

CRAFTING BONE – SKELETAL TECHNOLOGIES THROUGH TIME AND SPACE

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

Editors

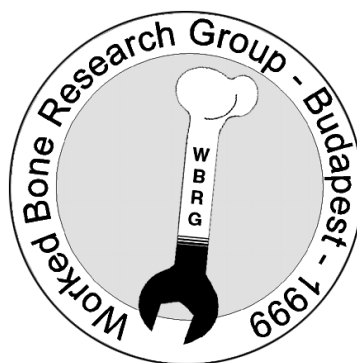
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Table of Contents

Introduction	III-IV
 General Theory	
Genevieve LeMoine – <i>Skeletal Technology in Context: An Optimistic Overview</i>	1
 Raw Material Exploitation	
Lyuba Smirnova – <i>Utilization of Rare Bone Materials in Medieval Novgorod</i>	9
Liina Maldre – <i>Bone and Antler Artefacts from Otepää Hill-fort</i>	19
Sabine Deschler-Erb – <i>Do-it-yourself Manufacturing of Bone and Antler in Two Villas in Roman Switzerland</i>	31
Rosalia Christidou – <i>Study of Bone Tools at Three Late/Final Neolithic Sites from Northern Greece</i>	41
 Manufacturing Technology	
Jörg Schibler – <i>Experimental Production of Neolithic Bone and Antler Tools</i>	49
Daniella Ciugudean – <i>Workshops and Manufacturing Techniques at Apulum (AD 2nd-3rd Century)</i>	61
Kitty F. Emery – <i>The Economics of Bone Artifact Production in the Ancient Maya Lowlands</i>	73
Karlheinz Steppan – <i>Worked Shoulder Blades: Technotypological Analysis of Neolithic Bone Tools From Southwest Germany</i>	85
Noëlle Provenzano – <i>Worked Bone Assemblages from Northern Italian Terramare: A Technological Approach</i>	93
Aline Averbouh – <i>Methodological Specifics of the Techno-Economic Analysis of Worked Bone and Antler: Mental Refitting and Methods of Application</i>	111
 Function	
Mária Bíró – <i>A Round Bone Box Lid with a Mythological Representation</i>	123
Cornelia Becker – <i>Bone Points - No Longer a Mystery? Evidence from the Slavic Urban Fortification of Berlin-Spandau</i>	129
Mickle G. Zhilin – <i>Technology of the Manufacture of Mesolithic Bone and Antler Daggers on Upper Volga</i>	149
Tina Tuohy – <i>Bone and Antler Working on the Iron Age Sites of Glastonbury and Meare in Britain</i>	157
Gitte Jensen – <i>Macro Wear Patterns on Danish Late Mesolithic Antler Axes</i>	165
Yekaterina Antipina – <i>Bone Tools and Wares from the Site of Gorny (1690 - 1410 BC) in the Kargaly Mining Complex in the South Ural Part of the East European Steppe</i>	171
Andreas Northe – <i>Notched Implements made of Scapulae - Still a Problem</i>	179
Janet Griffiths – <i>Bone Tools from Los Pozos</i>	185
Sandra L. Olsen – <i>The Importance of Thong-Smoothers at Botai, Kazakhstan</i>	197
Janet Griffiths and Clive Bonsall – <i>Experimental Determination of the Function of Antler and Bone 'Bevel-Ended Tools' from Prehistoric Shell Middens in Western Scotland</i>	207
 Social Context	
Isabelle Sidéra – <i>Domestic and Funerary Bone, Antler and Tooth Objects in the Neolithic of Western Europe: a Comparison</i>	221
George Nash – <i>Altered States of Consciousness and the Afterlife: A Reappraisal on a Decorated Bone Piece from Ryemarksgaard, Central Zealand, Denmark</i>	231
Nerissa Russell – <i>The Social Life of Bone: A Preliminary Assessment of Bone Tool Manufacture and Discard at Çatalhöyük</i>	241
Alice M. Choyke – <i>Late Neolithic Red Deer Canine Beads and Their Imitations</i>	251
Colleen Batey – <i>Viking and Late Norse Combs in Scotland: An Update</i>	267
Nerissa Russell – <i>Neolithic Relations of Production: Insights from the Bone Tool Industry</i>	271

Special Assemblages

Péter Gróf and Dániel Gróh – <i>The Remains of Medieval Bone Carvings from Visegrád</i>	281
László Bartosiewicz – <i>Roman Period Equid Ilium Implement from Pannonia Superior (NW Hungary)</i>	287
E.E. Bulten and Anneke Clason – <i>The antler, bone and tooth tools of Swifterbant, The Netherlands (c. 5500 – 4000 cal. BC) compared with those from other Neolithic sites in the western Netherlands</i>	297
Heidi Luik – <i>Bone Combs from Medieval Tallinn, from the Excavations in Sauna Street</i>	321
Steven R. James – <i>Prehistoric Hohocam Bone Artifacts from Southern Arizona: Craft Specialization, Status and Gender</i>	331
Arthur MacGregor and Ailsa Mainman – <i>The Bone and Antler Industry in Anglo-Scandinavian York: the Evidence from Coppergate</i>	343
Ernestine Elster – <i>Middle Neolithic to Early Bronze Age Bone Tools from Sitagroi, Greece</i>	355
Ülle Tamla and Liina Maldre – <i>Artefacts of Bone, Antler and Canine Teeth among the Archaeological Finds from the Hill-Fort of Varbola</i>	371
Kordula Gostenčnik – <i>Pre- and Early Roman Bone and Antler Manufacturing in Kärnten, Austria</i>	383
Index of Authors	399



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 Griffiths, Andreas Northe, Noëlle Provenzano, Jörg Schibler, Nerissa Russell, Colleen Batey, Lyuba Smirnova, László Daróczy-Szabó, Daniella Ciugudean, Mária Biró, Kordula Gostenčnik, Eszter Kovács, Christopher Morris, Sabine Deschler-Erb, Ans Nieuwenberg-Bron, Katalin Simán, Isabelle Sidéra, Mickie Zhilin

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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 in 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 commitment 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 traditions 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 sur l’Industrie de l’Os Préhistorique*” headed by 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 methodological points of view. One striking example of this can be seen in 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 concentrate 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 comparative 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.

BONE AND ANTLER ARTEFACTS FROM OTEPÄÄ HILL-FORT

Liina Maldre

Abstract: The archaeological finds of the Otepää hill-fort are dated from the Middle Iron Age to the Middle Ages, the bulk of it to the Late Iron Age. Among the finds, bone and antler artefacts are quite numerous, as well as bone refuse from their manufacturing. The artefacts include tools (spinning whorls, needles), ornaments (pendants) and toys (spinner bones). As raw material, both bone and antler have been used, pendants have also been made of animals' teeth (mostly canines). In most of the cases bones of domestic animals have been used, but artefacts made of bones and teeth of wild animals have also been found. A few objects are made of birds' bones. Since red deer did not live on Estonian territory in that period, it can be presumed that only elk antlers were used. The occurrence of bone refuse from manufacturing proves that the artefacts were locally made.

Key Words: Estonia, Otepää hill-fort, bone and antler artefacts

Résumé: Les découvertes archéologiques de la colline fortifiée de Otepää se rapportent à une occupation s'étendant du milieu de l'Age du fer au Moyen Age, la plus grande partie d'entre elles datant de la fin de l'Age du Fer. Les artefacts en os et de bois de cervidés sont particulièrement nombreux, ainsi que les déchets provenant de leur fabrication. Ceux-ci comprennent des outils (navettes, aiguilles), des éléments de parure (pendeloques) et des jouets (toupies). L'os et le bois de cervidé ont été tous deux utilisés comme matière première ; les pendeloques ont également été aménagées sur des dents d'animaux (essentiellement des canines). Dans la plupart des cas, ce sont les os d'animaux domestiques qui ont été utilisés ; des artefacts sur os ou dent d'animaux sauvages ont cependant également pu être identifiés. Quelques objets ont été aménagés sur os d'oiseaux. Le cerf ne vivant pas sur le territoire estonien au cours de cette période, nous pouvons présumer que c'est seulement le bois d'élan qui a été utilisé. La présence de déchets de fabrication prouve que les objets ont été fabriqués sur place.

Mots clés : Estonie, colline-fortifiée de Otepää, industries en os et bois de cervidé.

Zusammenfassung: Die archäologischen Funde der befestigten Höhensiedlung von Otepää werden in eine Phase gestellt, die von der mittleren Eisenzeit bis ins Mittelalter reicht; die meisten Stücke kommen jedoch aus der Späten Eisenzeit. Knochen- und Geweihartefakte sind im Fundgut ebenso zahlreich wie Fabrikationsabfall. Die Artefakte umfassen Geräte (Spinnwirtel, Nadeln), Schmuck (Anhänger) und Spielzeug (Schnurrer). Als Rohmaterial dienten Knochen und Geweih; Anhänger wurden auch aus Tierzähnen, zumeist Eckzähnen, hergestellt. Fast immer hat man Haustierknochen ausgewählt, Wildtierknochen und -zähne wurden allerdings auch verwendet. Einige wenige Objekte wurden aus Vogelknochen angefertigt. Da Rothirsche in dieser Periode auf estländischem Territorium nicht verbreitet waren, kann vermutet werden, daß ausschließlich Elchgeweih benutzt wurde. Das Vorhandensein von Fabrikationsabfall beweist eine lokale Herstellung der Artefakte.

Schlüsselworte: Estland, befestigte Höhensiedlung von Otepää, Knochen- und Geweihartefakte

Research up to the present

The hill-fort of Otepää lies in south Estonia, on an upland area of the same name (fig.1). The finds from Otepää hill-fort span a very long period – from the Middle Iron Age to the Middle Ages (the hill-fort was destroyed in 1396–1397 in a feud between the Order and the Bishop). The majority of finds date from the Late Iron Age.

The first small-scale excavations were already carried out by Sergei Bogojavlenski at the end of the 19th century. More thorough investigations took place in the years 1950–1962 and 1967–1974 by Osvald Saadre. In 1983, Ain Mäesalu carried out small-scale excavations on the outwork of the hill-fort. The finds from Otepää hill-fort are mostly unpublished. The excavation results have only been published in brief

reports (Saadre 1954, 1955; Mäesalu 1984) together with drawings and photos of a few bone artefacts. Ain Mäesalu has studied the weapons of Otepää and published a number of articles on this subject (Mäesalu 1989a, 1989b, 1990, 1991, 1995, 1996). In the first of these he also discusses the few arrowheads of bone and antler found at the hill-fort. The earliest settlement phase of the hill-fort – the 2nd half of the 1st millennium – has been reviewed in the monograph by Mare Aun (1992), together with a discussion of bone artefacts of this period. Bone combs from Otepää have been primarily published by Heidi Luik (Luik 1996, 1998) while bone spinning-whorls are discussed in the article by Gurly Vedru (1999).

Review of the bone and antler artefacts and raw material

Bones of both domestic and wild animals were used as raw material. The antler artefacts are most likely made of elk (*Alces alces*) antler, since red deer (*Cervus elaphus*) did not belong among Estonian fauna in the discussed period. Red deer antler might compose the material of some imported artefacts. With several well-finished objects it was impossible to determine the exact raw material, in some cases it was even difficult to distinguish bone from antler.

Antler debris with clear traces of cutting, sawing and splitting is quite numerous. In most cases the antler has been sawn through to get a piece of necessary shape; on some antler fragments it can be seen that the last edge has been broken (deliberately?). Among the antler debris there are two tines. These may be either production refuse, or used for splitting bone and antler (Ambrosiani 1981, fig. 62; Ulbricht 1984, pl. 45, 93). There are two fragments of saw blades among the finds, which could have been used for cutting bone.

Among the bone and antler artefacts from Otepää hill-fort there are ornaments and amulets (a brooch, pendants of bone, antler, tusks and teeth of animals), various tools and commodities (spinning-whorls, needles, awls, knife handles, hammers and, combs), weapons and parts of weapons (arrow-heads, a detail from a crossbow) and toys (die, toggles). The purpose of several objects remained unclear.

Cattle (*Bos taurus*)

Many bone objects are made of cattle bone. Spinning-whorls made of bovine bones are numerous – 18 of the 27 whorls found are most likely made of bovine *caput femoris* (fig. 2 a–d), some of the whorls are possibly made of *caput femoris* of elk, in one case a *caput humeri* (cattle? horse? elk?) has been used. Most of the spinning-whorls have been cut smooth underneath. One whorl of bovine *caput femoris* has four crosses cut on the bottom surface. The spinning-whorls of Otepää are not ornamented.

A numerous find group (21 in total) among the material from Otepää were made from bovine phalanges with bored holes (fig. 3). Nine of them have a hole bored only in the middle of the proximal articular surface, one other has only a cavity there. One of the phalanges was cast with metal. Such finds are known also from Estonian medieval and later towns and settlements. However, the phalanges cast with metal are quite rare in our material. The rest of the phalanges had several bored holes, one of them even has five holes (in the proximal and distal ends and all sides of the diaphysis, except the caudal surface). No such phalanges have been found in Estonian prehistoric hill-forts (Ain Mäesalu, personal comment), so these finds from Otepää evidently date from the Middle Ages, too. Besides the phalanges with bored holes, two phalanges had a carved cross on the front surface of the diaphysis. One of them comes from an animal younger than two years. The proximal part has been slightly smoothed with a knife. The

ends of the other are a little crumbled although the cutting of the ends cannot be excluded.

One object of unknown purpose is made of a bovine metacarpal bone. Only the distal end of the bone is preserved, with a hole bored at the *canalis metacarpi distalis*. The diameter of the hole is 7 mm. The palmar surface of the bone and the dorsal surface of the joint as well as the sides of the joint have been smoothed (fig. 4a). With some bovine bones it is impossible to determine whether they are half-finished objects or production refuse. Examples of such are two metatarsal bones with cut-off ends and smoothed sides (fig. 4 b–c), and a fragment of a metacarpal or metatarsal bone with indentations of various shapes and sizes. A fragment of a bovine metatarsal bone (fig. 4d), and a radius with small bone disks cut out of its diaphysis, can be indubitably considered scrap bone.

The material also included a bovine rib, 12 cm long, one end of which has been cut off while the other is evidently broken. The caudal edge has been cut as well. In the middle of the rib, about 4.5 cm from the broken end there is a hole with a diameter of 8 mm (fig. 5a).

The occurrence of bovine horn cores with cut ends in the bone material of Otepää indicates the use of bovine horn in the craft industry. Unfortunately no artefact made of horn has been preserved.

Pig (*Sus scrofa* dom.)

The objects from pig bone are mostly metatarsal and metacarpal bones with bored holes in them. Many of them, especially metatarsal bones, have either the proximal end or even both ends rounded by cutting. In most cases these are the bones of young pigs, which is only natural, as they are so-called garbage. These objects are usually called toggles, but it is also possible that they were used as yarn spools (fig. 6 a–e). Toggles form a very numerous group of finds – 40 in total. Mostly metatarsal bones of pigs have been used (22 pieces). Fifteen of the toggles were made of metacarpal bones and in three cases it was impossible to determine the bone (tab 1). Ulbricht (1984, 62) has also observed that for making toggles, metatarsal bones were preferred to metacarpal bones.

To some extent, pig bones were also used for making other objects. Though most of the spinning-whorls are made of bovine bones, at least one has been found, made of a pig's *caput femoris* (fig. 2e). With three more, suspicion arose that they might be made of a pig's *caput femoris*, but the possibility remains that the epiphysis of goat's or sheep's *caput femoris* was used. Two small spinning-whorls made of epiphysis of a pig's or sheep/goat's *caput humeri* were also problematic. The purpose of these small objects in the shape of spinning-whorls is not quite clear. It is possible that they have symbolic meaning. For instance in Lithuania, miniature spinning and weaving tools, mostly of bronze but sometimes also of amber, have occasionally been found with female burials (Vaitkunskiene 1992, 54). In Estonia, a fragment of such a

small bone spindle-whorl was found in a Viking Age cremation burial.

Fibulae of pigs were often used for making bone needles. The find material from Otepää contained at least four, but possibly five, such needles and their fragments. One needle, made of a pig's left fibula, was found undamaged (fig. 6f). The eye of the needle is cut in the distal end of the bone and the end rounded by more cutting. Two needles are only slightly processed – both are made of the fibula from the right limb and the eye is made in the proximal end of the bone. Unfortunately the points of both needles are broken. One of the needles has a tapering eye end (fig. 6g), the other is cut flat (fig. 6h). Only one relatively carefully processed point from a needle is preserved. Such needles could have been used for the so-called loop needle-netting (Ambrosiani 1981, 136). The needle with a chain-link of bronze, found at Varbola, indicates the possibility that these needles could have been decorative pins (Tamla & Maldre, present publication).

One object of unknown purpose is made from the left humerus of a pig – the proximal end is cut off and of the distal end only the *trochlea humeri* is left. This is rounded and has a hole bored through the middle. Two holes have been made in the diaphysis of the bone, one of which is broken across the middle (fig. 6i).

Ornaments were made from pig canines and teeth, but these are discussed together with pendants.

Sheep and goat (*Ovis aries* and *Capra hircus*)

Bones of sheep and goat were very seldom used for manufacturing artefacts. The bone material from Otepää contained one rib of a goat or sheep with both the dorsal and ventral ends cut off. A round hole was cut in the ventral end of the remaining part. The purpose of the object is unfortunately not clear (fig. 5b).

As has already been mentioned, it is possible that some of the spindle whorls are also made of *caput femoris* and *caput humeri* of sheep or goats. The ribs of sheep and goats could also be used for making connecting plates for combs. Some fragments of tibia with cutting traces were found but it is not clear whether these are traces of manufacturing or perhaps culinary in origin.

Horse (*Equus caballus*)

The bone material from Otepää contains two horse's bones with traces of processing. One of them obviously a skate made of a right metacarpal bone (fig. 7b). The bone's distal end is unfortunately broken, the proximal end has been narrowed on the sides by cutting, and a hole has been bored through it. The other find, a sawn off proximal end of a horse's right metatarsal bone, obviously belongs among the scrap bone (fig. 7a).

Elk (*Alces alces*)

The bone material from Otepää contains 11 processed II or V metapodial bones of elk (fig. 8). The proximal end of the bone has been sharpened by cutting. Several pieces have also the surface of the bone smoothed and polished. In two cases a hole has been made in the distal end of the bone. One of these objects, made from the bone of adult elk, also has the edges of the distal epiphyseal surface cut smooth. Both objects are glossily polished. Most of the objects (all polished) unfortunately have broken distal ends, thus it is not known whether they had holes cut in them or not. The material also contains pieces without holes. These are not polished but bear clear traces of cutting. Thus, it is possible that the objects were polished during use, and when broken were cast off. The objects with clear cutting traces and without holes were probably, for some reason, unfinished (Heidi Luik, personal comment).

Elk antler was very often used in manufacturing. This is chiefly indicated by the presence of numerous antler fragments with cutting traces. Also, it was possible to identify antler as the raw material of several objects. It was used to make ornaments as well as tools and other commodities. One of the most interesting finds is an antler hammer, decorated with a scraped ornament. The striking surface was reinforced with six iron nails, and the butt with one iron nail (fig. 9). The hammer could have been used for splitting bone and antler. Another interesting antler find is a detail of an arbalest (fig. 10a). There is a worn trace just below the string dent and the place is also marked with a scratched cross. The detail lacks the lower trigger notch. Thus, it may be an unfinished product (A. Mäesalu, personal comment). The curved surface is most likely turned. The bone material also includes one half-finished product – the rectangular piece of antler has one curved edge and has a compass-drawn semi-circle with the trace of the needle point in the centre (fig. 10b). It is possible that this piece of antler was also meant as an arbalest detail similarly to the above-mentioned one. The diameter of the circle is slightly smaller than the finished object. Two conical arrow-heads are also made of antler.

Of commodities, knife-handles and awls were also made of antler (fig. 11 a–c). Antler ornaments were represented by two bird-shaped pendants and a brooch. One of the pendants was decorated with scraped diagonal squares, the other (fig. 12n) and the brooch (fig. 11d) were not decorated. The brooch has a hole at the edge, with a small preserved fragment of a bronze pin. A loop for the catch has been cut on the opposite edge. The surface of the brooch is most likely turned.

Rings of various shapes and processing levels can also be made of antler as one object shaped as a truncated cone, with a round hole and irregular transverse groove. The purpose of a rectangular, carefully polished object with five holes in it is unknown (fig. 11e).

Age	Mc3	Mc4	Mc5	Mt4	Mp	Total
Distal epiphysis is open (under 2 years)	4	4	4	12	2	30
Distal epiphysis is closed (over 2 years)	1	2	-	-	-	3
Age not determined	1	1	2	2	1	7
Total	6	9	8	14	3	40

Tab. 1 Raw material for toggles (Mc - metacarpal bone, Mt - metatarsal bone, Mp - metacarpal or metatarsal bone)

Species	Carnivore				Invertebrate	
	distal ulna		distal radius		distal ulna	distal radius
	left	right	left	right		
Ursus arctos	1	2	3	1	-	-
Canis lupus	1 (M)	-	1 (M)+1 (F)	2 (M)+1 (F)	-	3
Canis familiaris					-	2
Lynx lynx	1	-	-	-	-	-
Canis lupus	1	-	-	1	-	-

Tab. 2 Raw material of tooth pendants

Pendants and beads

Pendants form one of the most numerous group of bone finds. Many tooth pendants were found, most of them made of canines although the mandibular incisors of pigs and beavers were also used (tab. 2).

Besides the pendants noted in the table, a small fragment was found, made of a canine of a smaller carnivore, but due to its small size it was impossible to determine the species. In most cases the root of the tooth or the canine was drilled. However, one maxillary canine of a boar and one incisor of a beaver (fig. 12h) have a notch at their root while one incisor of a wild boar has a groove cut round its root (fig. 12d). The canine tooth of a lynx (fig. 12i) has an attached bronze ring preserved.

Pendants from the talus of beavers (fig. 12 l) were made in a simple way: a hole was bored in the neck of the talus. According to Mare Aun, such pendants from beavers' talus occur everywhere on hitherto investigated southeast Estonian hill-forts and settlements (Aun 1992, 68). In one case, even a mandible of a marten, was worn as a pendant (fig. 12k).

The one knife-shaped and three bird-shaped pendants represent an even more complicated technology. Two of the bird-shaped pendants are made of elk antler, the third, evidently, of bone (fig. 12o). The latter is considerably smaller than the two antler ones and not so carefully finished. The knife-shaped pendant (fig. 12m) is made of bone. One side of the pendant is decorated with small holes, evidently representing the rivets of the knife sheaths used in the Late Iron Age.

One bone bead, quite roughly finished, was also found.

Objects of unidentifiable materials

Concerning the very carefully polished objects it was often not clear whether they were made of antler or bone. The species and the part of skeleton could not be determined on several objects – a die, a small bone spade, a presumed section of a knife handle, some bone points and arrowheads.

The die is made of bone or antler and is preserved only fragmentarily. Its surface is carefully polished. Relying upon the size of the die (length of the edge is 13 mm) it seems likely, however, that it was made from antler.

The small spade, some bone points and the plates with rivet holes are made from bone. Long bones of animals have been used for the bone points. One point is evidently made from pig tibia, another might be the proximal part of a bovine metacarpal bone on the basis of a fragment of the epiphseal surface which remains. One of the two smaller points could be made of pig fibula, so it should, perhaps, be discussed together with needles made from pig fibulae. The material of the other small bone point is made of bovine long bone, but exactly which long bone cannot be determined with more

accuracy. The small spade is made either from a rib or some other flat bone. Most of the connecting plates of combs are presumably also made of ribs. The tooth plates are mostly made of bone although more accurate identification is impossible. The leaf-shaped arrowheads are evidently also made from bone but due to their wonderful finishing nothing more can be said about them.

Summary and conclusions

Analysing the bone objects from Otepää, it appeared that often those bones were used as manufacturing raw material whose shape most resembled the ready object so that only slight processing would have been necessary. Examples of such tools include needles and awls of elk bone and pig fibulae, as well as spindle whorls and toggles. This means that certain bones were chosen for certain types of objects. Such technology leaves next to no debris. The situation is different when antler is used. The material of Otepää is rich in antler fragments with the traces of sawing, cutting and splitting. These, the half-finished object described with antler artefacts, and the few scrap bones demonstrate that bone and antler were manufactured locally. Two fragments of saw blades which could have been used for sawing bone and antler, were also among the finds. One of the most interesting finds is the antler hammer with the striking side and butt reinforced with iron nails. This could have been used for splitting bone and antler. Unfortunately, not all the finds from Otepää hill-fort are completely documented and published which means that most of the bone objects lack dates. The possible methods, technologies and tools for bone processing have not yet been investigated. Since bone and antler have been the most accessible and widely used raw materials throughout the prehistoric period and the Middle Ages, their material-technological investigation deserves special attention in co-operation with archaeologists.

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Fig.1 The location of Otepää

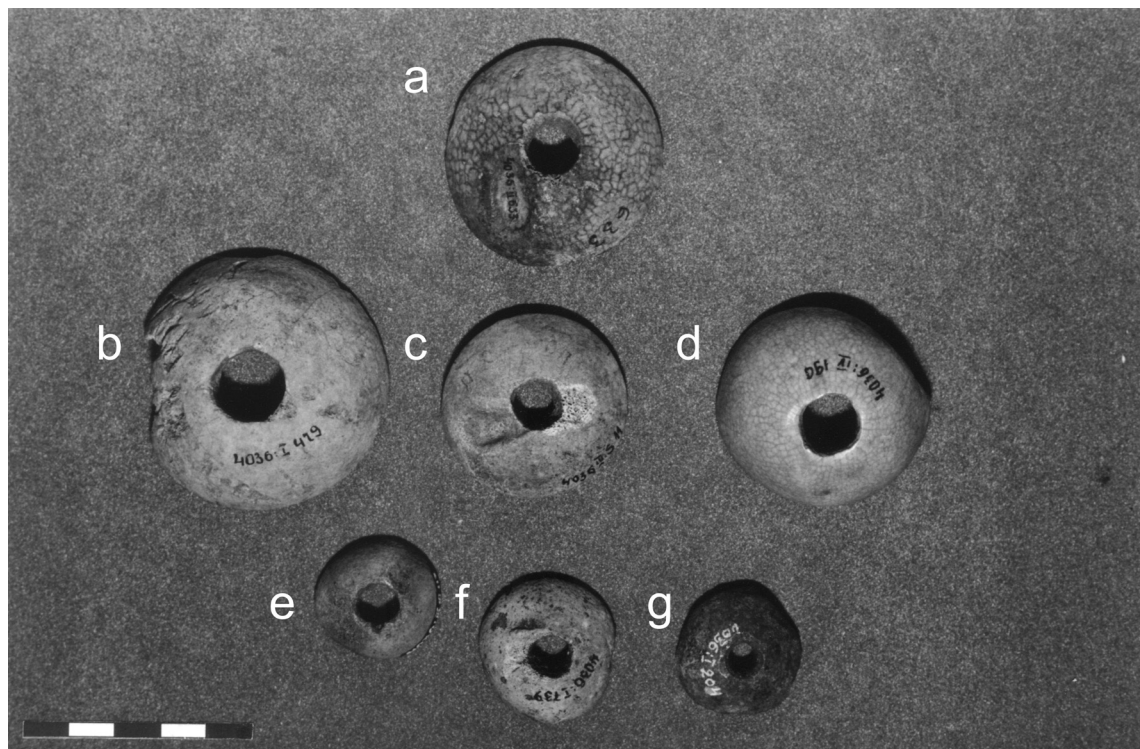


Fig. 2 Spindle-whorls



Fig. 3 Bovine phalanges with bored hole

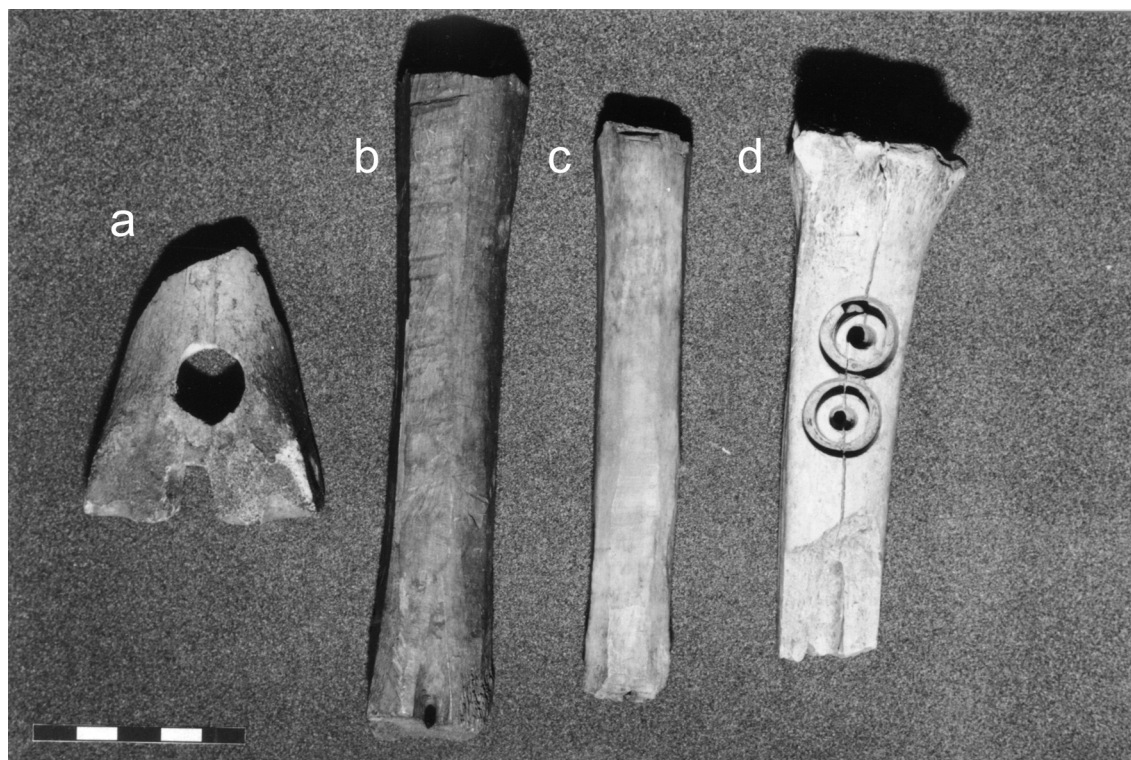


Fig. 4 Object of unknown purpose and unfinished products or scrap bone

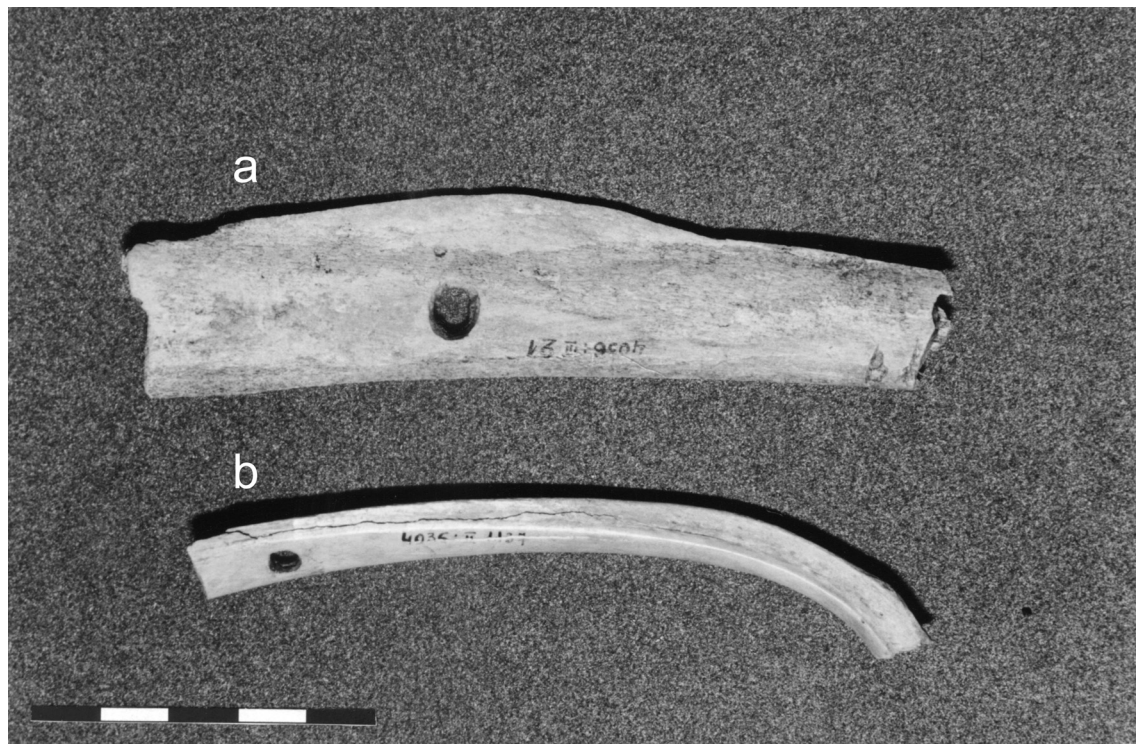


Fig. 5 Worked ribs

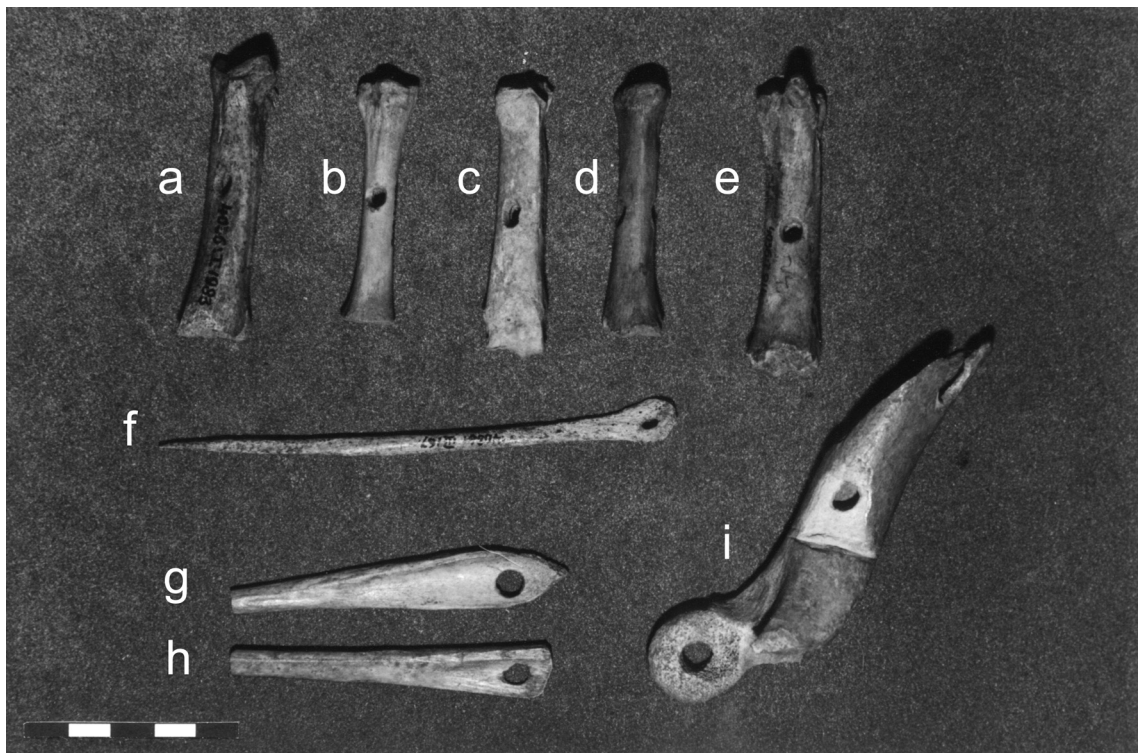


Fig. 6 Objects made of pig bone

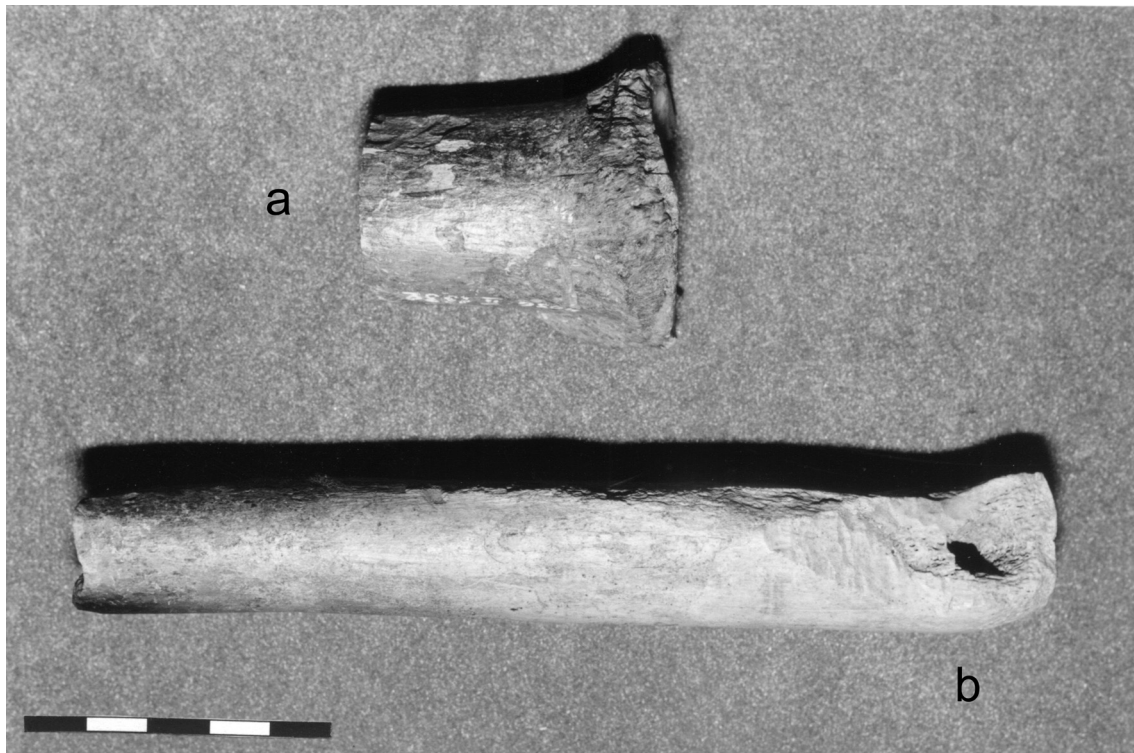


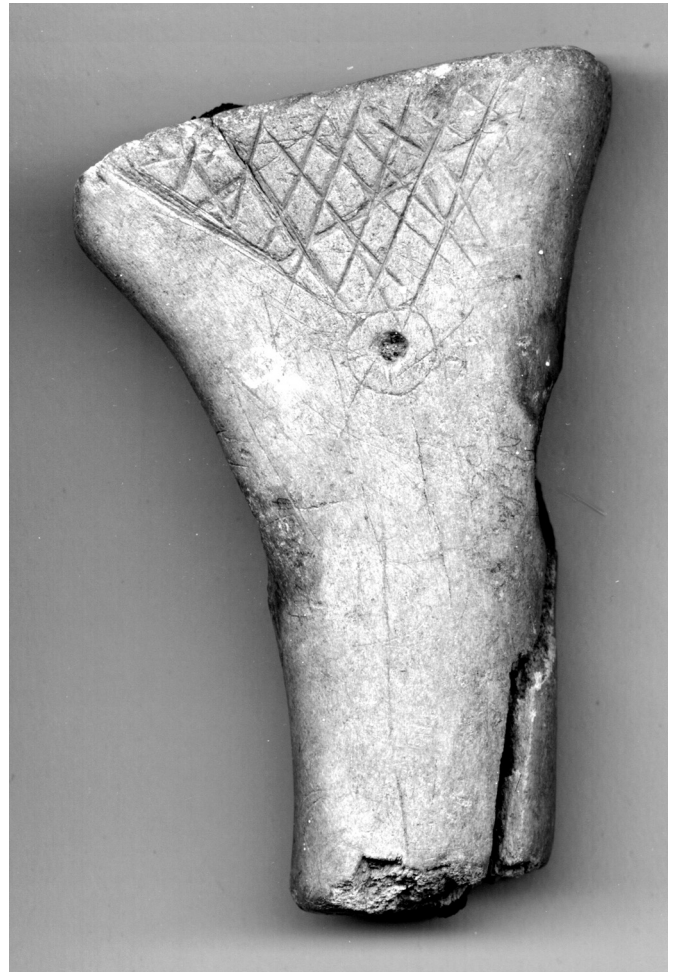
Fig. 7 Artefacts of horse bone



Fig. 8 Metapodial bones of elk

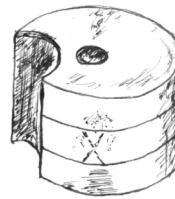
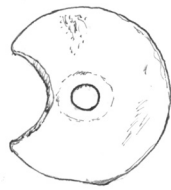


a

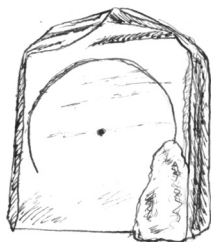


b

Fig. 9 Hammer of elk antler



a



b

Fig. 10 Arbalest detail and a half-finished object of antler

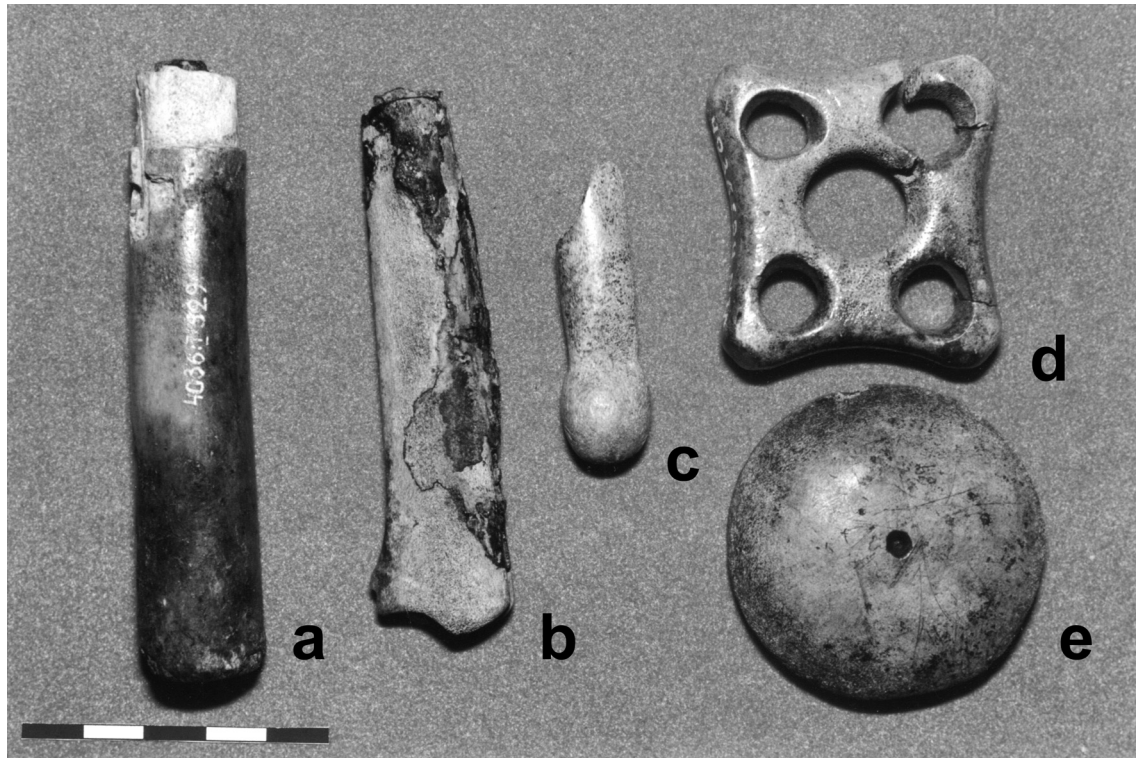


Fig. 11 Objects of antler

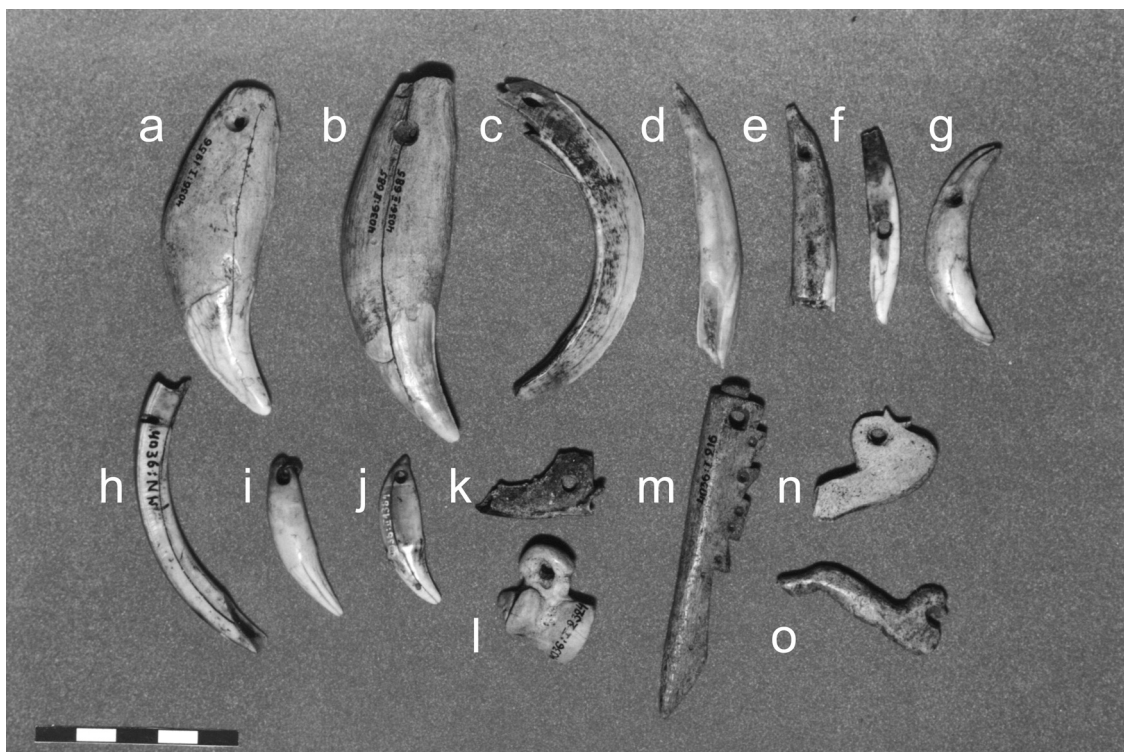


Fig. 12 Pendants