of processing. So this almost surely represents scrap bone. A horse metatarsal should be mentioned as another example (fig. 4: B). Its distal end has been sawn off, the medial surface of the diaphysis bears slight traces of sawing or cutting and the lateral surface is carved. This might be an unfinished product.

Well-finished and primitively processed bone objects are both distinuishable in the finds from Varbola. For quality of processing, a fragment of a long bone needle (fig. 5) is outstanding for the high level of its manufacture. Its original length may have been at least 16 cm. The clearly discernible transverse furrows at one edge of the needle with its oval cross-section, measuring 1.5-0.6 cm at the eye, indicate that the needle was shaped by cutting and grinding. Only after that was the eye bored in the wider flat end. As the needle is heavily worn, it is not possible to determine whether it was polished after grinding. It is also possible that the polished surface is due to the intensive and long-time use of the needle. Considering its size, it was most likely used for looped needle-netting.

Made of long bones of cattle or elk antler, ground and carefully polished, with one or two eyes, knitting needles already appear to have come into use in North Europe during the Neolithic. The earliest object made using the looped needle-netting technique is the woollen mitten from the Asle mire, Västergötland, Sweden, dated to the first centuries AD (Hald 1980, 299, fig. 347). In Estonia the earliest bone needles with eyes, seemingly fit for looped needle-netting only, were found in the Late Bronze Age stone cist grave of Joelähtme (Kraut 1985, Pl. VI:4). Such bone knitting needles, sometimes also of iron, are found at the Late Iron Age hill-forts, settlements and Early Medieval towns of the Baltic region including Estonia. They mostly have an oval cross-section, widening around the eye (Tamla 1992, Pl. XIV:4, 5; Mugurevičs 1977, Pl. XXIX: 12-14). Unfortunately, the needle from Varbola cannot be dated accurately since it was found in the cultural layer of the medieval village cemetery, mixed by the entrenchments. Thus, the needle can be dated only indirectly, to the period of the existence of the hill-fort in the $11^{th}$ -$13^{th}$ centuries.

A carefully ground and polished profiled end plate of a comb (fig. 6) is broken on one edge. It is presumably made from a bovine rib. This fragment is very interesting since it lacks rivet holes. So the comb was probably not finished. Evidently the comb-maker was going to cut two triangular dents in the edge of the plate, but one of them is not finished. Since the plate is very thin (porous bone tissue can be seen on the back-side), we may presume that the comb broke during the course of processing. In the present context the plate is especially interesting since it shows that double composite combs with profiled end plates were locally manufactured. Most likely the plate dates from the $13^{th}$ century.

The two fragments of connecting plate(s), also made of bovine rib, evidently come from a double comb (fig. 7). The traces left from sawing the teeth can be seen on both edges of the connecting plate. The fragments are not decorated and are rather wide (1.1 cm), thick (0.2 cm) and flat. Flat unornamented connecting plates occur with different types of combs and are quite widespread around the Baltic. They mostly date to the $13^{th}$-$14^{th}$ centuries (Luik 1998, 121). On the basis of accompanying finds and conditions of recovery, this comb from Varbola is dated to the $13^{th}$ century and is probably a local product.

Four spade-shaped pendants (fig. 8-11) are cut from a stencil on a bovine long bone and are well polished on both sides. These also represent more advanced bone processing. One pendant has a hole bored in the widening part of the shaft and the outer surface is decorated with pits of various diameters, forming a cross (fig. 8). The other pendant, bearing clear traces of grinding, is not ornamented (fig. 9). Triangular dents are cut in both sides of the shaft of this pendant – probably for functional reasons, since the pendant is most worn at these dents. The making of the third pendant was also the most complicated – it was ornamented with equal care both on the obverse and reverse sides (fig. 10). The figures were deeply engraved with a knife and/or sharp graver. Six pierced holes complete the ornament. The fourth pendant is only a fragment (fig. 11). Since it does not show any traces of wear, it is possible that it was broken during manufacture.

About thirty spade-shaped pendants of different shapes and at different stages in the manufacturing process have been found in Estonia. They have been found in the settlements dating to the end of the prehistoric period (Kuusalu, Lehmja, Viljandi), hill-forts (Lohavere, Otepää), cemeteries (Pada). There is also a hoard (Savastvere). This set of ornaments, deposited in the middle or the 2nd half of the $12^{th}$ century, which probably belonged to a wealthy woman, contains three quite rough bone spades together with bronze and silver ornaments (Jaanits et al. 1982, 363-365). The finds from Pada cemetery, belonging to the late $12^{th}$-early $13^{th}$ centuries, demonstrate that bone spade pendants were also worn as ornaments by men and children (Tamla 1989). It should be mentioned here that in earlier literature the spade-shaped pendants were regarded as toilet objects, probably used to remove dandruff (Moora & Saadre 1939, 176).

Spade-shaped pendants are also known from the towns of Old Russia (e.g. Pskov and Novgorod), where they are dated to the period from the second half of the $11^{th}$ century to the $13^{th}$ century (Beletski 1991, 33, no 30; Drevnij Novgorod 1985, 80). The pendant with an openwork shaft segment from the Cesis hill-fort, Latvia, is dated to the $12^{th}$-$13^{th}$ centuries (Apala & Apals 1991, fig. 35:6). Three of the pendants from Varbola (fig. 8, 10 and 11),were found in the built-over part of the enclosure, and are respectively dated to the $11^{th}$-$13^{th}$ centuries (Selirand & Tõnisson 1978, 93 ff.). One piece (fig. 9), found by the western gate, dates to the 1st quarter of the $13^{th}$ century, based upon the accompanying finds which also include coins (Tamla & Tõnisson 1990, 423 ff.).

Another well-finished bone or antler object from Varbola is a small broken die (fig. 12) with sharp corners and edges 1.0 cm long. The well-polished faces of the cube have from 1-6 small circles on them with the inside being hollow. The numbering on each opposing face adds up to seven. Since the die displays no trace of wear, we may presume that it was broken when dots and circles were made on it.

Dice in a variety of forms and materials are among the earliest gaming equipment known. Dice are recorded from Scandinavian sites from the $5^{th}$ century on, and the oblong Viking form is a common find in settlements and grave assemblages (McLees 1990, 36). In the archaeological material of Estonia dice are quite rare, and even those few that have beeen found come mostly from medieval towns, from the layers of the $13^{th}$-$16^{th}$ centuries (Aus 1990, 462). The precise dating of the dice from Varbola is impossible since it was found at a depth of 14 m in the well of the hill-fort.

The only object from Varbola, made of elk antler, is a disc, 1.3 cm thick, with a diameter of 6.5 cm, with a 1 cm hole bored in the middle (fig. 13). Most likely it is a cast-off spindle-whorl. Its polished surfaces and edges are heavily worn.

The earliest Estonian disc-shaped bone spindle-whorls come from the fortified settlement of Asva, from the period between the $8^{th}$-$7^{th}$ centuries BC to the mid-$1^{st}$ millennium, and from the stone grave of Vohma Tandemägi, erected in the Pre-Roman Iron Age. Compared to the late spindle-whorls of this type, used at least up to the $17^{th}$-$18^{th}$ centuries, the early ones are richly ornamented (Vedru 1999). Since spindle-whorls of bone as well as of stone have been found from Varbola, we can presume that woollen as well as flax thread was spun and twisted here. Wool required a lighter, wooden, bone or antler spindle-whorl to preserve its elasticity. Flax is a stronger fibre and for that, heavier whorls made of stone and clay were used. The disc-shaped antler spindle-whorl, suitable for spinning wool given its shape as well as its weight, was used during the $11^{th}$-$13^{th}$ centuries.

Special mention should be made of a bone fragment (fig. 14) that was found when excavating the building remains containing a keris-stove, dating from the $12^{th}$-$13^{th}$ centuries. The fragment is a 3 cm long end of an animal bone, with a diameter of 0.7 cm; its purpose is unknown. Its polished surface is decorated with geometric patterns: parallel indented rows, straight lines and concentric rows of circles and dots. Well-polished ends of long bones with all the patterns showing examples of cutting being transferred onto them most probably with metal artefacts, are called "motif-pieces" in the archaeological literature. They have been found in early historic or Early Christian settlements in Ireland (O`Meadhra 1979). One decorated bone fragment, very similar to this "motif-piece" was also found at the Olinkalns hill-fort, Latvia (Mugurevičs 1977, Pl. XXX:26).

Very little trouble was taken in the manufacture of the eleven long needles (figs. 15 and 16). Their maximal length is 8 cm and they are flat at the eye. Most of the needles from Varbola are made from pig bone, both young and adult, merely by cutting and boring a round eye. The function of such needles, widespread over the whole of Europe and mostly made from the bones of young pig, is not clear. Certainly these needles are not suitable for "fine" sewing. It is possible that they were used either for sewing coarse cloth and leather, or for making things from birch bark (Davidan 1966, 104). On the basis of the archaeological material from the 12$^{th}$-13$^{th}$ c. Pada cemetery, in northern Estonia, we may also presume that such needles were used by women, along with bronze pins, to fasten a linen kerchief and chain in the hair (Tamla 1989). The fragment of a bone needle found at the western gateway of the Varbola hill-fort, with bronze wire chain links preserved in its eye (fig. 16), supports this opinion. Relying upon the conditions of discovery we may date the needles of Varbola mostly to the 12$^{th}$-early 13$^{th}$ centuries, but it is possible that some of them also date from the 11$^{th}$ century.

The very coarse four-faced wedges (fig. 17) with one sharp end are cut from the long bones of cattle. The traces of cutting and carving display no polish. The real purpose of these similar size wedges (length 4-5 cm and the largest diameter 1.5 cm) is not known. It must only be mentioned that two of the three wedges were found in the well of the hill-fort, so they may have been part of the well construction. The advantage of bone wedges compared to the wooden ones is their strength and elasticity.

The presumed toys and/or music instruments, toggles (fig. 18), made of pigs' metacarpal or metatarsal bones, are also very casually worked. They have only a round perforation, with a diameter about 0.5 cm, bored in the middle from both sides. The surface is not processed. They occur in quite large numbers in the archaeological material of northern, eastern and western Europe. Usually they are made of mammal bones but sometimes also of bird bones and mostly have one hole but sometimes also two. They have also been called spindle-shaped buttons (Gurevitch 1981, 115), and spools for thread (Mugurevičs 1977, 136). To my knowledge they have never been found together with the necessary cord. The earliest toggles are known from 10$^{th}$-11$^{th}$-century York (From Viking to Crusader 1992, no 379). In the archaeological material of the Baltic countries (including the well-dated material of Novgorod), toggles occur most frequently in layers from the 11$^{th}$-15$^{th}$ centuries (Povetkin 1990, 187). In Varbola the five toggles were found in the built-over part of the enclosure and were respectively dated to the 11$^{th}$-13$^{th}$ centuries.

Canine pendants (fig. 19), dated to the 11$^{th}$-13$^{th}$ centuries, form a separate group within the bone artefacts. Eight of them (from the total of eleven) are made of the canines of domestic pigs, mainly boars' tusks. Since the tips of many of the canines were broken, it was difficult to determine the age of the animals. On the basis of size, most of them come from adult but not very old animals. Mandibular tusks of boars were preferred, five of the pendants are made of left and three right side canines. Two of the pendants are made of maxillary canines, both from the left side. In two cases, left mandibular sow canines were also worn as pendants. All the canine pendants have drilled perforations. In several cases it is evident that the drilling was a failure – at least one of them has the hole drilled too near the edge. In some cases a new hole has been drilled in the pendant because the old one split during wearing.

Among the amulet pendants, one made from the right maxillary canine of an adult dog and the left talus of an adult hare (fig. 20) deserves special attention. Such an amulet which combines bones of two different animal species is unique in Estonian archaeological material. No close parallels are known from other regions either.

Only two objects made of birds' bones were found at Varbola. This surprisingly small number of finds may be caused either by poor preservation of birds' bones, or their infrequent use in manufacturing. An interesting ornament (possibly with a magical meaning) is a small tube from a bird's bone on the central part of a bronze penannular brooch from the 1$^{st}$ quarter of the 13$^{th}$ century (fig. 21). A needle-case made from a goose's bone with a ground surface, dates from the same period.

A knife sheath made of goat's horn (fig. 22) is also unique in this archaeological material. The object, evidently made for carrying a bigger knife, is made in the most rational possible way: both ends of the horn were cut off, then smoothed, and the tip rounded by grinding. The sheath has four round perforated holes for carrying it on the belt. Two bigger holes have equal diameters and they are evidently drilled. Two smaller holes with uneven edges seem to be pierced with an awl. Since the sheath was found in the mixed cultural layer in the medieval village cemetery, it can not be dated accurately.

**Summary**

Bone processing is technically rather similar to carpentry, they can be both performed with the same tools. The basic difference (and advantage) of bone is its strength combined with elasticity and better durability. Compared with wood, bone needs thorough prefabrication: soft tissues must be removed, the bones must be boiled to remove grease and marrow. Knowledge through experience of the most suitable parts of the skeleton to use is very important.

The find material from Varbola does not contain bone objects of top quality. There is no reason to consider the better worked objects, the knitting needle (fig. 5), spade-shaped

pendants (figs. 8-11) and the die (fig. 12) as coming from the hands of a specialized master either. Only comb fragments (figs. 6 and 7) found from the hill-fort might be attributed to a more skilled craftsman. The rest of the objects are tools for everyday use, products of plain and even crude home handicrafts, where expediency in producing the product was preferable to beauty. The main tools for making these objects and breaking bigger bones and antlers were axes, saws, knives and files. For processing smaller bones and canines, usually only a knife was used – for cutting, carving and grinding. Bigger holes were drilled in the objects, smaller and uneven ones were presumably made with an awl. Several pieces of all these bone working tools, with the exception of drills and files, have been found at Varbola.

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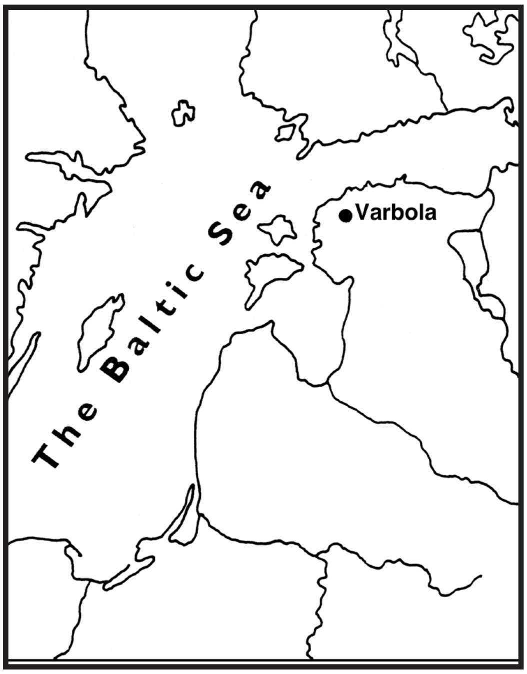



Fig. 1 Location of the hillfort of Varbola, west Estonia

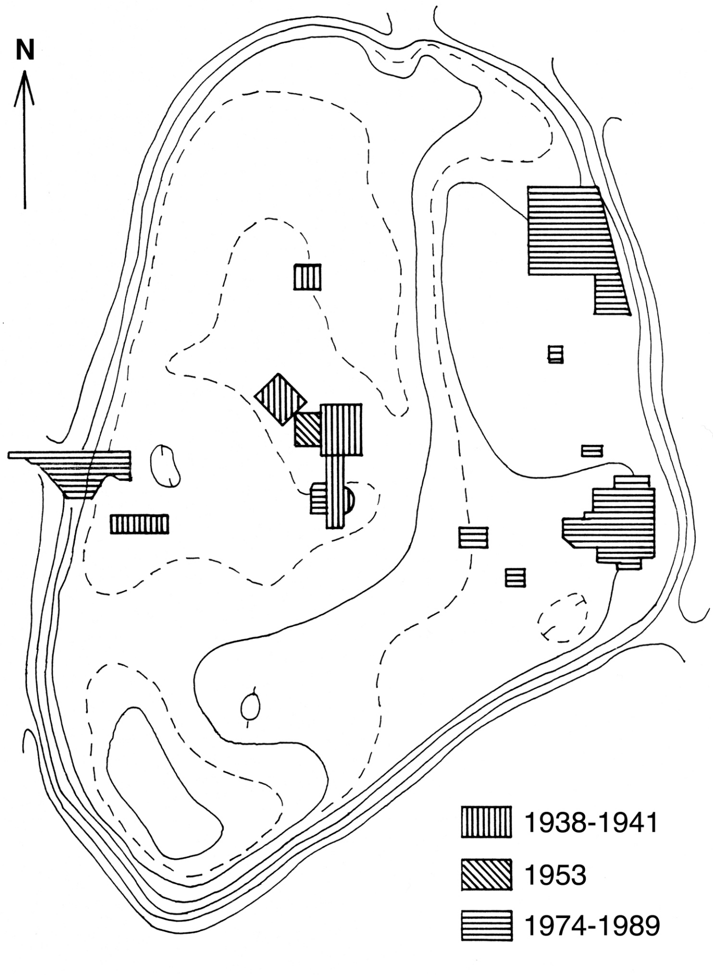



Fig. 2 Plan of the hillfort of Varbola with excavated areas. Redrawn by K. Siitan after E. Tonisson (1999, fig. 4)

Fig. 3 Bone fragments with traces of cutting, polishing, sawing, boring and ornamention from Varbola (1:2)


Fig. 4 Distal end of a forelimb bone from cattle (A) with traces of sawing. A horse`s metatarsal (B) with distal end sawn off, slight traces of sawing or cutting on the medial surface of the diaphysis, the lateral surface is carved (1:2)

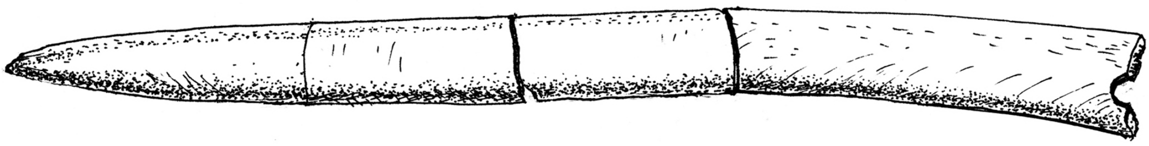


Fig. 5 Long bone needle (1:1)

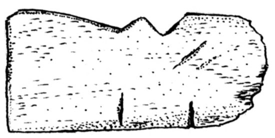


Fig. 6 Profiled end plate of a comb (1:1)

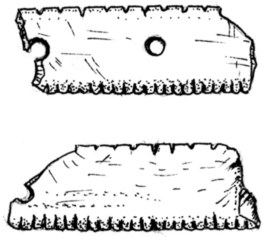


Fig. 7 Fragments of connecting plates of a double comb (1:1)

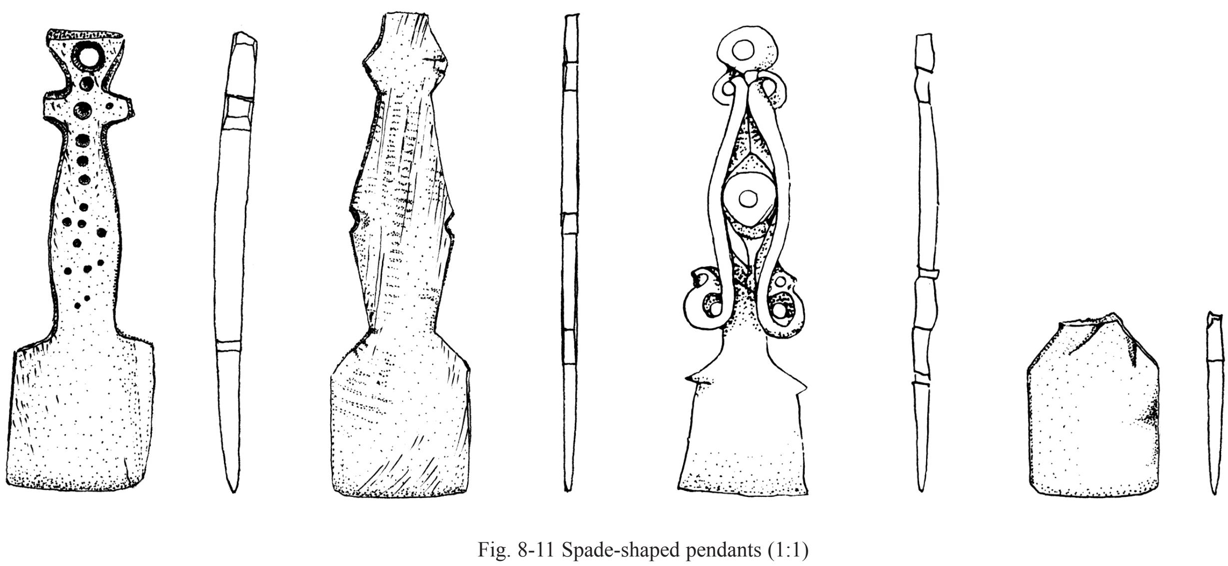


Fig. 8-11 Spade-shaped pendants (1:1)

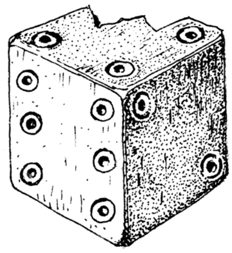


Fig. 12 A small broken die from the well of Varbola hillfort (2:1)

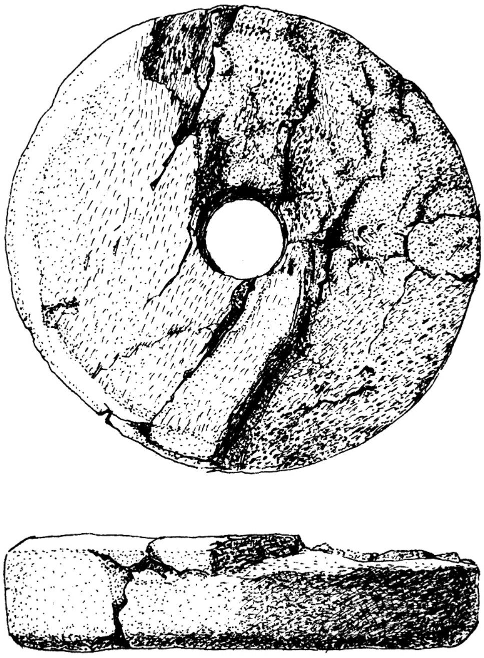


Fig. 13 A cast-off spinning-whorl (?) made of elk`s antler (1:1)

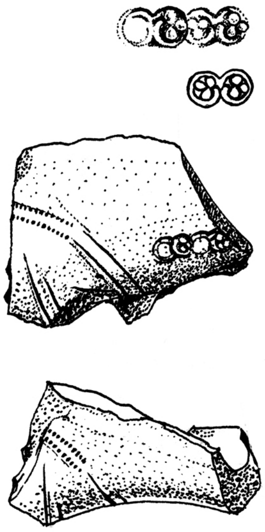


Fig. 14 A bone fragment with polished surface and with geometric patterns (1:1)

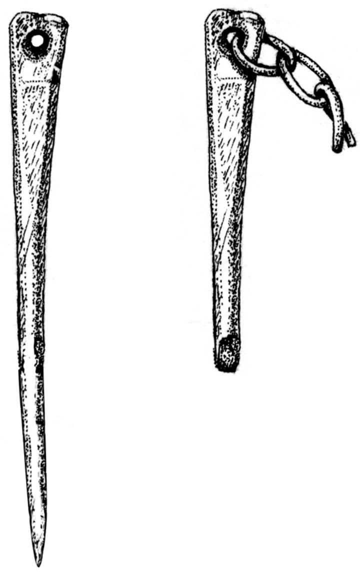
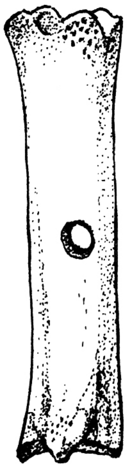


Fig. 15-16 Needles made of bones of pigs (1:1)



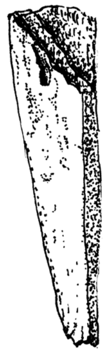


Fig. 17. A wedge (1:1)

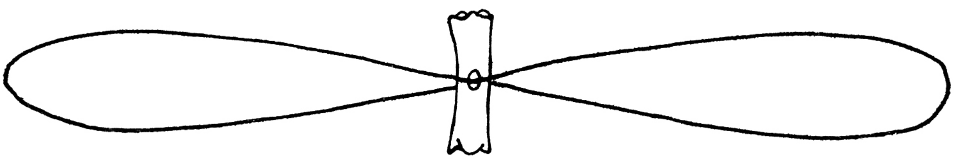


Fig. 18. A toggle: toy or music instrument? (1:1)

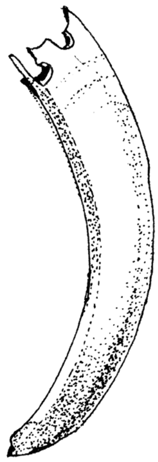


Fig. 19. A canine pendant with two bored perforation (1:1)

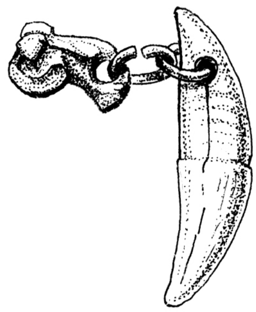


Fig. 20. Amulet pendant made of the canine of an adult dog and a left talus of an adult hare (1:1)

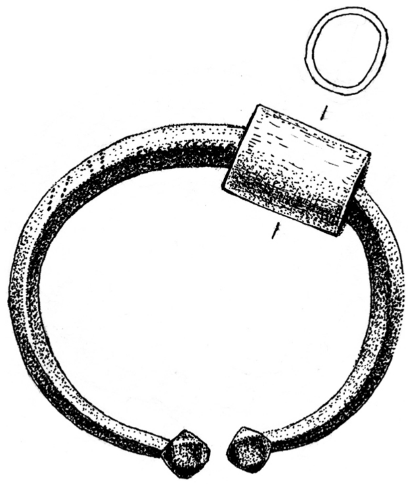


Fig. 21.A bronze penannular brooch with a small tube of bird`s bone (1:1)

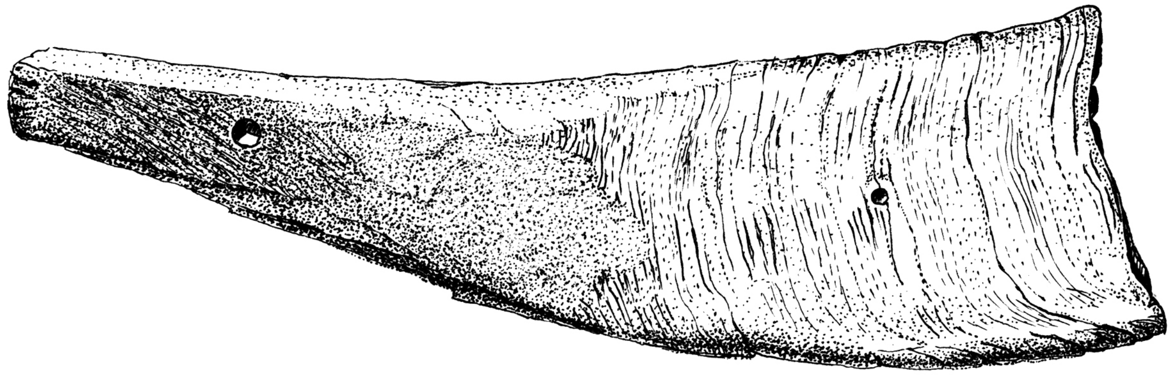


Fig. 22. A knife sheath made of goat`s horn (1:1)